

## STATUS AND TRENDS IN PRODUCTION AND CONSUMPTION OF ELECTRICITY IN GUJARAT

TARANG SOLANKI

Assistant Professor, Department of Economics, School of Social Science, Gujarat University, Ahmedabad, India

### ABSTRACT

India is the world's fifth largest electricity generator with total installed capacity of 2,28,722 MW. India's energy electricity has been growing rapidly in the last two decades. This demand has been boosted by industrial growth as well as a rise in household consumption. On the other hand, supply of energy too has grown but has been outstripped by demand. India derives most of its electricity from fossil fuels; primarily from coal. The state of Gujarat is on second position with 26,126 MW of installed electricity generation capacity followed by Tamil Nadu, Andhra Pradesh and Uttar Pradesh. The power situation in India is characterized by demand in excess of supply, high transmission and Distribution losses, peak demand and energy shortages, low plant load factors and decreasing availability of best quality fuel to run the power plants. However, over the last few years, Gujarat has successfully crossed all these barriers. Gujarat has become successful in securing its overall energy requirements with installed power generation capacity of 23,927 MW (as of Aug 2012). Power is one of the basic infrastructures necessary for the Industries and socio economic development in the State. Installed capacity of the State has increased from 315 MW in 1960-61 to 13144 MW in 2010-2011. Per capita consumption of power in the State of Gujarat in 2009-10 was 1491 Units (as per CEA revised formula).

In the context of above fact, present paper intends to present the situation of electricity generation, consumption and distribution in Gujarat. Paper also takes the stock of power sector over a period of time in terms of growth in installed capacity, generation and consumption of electricity in state.

**KEYWORDS:** Electricity Generator, Energy Electricity, Energy Statistics

### INTRODUCTION

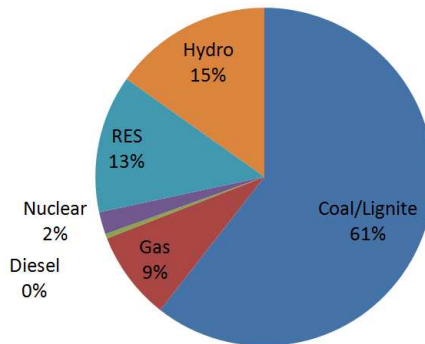
India is the world's fifth largest electricity generator with total installed capacity of 2,71,722 MW (as on 31/3/2015). The electricity sector in India has growth from installed capacity of 1362MW in 1947 to 271722 MW in 2015. The total number of villages electrified increased from 3061 in 1950 to 577629 in 2015. Per capital consumption has increased from 16.3kWh in 1947 to 1010kWh. The pace of investment from private players is considerable which shows an encouraging environment for the electricity sector<sup>1</sup>.

India's energy electricity has been growing rapidly in the last two decades. This demand has been boosted by industrial growth as well as a rise in household consumption. On the other hand, supply of energy too has grown but has been outstripped by demand. India derives most of its electricity from fossil fuels; primarily from coal (India has 271722

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<sup>1</sup> <http://greencleanguide.com/2013/12/23/top-five-states-in-india-with-highest-installed-electricity-generation-capacity/>

MW of capacity on coal which is 61% of total capacity). India also derives considerable amount of electricity from hydro power sources.



Source: Growth of Electricity Sector in India from 1947-2015, GOI

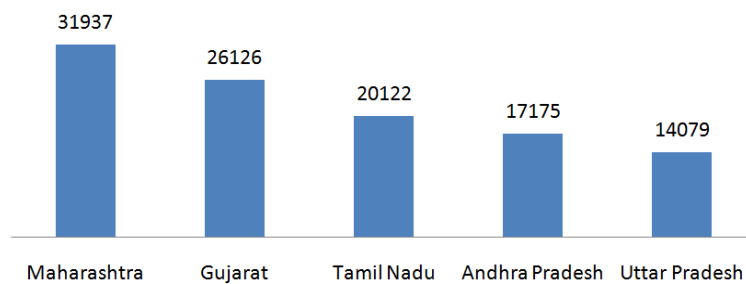
Figure 1: All India Installed Generating Capacity 2015

Table 1: All India Installed Generating Capacity (2015)

Source	Installed Capacity	Percentage
Coal/Lignite	164636	60.59%
Gas	23062	8.49%
Diesel	1200	0.44%
Nuclear	5780	2.13%
RES	35777	13.17%
Hydro	41267	15.19%
Total	271722	100.00%

Source: Growth of Electricity Sector in India From 1947-2015, GOI

State wise breakups of installed generating capacity shows wide variations across the states. The top five states with highest installed electricity generation capacity are given below;



Source: Growth of Electricity Sector in India from 1947-2015, GOI

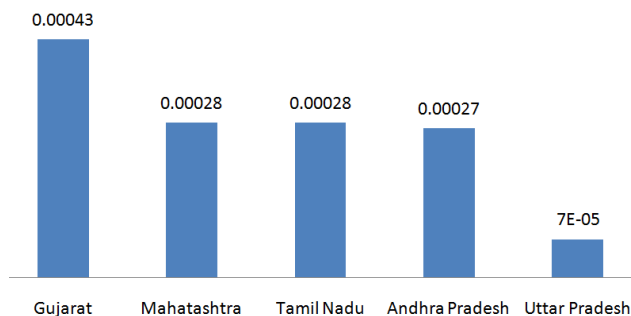
Figure 2: Top Five States in India with Highest Installed Electricity Generation Capacity (in MW)

The state of Maharashtra is at the top position in installed electricity generation capacity in India. By Sep 2013, Maharashtra has 31,934 MW of installed capacity. The state of Gujarat is on second position with 26,126 MW of installed electricity generation capacity followed by Tamil Nadu, Andhra Pradesh and Uttar Pradesh.

**Table 2: Breakup of the Total Installed Capacity (Capacity in MW (As on Sep 2013))**

Type	Maharashtra	Gujarat	Tamil Nadu	Andhra Pradesh	Uttar Pradesh
Coal	19,939	15,738	8,476	8,573	10,523
Gas	3,476	4,979	1,026	3,370	550
Diesel	-	17	412	37	-
<b>Total Thermal</b>	<b>23,415</b>	<b>20,734</b>	<b>9,914</b>	<b>11,980</b>	<b>11,073</b>
Nuclear	690	559	524	276	336
Hydro	3,332	790	2,182	3,735	1,847
RES*	4,497	4,042	7,491	1,184	824
<b>Grand Total</b>	<b>31,934</b>	<b>26,125</b>	<b>20,111</b>	<b>17,175</b>	<b>14,080</b>
<b>Sector Wise Breakup is Given Below (Capacity in MW)</b>					
Sectors	Maharashtra	Gujarat	Tamil Nadu	Andhra Pradesh	Uttar Pradesh
State	12,269	6,887	7,594	9,050	5,472
Private	13,038	15,590	8,687	4,968	3,649
Central	6,627	3,650	3,830	3,157	4,959
<b>Total</b>	<b>31,934</b>	<b>26,127</b>	<b>20,111</b>	<b>17,175</b>	<b>14,080</b>
<b>Source: Central Electricity Authority, Government of India</b>					

The state of Maharashtra, Gujarat and Tamil Nadu are highly industrialized. Therefore, their electricity demand is also higher than other states. If we compare total installed electricity generation capacity with the population of respective states, then following results are arrived at;



**Source: Growth of Electricity Sector in India from 1947-2015, GOI**

**Figure 3: Per Capita Installed Capacity**

All these five states contribute towards 48% of installed electricity generation capacity of the entire country<sup>2</sup>.

### ELECTRICITY IN GUJARAT

Indian power sector is facing challenges despite the significant growth in generation capacity over the past few decades. The power situation in India is characterized by demand in excess of supply, high transmission and Distribution losses, peak demand and energy shortages, low plant load factors and decreasing availability of best quality fuel to run the power plants. However, over the last few years, Gujarat has successfully crossed all these barriers. Gujarat has become successful in securing its overall energy requirements with installed power generation capacity of 23,927 MW (as of Aug 2012).

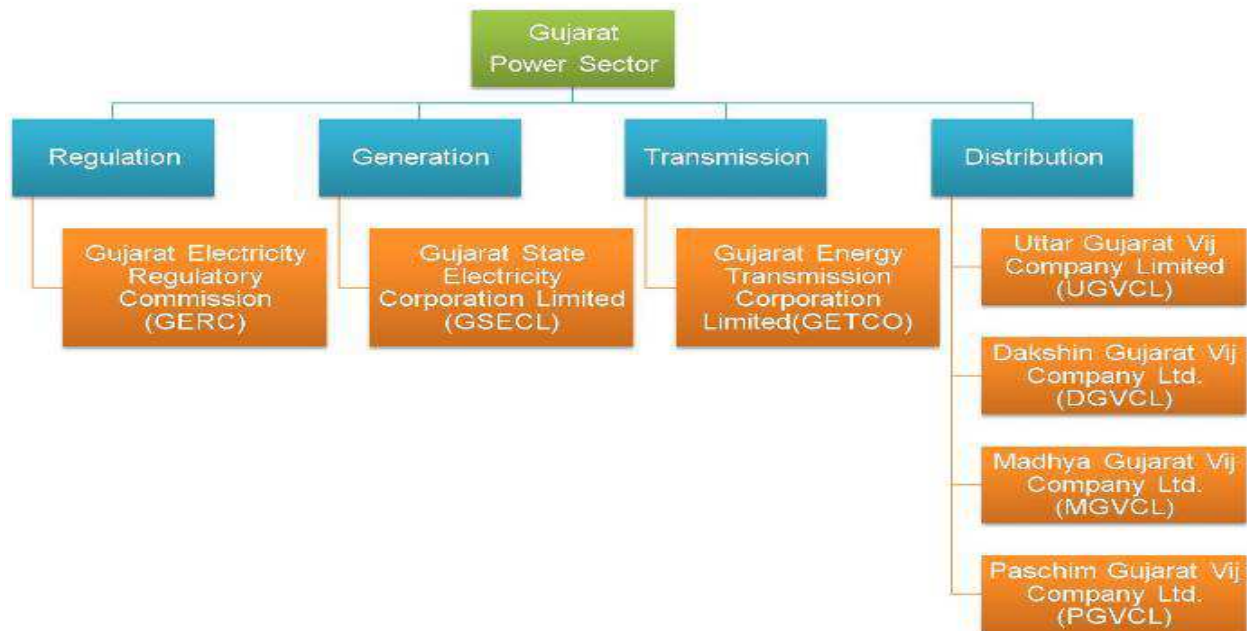
<sup>2</sup> Central Electricity Authority (Sep 2013)

Power is one of the basic infrastructures necessary for the Industries and socio economic development in the State. Installed capacity of the State has increased from 315 MW in 1960-61 to 13144 MW in 2010-2011. Per capita consumption of power in the State of Gujarat in 2009-10 was 1491 Units (as per CEA revised formula)<sup>3</sup>.

**INSTITUTIONAL STRUCTURE OF POWER SECTOR IN GUJARAT**

In the year 1999, the state of Gujarat established the Gujarat Urja Vikas Nigam Limited (GUVNL) under the Companies Act, 1956. The GUVNL was created by the Gujarat Electricity Board (GEB) as its wholly owned subsidiary towards restructuring of the power sector for better management. GUVNL was incorporated as a Government of Gujarat Company which holds 100% of shares in the other six companies i.e. Gujarat State Electricity Corporation Limited(GSECL), Gujarat Energy Transmission Corporation Limited GETCO), Uttar Gujarat Vij Company Limited (UGVCL), Dakshin Gujarat Vij Company Limited (DGVCL), Madhya Gujarat Vij Company Limited (MGVCL) and Paschim Gujarat Vij Company Limited (PGVCL).

**STRUCTURE OF GUJARAT POWER SECTOR**



**Figure 4**

All six companies are 100% subsidiaries of GUVNL. The GUVNL is engaged in Supervision, Co-ordination and facilitation of the activities of its six Subsidiary Companies.

**POWER SUPPLY-DEMAND POSITION IN GUJARAT**

As a result of growing installed power generation capacity, the peak demand-peak deficit in the state has decreased by Compound Annual Growth Rate of 31%.

<sup>3</sup> <http://www.gsecl.in/powerplants.php>

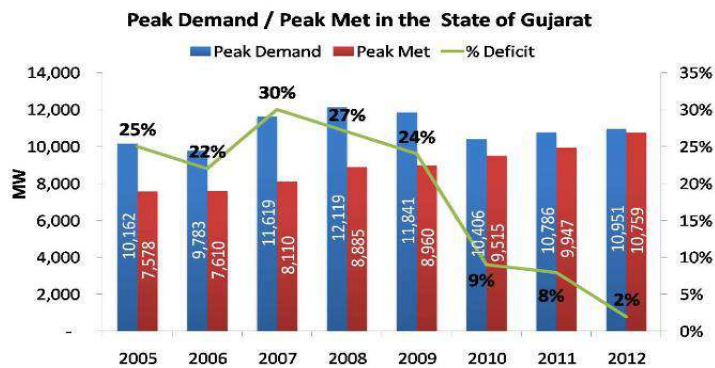


Figure 5: Peak Demand and Peak Met in the State of Gujarat, Source: CEA

Actual power supply position of the state of Gujarat has improved in the last seven years considerably. The power requirement and availability deficit in the state has been decreased by CAGR of 38%. Year 2012 shows nearly zero percent deficit made Gujarat power sufficient.

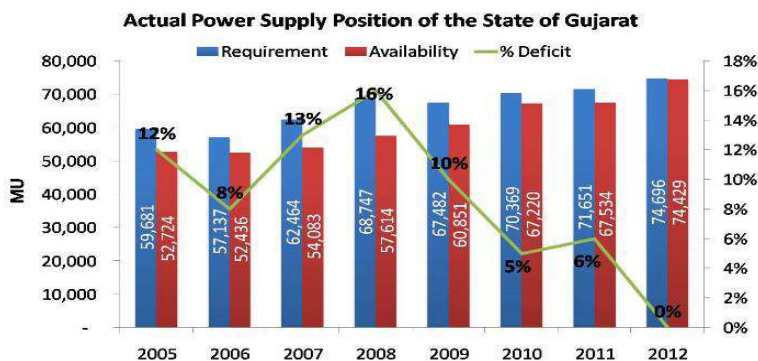


Figure 6: Actual Power Supply Position of the State of Gujarat, Source: CEA

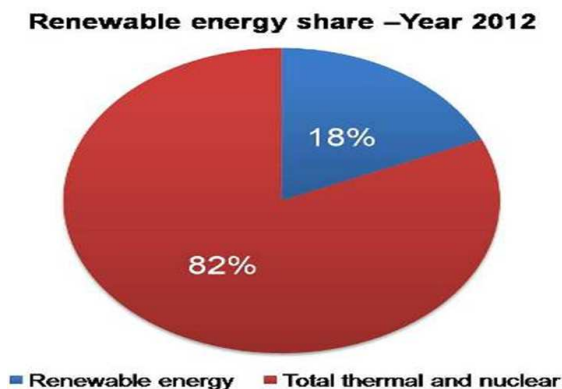


Figure 7

**RENEWABLE ENERGY SCENARIO IN GUJARAT**

Gujarat is rich in solar energy, biomass and wind energy. It is also the leading state in terms of overall solar energy installation in India. As part of its renewable energy promotion policy, Gujarat enacted the country’s first Wind Energy policy in 1993 and become the first state with a Solar Policy in 2009. As per the Gujarat Energy Development Agency (GEDA), the state has tremendous renewable energy potential;

The economics time quoted, "Gujarat's overall integrated renewable energy potential is estimated to be around 748.77 GW. A study conducted by TERI, Gujarat's potential for concentrated solar power (CSP) with water availability stands at 345.71 GW, solar photovoltaic (SPV) wind hybrid excluding CSP at 240.60 GW, only SPV excluding wind and CSP at 21.36 GW, only wind excluding solar potential at 139.21 GW and biomass at 1.89 GW." (ET, 20 April 2012).

Increasing power generation capacity in each year along with the growing share of Renewable energy in its total energy mix has made Gujarat a prominent destination for investment. Gujarat government is positively looking towards renewable energy which reduces dependency on conventional fuel. Let's hope for a similar model in other parts of the country.

### ELECTRICITY PRODUCTION AND CONSUMPTION AND INSTALLED CAPACITY IN GUJARAT

The data about the decadal growth in installed capacity, electricity generation and electricity consumption in Gujarat is presented in table below. It can be seen from the data that installed capacity of electricity generation has increased by 119.55 percentages in the decade of 1980-90. This growth rate in installed capacity declined to 72.97 percentages during the decade of 1990-2000 and further to 43.93 percentages during the decade of 2000-2010.

**Table 3: Decadal Growth in Installed Capacity, Electricity Generation and Consumption**

Decade	Installed Capacity (MW)	Electricity Generation	Electricity Consumption
1980-1990	119.55%	143.87%	163.63%
1990-2000	72.97%	139.35%	166.72%
2000-2010	43.93%	150.26%	191.36%

**Source:** Socio Economic Review of Gujarat

Electricity generation in Gujarat has increased by 143.87 percentages during the decade of 1980-1990. This growth in electricity generation declined to 139.35 percentages during the decade of 1990-2000 which increased again to 150.26 percentages during 2000-2010. There has been remarkable growth in electricity consumption since 1980. The decadal growth in the electricity consumption shows growth of 163.63 percentages during the decade of 1980-90. During the decade of 1990-2000, electricity consumption in Gujarat has increased by 166.72 percentages which further increased to 191.36 percentages during the decade of 2000-2010.

**Table 4: Electricity Production and Consumption and Installed Capacity in Gujarat**

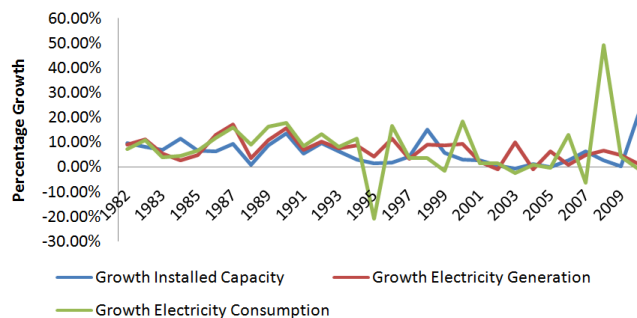
Year	Installed Capacity (MW)	Growth Installed Capacity	Electricity Generation	Growth Electricity Generation	Electricity Consumption	Growth Electricity Consumption
1981	2197	-	9363	-	7566	-
1982	2407	9.56%	10207	9.01%	8106	7.14%
1983	2576	7.02%	10778	5.59%	8401	3.64%
1983	2786	8.15%	11999	11.33%	9303	10.74%
1984	3106	11.49%	12314	2.63%	9717	4.45%
1985	3316	6.76%	12934	5.03%	10353	6.55%
1986	3527	6.36%	14625	13.07%	11570	11.76%
1987	3863	9.53%	17160	17.33%	13403	15.84%
1988	3903	1.04%	17786	3.65%	14602	8.95%

**Table 4: Contd.,**

1989	4243	8.71%	19731	10.94%	16960	16.15%
1990	4824	13.68%	22834	15.73%	19946	17.61%
1991	5094	5.61%	24430	6.99%	21620	8.39%
1992	5593	9.80%	26973	10.41%	24477	13.21%
1993	5958	6.52%	28995	7.50%	26476	8.17%
1994	6141	3.07%	31592	8.96%	29492	11.39%
1995	6241	1.64%	32908	4.17%	23303	-20.99%
1996	6363	1.95%	36732	11.62%	27138	16.46%
1997	6630	4.20%	38010	3.48%	28082	3.48%
1998	7642	15.26%	41494	9.17%	29050	3.45%
1999	8093	5.90%	45103	8.70%	28586	-1.60%
2000	8343	3.09%	49379	9.48%	33829	18.34%
2001	8582	2.86%	50506	2.28%	34325	1.47%
2002	8651	0.80%	50069	-0.87%	34797	1.38%
2003	8606	-0.52%	55127	10.10%	33860	-2.69%
2004	8713	1.24%	54727	-0.73%	34145	0.84%
2005	8723	0.11%	58209	6.36%	34018	-0.37%
2006	8974	2.88%	58724	0.88%	38358	12.76%
2007	9561	6.54%	61543	4.80%	35862	-6.51%
2008	9827	2.78%	65656	6.68%	53473	49.11%
2009	9864	0.38%	68962	5.04%	55610	4.00%
2010	12008	21.74%	69883	1.34%	55005	-1.09%

**Source:** Socio Economic Reviews of Gujarat

The yearly growth in installed capacity, electricity generation and consumption is presented in table above. The installed capacity of electricity generation in Gujarat has increased from 2197 MW in 1980 to 4823.5 MV in 1990 which further increased to 8343 MW in 2000 and 12008 MW in 2010. Data on annual growth in installed capacity show variation from marginal negative growth of 0.52 percentage in 2003 to highest growth on 21.74 percentages registered during 2010.



**Figure 8: Growth in Installed Capacity, Generation and Consumption of Electricity in Gujarat**

Electricity generation in Gujarat has increased from 9363 MW in 1980 to 69883 MW thus showing the growth of 643.37 percentages during three decade i.e. 1980-2010. On yearly basis electricity generation has increased from 9363 MW in 1980 to 22834 MW in 1995, which further increased to 49379 MW in 2000 and to 69883 MW in 2010 The

computation of yearly growth in electricity generation shows variations from as low as negative growth by 0.87 percentages in 2002 to highest growth of 17.33 percentage registered in 1987.

Similarly the consumption of electricity shows increase from 7566 MW in 1980 to 19946 MW in 1990. Electricity consumption further increased to 33829 MW in 2000 and to 55005 MW in 2010. Thus electricity consumption has increased by 627 percentages during the three decade i.e. 1980-2010. The data on annual growth in electricity consumption show variation from negative growth (declining consumption) of 20.99 percentages in 1990 to highest ever growth of 49.11 percentages registered in 2008.

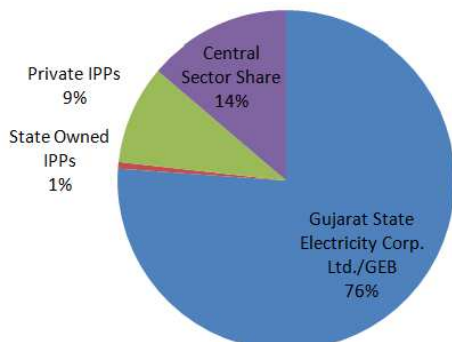
**INSTALLED CAPACITY IN GUJARAT BY SOURCES**

The installed capacity in Gujarat state has increased from 7085 MW in 1991 to 17318 MW in 2012. The breakup of total installed capacity by source indicates variations over a period of time.

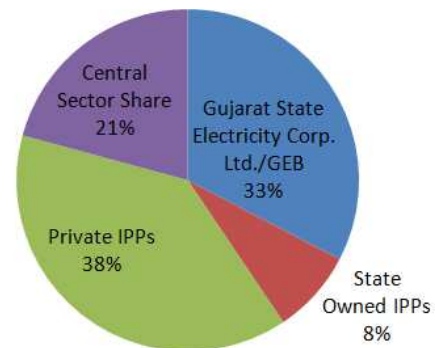
**Table 5: Installed Capacity in Gujarat (MW)**

Source	1991		2012	
	MW	%	MW	%
Gujarat State Electricity Corp. Ltd./GEB	3878.00	76.13%	4996.00	32.64%
State Owned IPPs	32.00	0.63%	1216.00	7.94%
Private IPPs	482.00	9.46%	5914.00	38.64%
Central Sector Share	702.00	13.78%	3180.00	20.78%
<b>Total</b>	<b>5094.00</b>	<b>100.00%</b>	<b>15306.00</b>	<b>100.00%</b>

**Source:** Socio Economic Reviews of Gujarat, various issues



**Figure 9: Installed Capacity in Gujarat 1991**



**Figure 10: Installed Capacity in Gujarat 2012**

There has been remarkable 200 percent growth in the installed capacity from 5094 MV in 1991 to 15306 MV in 2012. Along with this growth in installed capacity, another remarkable thing was in terms of shift in share in installed capacity from Gujarat State Electricity Corp. Ltd to Private sector IPPs. It can be seen from the figure that more than 76 percentages of total installed capacity was with Gujarat State Electricity Corp. Ltd. /GEB. The share of state owned IPPs was less than one percent. Private sector IPPs was contributing nearly 10 percent of total installed capacity. This situation has changes since then and the share of Gujarat State Electricity Corp. Ltd. /GEB has declined to 32.64 percent in the year 2012. The share of state owned IPPs has increased from 0.63 percent to 7.94 percent. Major shift is observed in the case of private IPPs for which the share in total installed capacity has increased from 9.46 percent in 1991 to 38.64 percent in 2012. Gujarat State Electricity Corp. Ltd. /GEB was having the largest share in total installed capacity in the year 1991 which has been taken over by private sector IPPs in 2012.

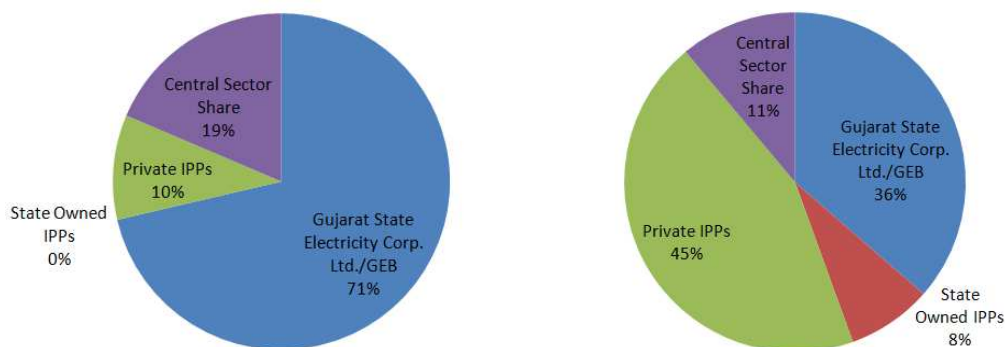


### ELECTRICITY GENERATION IN GUJARAT BY SOURCES

The electric generation in Gujarat by various sources is presented in table and figure below. It can be seen from the data that total electricity generation in Gujarat has increased from 24430 MV in 1991 to 78651 MV in 2012 representing increase over 220 percent during the period.

**Table 6: Electricity Generation in Gujarat (MW)**

Source	1991		2012	
	MW	%	MW	%
Gujarat State Electricity Corp. Ltd./GEB	17433	71.36%	28638	36.41%
State Owned IPPs	0	0.00%	6342	8.06%
Private IPPs	2455	10.05%	34948	44.43%
Central Sector Share	4542	18.59%	8723	11.09%
<b>Total</b>	<b>24430</b>	<b>100.00%</b>	<b>78651</b>	<b>100.00%</b>
<b>Source:</b> Socio Economic Reviews of Gujarat, various issues				



**Figure 11: Electricity Generation in Gujarat (MW) 1991    Figure 12: Electricity Generation in Gujarat (MW) 2012**

Increase in electricity generation by various sources since 1991 shows that electricity generation by Gujarat Electricity Corp. Ltd has increased from 17433 MV in 1991 to 28638 MV in 2012 which represent growth of nearly 64 percent. During the same period the electricity generation by private IPPs has increase from 2455 MV to 34948 MV representing growth of 1323 percent. The share of center sector has also increased from 4542 MV to 8723 MV, an increase of 92 percent. Thus the electricity generation by private sector IPPs has increase by more than 1323 percent from 1991 to 2012.

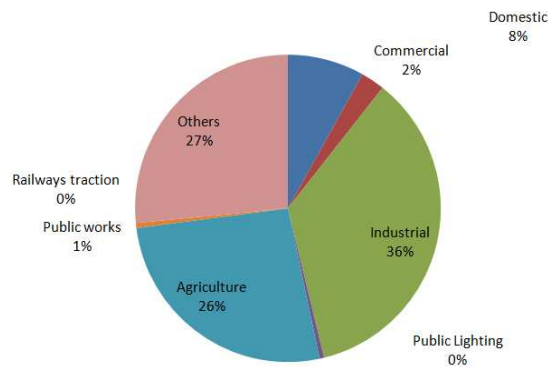
Another notable phenomenon was shift in the share of each sector in total electricity generation. Gujarat State Electricity Corp. Ltd was leading with 71.36 percent share in total electricity generation in the state during 1991 which declined to 36.41 percent in 2012. Against this the share of private sector IPPs has increased from 10.05 percent in 1991 to 44.43 percent in 2012. The central sector share has declined from 18.59 percent in 1991 to 11.09 percent in 2012.

**ELECTRICITY CONSUMPTION BY USAGE IN GUJARAT**

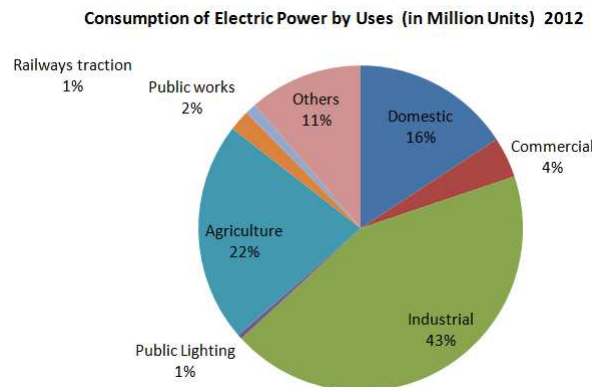
**Table 7: Consumption of Electric Power by Uses (in Million Units)**

Source	1991		2012	
	MU	%	MU	%
Domestic	1756	8.12%	10067	15.80%
Commercial	544	2.52%	2571	4.04%
Industrial	7689	35.56%	27606	43.33%
Public Lighting	103	0.48%	275	0.43%
Agriculture	5678	26.26%	13955	21.90%
Public works	116	0.54%	1323	2.08%
Railways traction	0	0.00%	708	1.11%
Others	5734	26.52%	7210	11.32%
<b>Total</b>	<b>21620</b>	<b>100.00%</b>	<b>63715</b>	<b>100.00%</b>

**Source:** Socio Economic Reviews of Gujarat



**Figure 13: Consumption of Electric Power by Uses (in Million Units) 1991**



**Figure 14: Consumption of Electric Power by Uses (in Million Units) 2012**

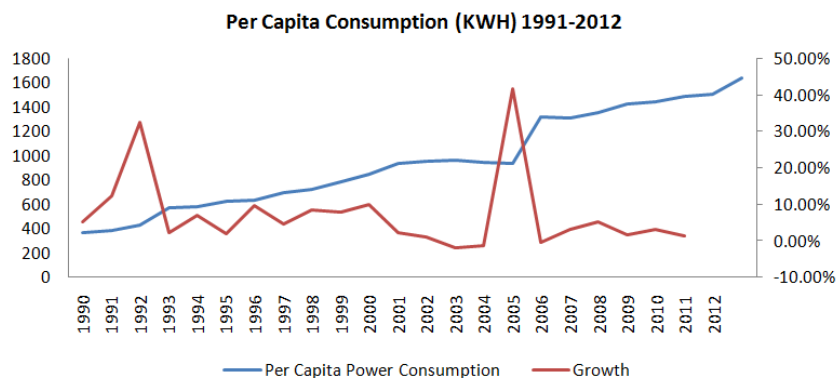
The data about power consumption in Gujarat for the year 1991 and 2012 presented in table above and depicted in figure indicates that total power consumption has increased by nearly 195 percentage, from 21620 MU in 1991 to 63715 MU in 2012. The largest growth in consumption of electricity is noticed in public works (1040.52 percentages) from 116 MU in 1991 to 1323 MU in 2012. Domestic consumption of electricity has increased from 1756 MU to 10067 MU during the same period which represents the growth of 473.29 percentages while commercial consumption of electricity has

increased by 372.61 percentages, from 544 MU to 2571 MU during the same period. The proportion of electricity used in agriculture has declined from 26.26 percentages of total consumption in 1991 to 21.90 percentages of total consumption in 2012 while that of industrial usages increased from 35.56 percentages to 43.33 percentages during the same period.

The proportion of electricity consumed for different purposes indicates that among various uses of electricity, largest proportion (43.33 percentages) goes to industries followed by agriculture (21.90 percentages). Nearly 4 percentages of electricity consumption is by commercial usages while less than two percentages goes to public lighting (0.43 percentages), Public works (2.08 percentages), and railway traction (1.11 percentages).

**PER CAPITA CONSUMPTION OF ELECTRICITY IN GUJARAT**

The per capita consumption of electricity has increased by 352 percentages during the period 1991 to 2012. The per capita electricity consumption was 363 KWH in 1990 which increased to 953 KWH in 2001 and further increased to 1642 KWH in 2012.



**Figure 15: Per Capita Consumption (KWH) 1991-2012**

Growth in per capita electricity consumption has been fluctuating over times since 1991. The highest growth has been observed during 2004-04 where per capita electricity consumption has increased by 41.74 percentages from 932 KWH to 1321 KWH in a single year. Year 1991-92 also witnessed high growth in per capita electricity consumption by 32.40 percentages from 429 KWH to 568 KWH.

**CONCLUSIONS**

It can be concluded from the analysis above that the electricity production and consumption has been fluctuating over a period of time. The share of state owned electricity companies in production of electricity has declined over a period of time while that of private sector has increased remarkably. The proportion of electricity consumed for different purposes indicates that among various uses of electricity, largest proportion goes to industries followed by agriculture. Nearly 4 percentages of electricity consumption is by commercial usages while less than two percentages goes to public lighting (0.43 percentages), Public works (2.08 percentages), and railway traction (1.11 percentages). Growth in per capita electricity consumption has been fluctuating over times since 1991. The highest growth has been observed during 2004-05 where per capita electricity consumption has increased by 41.74 percentages

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