CHAPTER VII
CONCLUSION

VII.1 Growth of Installed Capacity of Power Plants.

The Govt. of India has considered the reform in power sector to increase the generating capacity by installing more and more Power Plants. However, as the Govt. has limited sources of fund, Government could not achieve the required target of power Generating capacity. Therefore, Govt. of India has started reform process from 1991 onwards.

Table No.7. 1 Addition of Installed Capacity in MW

Particulars	Pre Reform period	Post Reform period	Total
India	63636	263213	326849
Gujarat	4365	22361	26726
GEB (GSECL)	3259	2619	5878

Source Researcher Own Calculation.

The installed capacity of power generation was very low. Therefore, the Govt. of India had started reform process from 1991 onwards. However, due to paucity of fund, Govt. was not in a position to give financial support to increase the installed capacity for power generation.

It is observed from the above table that during pre reform period, there was only 63636 MW installed upto 1990 i.e. by end of 7th Five Year Plan. While during the post reform period i.e. from 8th Five Year Plan to 12th Five Year Plan, there was addition of 263213 MW installed capacity, and as on 31.03.2017, the total installed capacity is 326849 MW. This shows only 19.47 % of installed capacity during pre reform period. However, as against this, 80.53% installed capacity is increased during post reform period.

It means per year capacity is 1590 MW during pre reform period as against 9748 MW during post reform period and over all increase is 4878.343 MW. In other words, during post reform period, the installed capacity was increased by about six times than increase during pre reform period.

Similarly in Gujarat also, out of total installed capacity of 26726 MW, there was installed capacity of 4365 MW only during pre reform period as against 22361 MW during post reform period. It shows average per year installed capacity of 109 MW during pre reform period as against the 828 MW per year during post reform period. Therefore, over-all

increase per year is 399 MW, which is equivalent to 60% during pre reform period and 84% during post reform period.

Similarly out of total installed capacity of 5878 MW of GEB/GSECL, the Govt. Power Generating Company', there was installed capacity of 3259 MW in pre reform period and 2619 MW in post reform period. It shows that average capacity installed per year is 81MW in pre reform period and 97MW average per year is during post reform period. It indicates that 55% installed capacity is increased in pre reform period and only 45% capacity increase during post reform period.

It is, therefore, concluded that during the process of reform, installed capacity of power generation is increasing significantly. However, the share of private sector is more compared to Govt. Generating Company.

1 Generation :

The generation capacity during pre and post reform period in Gujarat, the share of GoG own Generating Company (GEB/GSECL) was about 90% in 1961. However, after reform period i.e. 1991 onwards, it is decreasing regularly i.e. it has reduced to 66.80% in 1995 and 48.08% in 2005.If we analyses the percentage increase in generation of Gujarat as a whole, it was increasing at higher rate i.e. on an average 6 to 7%.per year However, the share of GEB /GSECL is reduced .At the time of unbundling, GEB share was 48%, whereas in 2017, the share is reduced up to 15.67%. Though the generating capacity in Gujarat is increasing regularly, the share of GSECL has been dropping generally. This is mainly more & more private participation growing due to reform of power sector reform policy.

Table No.7. 2 Generation of India Units in GWH

Type of Fuel	Pre Reform Period	Post Reform Period	Total	% of Generation Pre Reform	% of Generation Post Reform	% of Generation Total
Coal	391835	2066917	2458752	61.20	73.29	71.05
Gas	8723	187335	196058	1.36	6.64	5.67
Diesel	1579	7810	9389	0.25	0.28	0.27
Hydro	224266	378361	602627	35.03	13.42	17.41
Nuclear	13866	85264	99130	2.17	3.02	2.86
RES	6	94690	94696	0.00	3.36	2.74
Total	640275	2820377	3460652	100.00	100.00	100.00

Source Researcher Own Calculation.

- Generation of power from coal is 71%.share of coal base generation increase from 61 % to 73 % during post reform period. Generation of power from coal is always lead .

- Generation of power from Gas is 6 % only. Share of gas base generation increase from 1.36 % to 6.64 % during post reform period. Generation of power from gas is very nominal .Generation of power from diesel is very nominal .it is not economical .its produce pollution . So there is no impact of reform of power sector.

- Generation of power from Hydro is 17.%. . This is rest on on rain during monsoon spell.

- Generation of power from Nuclear is 2.86 % only . This is principally on the policy of GoI.

- Generation of power from RES is 2.74 %. share of RES base generation increase from 0 % to 3.36 % during post reform period. Generation of power from RES. This will increase at increasing rate in future .

Table No.7. 3 Generation of Gujarat and GEB-GSECL with share in Total Generation in MUs

	Pre Reform Period	**Post reform Form Period**
Gujarat Over All	512219	952982
GEB-GSECL	256493	293792
% of Share of GEB-GSECL in Gujarat	**50.07**	**30.83**

Source Researcher Own Calculation.

- Generation of Gujarat of 512219 MUs during pre - reform as against 952982 during post reform period. It indicate that generation is growth by 1.86 times. GEB-GSECL with share in Total Generation in MUs

- Generation of GEB-GSECL of Gujarat of 256493 MUs during pre - reform as against 293792 during post reform period. It indicate that generation is growth by 1.15 times.

- The real impact of reform is share of private IPP is increase but share of Government Generating companies is descending trend. This is straightforward purpose of reform realised .

2. <u>Auxiliary Consumption</u> :

The auxiliary consumption during pre reform period was ranging from 8.79% to 10.06%. Similarly during post reform period also, it is more or less the same i.e. 8.4% to 10.6% though the efficiency key para meters are improved. The main reason for this is that the Gujarat State is surplus in power i.e. the present installed capacity is 27542 MW as against the demand of 15142 MW. Therefore, the Plants were compelled to operate on partial load as well as to put on Reserve Shut Down. Accordingly the auxiliary consumption is increased even though the parameters are improved. So there is no significant benefit achieved during post reform period on account of auxiliary consumption.

3. Station Heat Rate :

The Station Heat Rate (SHR) during pre reform period was ranging for

(1) Ukai TPS from **2576 to 2760** Similarly during post reform period also,
(2) Wankbori TPS from **2515 to 2639** Similarly during post reform period also,
(3) Gandhinagar TPS from **2455to2929** Similarly during post reform period also,
(4) Sikka TPSs from **2485 to 3116** Similarly during post reform period also,
(5) KLTPS. from **3197 to 3802** Similarly during post reform period also,

though the efficiency key para meters are improved. The main reason for this is that the Gujarat State is surplus in power i.e. the present installed capacity is 27542 MW as against the 15142 MW. Therefore, the Plants were compelled to operate on partial load as well as to put on Reserve Shut Down. Accordingly the SHR is increased even though the para meters are improved. So there is no significant benefit achieved during post reform period on account of SHR. The Station heat Rate of almost all the Plants is having more or less the same except in last couple of years at Wanakbori, Ukai and G'nagar TPS. Though the technical improvement is made, but due to backing down and RSD, higher start or stop, SHR is increasing at KLTPS. However, the Company is in a position to maintain more or less the same SHR after unbundling.

Table No 7.4 HEAT RATE (KCAL/KWH)

YEAR	UKAI TPS	GTPS	WTPS	STPS	KLTPS
1997-98	2644	2511	2509	2516	3787
1998-99	2760	2455	2501	2480	3329
1999-2000	2536	2456	2528	2501	3349
2000-01	2595	2489	2472	2506	3404
2001-02	2608	2513	2464	2665	3250
2002-03	2590	2505	2459	2725	3662
2003-04	2675	2534	2515	2835	3521
2004-05	2680	2535	2534	2909	3802
2005-06	2721	2677	2658	2925	3355
2006-07	2745	2919	2562	2826	3197
2007-08	2769	2662	2599	3064	3583
2008-09	2731	2655	2616	3044	3397
2009-10	2717	2793	2625	3049	3520
2010-11	2850	2820	2624	2971	3507
2011-12	2764	2647	2597	3014	3509
2012-13	2741	2637	2609	3002	3239
2013-14	2739	2538	2631	3009	3185
2014-15	2673	2617	2639	2996	2951
2015-16.	2636	2548	2661	3116	3049
2016-17	2576	2525	2621	2763	3169

(Sources . MIS repots of relevant period of Generation Department of Generating Company.)

4. Renewable Energy

Before reform started no such importance was given to clean energy, So installation of renewable energy was less considered. However from 1991 onwards, the addition of renewable energy has been started which is gradually increasing very fast after reform period i.e. after 1990 onwards. In the beginning of 1992, the installed capacity of renewable energy was 32 MW only, which was equivalent to 0.91 % of total installed capacity. However, in the F.Y. 2016-17, 32757 MW was added in the total 57260 MW, which is equivalent to 17.52%.

(sources: *Electrcicity Sector In India.* Retrieved from en.wikipedia.org/wiki/electricity-sector-in -India: on January 4 .2018.) (Power M. o., 2016-17) (Power M. o., 2017)

Table No.7. 5 Renewable Energy installed capacity in India (as of 31/03/2017)

Grid Connected Power	**Capacity (in MW)**
Wind	32279.77
Solar	12288.83
Small Hydro Power projects	4379.86
Biomass Power & Gasification and Bagasse Cogeneration	8181.70
waste power	130.08
Total - Grid Connected Power	57260.23
Off-Grid/Captive Power	
Biomass (non-bagasse) Cogeneration	651.91
SPV system(>1kw)	313.88
waste to power	160.16
Bio mass Gasifiers	182.39
water mills/micro hydro	18.71
Aero generator /Hybrid Systems	2.69
Total - Off-Grid/Captive Power	1,329.74

(Sources:*Electrcicity Sector In India.* Retrieved from en.wikipedia.org/wiki/electricity-sector-in -India: on January 4 .2018.)

Wind Farm :

"Huge wind capacity is installed in the state , However There is remarkable potential is left out. wind capacity is 5400 MW expected that the capacity will be reached to 8000 MW by 2020. "

Table No.7.6 Wind Mill Installed Capacity in MW

F.Y	Wind Mill Installed Capacity in MW		Gujart % of Installed Capacity of India
	India	Gujarat	
2005-06	6270	-	0
2006-07	7850	-	0
2007-08	9587	-	0
2008-09	10925	1463	13.39
2009-10	13064	1782	13.64
2010-11	16084	2094	13.02
2011-12	18421	2694	14.62
2012-13	20150	3087	15.32
2013-14	22465	3352	14.92
2014-15	23447	3542	15.11
2015-16	26777	3933	14.69
2016-17	32280	5318	16.47
2017-18	32508	5405	16.63

(sources : *Electricity sector in India-wikipedia*. Retrieved December 28, 2017, from en.wikipedia.org: (Power M. o., 2017)

The above table No 5.6 level is escalation form Specify that Government of Gujarat share of wind mill in India national 13.39 % to 16.63 % within the span of nine years.

Solar

Solar price per unit is decreasing day by day. In India, the renewable energy source is become important after reform process started i.e. 1990. After reform process, the generating capacity from solar and bio-gas etc. is increasing. The cost of installed capacity of solar plant was initially very high . But subsequently, it has been decreasing at increased rate. If we analyses the selling price of solar of international market, it was 76 US$ per watt in 1977, which was reduced to 10 US$ in 1987 and 0.03 US$ in 2015. In India also, the rate of solar energy of Rs.15 per unit was determined in 2011-12. Now it has reduced to Rs.0.95 per unit. Similarly the rate of installation of solar plant was Rs.15 crore per MW, which is redcued to Rs.3 crores per MW Plant.

Table No 7.7 PRICE OF SOLAR PV CELL (US $/watt)

Year	Solar PV sell rice (Us $ /Watt)
1977	76.00
1982	19.00
1987	10.00
1992	9.00
1997	6.50
2002	6.00
2007	3.50
2012	0.70
2017	0.30

(Sources:*Electricity sector in India-wikipedia*. Retrieved December 28, 2017, from

en.wikipedia.org: www.iea.org)

Table No. 7.8 Solar Price per Unit of Indian Market.

Year	Installed Capacity of India in MW	Installed Capacity of Gujarat in MW	Gujarat % of Installed Capacity of India	Price Per Unit in Gujarat in Rs.Nps
2010-11	161	5	3.11	**15.00**
2011-12	461	554	120.17	**15.00**
2012-13	1205	857	71.12	**10.37**
2013-14	2319	861	37.13	**9.70**
2014-15	2632	974	37.01	**8.39**
2015-16	3744	1016	27.14	**6.77**
2016-17	6763	1230	18.19	**6.30**
2017-18	12289	1262	10.27	**5.86**

(Sources :*Electricity sector in India-wikipedia*. Retrieved December 28, 2017,& Researcher own Calculation on the bases of information collected from commerce department of GUVNL & GEDA**.)**

Cost of installed capacity of MW was very higher. Rs.15 Crores per MW was in the beginning of 2010 period.in consequence , Power Purchase cost was Rs.15.00per unit of KWH .Government of India has plan of 75 GW solar. Therefore Plan of production at higher level as a result Fixed cost is on reducing trend. Considering the other factor and various Government polies cot per MW is reduce upto Rs .5.86 Per MW..This is further reduce to Rs.3.85 per KWh .during the period .

SCHEME FOR FINANCIAL TURNAROUND

Government of India has started various schemes to increase the efficiency after reform to maintain the flexible competitiveness in power sector.

1. Availability of based tariff. (ABT)
2. Deviation and Settlement Mechanism.(DSM)
3. Performance achieved and Trade Mechanism.(PAT)
4. UjjavalDiscom Assurance Yojna (UDAY).
5. Captive Mine.

Govt. of India has also notified the Electricity Policy from time to time GoI also announced schemes for financial turnaround of distribution loses.

AVAILABILITY BASED TARIFF (ABT)

Availability Based Tariff (popularly known as **ABT**) is a frequency based pricing mechanism for electric power. The Availability based tariff falls under Electricity market mechanisms to charge and regulate power to achieve short term and long term grid stability. It involves incentives and de-incentives to market participants against deviations in committed supplies. ABT aims at encouraging generators to produce more during peak load hours and curtail generation adequately during off-peak hours on one hand and discouraging consumers from overdrawing on the other hand.

ABT MECHANISM - OBJECTIVE

- Assists in maintaining grid security & reliability.
- Frequency - an indicator of imbalance in demand & supply. Grid frequency is dramatically improved to the range of 49.0 to 50.5
- Encourage generators to maximise generation during peak hours by built in incentives, to meet higher consumer load demand.
- Encourage DISCOMs to manage their load demand when overdrawing or during low frequency.
- Encourage merit order operations of power station, and other purchases - cheaper power to be utilized first & costlier later.
- Encourage CPP, excess availability to be utilized when cost effective.

- Encourage generators to maximise generation during peak hours by built in incentives, to meet higher consumer load demand.
- ABT is a scientific settlement system for contracted sale & purchase of power
- Provides platform for power market to flourish

ABT having Three Part Tariff:

(1) Fixed Charge : Based on Plant Availability

(2) Energy Charges : Based on Scheduled Energy

(3) Unscheduled Interchange Charge :

(a) UI = Schedule Energy - Actual Generation (for SGS/IPP/CPP)

(b) UI = Scheduled Energy - Actual Drawl (DISCOM/AECO/SECO/DD/DNH)

- Fixed charges / Capacity charges/: The fixed charge (FC) in case of ABT is payable every month by each beneficiary to the generator for making generation capacity available for use. However, it is not the same for each beneficiary and varies with the share of a beneficiary in a generators capacity. It also vary with the level of availability achieved by a generator. As per the ABT mechanism, FCs excluding RoE is payable on a proportionate basis for 30% availability. Pro-rated RoE is payable from 30- 70% availability and beyond this level, an incentive is payable to generating station at 0.4% of equity for each percentage increase in availability in the 70- 85% range. Thereafter the incentive falls to 0.3% in order to discourage generating facility from overloading the units at the cost of maintenance and equipment life. It is a function of ex-bus MW capability of the power plant for the day declared in advance, paid by beneficiaries proportionate to their respective % share in the plant.

- Variable charges : It is the energy charge per kwh of energy supplied as per a pre-committed schedule of supply drawn upon a daily basis by LDCs. Under the earlier regime, fixed and variable charges were bundled together and payable in proportion to the actual energy drawn by the consumer. The splitting under the new regime will promote power trading which is discussed later on in this paper. Energy charges are calculated as:

    - Energy Charge = MWh for the day as per drawl schedule for the beneficiary finalized in advance x Energy Charge rate for the plant (OR) Energy Charge = Scheduled Energy X Energy Rate

- Unscheduled Interchange: Under the earlier regime, no penalty was applicable for deviation from generating/drawal schedule by an entity. An attempt has been made to do away with this drawback under the ABT regime through introduction of UI charge. Here, for any withdrawal of power other than the schedule, the beneficiary has to pay an unscheduled interchange (UI) charge for deviation from the day ahead schedule which is linked to the frequency. The relationship between the UI rate and grid frequency, for the inter-state system, is specified by Central Electricity Regulatory Commission. UI charges are calculated using the following relationship:

- A generator generates more/less than the schedule causing grid frequency to deviate upwards/ downwards.

- Beneficiary draws more/ less than the schedule causing grid frequency to deviate downwards/upwards.

Benefits of ABT

- Rational recovery of fixed costs from beneficiaries.
- It provides a fiscal mechanism to encourage high availability of plants to meet the peak demand.
- Merit order and most economic generation is encouraged as a result of which low cost power gets a priority in generation.
- Rationalization of the contractual demand between the SEB's and the generators.
- Fiscal disincentives for over drawl during low frequency conditions and under drawl during high frequency conditions.

(Sources: CERC.http://www.cercind.gov.in/orders/2-1999GOIABT040100.pdf.)

(Commission C. E., 2014)

Deviation Settlement Mechanism (DSM)

The objective of these regulations is to maintain grid discipline and grid security as envisaged under the Grid code through the commercial mechanism for Deviation settlement through drawl and injection of electricity by the users of the grid. To drive distribution utilities to go for planned procurement of electricity and creating an environment for investors to set up new power plants and not to rely upon over-drawl from the grid for meeting their consumer demands. Due to integration of regional grids, the economic cost of grid failures is too high and grid failures should be avoided at all costs. To enforce strict volume limits on over drawl / under drawl and over-injection/under-injection irrespective of the grid frequency. Replace the Existing UI regulation. These regulation shall be applicable to sellers and buyers involved in the transactions facilitated through short-term open access or medium-term open access or long-term open access in inter-state transmission of electricity.

(Sources: Central Electricity Regulatory Commission (DSM& Related Matters)

UDAY

What is UDAY?

Ujwal is a scheme of MoP of India for the financial help to Distribution Companies. Known as "UDAY" It stands for DISCOM (**Distributions Companies) Assurance Yojana.** Under UDAY, state governments, who own discoms, can take over 75 percent of their debt and pay back lenders by selling bonds. The remaining 25 percent debt will be financed by bonds issued by DISCOM. Several incentives for the state electricity boards are envisaged under the scheme once they join UDAY.

UDAY is a financial restructuring and efficiency enhancing programme, aims to reduce the debt burden of the state owned electricity distribution companies . DISCOMs – most of them are owned by state governments have an accumulated huge losses of approximately Rs. 3.8 lakh crore and outstanding debt of approximately Rs. 4.3 lakh crore (as on March, 2015).

PERFORM ACHIVE AND TRADE (PAT MECHANISM)

To improve energy efficiency in industries by trading in energy efficiency certificates in energy-intensive sectors as per the policy of National Mission on Enhanced Energy Efficiency (NMEEE) in National Action Plan on Climate Change (NAPCC).There for GoI has launch new Scheme of PAT . PAT is an innovative, market-based trading scheme announced by the Indian Government in 2008. It is compulsory /obligatory for Designated Consumers under the ECA. Scheme of PAT decided targets for energy consumption for larger, energy-intensive facilities. The PAT Scheme is being executed in thermal power plants of power sector from 2012-2015 with eight energy-intensive sectors. . This accounts for roughly 60% of India's total primary energy consumption. It targets energy consumption reductions of 6.6 million tons of oil equivalent in the 478 covered facilities .

The scheme carry out compulsory specific energy consumption targets on the covered facilities with less energy efficient facilities having a greater reduction target than the more energy efficient ones. A facility's baseline is determined by its historic specific energy consumption between 2007-2010. Facilities making greater reductions than their targets receive "EsCerts" or "energy saving certificates" which can be merchandised with facilities that are having anxiety meeting their targets, or banked for future use. The PAT scheme establishes plant-specific targets rather than a sectorial target, with the average reduction target being 4.8% that is to be achieved by the end of the first phase (2015).

(sources. Bureau of Energy Efficiency (2010). Implementation of Energy Conservation Act and BEE Action Plan. Retrieved from: http://www.emt-india.net/Presentations2010/26-Fertiliser_30Aug2010/BEE.pdf)

Captive Mine

Govt. of India has allocated coal mines to various Power Generating Companies to avoid various issues of coal linkage, price, quality etc. Govt. of India has also allocated all State Electricity Generating Companies coal captive mines, so that Generating Companies can control production, quality, cost etc. as per the requirement of Power Generating Companies in the State.

For GSECL also, GoI has allocated Coal mine located in Chhattisgarh State. Gujarat State has option of tolling the power in Gujarat by job work process by private independent power producer or to install new Power Plant in Chhattisgarh to minimize the cost of railway

freight, which is very high. This is good beginning , However Power Generating has limited fund available ,there for it is difficult to invest in Excavating of coal from Mine. To obtain Land, Rehabilitation of land loser and statutory clearance etc. are costly affairs require huge amount of Investment. Interest during upto the production will be capitalize increase cost of Coal and so on.

TESTING OF HYPOTHESIS

Table No.7.9 Calculation of P value ,Correlation, Coefficient T stat Regression R square and F

Ratio	P value	Pearson Correlation	Coefficient	t stat	F	Null Hypothesis (Rejected/Accepted)
HYPOTHESIS	No.I					
Gross Profit Ratio	0.1893	-0.4523	-0.1645	-1.4345	2.0580	Rejected
Net Profit Ratio	0.2077	-0.4360	-1.3706	3.2918	1.8786	Rejected
Operating Ratio	0.1344	0.5073	0.1290	1.6651	2.7727	Rejected
HYPOTHESIS	No.II					
Current Ratio	0.3531	0.3290	0.51846	0.9856	0.9714	Rejected
Quick Ratio	0.9594	-0.0436	0.0442	0.0524	0.0152	Accepted
Cash Ratio	0.9046	0.0185	-0.0109	-0.1236	0.0152	Accepted
HYPOTHESIS	No.III					
Debt Equity Ratio	0.3146	-0.3546	-0.0237	-1.0727	1.1508	Rejected
Interest Coverage Ratio	0.9057	0.0431	0.0092	0.1221	0.0149	Accepted
Total Coverage Ratio	0.1429	-0.4980	-0.0378	-1.6241	2.6384	Rejected
HYPOTHESIS	No.IV					
Generation	5.6574	0.9211	1.5993	7.1015	50.4316	Accepted
Share of GEB/GSECL	0.0021	0.8172	0.9709	4.2545	18.1012	Rejected
Installed Capacity	0.0217	0.6785	1.2071	2.7712	7.6795	Rejected