

Efficiency of Indian Power Sector an Analysis of its Performance and Problems

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Abstract

This article aims at analysing the importance of power sector, consumer utility, demand and generation of power. Power sector has become important and indispensable practically in every sphere of activity. The production status of energy in India has not been a match to the power requirements of various categories of consumers. There is a constant widening of the gap between power generation and demand for power in India. Andhra Pradesh has abundant natural resources for power generation. Self-sufficiency in it is yet to be realised. Power consumption of the people in the state is much less than the average per capita consumption in the rest of the country. This article explains the overall operational efficiency of the Indian power sector. It also analyses the various multifarious problems encountered in the production and distribution of power sector such as theft of power, misuse of power, unauthorised use of power etc., The study also suggests suitable measures to be taken by the government for the development of the power sector.

Keywords

Power sector in India, generation and distribution of power in central, state and private sector, major problems of power sector, suitable measures for its development. Paper Type: - Research Paper

I. Introduction

Infrastructure has become supremely important for a nation's economic development, as it provides the basic structural foundation for it. And it is far more so in the case of developing countries of the world as their economic development, which had been neglected for long, for various reasons, depends very much upon their raising an effective and efficient infrastructure which can respond to demand and provide the required services promptly and efficiently. Effective service is the golden measure of infrastructure development [1]. Infrastructure services in return enhance the welfare of the people, foster economic growth and productivity, and help to improve the quality of life in general. Therefore it has been said that infrastructure is like the wheels of economic activity [2]. Its failure, especially in major areas such as power, reduces productivity and radically affects the quality of life. There is every reason to believe that in the developing countries today investments in infrastructure have been improper despite high cost, and therefore have not been rendering the services expected of its properly.

The Economic development of any country irrespective of its size mainly depends upon the development of the power sector, which in fact is a key indicator of the nation's overall economic development. Power is central not only to all household activities, but to economic development as well. In fact it is the fuel of economic progress in all sectors, not only agricultural and industrial but all allied areas. Economic progress depends very much upon how successfully and profitably a country manages its power sector. Agriculture, industry and other core areas of economy ultimately depend for their development and success on the availability of adequate power constantly and uninterruptedly throughout the year. How important is power

consumption in the economic development a country, apart from other factors, may be known by taking into consideration its power consumption. If power consumption by all sectors is seen to increase, then the index of eco-development as a measure of its progress is also found to increase. Usually the correlation between consumption of power and the growth of economy is taken as a measure of progress.

The production of Electricity is a basic indicator of a country's size and level of development in all spheres. Some countries are exporting electricity on a massive scale and others are importing it on a large scale. In India most of the power consumption is by the agricultural sector, where the rate of revenue is very low. Expanding the supply of electricity to meet the growing demand of ever increasing urbanised Indian economy without incurring unacceptable costs is a major challenge to it. People's standard of living depends on their use of energy in general and access to electricity in particular. It is a major factor on which the policy-makers have to seriously focus their attention and direct their efforts. Compared with several other countries of the world, India is lagging behind many in terms of production as well as per capita consumption of energy.

II. Power Scenario in the World

India has low energy consumption but high-energy intensity. In 1991 the energy consumption per capita (toe/persons) in India was 0.112, while it was 0.336 in Asia, and 7.67 in U.S.A in the year 1971. During 1996 it shot up to 0.277 in India, 0.733 in Asia, and 7.88 in USA. It clearly shows that the energy per capita consumption in our country doubled between 1971 and 1996 but there was a steady increase of it in USA. It clearly reveals that the energy consumption in India even in 1996 was only 0.277, whereas in Asia it was 0.733, and in USA 7.88. Obviously there is a lot of variation in terms of energy consumption between developing countries and developed countries. In terms of electricity intensity (toe/million US \$) it was 462 in India, 385 in Asia and 503 in USA during the year 1971 and it shot up to 597 in India, 406 in Asia and 384 in USA during the year 1996 [3].

It is clear that while the energy intensity has been increasing year after year in India, it is considerably getting reduced in USA over a period of time. But in the other Asian countries it exhibits a mixed trend. It indicates that though there is a considerable rate of growth in power generation in India over a period of time, its energy requirements have been so enormously increasing that there is no match between power generation and power requirement. It is dire necessity to reduce this disparity as quickly as possible to have overall economic development in the country. Unless adequate power is generated to meet the requirements of all sectors of our economy, economic progress will be invariably slow.

The world per capita use of energy was 1.9 tonnes of coal equivalent, (T.C.E). Developed countries like the USA, U.K and Japan have their respective per capita consumption at a much higher level of 11.1 T.C.E, 5.4 T.C.E and 3.2 T.C.E respectively, while developing countries like China and India have a per capita energy consumption of 0.5 T.C.E and 0.2 T.C.E respectively [4]. A lot of change has been taking place the world over in

the consumption of energy. High-income countries consume energy 3 ½ times that of Europe and central Asia. The total energy use by South Asia and Middle East and North Africa is almost the same. The Latin American and Caribbean countries use more energy than South Asia. But the sub-Saharan Africa consumes less power than half of South Asia. The U.S is the biggest consumer of commercial energy. It uses 4 times that of Japan and China, and the erstwhile Russian Federation was a large consumer of commercial energy. But India, Canada and the U.K consume almost the same quantities of energy, which indicate the stage of economic development of each of the countries. It is clearly noticed that rapidly industrialised countries have been increasing their consumption of energy considerably. India has registered a high overage growth of 4.4% [5]. The world development report 2000 [6] clearly specifies the world position of power in terms of per capita use. It points out that the use of electrical energy is very high in the developed and some of the Gulf countries. The per capita consumption of power globally was 2053 kWh. The per capita use of the U.S was only one half of that of Norway. Japan, Belgium and Switzerland consumed 7000 kWh per capita each in the year 1997.

III. Power scenario in India

Power has become important and indispensable practically in every sphere of activity. It is used by many categories of consumers. Innumerable gadgets not only domestic ones are run on electricity. Industrial application of power has no bounds. Different kinds of machinery, which run on power, are in use in large, medium and small-scale industries, which have been major consumers of power. To run computers and robots power is required. It is now possible to contact and communicate with whomsoever one wants to, from any point of the universe, through telephone, inter-net, e-mail, e-commerce, video conferencing etc. Distance between places has little significance now, due to the development of modern communication systems. Satellites supporting all these channels of communication are controlled from earth stations, with the help of both conventional and non-conventional power systems. The ever-increasing living standard of people leads to increasing energy consumption for meeting various comforts by means of energy-intensive devices, by electrical appliances, air conditioners and the like. But the production status of energy in India has not been a match to the power requirements of various categories of consumers.

The production efforts in the power sector have not been increasing correspondingly and positively for enhancing the consumption levels of people and their standard of living. There is a constant widening of the gap between power generation and demand for power. Though there is a strong correlation between level of income and energy consumption, power development strategies have not been fruitful so far. The stimulus for economic development is to be found in continuous energy production and supply. Energy consumption and National income are interrelated, and require providing a strong link between adequate energy supply and economic growth in developing countries like India [8]. It is also clear that economic development and power sector development are interrelated and inter-dependent. A close link between energy consumption and National income in both cross-sectional and time series data power sector implies that inadequate power generation and supply could inhibit the economic growth of the country [9].

The overall operational efficiency of the Indian Power Sector is

explained below by using the following parameters.

A. Total Power sector at glance:

The total power production of the power sector in India is furnished below.

Table 1 : Power Sector at Glance

Fuel	MW	%age
Total Thermal	93,332.64	64.6
Hydro (Renewable)	36,762.76	24.7
Nuclear	4,120.00	2.9
RES** (MNRE)	13242.41	7.7
Total	1,47,457.81	

Source: Annual reports of Ministry of Power

Table 1 clearly shows that in general the fuel for power production is divided into thermal, nuclear and hydro. Mostly in India, the power generation is done by thermal way only and it is the highest say 93332.64MW. This can be well seen in the following diagram.

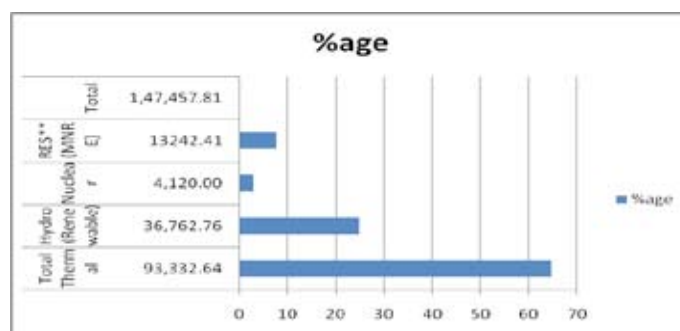


Fig. 1 : Electricity Generation

There has been significant improvement in the growth in actual generation over the years. As compared to annual growth rate about 3.1% at the end of 9th Plan initial years of 10th Plan, the growth in generation during 2007-08 was of the order of 6.3%. We can also observe that the difference between target and achievement is reduced a lot in few years. It shows in table 2

Table 2 : Programme, actual achievement and growth in electricity generation in the country during 2002-03 to 2007-08

Year	Target	Achievement	% of target	% growth
2002-03	545.552	531.40	97.4	3.1
2003-04	572.900	558.300	97.5	5.0
2004-05	586.41	587.42	100.2	5.2
2005-06	621.50	617.51	99.4	5.1
2006-07	623.00	662.52	99.9	7.3
2007-08	710.0	704.45	99.2	6.3

Source: Annual reports of Ministry of Power

The above table reveals that in the year 2002-03 only the growth rate recorded at about 3.1% and thereafter the growth rate recorded at above 5%. This shows that power sector has been improved in terms of electricity generations as well as implementation of their plans successfully. The graphical presentation of it gives a better idea about the growth in a detailed way.

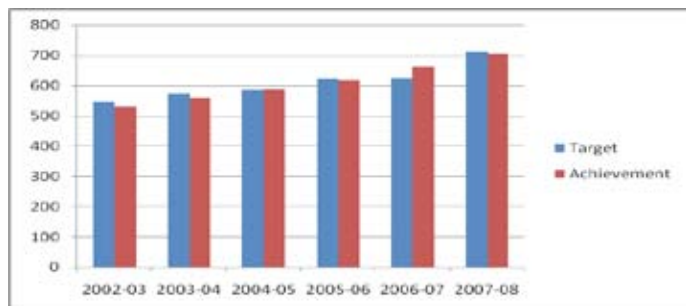


Fig. 2 :

From the above figure as we can observe that there is almost full achievement for their respective targets. In other words, the targets are achieved in each and every year. To find whether the difference between target and achievement we can apply paired t test as follows.

T-test for the difference between target and achieved:

Here T- test is applied to test whether the target is achieved significantly or not. To do this test, we have framed the null hypothesis as follows

H0: The targets are achieved significantly for the past six years. (Diff=0)

The respective output from SAS software is

Tests for difference: DIFF=0

Test	-Statistic- -----	p Value-----
Student's t t-	0.04547	Pr > t 0.9655
Sign M	1	Pr >= M 0.6875
Signed Rank S	3.5	Pr >= S 0.5625

The paired t test for the above analysis gives the P-value as 0.9655 which gives very good sign that each year the targets are significantly achieved by the ministry of power. Form the above t-test; we can conclude that for the past six years, the targets are showing an increasing trend.

B. Plant Load Factor

This is another important factor in generation of electricity as it deals with the generation at each center and their targets achieved. Notwithstanding the fact that many of the TPCS in the country are vary old, the plant load factor has shown improvement over the years 2002-03 to 2007-08.

Table 3 : The PLF in the country during 2004-05 to 2007-08

Source: Annual reports of Ministry of Power

Year	Target	Actual	Sector-wise Actual		
	(%)	(%)	Central	State	Private
2002-03	70.8	72.1	77.1	68.7	68.7
2003-04	72.0	72.7	78.7	68.4	80.4
2004-05	73.4	74.2	81.3	68.9	84.1
2005-06	74.7	74.0	82.6	67.3	85.4
2006-07	76.3	76.8	84.8	70.6	86.3
2007-08	77.1	78.6	86.7	71.9	90.8

The above table conveys that most of the years the actual power load is more than target set to them. This is the most welcoming trend in power generation scenario. If we look at the sector wise distribution, it is revealing that there is hardly small difference between them. To get clearer picture about

the sector wise distribution, we can look at the following figure 3 and 4.

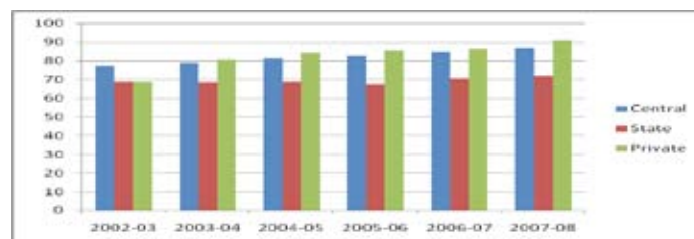


Fig. 3

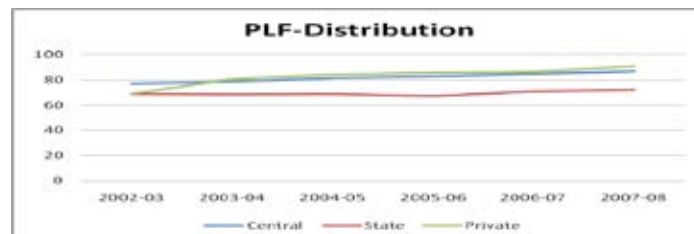


Fig. 4

This evidently shows that all the three sectors are showing some improvement in their PLF distribution over the past years. But the state sectors have shown less growth as compared to central and private sectors.

C. Total distribution of Power:

In the following table furnishes the year wise distribution of power in central, state and private sector separately.

Table 4 : Distribution Power

Year	Central	State	Private
2002-03	77.1	68.7	68.7
2003-04	78.7	68.4	80.4
2004-05	81.3	68.9	84.1
2005-06	82.6	67.3	85.4
2006-07	84.8	70.6	86.3
2007-08	86.7	71.9	90.8
TOTAL	491.2	415.8	495.7

Source: Annual reports of Ministry of Power

The following diagram gives the picture of toal share opf power production.

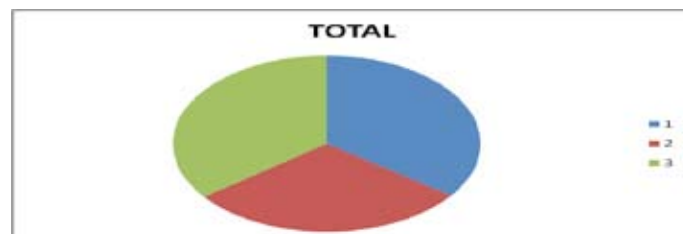


Fig. 5

The following line graph shows the distribution wise improvement in power generation.

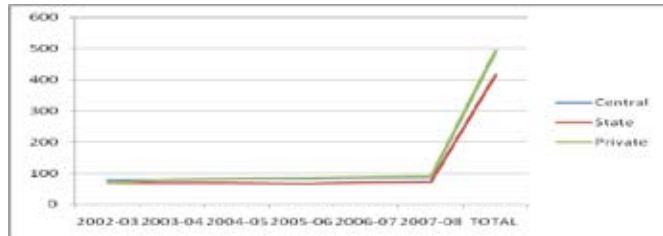


Fig. 6

D. Means of Power Generation:

The power generation has been done mainly in Hydro, thermal and nuclear. There is no private partnership for nuclear power generations and it is completely held by central government. The following diagram shows the distribution of power generation in different ways as follows.

Table 5 : Various Types of Power Generation

Sector	Hydro	Thermal	Nuclear	Total (MW)
CENTRAL	9685	26800	3380	39865
STATE	3605	24347	0	27952
PRIVATE	3263	7497	0	10760
TOTAL	16553	58644	3380	78577

Source: Annual reports of Ministry of Power

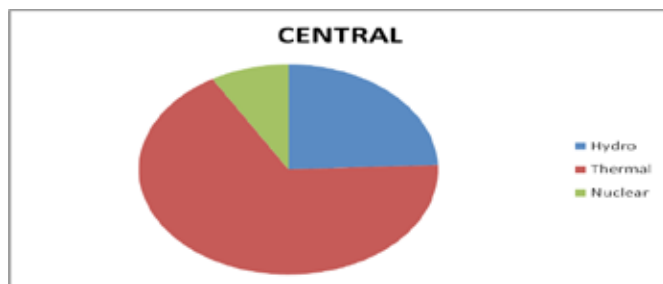


Fig. 7

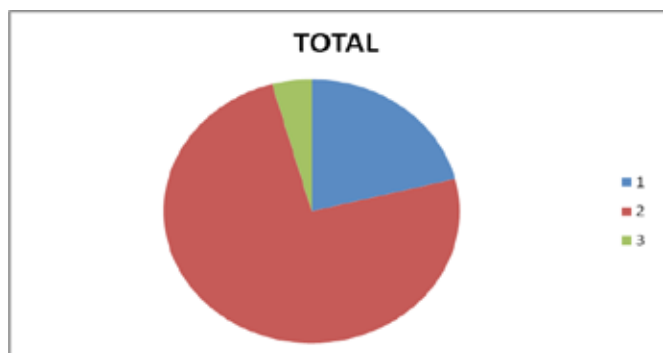


Fig. 8

Table 6 : Distribution of power in Peak time and shortages

Year	Peak Demand (MW)	Peak Met (MW)	Peak Shortage (MW)	Peak Shortage (%)
1997-98	65435	58042	7393	11.30
1998-99	67905	58445	9460	13.90
1999-00	72669	63691	8978	12.40
2000-01	78037	67880	10157	13.00
2001-02	78441	69189	9252	11.80
2002-03	81492	71547	9945	12.20
2003-04	84574	75066	9508	11.20
2004-05	87906	77652	10254	11.70

2005-06	93255	81792	11463	12.30
2006-07	100715	86818	13897	13.80
2007-08	107010	90793	16217	15.20

Source: Annual reports of Ministry of Power

C. Problems of Power Sector

Power shortage in our country has had a crippling effect on economic activity in all the core sectors of the nations' economy, notably in agriculture, industry, and other related spheres. The shortage of power supply has lowered industrial and agricultural production, and tardy progress in all the vital sectors has inevitably slowed down economic growth. Further strategies in estimating power demand have not been scientific and effective. As a result, the financial performance of the power sector has been hindered. Further, lack of a futuristic approach in developing the power sector also has caused a setback in this sector. Governments have been adopting only shortsighted approaches as to power generation, from time to time. Therefore power supply to the public has not been constant and stable.

Another important factor affecting adversely power production is the uncertainty about factors of production, which seem uncontrollable. The high degree of uncertainty in the resources for power production and the cost of energy would deter investment, which is highly dependent on the inputs of energy. The wide fluctuations and uncertainty in generation and supply of power are discouraging investments in industrial and other related sectors. Total assurance of uninterrupted power supply will certainly encourage industrial development and ultimately stimulate overall economic development, on which depends the economic future of the country. The upshot of the above observations is that evolving a sound energy policy and acting promptly on it is supremely important for the sustainable economic development of the country.

Unfortunately the power situation in our country as a whole and in the states has not been satisfactory. There is an acute power shortage. Power cuts are frequent, power supply is insufficient and irregular and high voltage fluctuations are common. These imbalances in the supply of power have been causing a lot of damage to the domestic, agricultural, and industrial sectors. Frequent fluctuations in power supply have been doing a lot of harm to valuable electrical equipment, electrical motors, electrical appliances, power stations etc. For want of constant power supply, agricultural and industrial productivity is being impeded. Farmers get only a few hours of power, mostly during the night, which makes their task full of hardship. There is ample evidence to show that the agricultural sector has been losing valuable output and productivity because of inadequate and erratic power supply. What is said of the agricultural sector is equally true of the industrial sector too. The domestic sector too is facing severe hardships. Another depressing fact is that even after 50 years of Independence, several villages in the country do not have electricity and only some have partial power supply.

Though Andhra Pradesh has abundant natural resources for power generation, self-sufficiency in it is yet to be realised. Naturally, power consumption of the people in the state is much less than the average per capita consumption in the rest of the country. That there are resources to generate adequate power but yet there is not enough power supply is a paradoxical situation. To be fair to the state and central governments, it must be admitted that they have taken several measures during the various plan periods to meet the needs and demands of

people for power supply. However the requirements of the country are far greater, and demands further increase in generation capacity. The demand for power from industry and irrigation presently is over 8.5 per cent of the total Indian electrical consumption. It has increased substantially during the last decade. Energy deficiency is approximately 11% with a peak shortage of 18.8% [10]. According to the 15th electrical power survey conducted by the Central Electricity Authority (C.E.A), the demand is expected to rise at the rate of 7.5% per annum over the next decade.

There is flagrant inefficiency and shortsightedness in all sectors. There is no insistence on accountability. Few feel that they are answerable for the lapses. As a result, costs have remained above revenues, which are constrained by irrational policy and practice of subsidising prices by successive governments [11]. It is clear that State Electricity Boards in all most all stases have failed to manage the power sector properly. As a consequence both production and distribution of power have suffered badly. The majority of consumers of various categories have been deprived of the power they require. Outwardly, taken by it, the growth of the power sector in India looks impressive, but it conceals many innate inadequacies of the system and its capacity to build up because of which it is lagging far behind the growing demand. There is a chronic shortage of power [12]. A number of forces have been responsible for this plight. Firstly, no plan period could reach the target for installed capacity; the cumulative slippage between target and achievement has remained more than 20%. Secondly, low capacity utilisation has hampered the performance of the system; thirdly, the performance of the sector for the last 4 decades indicates a velocity of energy sales, with respect to energy generated, of just 0.843. It exhibits high levels of auxiliary consumption and high transmission and distribution losses. In addition to these infirmities there have been finance failures arising from irrational pricing policies, over-manning, politicised subsidies at the cost of efficiency and an overarching professional inefficiency (what economists call “ex-inefficiency”), all of which contribute to and reinforce the whole malady [13]. The existing status of the power sector in India is dark. In fact it is in the doldrums.

Another serious problem confronted by the power sector of various states is lack of sufficient investment. The enthusiastic power development programmes and targets devised by them could not realise for want of required investment. The resource crunch in channalising sufficient investment into the power sector has made it difficult to meet the power demand. The share of the power sector in the total plan outlay records a declining trend over the several plan periods. Further under utilisation of power generation capacity has resulted in purchase of power from outside. This means that the already meagre resources have had to be diverted towards the purchase of power. Consequently, an unbearable burden is imposed on the electricity boards which, to make up the required funds, increase the power charges and thus pass the buck on to consumers. The targeted capacity addition also necessarily exerts heavy pressure on the Government to make further investments. It is all like a vicious circle.

Further, increasing transmission and distribution (T&D) losses have made the power sector a most uneconomical venture. The present reported T&D loss of 22% is much above the International standards. The T&D loss of China is about 7% and in the other developed countries, the loss is considerably less than in India. This goes to show how inefficient is the

functioning of the power sector in our country. According to unofficial reports, the T&D loss in the power sector in our country is much more than the recorded figure. The T&D losses are also another setback to the power sector. These losses have to be kept at as low a level as possible. As energy saved is energy produced and also saving in capacity addition, proper control measures are necessary to curb the T&D losses.

The power sector is in the vicious circles of multifarious problems encountered in the production and distribution of power. Theft of power, Misuse of power, unauthorized use of power; Line leakages are rampant in both rural and urban sectors. Apart from all these, outdated substations and transmission lines, Excessive political involvement for their political benefit, populist policies of various governments with out considering economic status of the power sector, uncommitted line staff are also contributing for the plight of power sector in India. All these problems are crippling the power sector and mitigating its financial health.

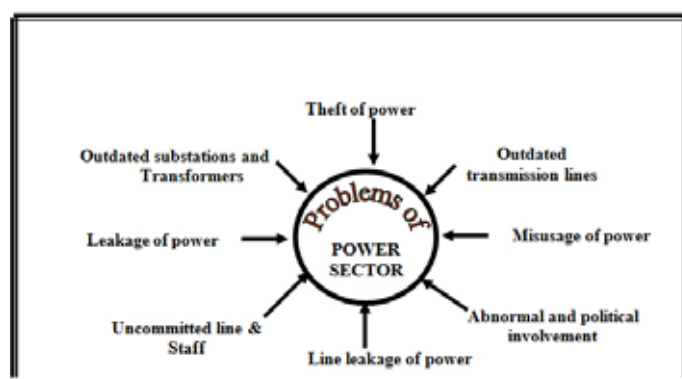
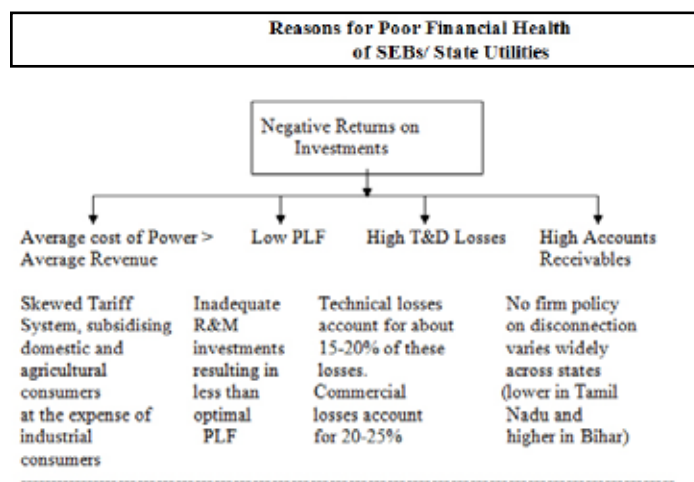


Fig. 9 : Poor Financial Health

All the SEBs of all the states with out exception experience severe financial strain due to various inherent problems. All of them are getting negative returns on their investments, as the average cost of power is less than average revenue, low PLF, High T&D losses and High Accounts Receivables. The causes for all these maladies are presented in the following chart.



Source: Blue Print for Power Sector Development, Ministry of Power, 2008.

Source: Blue Print for Power Sector Development, Ministry of Power, 2008.

Apart from these problems, the technical obsolescence and managerial inefficiency are added factors to make the power sector very bleak. Though the power sector is said to be an

autonomous body as per the electricity (supply) Act 1948, in fact it is under the tight control of the government, which interferes every now and then. This neutralises its autonomy and makes it virtually a Government department, very much influenced by whichever party is in power. Besides, lack of professional management, and labour productivity, and absence of the competitive spirit are also complicating the problems of the power sector. Pilferage, estimated to be between 7 to 25%, is the worst problem faced by all State Electricity Boards. Distribution losses, though officially estimated to be 22%, are sometimes much higher. The power sector is on the verge of a severe financial crisis and is unable to attract any public or private investments [14].

In view of the problems faced by the power sector, some reforms were initiated. But their implementation was very slow that there was not much improvement. Therefore attempts were made by the government to speed up the reforms in the power sector and to improve power generation. Meanwhile a number of working committees and commissions were appointed to review the existing power set up and to suggest measures for restructuring the power sector on commercial lines. A bill to facilitate the restructuring of the Power Sector was introduced. But the results out of it get to be realised.

IV. Suggestions:

- As great part of the financial problems of the SEB's and the present corporations in some states are due to unscrupulous thieving of power, the theft of power, illegal and unauthorized use of power should be stopped at all costs.
- A mechanism for vigilance and control of malpractices has to be set up and made to function properly. A separate Act should be enacted to control and punish the culprits in the misuse of power. As power is very vital, culprits and trespassers have to be dealt with promptly and with out compunction.
- The Generation and Distribution of power are the two faces of the power sector. Therefore, maintaining a proper balance should be the main task of the Corporation/Boards. They should plan properly to meet the demand for power on a longtime basis during the 10th plan and even beyond.
- It has to work and streamline the entire production system by entrusting some power projects to the private sector taking care to have controlling safeguards in its hands. This would facilitate augmenting power generation and meeting the power requirement.
- Since demand for power would only increase power generation is an area where constant and alert watch for the needs is necessary, and appropriate steps have to be taken for generation to meet the increasing demand. It would be wisdom to plan a long-term power generation strategy to enhance power generation efficiency.
- Leakages and wastages have to be prevented at all costs. Likewise power distribution efficiency should also be improved with an appropriate new technology. Totally concealed power lines and substations should be erected to transmit power without any undue loss in power distribution. It has to plan for long-term development of the distribution system, to give satisfactory service to consumers of all categories. Faulty lines have to be replaced by new transmission lines with fully concealed and distribution centers.
- It is the responsibility of the distribution authorities to plan properly to have a foolproof transmission system, free from

leakage, wastage, pilfering etc.

- All substations should be strengthened and restructured to transmit the power without any loss to the consumers. Further transformers have to be set up at different stages of transmission of power. They have to be fault free and of quality.
- Spurious or substandard ones have to be replaced by genuine and efficient ones. These and other steps can prevent frequent power cuts, fluctuations of voltage etc. While distributing power a new strategy should be adopted to minimise power losses as transmission and distribution losses add to the financial burden of the corporation.

V. Conclusion:

The power sector - its Boards and corporations - alone cannot be blamed for its lapses and failures. Consumers, for whose benefit the corporation strives, have their share of responsibility. Consumers have to be responsible and must not take to unethical practice and malpractices such as illegal tapping of power, and unauthorized use of power. In return for the service they receive, they should feel a sense of responsibility and properly utilize the power and account for power consumed by them. They should impose self-discipline and to pay their bills properly and regularly. That would facilitate the power corporation to render better service to them. As a law abiding and consumer of power, each consumer in his own way contributes to the stability and sustenance of the power sector, and to the economy of the state. His contribution may seem negligible, but it is wrong to think so or regard it as unimportant. As the adage goes, a million drops of water make an ocean.

In view of the plight of the power sector in our state in particular and in the country in general, it is very necessary to take up with all seriousness, measures to improve capacity addition to maximize power generation into balance supply and increasing power demand by different categories of consumers. Unless power is sufficiently available to the industrial sector, the state cannot be progress industrially. Industrial backwardness in today's world is an indication of economic backwardness. Therefore availability of sufficient power is an index of economic development. Likewise the sufficient un-interrupted power supply to consumers is as important as power generation. Consumers expect power to be supplied at a reasonable price, a price that they can afford. Regular supply of power with required quality would infact gain the confidence of consumers and facilitates overall economic development of the country in various dimensions.

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