PERFORMANCE OF THE STATE ELECTRICITY BOARDS

Dissertation submitted in partial fulfilment of the Requirements for the award of the Degree of Master of Philosophy in applied Economics of the Jawaharlal Nehru University, New Delhi

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JULY 1996

July 22, 1996

I HEREBY AFFIRM THAT RESEARCH FOR THIS DISSERTATION TITLED

"PERFORMANCE OF THE STATE ELECTRICITY BOARDS"

BEING SUBMITTED TO THE JAWAHAR LAL NEHRU UNIVERSITY FOR THE AWARD OF THE DEGREE OF MASTER OF PHILOSOPHY, WAS CARRIED OUT ENTIRELY BY ME AT THE CENTRE FOR DEVELOPMENT STUDIES, THIRUVANANTHAPURAM.

KANDULA SUBRAMANIAM

CERTIFIED THAT THIS DISSERTATION IS A BONAFIDE WORK OF KANDULA SUBRAMANIAM. THIS HAS NOT BEEN CONSIDERED FOR THE AWARD OF ANY OTHER DEGREE BY ANY OTHER UNIVERSITY.

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ACKNOWLEDGEMENTS

"...as through these words I ramble,
I have seen a lot of funny men ,
some rob you with a six gun,
some with a fountain pen."
(a folk song called "Pretty boy Floyd" by Woody Guthrie)

I was drawn towards the Power sector ever since 'Enron' became a topic on which almost everyone had some thing to say. While criticism on this project varied, critics mostly concurred on one point - that the State Electricity Boards are just bottomless pits. There were a spate of deals that were signed in a very short time span - deals which totally ignored the fundamentals of Power planning and development and most important of all, the basic interests of the Boards. Questions were also raised about the right of the SEBs to exist and strong suggestions have been made to "privatise" the Boards themselves. It is often very easy to criticise, but, the pertinent questions that should be raised are, who made them such 'pits', are the Boards themselves to be blamed for their poor performance and whether the situation is beyond remedy. Also, pertinent is the question whether privatisation would succeed without identification and remedying the underlying problems?

I take this opportunity to first thank my guides, Dr. Sunil Mani and Dr. P. Mohanan Pillai for having given me this opportunity to work on a topic which had captured my interest since 1993. They constantly encouraged, helped and guided me whenever I felt discouraged and lost on a topic which is intriguing, confusing and at the same time very interesting. I am very grateful to Dr N.Tata Rao, M.K.Sambamurthy, S.N.Roy, Dr Kirith Parikh, Arun Ghosh, J.C. Gupta, J.V Sastry, S.Venkitaramanan, T. L. Shankar, M .K. Ganesan, and K.P.Rao, for the invaluable suggestions, responses and material they had provided me for my work. I would also like to thank Dr. Nirvikar Singh and Dr. Kaushik Basu for having read parts of my draft (with respect to the conflicts of interests) and Dr. Pulapre Balakrishnan for giving me the much needed encouragement & suggestions. I would specially like to thank Sh. K.P.Rao, for, whatever 'little' I know in this subject would not been possible without his help. I also thank Sh. Harish Chander for helping me get valuable information/documents from CEA/Boards.

Course work would have proved to be very difficult to weather, but for the company and friendship of Pulak, Ramakant, Josey and Vijay Anand. Reddy's presence at CDS not only helped during the seminars but also when 'food' became a matter of crisis. Both Ashok and Reddy ensured homesickness did not get to me. Suresh, Sanjit,Kurup,Bhaskar, Dennis, Ram, Anandraj,Pyare,Pinaki and Srijit not only made my stay at CDS entertaining but also advised and helped me whenevever I needed. Mr.M.R.Anand's suggestions on my work helped me to make my presentation more meaningful. I would also thank Ramu and Gayathri for helping me gain access to the ISEC library.

It would be an understatement if said writing and finishing my thesis would have been impossible without the help I received from Mrs. L.Krishnamurthy, Mrs.Nathan and Mr.Subramaniam. Not only do I thank them for that, but also for having borne my presence patiently at ADA.

Finally, I would like to thank my parents and all my family members for constantly encouraging and pushing me, without which I would never have been able to complete my work on time.

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CHAPTER I
INTRODUCTION

Broad overview

The provision of adequate, reliable and high-quality energy supplies is an essential condition for economic growth and social improvement. The lack of such supplies can impose economic and social burdens on a country,and, has been correctly put as '..there is no power more expensive than no - power.'[1]

Electricity shortages in China implied 20% of the industrial capacity remaining idle (Smil 1990). Sanghvi (1991) estimated that in countries like India and Pakistan, electricity shortages led to a loss of GDP by about 1.5-2%. Shortages in India, according to Sanghvi, are mostly in the form of controlled load shedding. The World Development Report (WDR) (1994) points out that infrastructure grows step for step with economic output - ***a 1% increase in the stock of infrastructure is associated with a 1% increase in GDP***. And as countries develop, (moving from low to high income countries), infrastructure must adapt to support changing patterns of demand, as the shares of power, roads and telecom in the total stock of infrastructure increases relative to those of such basic services as water and irrigation. The share of power almost increases to 50% in investment for infrastructure as countries develop. Services associated with the use of infrastructure account for roughly 7-11% of GDP in terms of value added, with gas, electricity and water being the highest contributors. These elements of infrastructure are important to every sector of the economy and thus can be termed as the 'wheels' of economic activity (WDR).

The Indian power sector has grown rapidly since independence. The installed capacity increased from 1713 Mws in 1950 to 76718 Mws in 1994. The *15th Power Survey*** estimates the total installed capacity to double by the end of the Ninth plan and estimates the total installed capacity required by the end of the Tenth plan to be 1,31938 Mws. This growth of installed capacity requires massive investments. There are three aspects of electricity which need to be met (i) availability (ii) reliability, and of late (iii) environment friendly. Improving electricity quality and minimising environmental impact are likely to add to capital investment.

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[1] Homi Baba's statement quoted in *Financial Times* survey of Maharastra, 19 June 1995.

** Yet to be published. (by whom ?)

Capital investment required, of the tune of US $ 8 billion (VIIIth plan), US $ 12.6 billion (IXth plan)and US $14 billion (Xth plan), would mean massive funds that need to be mobilised from various sources. In principle, revenues from the sale of power should provide with sufficient finances to cover operating costs and also meet for future expansion (at least partly). However, tariffs in India are kept at very low levels and have not been allowed to increase resulting in a wide and increasing gap between the costs and realisations from sale of power. According to Schramm (1993), tariffs cover no more than one third of the costs and some estimates by Anderson (1994) point out that the revenue shortfall for most developing countries including India is over $ 100 billion a year. The financing of the gap caused by these low tariffs has largely to be met through advances from Governments which leads to increased budget deficits and difficulties for the Governments. Further, external finances have been difficult to come by due to increasing debt service ratios and high external debts - thereby leading to a situation quite converse to that in early 1980s, where commercial banks and other lending agencies were willing to finance the needs of the developing countries.

Other than financial problems, power sector in India also faces low operational efficiency and high losses which account for a large fraction of power being unavailable to the consumers, given the installed capacity.

In 1991, private enterprise was given an initiative in India to offer a solution to the financing problem. However, this approach encounters a major problem, owing to the financial weakness of the purchasing agents,namely, the SEBs (statutorily the sole distributors of power) who play a dominant role. Carstairs and Ehrhardt (1995) point out that the SEBs are mostly loss-making where even the best performers realise returns on assets well below the cost of capital. They point out that the situation is likely to become worse as costs increase, further weakening the ability of the SEBs to sign ***credible long term power purchase contracts***. This can be gauged from Table 1.1 below which summarises the financial position of the SEBs. It indicates a rapidly increasing amount of uncovered subsidy over the last four years (almost doubling) and a very poor rate of return (ROR) around -12%. The private sector has obtained guarantees and counter-guarantees from the State and Central Governments respectively for payments due to them from the SEBs for the power supplied. These guarantees are being insisted upon by lending agencies of IPPs in view of the Boards' liquidity problems. Further, the issue of guarantees and counter-

guarantees is still being debated by policy makers and has not been finally resolved. In this context it becomes important to look at the finances of the SEBs and the ways and means to make them more credible long-term power purchasers. Carstairs and Ehrhardt further point out that SEBs are to be made profitable entities if they want to maintain their dominant role in State level electricity provision and to attract finances from domestic and international sources.

It is in this context that it becomes important to look at the performance of the SEBs which focuses on the financial as well as technical areas of the Boards and also suggest ways and means by which they can improve their present performance which in turn would make them more credible organisations. Also, it would be interesting to look at the contributions the Boards have made to the economy in the process of becoming insolvent especially with reference to Rural Electrification where benefits are very difficult to quantify - Pearce & Webb(1987) - an issue which is little realised and taken note of.

TABLE 1.1

FINANCIAL PERFORMANCE OF THE STATE POWER SECTOR

(All figures in Rs. Crores)

	1991-92	1992-93	1993-94	1994-95
A. Gross subsidy involved				
i. On account of sale of Electricity to....				
a. Agriculture	5938	7411	8304	9590
b. Domestic	1310	1609	2126	2683
c. Inter State sales	201	198	233	276
Total	***7449***	***9218***	***10663***	***12549***
ii. Subventions received from state govts.	2045	1928	2059	2051
iii. Net subsidy	5404	7290	8604	10498
iv. Surplus generated by sale to other sectors	2173	2590	3669	4396
v. Uncovered subsidy	3231	4700	4935	6102
B. Commercial losses	4117	4363	4875	5547
C. Revenue mobilisation				
i. Rate of return (ROR)	-12.7	-11.4	-12.6	-12.6
ii. ARM from achieving:				
a) 3% ROR	4959	5411	6071	7235
b) From introducing 50p/unit for agriculture/irrigation	2176	2137	1924	1943

Source: Economic survey of 1994-95

Note: ARM stands for Additional Resource mobilisation

OBJECTIVE OF THE STUDY

The main objectives of the study are the following :

1. To analyse the present structure and growth of the electricity sector in India, and
2. To analyse the performance of the power sector specially with respect to the technical and financial performance of the SEBs.

The following asplects would be covered.

1. Development and structure of the Power Sector :

Here we trace the planwise growth of the power sector and, would look at the trends in hydro and thermal generation since 1950 . An attempt would be made to outline the structure of the power sector and the respective roles of the various agencies.

2. Technical and Financial performance of the SEBs:

Under technical performance, we look at statewise PLF of thermal plants over a time period of 1975-92 and also look at the overall trend of PLF in the power sector. An attempt would be made to analyse the trend in PLF for the power sector and arrive at reasons for changes in PLF. Along with this, we would also attempt to analyse factors such as availability of thermal plants regionwise, and bring out the causes which affect the operations of the plants. These factors would include forced outages, partial unavailability etc. On distribution of power, we look at the main causes which have led to high T&D losses, as now seen from published data and would try and arrive at what the "real" T&D loss figures could be.

Under financial performance of SEBs, we would look at the main factors that effect their profitability like tariffs (for the agricultural sector and non-agricultural vis-a-vis the average cost of generation and supply of power),the capital structure, revenue outstandings and levels of manning. Further, we would also look at the costs of inputs such as coal, gas and railway freight, which affect the Boards' finances and profitability. Supply of power to the agricultural sector would be studied and analysed in a greater detail. In this area, we look at the growth of agricultural consumption of power and its

impact on the Boards. Further, with a view to demonstrate the implications and dimensions of the problems, an estimate of the total impact on a Board of energising pumpsets and supplying power to them (with reference to Andhra Pradesh SEB) would also be made.

Finally, we would try and assess the need and the likely impact of private sector participation in the present context. The study also addresses the questions that have been thrown up in this thesis to experts in this area for their views through a questionnaire. These opinions have been incorporated in various parts of the thesis and have been summarised in the Appendix.

Methodology adopted: The methodology adopted in this study is interpretative analysis of data using simple descriptive statistics involving calculation of averages, percentages, growth rates and trend fitting. Also, annual accounts of Boards have been shuffled and reworked.

Sources and Limitations of data and the associated problems :

The study uses data available from the CEA, Planning Commission (Energy Division) and the Boards. Also, information from CMIE documents is made use of to substantiate the arguments put forward in the thesis. This study also make use of Annual Accounts of the Boards and some Electricity Departments and also some unpublished information/data available from the Boards/CEA and experts in this field. Data to analyse the technical performance is taken mostly from the CEA and the Planning Commission, along with some additional information from experts and CMIE documents. The objective of the questionnaire is to gather information about the Indian Power system (especially in the present context) and also to substantiate the arguments put forward in this thesis. The questionnaire addresses issues on which there is not much literature. These concern trends in PLF, T&D losses and questions related to their possible improvements, tariffs and private sector participation in power and privatisation.

On the problems and limitations of data, even though the Boards gather information on varied issues, one finds that they are tempted to **represent that data which suits the Board more favourably**. For example, in the case of tariffs, the Boards project anticipated tariffs to the Planning Commission which in turn reflects better performance and not the position based on actual tariffs, as projected tariffs do not generally fructify. Data has been very difficult to come by, mostly because of the controversy created by the private sector participation in the last few years.

SIGNIFICANCE OF THE STUDY

The Power Sector, especially the SEBs, poses a very interesting case of varied inter-relationships and conflict of interests. The importance of this sector increases in the present context of economic reforms and private sector participation on the one hand and shortages of power predicted for the future years. This study looks at the Power Sector in its entirety and highlights most of the facts which hamper the performance of the Boards. It further brings out as to why "profits" actually earned by the Boards should not be the sole indicator of their performance, given the present capital structure and other constraints. The study also brings out the important role that the Boards have been playing in agricultural pumpset energisation despite severe losses the Boards have been suffering as a direct consequence of this. At the same time they continue to provide power to the industries and domestic consumers at a fairly 'economical' rate The study questions the concept of Plant Load Factor (PLF) being an indicator of operational efficiency. Further, this study makes an in-depth analysis of Transmission and Distribution (T&D) losses and also tries to establish the 'actual' T&D loss figures which are different from the figures represented by the Boards/CEA/Planning Commission. All in all, the study looks at the performance of the Boards in a total framework.

There have been no previous studies which have looked at the performance of the Boards along the lines of this study. However, there are a few Government reports (see table1.2 below) which have looked at the SEBs in great detail. Given the economic significance of this sector and the vital role the Boards will continue to play, it is very important to systematically highlight all the factors of the Power Sector and represent the true picture of the Power Sector.

Chapterisation and organisation of the Study

The study is presented in five chapters. The first section of the second chapter looks at the development of the power sector in India both historically and plan-wise. Here, the aspects that are highlighted include the plan-wise allocations to the power sector, achievements and shortfalls. The next section highlights the special features of the power industry that make the power sector unique in several respects. Following this, the organisation and structure of the power sector have been outlined and also the conflicts of interests between the various players

in the field. The final section of this chapter looks at the technical performance of the power sector. In this section, the three main subjects that are dealt with are:

(a) plan-wise growth of the power sector, trends in hydro and thermal generation and assessment of power requirements via the power surveys;
(b) plant load factor and availability of thermal power stations; and
(c) a detailed analysis of T&D losses in India.

The third chapter is on financial performance of the SEBs. This chapter analyses indepth the profitability of the Boards over a period of time and the factors that affect the finances of the SEBs. These have been characterised as exogenous factors (factors which are beyond the control of the Boards) and (endogenous factors) (within the Boards control). This chapter also looks at power tariffs including the following:

(i) objectives of power tariffs;
(ii) tariffs for bulk power supply from Central generating stations and it's associated problems ; and
(iii) agricultural tariffs and tariffs for other than agricultural sector.

The fourth chapter is on supply of power to the agricultural sector. The supply of power to the agricultural sector is one single factor which is totally *ruining* the SEBs financially and it is for this reason one full chapter has been dedicated to this topic. The following aspects have been discussed in this chapter :

(a) the growth of power supply to the agricultural sector;
(b) the mounting losses to the Boards due to the sale of power to the agricultural sector; and
(c) the massive energisation of pumpsets and the costs involved to the Board (with an illustration from APSEB).

The final chapter sums up the earlier chapters and looks at the present position of the power sector and SEBs with the entry of the private sector.

TABLE 1.2

LIST OF GOVERNMENT REPORTS/PUBLICATIONS AND THEIR SCOPE

NAME OF THE REPORT	ISSUING AUTHORITY	YEAR	SCOPE OF THE STUDY
1. Report of the Committee on Power(Rajadhyksha Committee)	Department of Power, Government of India (GoI).	1980	Examined *all aspects* of the functioning of the SEBs and Central organisations and suggested ways of improving them.
2. A Financial Performance Review of the SEBs.	Department of Power, CEA (GoI).	1988	A presentation of the financial performance of SEBs during 1980-85.
3. Report of the Subgroup on energy pricing,SEBs' finances and related issues.	Department of Power, CEA (GoI) and Planning commission, Energy division.	1989	Reviewed and made suggestions for improvement regarding i) the financial viability of SEBs ii) the pricing of ele-ctrical energy in the SEBs, the prices of inputs for electrical energy and the pricing of power from CGS.
4. Report suggesting steps for strengthening the finances of the State Electricity Boards	Department of Power, CEA (GoI).	1989	Made an indepth study into the financial performance of the SEBs and iden-tified the areas of weaknesses and suggested steps for improvement.
5. Report on cost of generation and losses sustained by UPSEB. at ideal, reasonable and actual parameters of operation. (K.P.Rao report)	UPSEB, Lucknow.	1991	Objective was to see whether the Board would generate profits if its efficiencies of operations were improved, and, if not what are the losses attributable to inefficiencies of the Board and those attributable to extraneous factors.

CHAPTER II
DEVELOPMENT, STRUCTURE &; TECHNICAL PERFORMANCE OF THE POWER SECTOR

Section I

Introduction :

Electric power is one of the most important and powerful economic infrastructure[#] element of social and economic change. It has many unique properties, for example: to the household consumer, it represents the most convenient and versatile form of energy providing simultaneously motive power, heat or light. In many industries, there is no substitute for electric power. Power also plays an important role in agriculture and transport - because of the rising cost of petroleum products and the growing burden they throw on the country's balance of payments(Bop). Power thus being the basic input for all growth and development, is taken as an **essential ingredient for improving the standard of living.** The per-capita consumption of power is taken as an indicator of development while making comparisons with other countries. Our per-capita consumption of power, which is about 231 Kwh(units), is very low when compared with some of the developed/developing countries as is seen in Table 2.1 below.

TABLE 2.1

PER CAPITA CONSUMPTION OF ELECTRICITY (1987)

Country	*Per Capita Consumption (Kwh.)*
MEXICO	1284
USA	11379
UK	5625
CANADA	17658
CHINA	495
JAPAN	5893
INDIA	202
FRANCE	6320

Source: World Energy Council (1989) : International Energy Data

[#] ***Economic infrastructure*** includes services from:
- Public utilities ; Power, telecommunications, piped water supply, sanitation and sewerage, solid waste collection and disposal, and piped gas.
- Public works which includes, roads, major dam and canal works etc.
- Transport sector inclusive of airports, water-ways, railways etc.

Infrastructure is basically referred to as *"social overhead capital" in development economics.*

Electric power suffers from two serious shortcomings; **First**, it cannot be stored and has to be consumed when produced and **Second**, it is the most expensive form of commercial energy sources in both capital and operating costs. Power being a secondary form of energy, even with the current technologies, the efficiency of **conversion from fossil fuel energy into power is 40%*** and is generally much lower.

DEVELOPMENT OF THE POWER SECTOR

The electricity supply on a commercial basis had first begun in India in Darjeeling in 1897 which was from a Hydro-electric plant, while the first steam power plant came up in Calcutta in 1899. Recognising that electricity is the most convenient form of energy and an essential pre-requisite for Industrial development, the Indian Industrial Commission which reviewed the Industrial development of the country during 1916-18, stressed upon the importance of power development in the country and emphasised the need for a detailed hydro-electric survey to enable systematic development of water power resources. Responding to these recommendations, the Central Government instituted a survey of potentialities of hydro development and a preliminary assessment of water power resources was made in their annual reports during 1919-1921. The work that started could not be continued further due to Constitutional changes, under which the development of electricity was left entirely to the Provincial Governments. Several Provincial Governments took interest in the development of water resources and entered the field by taking up a number of hydro-electric projects. The period between the two World wars had witnessed the development of the *Pykara*, the *Mettur* & the *Papanasanam* hydro-electric projects in Madras (now in Tamilnadu); *Uhl* river project in Punjab; the chain of power stations along the Ganga canal in Uttar Pradesh; *Pallivasal* project in Travancore (now Kerala); and the expansion of the *Sivasamudram* project in Mysore (now in Karnataka). In these States, grid systems began to emerge, as electricity from the hydro-electric projects was carried to distant load centres. Tatas' who first set up a 50 Mw *Kopoli* hydro-electric plant to provide power to Bombay area (prior to the first world war), expanded their hydro stations along the Western Ghats close to Bombay, to form the largest existing system at that time in the whole of Asia. Thermal power continued to be developed in all important urban centres as a close preserve of Private enterprises. The effort during the second world war was mainly to orient the power supply industry to war efforts. However, there was a stagnation in

* Rajadhyaksha Committee Report on Power

power development- the aggregate installed capacity which stood at about 1.14 million Kw at the beginning of world war-II , increased to 1.33 million Kw at the time of Independence.

One of the first steps taken in the Power sector after Independence was to introduce a comprehensive legislation to restructure the Power Supply Industry, with a view to promote and rationalise power development in the country. A new act viz. The Electricity Supply Act Of 1948 [E(S) Act, 1948] , provided for the establishment of a Central Electricity Authority (CEA)* and organisations in the States, known as the State Electricity Boards (SEBs). Under the Constitution Electricity was placed in the Concurrent list of subjects. While the E(S) Act assigned extensive responsibilities to the State authorities, it also provided for broad guidance, coordination and planning from the Centre through CEA.. CEA was charged with responsibility of developing the National Power Policy and coordinating the power development in relation to the control and optimal utilisation of national resources.

Although the CEA was formally created in 1950 as a Statutory Body, it functions mostly as a Govt Department, as an extended wing of the Department of Power functioning under its overall control and has remained for the most part an Adviser, without staff of its own (all its employees are Govt servants and appointed by Govt) and no clear and accepted functions to perform. The SEBs were envisaged as semi-autonomous bodies designed to promote power development in the area of their jurisdiction. The Industrial Policy Resolution (IPR) adopted by the Government in 1956 enunciated** a major policy bringing the power industry entirely under the Government sector, barring continuance and expansion of a few existing licensees like the Tata Electric Company, Calcutta Electric Supply Company and Ahmedabad Electric Supply Company. The State Electricity Boards (SEBs) were constituted under section 5 of the E(S) Act of 1948, one for each State. These were organs of the State Governments and were charged with the responsibility of *planning, developing and generating* power and

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* The Power wing of the CWPC was re-designated as CEA.

** Extract from IPR ".....all new units in these industries(schedule A), save where establishment in the private sector has already been approved, will be set up only by the State. This does not preclude the expansion of the existing privately owned units, or the possibility of the State securing the cooperation of private enterprise in the establishment of new units when the national interests so require. Railways and air transport, arms and ammunition and atomic energy will, however, be developed as Central Government monopolies. Whenever cooperation with private enterprise is necessary, the State will ensure, either through majority participation in the capital or otherwise, that it has the requisite powers to guide the policy and control the operations of the undertaking."

its *distribution and supply* to various consumers in the most *economical manner.* The Electricity Boards were to operate with due autonomy and on commercial lines and as per guidelines then, in such a manner that, *as far as possible,* the revenues balance the operating expenditure.

Planned development of the Indian economy was initiated in 1951 to improve the socio-economic conditions of the people . Development of power was of significant importance in the plan programmes. The main objective of power development plans since Independence has been to increase power availability rapidly and extend power supply to all regions of the country. The **installed capacity at the beginning of the First Five year plan 1951 was 1712.52 Mws and in 1995 the figure was 81164.4 Mws.**

PLANWISE DEVELOPMENT OF THE POWER SECTOR

The **first two Five Year plans** spanned the first decade of planned development. In 1951, when the **first Five Year plan** was drawn up, the country was facing serious food shortages and emphasis was logically laid on extension of irrigation facilities and improvement of agricultural practices. The programme included a number of multi-purpose river-valley projects, with hydro-electric power generation as an important component. The most important multi-purpose river-valley projects was the *Bhakra Nangal* project which was to irrigate vast areas of land in Punjab, Haryana and Rajasthan and provide electricity generation with a total installed capacity of 1204 Mws. The programme also included unified development of the *Damodar Valley* (DV) for providing flood control, irrigation and power supply to the DV area. Integrated development programme of *Chambal valley* for irrigation and power supply for Rajasthan and Madhya Pradesh was also taken up. Besides these multi-purpose hydro-electric projects, a number of single purpose projects were also taken up for implementation. This includes the gigantic *Sharavati* hydro-electric project in Karnataka, the Koyna project in Maharashtra and the *Kundah* project in Tamilnadu. Emphasis was laid on the development of basic and heavy industries as a part of the strategy of self-reliance. Several Thermal Power Plants were also taken up to augment power supply to meet the power needs of infrastructure industries. Due importance was also given to Rural Electrification and extension of electricity supply facility to remote areas in the country. The installed generation capacity increased from 1712 MW in 1950-51 to 4653.05 by 1960-61. The total length of T&D lines increased from 29271 kms [31-12-50] to 157887 kms [31-3-61], the number of villages that were electrified

increased from 3061 to 21754 and the per capita consumption increased from 15.5 kwh to 37.90 kwh.

The third Five Year Plan (1961-66) and the three annual plans that followed continued to lay emphasis on the infrastructural industrial development. The power supply industries had witnessed qualitative shifts in the utilisation of power supply facilities. The importance of coordinated development of electricity supply with regions as spatial units for development was recognised. Steps were taken to divide the country in five convenient regions and Regional Electricity Boards were established in each region for promoting integrated operation of constituent power systems. One other significant feature in the power development in the period was the initiation of nuclear power development at Tarapur with a 400 Mw power plant. The progress of power development under the three Annual Plans (1966-69) was rapid and the installed generating capacity was increased to 12957 Mw [three Annual Plans ending on 31.3.69] from 9027 Mw [third plan ending on 31.3.66]. Extra High Voltage (EHV) transmission in the country at the level of 200 kV had been established in all regions. The need for providing electricity for agricultural pumping to boost agricultural production was recognised and a massive Rural Electrification programme specifically oriented to agricultural pumping was initiated during the later part of the third plan. The number of villages electrified increased to 73769, the T&D lines increased to 836307 Kms and the per capita consumption increased to 77.88 Kwh by 1969 March.

The fourth and fifth plans laid emphasis on rapid expansion of power supply facilities. The most significant feature in the two plans was the participation of the Central Government in the expansion of power generation programmes in order to supplement the efforts of the State. Realising the vast capital outlays involved, the fact that the State Governments and the Boards do not have such resources to finance new generating capacities in adequate measure and also keeping in view the economies of scale of operations, the advantages of pit head locations of thermal stations and the objective of balanced regional development (as opposed to state-wise planning), the Central Government formed in mid-70s the National Thermal Power Corporation (NTPC) and the National Hydro-electric Power Corporation (NHPC). These were charged with the responsibility of setting up, respectively, Super Thermal Power Stations (STPS) and major hydro-electric projects involving inter-state involvement and interests. In addition, power generation using nuclear technology was looked after by the Department of

Atomic Energy (DAE) and has since been entrusted to Nuclear Power Corporation under DAE.

The power programme in the Fourth plan included three hydro-electric projects viz., *Salal* (345 Mw) and *Baira-Siul* (180 Mw) in the northern region and *Loktak* (105 Mw) in the north-eastern region and the *Badarpur* Thermal Project in the Central Sector. The fourth plan also marked the transition to self-reliance in equipment and supplies for power projects. One other special ***feature of this plan was that emphasis was laid on extension of electricity facility to rural areas under minimum needs programme.*** The **Fifth Five Year plan** laid emphasis on speeding up the construction programme and commissioning of power generation projects and also maximising generation from available capacities. The installed capacity at the end of the Fifth five Year plan, March 1979 went upto 26682 Mw; [IV plan ending 31.3.74 was 16664 Mw]. Advance action was initiated in this period on a number of major schemes for benefits in the Sixth Plan. This includes four STPS projects one in each region by the NTPC planned for an ultimate installed capacity of 2000 Mw at each site. A large *pit-head* station at *Neyveli Lignite mines* was also started. It was during this decade that Thermal Power plants graduated to adoption of 200 Mw as a standard unit size. The first 200 Mw unit was commissioned in Uttar Pradesh at *Obra* in December 1977 and this was followed by 9 more units by the end of the Fifth Plan. A thermal project with a 500 Mw unit installation was taken up at *Trombay* in Bombay in 1977. The STPS of NTPC were also adopting 500 Mw units in the second stage. Besides technological improvements significant progress was also made in Transmission and distribution (T&D) facility. The highest transmission voltage in commercial transmission went up to 400kV in the country for the first time in the country with the energisation of *Obra-Sultanpur* 400kV transmission line in U.P. in the year 1978. Additional 400kV lines had been initiated in all the major power systems in the country. The number of villages electrified increased to 232770 (fifth plan) from 156729 (fourth plan). The T&D lines increased from 1546097 to 2145919 kms (from fourth to the fifth plan). Also, the per capita consumption at the end of the fifth plan stood at 130.49 Kwh. By the end of the fifth five Year plan , the country had well connected power systems enabling exchanges of power between large number of State/systems and this greatly facilitated better utilisation of available capacity and mitigating shortages in several systems. The seventies also witnessed initial steps towards establishment of Regional Load Dispatch Centres in different regions to facilitate integrated operation of power systems.

The **Sixth FIVE YEAR PLAN** (1980-85) laid emphasis on the augmentation of power supply facilities with the main objective of achieving a balance between supply and demand as early as possible. One of the foremost tasks in this period was to improve the functioning of the Thermal Power Stations. Attention was concentrated on installing of 200/210 Mw units which are by now produced indigenously as standard units. Towards the end of the sixth plan, a comprehensive renovation and modernisation programmes for poorly functioning thermal power plant was approved as a centrally sponsored scheme at an estimate of Rs 500 crores. The installed capacity was increased to 42585 Mw (sixth plan end) during this plan with a total expenditure of Rs 18,298.56 crores. The boiler installed at the 500 Mw plant in Trombay was the first indigenous one to be installed. Also, in the period the average gestation of which had increased substantially during the IVth plan had been brought down. Some thermal generating units had been commissioned in 40 months from the date of placing orders for the main equipment. The industry has been able to achieve an average addition of 3000 Mw per year during the sixth plan against an average 2000 Mw during the earlier period. In fact, 1983-84 witnessed an addition of 4000 Mw. The large programmes taken up in the Central Sector in the mid-70s began to yield results from 1982 onwards. A significant feature of the programme has been the project implementation according to schedule and without any serious cost over-runs. ***A major policy change that was brought about was that the Boards were required to generate a minimum return of 3% over its Net fixed assets.*** The sixth plan did not include any specific physical targets for transmission lines, but these were fixed on annual basis. During this period, about 15000 Km of 220 kV and 4300 Km of 400 kV transmission lines were erected. The number of villages electrified exceeded the target (villages electrified by VI plan end were 370332), while there was a shortfall in the number of pumpsets that was said to be energised (30% shortfall). T&D lines increased to 3211956 Kms and per capita consumption at 168.52 Kwh.

During the sixth plan, initiatives were taken to develop new and renewable sources of energy. The Commission on Additional Sources of Energy was established in 1981 and the department of non conventional energy source in 1982, both at the Central level. As against the approved VIth plan outlay of Rs. 100 crores, the actual expenditure during this period was Rs. 161.7 crores. The areas under which significant work had been done was bio-energy, solar energy, solar photo voltaics and wind energy. The number of bio-gas plants installed during the plan was 3,55,889. Around 2000 solar photo voltaic systems were set up and

around 30,000 solar cookers were sold on subsidised basis. About 1000 wind mills were also installed under demonstration programme. Research & Development efforts were initiated in the sixth plan on other renewable energy sources like, chemical sources of energy, hydrogen storage and utilisation, geo-thermal energy and ocean energy. For developing technologies for tapping low head and low capacity micro hydel potential, efforts to set up Research & Development base were initiated by establishing the Alternate Hydro Energy Centre at Roorkee with Central Government funding the CEA had also established the "techno-economic" feasibility of a Tidal power project in the Gulf of Kutch which envisages an installed capacity of 600 Mw.

The **Seventh FIVE YEAR PLAN** (1985-90) laid emphasis on reducing the power shortage; for this it was empasised to improve the performance of the existing power plants. For this, it was recommended that the Centre provides adequate schemes and funds and also maintains close scrutiny over timely maintenance of the plants. Another point was that, the need for a mechanism to bring down slippages of plan targets was recognised. Slippages of targets was seen as an important factor for the power shortages. Emphasis was also laid effective demand management to improve the power availablity situation. Recognising that power positions vary region to region and year to year, advance action should be taken to identify deficiencies in the transmission systems so that supply power from a State or region can be transferred to a deficit area.

The Seventh plan outlined that there required to be **adequate hydel back-up** without which meeting the power demand would be a very expensive option. In this regard, an **optimal hydro-thermal mix of 40:60 was suggested for implementation for this and for the successive plans.** The plan document suggested that an additional 858 Mws of power can be made available if the existing hydel plant equipment underwent renovation[2]. Small hydel plants especially in the Himalayan region have a potential of 5000 Mws. But, only about 158 Mws was available and another 130 Mws was to be added by the end of the plan. Given this vast potential and highly economic option of power supply, it was suggested that rural cooperatives should be encouraged and given the necessary finance to start such projects.

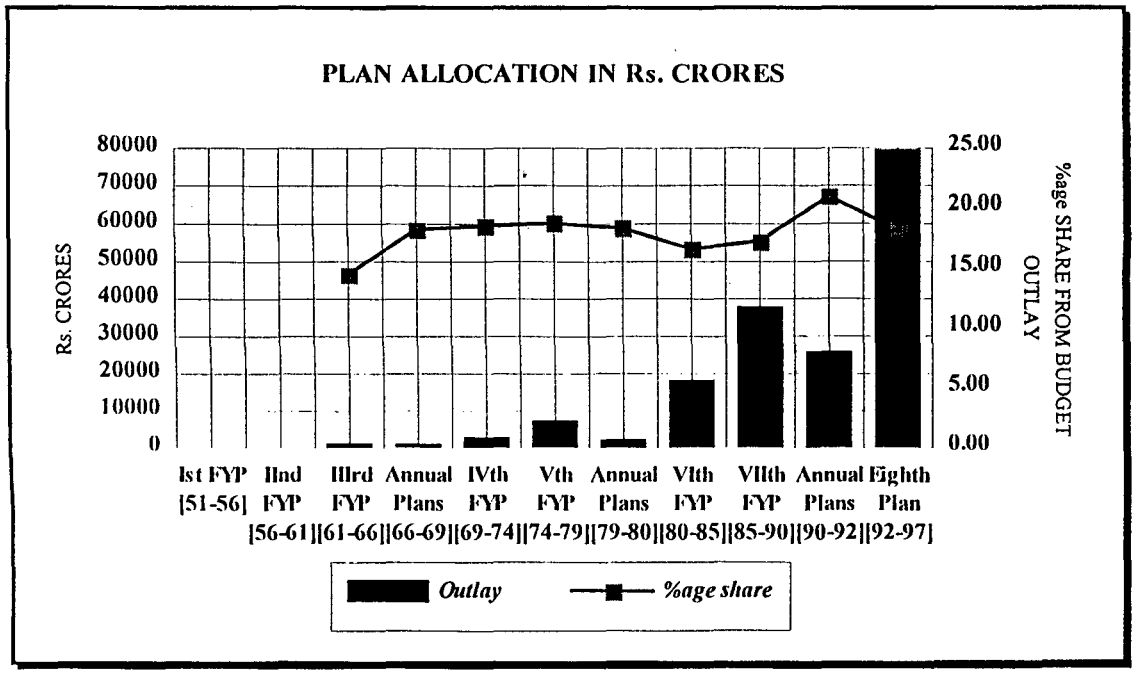
The seventh plan observed that the Central generating stations were not able to operate as an integral part of the power system. Power from the Central

[2] Most of the existing Hydel plants were commissioned during the Pre-Independence period, owing to which they were delivering below their rated output. It is in this regard that the above was suggested.

generating stations could not be evacuated as transmission lines were not either ready or were not adequate to transmit power to the States. To solve this problem it was suggested that HVDC transmission lines should be laid to the beneficiary States and also called for better cooperation among the States in the region and that the States should maintain grid disciple. Further, the plan also called for proper planning and coordination among the States in a region before commissioning a Central generating plant. If this is not done, there can then be dangers of investments in such projects not being fully utilised.

Figure 2.1 shows financial outlays and share of power sector against total plan outlays. It is seen that by and large, the share remained constant.

FIGURE 2.1



Source: Report on Perspective of National Power Development upto the end of Xth plan, CEA, 1991

The following are some salient observations in the Five Year Plan development by the power sector.

(i) The emphasis shifted from statewise development to balanced regional development. This has led to a significant role for Central Government and Central Government undertakings in the power sector.

(ii) Investments in transmission HT/EHT and more particularly distribution LT have been much less than necessary. This has led to a significant increase in Transmission and Distribution losses.

(iii) Considerable emphasis has been given to village electrification plans, underground water exploitation for agriculture etc. At the same time, adequate measures have not been taken to see that the Boards get properly remunerated for such services.

(iv) Even though the Boards from the mid-eighties were statutorily required to generate a surplus of 3% (over their net fixed assets), this has only remained on the statute book. There has been **no compulsion** either from the State or the Central Government to ensure that the Boards comply **with the statute**. This is the result of political apathy and convenience.

(v) Slippages from planned targets have been quite substantial. Despite several review processes and guidelines, slippages have not been eliminated. Some prima facie reasons for such slippages are technical and supply bottlenecks and environmental issues which gained importance recently, spreading scarce resources thinly over a large number of projects over a longer time frame. This in turn leads to project slippages, escalations in cost and non-productive blockage of funds already invested.

(vi) Another alarming fact that comes to light is the decline of the hydel content out of the total capacity. This is despite the frequent stressing on the need for an optimal hydro-thermal mix.

(vii) Meeting the power shortages through increased plant efficiency was highlighted only in the Seventh Plan. The Seventh Plan had found it more economical to increase power availability from the plant through corrective measures rather than through capacity additions. This fact was also emphasised in the Rajyadhyaksha Committee Report and was incorporated in the following plan. A study of the performance of thermal plants shows that little has been done along these lines.(See section III).

(viii) There are some States which face a deficit while others, (including neighbouring States) have surplus power available at the same point of time.

Adequate transmission systems to enable this surplus power being transferred from one State to another are found lacking.

(ix) Also, States do not maintain grid discipline and resort to overdrawing from the Central Generating stations (beyond their share and means). States like Andhra Pradesh, Karnataka overdraw from the Central Generating station (Ramagundam), leaving much lesser power available to Kerala, which lies at the end of the 'consumption line'. Thus if power shortages are to be removed through regional/national approach for planning, we must have a effective policy and means to ensure grid discipline and for evacuation of power from surplus to deficit States. This aspect was only recognised in the Seventh Plan but to this date, we do not have a satisfactory mechanism of enforcing grid discipline.

EIGHTH PLAN

The capacity addition planned for this period is 30538 Mws against 22245 MW in the Seventh Plan. Further, recognising the steep increases in demands in the years to come, and the need for massive finances for such expansions, the plan emphasises the need to attract private investment for power generation. The plan anticipated that roughly 3000 Mws would come from the private sector during this plan. The plan document also emphasised upon the need for a tariff structure which incorporates the time of the day metering for proper grid management and the need to bring down the T&D losses to about 15% through specific schemes.[2] The plan also emphasied on the continuation of the seventh plan programme of modernising the ageing plants to increase the power availability with the present capacity.

Over the plans, it was observed that although the SEBs were to be autonomous bodies created by the State Governments, responsible for running their own operations subject only to broad instructions and guidance in policy matters from State Governments. In practice, the Boards have been very much under the control of the State Governments. One consequence of this dependence (and at the same time a factor which perpetuates it) is the chronic financial weakness of most Boards. Because of political pressures and in the absence of strictly enforced targets of financial performance, power tariffs have generally been set at levels which made it difficult for the Boards to earn revenue surplus.

[2] This included schemes such as the revamping of the distribution systems in the urban area and system improvement schemes in the rural areas and massive policing to prevent theft of power.

Further, since their own internal cash generation has normally been low, they have been heavily dependent on borrowing, either from or with the sanction of the State Governments in order to finance their capital programmes and sometimes, even operations.

There are other agencies at the Centre are also concerned in the decisions that relate to the planning and financing of electric power. While the Boards continue to be afflicted by gross financial shortages, Central agencies have hardly done anything to ensure that matters are remedied. Where Central intervention has taken place, it is mostly aimed at ensuring that dues to Central sector organisations (eg., for power, coal and rail transportation etc) are paid by diverting States' plan allocations from Centre. The lack of identity between States and Centre's interests has its own effects on the power sector. The following Section II highlights these aspects further.

Section II

STRUCTURE OF THE POWER SECTOR AND CONFLICTS OF INTERESTS

An attempt is made in this section to list the major players in the field of Indian Power Sector, their main role, interests and conflicts. Figure 2.2 gives a broad picture of the power sector showing all the organisations and their respective roles in the sector.

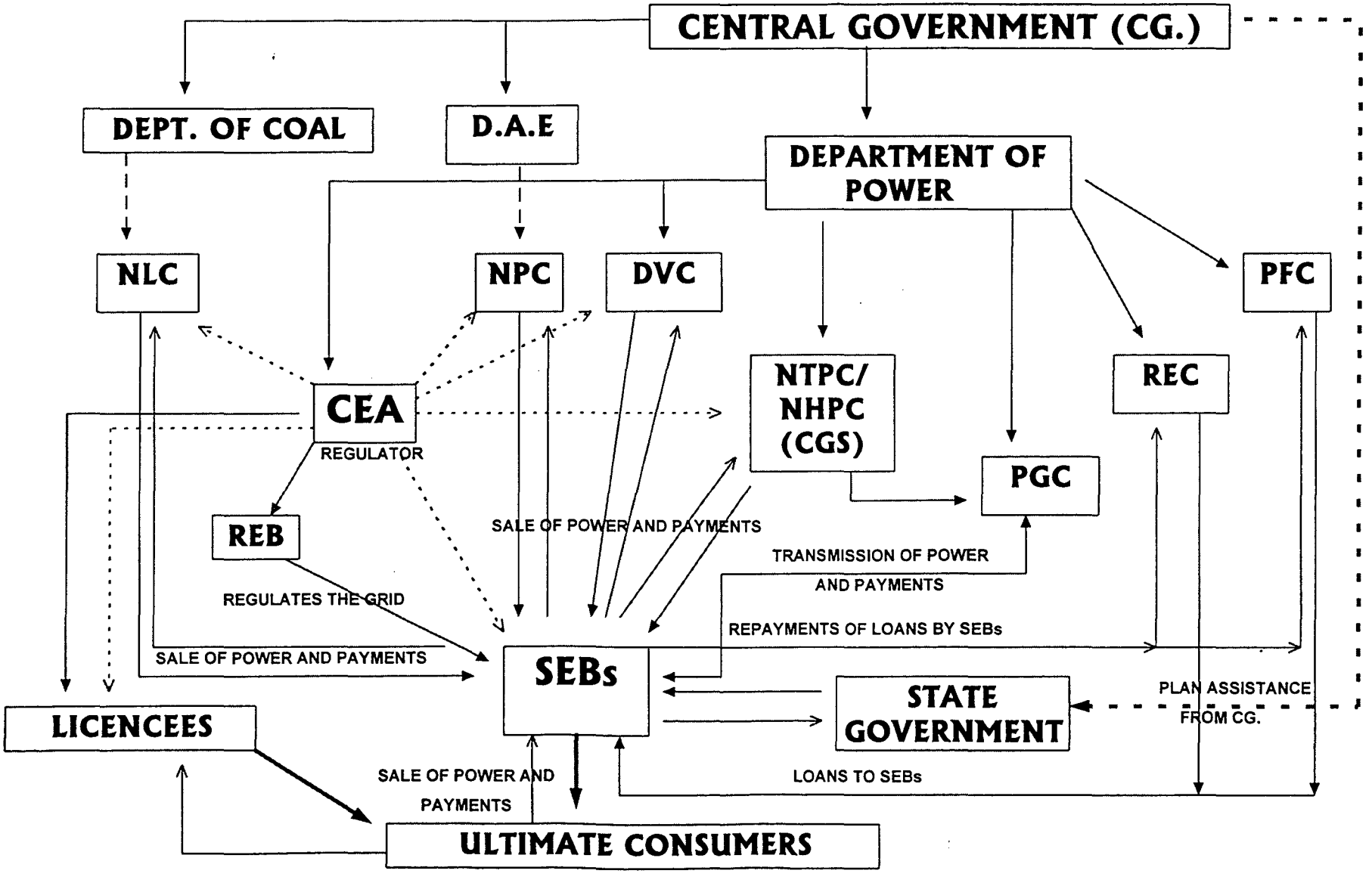
A. STATE ELECTRICITY BOARDS [SEBs]

SEBs are autonomous bodies set up under Electricity (Supply) Act, one for each State, and are charged with the responsibilities of :

- drawal of power plans for the State ;
- implementation of plans for setting up generating stations, transmission and distribution systems;
- meeting the ***power requirements of the ultimate consumers*** in the ***most economic manner and adequately;***
- supply of power to all consumers within the State and also cater for future requirements through forward plans;
- extend supply of power to areas not hitherto covered by power supply including villages, agricultural pump sets etc. ;
- ***to remain financially viable*** and ***generate such surplus as may be prescribed from time to time but not less than 3% of the value of the net fixed assets as at the beginning of the year after taking into account, charges for interest, depreciation etc., and subventions received.***

The above indicates that the SEBs are charged with the responsibility of supplying power to the ultimate consumer meaning that all other organisations ***can only generate power or aid in transmission of power, but not sell it directly to the consumers*** (there are some exceptions mentioned below). Also, as the SEBs own about 60-65% of the installed capacity (see figure 2.3) all other organisations in the power sector should coordinate its operations in accordance to SEBs responsibilities, interests and handicaps.

FIGURE 2.2 STRUCTURE AND POWER SHARING IN THE POWER SECTOR [pg.22]



B. CENTRAL GOVERNMENT:

a) Since electrical energy is in the concurrent list of subjects in the Constitution, Central Government is charged with the responsibility of managing the power sector conjointly with the State Governments. The Central Government as well as State Governments are competent to make legislations in this respect; where there is a conflict between the legislations of the State Government and those of the Central Government, the latter will prevail. The main legislations made by the Central Government in this respect are the Electricity (Supply) Act 1948 and the Indian Electricity Act.

b) Central Government is also responsible to lay broad policies in regard to the development of electric energy, keeping in view the integrated picture of energy development as a whole.

c) All the fuel resources viz., coal, lignite and petroleum products are controlled by the Central Government. Although the mines may be located in the respective states, mining is a central subject and the resources are controlled by the Central Government. It is the Central Government which decides and grants linkages of all fuels such as diesel, gas, coal/lignite etc. to power projects.

d) Planning Commission is responsible for national power plans and related investments in power generation, central transmission etc., as a part of an overall exercise of the National Development Plans.

C. CENTRAL ELECTRICITY AUTHORITY

Central Electricity Authority (CEA) is a statutory body created under the Electricity (Supply) Act and is charged with the responsibility of technical planning for power development, monitoring of implementation of power development plans, techno-economic clearance of power projects with a view to select ***optimal*** power plans keeping in view the requirement of minimising incremental costs associated with the additional capacity / generation plants; planning inter-State and inter-State transmission lines, monitoring of daily generation throughout the country, load dispatch through regional load dispatch centres, coordination between the SEBs, advising the Dept of Power in policy formulations; arbitration in matters of dispute between SEBs, between SEBs and State Governments etc., and also publication of statistical reports.

D. CENTRAL SECTOR GENERATING CORPORATIONS/STATIONS (CGS)

i) National Thermal Power Corporation [NTPC]

NTPC is a public sector undertaking under the Dept of Power which was created in 1974/75 for setting up and operating Super Thermal Power Plants [STPS] at pit head locations and supplying power to the grid. These plants are set up by NTPC for meeting the power requirements of the Electricity Boards of the region, and, are in lieu of power generating stations that may otherwise be set up by respective Electricity Boards for meeting their own needs. The primary objective in creating this organisation was a shift in the policy from ***statewise development to regional development for power development,*** taking advantage of pit head locations to avoid transportation of coal over long distances, entailing straining of surface transport systems mainly Railways, economies of scale etc. Under the philosophy, the capacity set up by NTPC in the STPS was to be allocated to the respective states of the region in accordance with the "Gadgil" formula, leaving 15% of the capacity at the disposal of the Central Government. This capacity at the disposal of the Centre itself is to be re-allocated by the Centre to States of the region from time to time depending upon such needs and exigencies of sudden and unforeseen demands of a transitory nature. In other words, the entire capacity of the STPS was to devolve entirely on the States of the region. Initially NTPC was also responsible to set up necessary transmission systems to transmit the power generated at their pit head locations to various delivery points of the respective States of the region. With the recent formation of the Power Grid Corporation, the responsibility of setting up and operation of transmission lines has now shifted to the latter. Accordingly, NTPC sets up the STPS, operates them and supplies power to the respective SEBs.

ii) National Hydro-electric Power Corporation [NHPC]

The NHPC was set up as a public sector undertaking in 1976. This organisation is responsible for setting up hydro electric projects involving inter-State interests. Here again, the capacity set up devolves upon the States of the region in accordance with a formula under which ***10 to 15% of the capacity is allocated for supply of free power to the State in which the project is located,*** and the balance capacities distributed to all the States of the region in accordance with the Gadgil formula.

iii) Rural Electrification Corporation [REC]

The REC was set up in 1963 as a Corporation under the Dept of Power. ***It is charged with the responsibility of funding the SEBs for extension of power for electrification of villages***, agricultural pump sets etc. The Corporation approves and monitors plans of the SEBs for these activities, obtains loans from various agencies for funding the capital outlays of the SEBs involved in extension of supply of power to the various users. ***REC shares no part of the operation costs*** associated with the supply of power under these schemes nor does it, in any manner, compensate the SEBs for the losses sustained by them in supply of power at concessional tariffs and loans to villages / agricultural pump sets.

iv) Power Grid Corporation [PGC]

Set up in 1988 as a Corporation under the Dept of Power, it is primarily ***responsible for operating transmission lines taken over from NTPC/NHPC and also to set up new transmission lines required for delivery of power from Central generating stations to the Boards of the region***. PGC has also the responsibility for establishing a National Power Grid that would enable transfer of surplus power from one region / state in the country to any region/State in another part of the country. There is as of yet no policy/decision as to whether PGC should act as a purchaser of total power from central generating stations for resale to the respective SEB or for purchase of surplus power from any State/region for delivery to 'needy' States elsewhere. PGC presently acts as an agency to 'wheel', without purchasing, power from one State to another or from Central sector stations to different delivery points in regional grids.

v) Nuclear Power Corporation [NPC]

NPC under Dept of Atomic Energy (formed in 1954) was formed to draw up plans for setting up nuclear power plants, build and operate the same and supply power to the States of the region as in the case of NTPC and NHPC. Prior this, this activity was departmentally looked after by Deptt. of Atomic Energy (DAE).

vi) **Neyveli Lignite Corporation [NLC]**

NLC is a corporation set up in 1956 under Dept of Coal to operate lignite mines and generate power for supply to States of the region.

vii) In addition, there are organisations like Bhakra Beas Mgmt Board **[BBMB]** set up in 1976 to operate Bhakra-Beas river valley, Damodar Valley Corpn **(DVC)** set up in 1948, was to look after power development in the Damodar river valley area etc. with participation of beneficiary States[1] .

E. STATE GOVERNMENTS

State Governments are responsible for power development plans within the State, interaction with the Central Government and the Planning Commission and ***overseeing the various activities of the SEBs, obtain plan funds for power development plans, re-route these through to the SEBs. State governments are also responsible for all policy decisions concerning power development within the State including power tariffs.***

F. LICENSEES

Licensees are private companies specifically ***licensed to supply power to consumers within an identified geographical region***, either using its own generating plants or by purchasing power from other agencies. Their operations are regulated ***in accordance with Schedule VI of the E(S) Act*** which inter alia provides suitable mechanisms for tariff fixation, accounting policy etc., ***and also stipulates a ceiling on the profit that may be retained by him.***

G. INDEPENDENT POWER PRODUCERS [IPPs]

These are recent origin following Government's policy to allow private entrepreneurs to set up power generating stations for generating power and supply the same to the Grid. While policy formulations have been made by the Central Government and certain entrepreneurs have come forward, several wide ranging problems have arisen which are yet to be fully resolved.

[1] The project was based along the lines of the Tennessee Valley Authority, U.S.A..

H. CONSUMERS

These are broadly divided into the following categories:

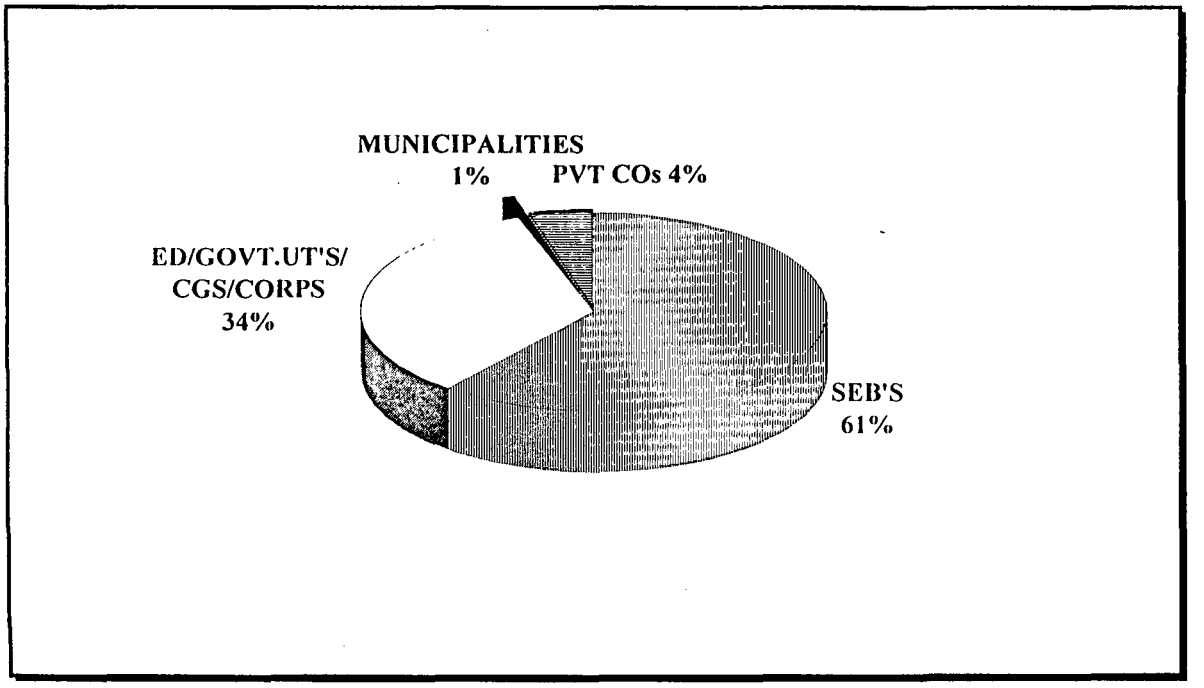
i) Domestic (representing mainly households)
ii) Commercial (representing shops and establishments)
iii) Industry - light, medium and heavy
iv) Railway traction
v) Municipalities and Corporations
vi) Agricultural pumpsets, irrigation pumpsets

Supply is made at either LT (less than 11 KVA) or HT (11 KVA and more).

Further finer classification of the consumers varies from State to State.

FIGURE 2.3

OWNERSHIP OF INSTALLED CAPACITIES (1991-92)



Source: General Review,CEA.

THE CONFLICTS OF INTERESTS[@]

While the above broadly outlines the major players presently in the Power Sector and their relative responsibilities, **there are several conflicts that come in the way of efficient functioning of the Power Sector** as a whole and, would come up in various forms (as would be seen in the rest of the thesis). Some of these are briefly outlined in the succeeding paras.

As was mentioned earlier SEBs continue to be responsible for setting up/operating about 62% of the generating capacity in the country and for the entire distribution of the power requirements to the ultimate consumers excepting for areas specifically set apart for licensees.

The ***Central Govt is responsible for approval of the national plans as well as the State plans for power sector development,*** and has taken a lead in shifting emphasis from statewise planning to regional planning keeping in view the overall national interests. However, both Centre and State do not seem to have paid adequate attention to the requirements of transmission and distribution networks commensurate with what is needed for the additions made in capacity. This has led to a sub-optimal distribution system contributing to increasing T&D losses. ***While the responsibility for the lower end of T&D systems rests with the States, the emphasis has been on adding to generating capacity and the Centre has not successfully persuaded the States to strengthen the systems***. Linkages of fuel for power plants is the responsibility of the Central Government, there appears to be no system of ensuring that such linkages are on optimal basis. eg., coal from Singareni/Ramagundam is linked to a thermal power plant in Tuticorin or coal from Bihar is linked to power plants in Punjab. Of late, the State Governments seem to stake a claim for control of the coal resources within the State and argue that they should be allowed to generate power and supply to the respective States anywhere in the country, instead of allowing coal from the State to be transported to other States[*]. Similar views are expressed from time to time by the *'coal belt'* States. While constitutional position appears to be that this authority rests with the Centre, States seem to be staking claims for control of National resources located within the State.

@ This section contains various opinions and views of experts collected and expressed during the preparation of this thesis and have either been summarised or put in quotations wherever possible.

[*] The Chief minister of Orissa refused to supply coal from IB valley to a power plant at Vishakapatnam.

While the Central Government is responsible for legislations in the Power Sector, they have no way of ensuring that statutory requirements are complied with. For eg., the SEBs are required under the E(S) Act to generate each year such surplus **as may be prescribed by the State Government** not less than 3% of the net fixed assets as at the beginning of the year. While the reason for such a stipulation on maintaining a minimum profitability through statutory provisions particularly is to ensure financial viability of the State Electricity Boards, this has, by and large, never been met by a majority of the States and yet the Central Government has been unable to remedy the matters in any manner. They squarely blame the State Governments/SEBs for not meeting the statutory requirement but have not taken any effective or concrete measures for compliance of the Statute.

At the same time, in areas where Central Government themselves are responsible, such as Union Territory of Delhi, the Central Government has itself been guilty of not ensuring the above criterion and has allowed matters to continuously drift to a point when Delhi Electric Supply Undertaking owed over rupees two thousand crores to NTPC , for power supplied and the entire amount was written off. At the same time, it has not ensured that such a situation does not arise again. It has been argued by the SEBs/State Governments, that the *precedent set by the Central Government does not give them authority to question the State Governments/SEBs, for their inability to ensure the financial viability of the Boards.*

While the SEBs are expected to function with total autonomy, and , are statutorily required to revise tariffs & manage operations in such a way as to generate the stipulated surplus in the matter of tariffs and more particularly tariffs related to supply of power to the domestic/agricultural sector, these have always been matters of ***political decision*** - There are no clearly drawn up or committed plans on the part of Government to make sure that the Board is not put to a disadvantage on this account. Often, it happens that by the time a Government comes into power after elections, they are too new to enforce tariff revisions and by the time they are convinced of the need, the next elections are round the corner. Often it happens that tariff do get revised downwards before elections *(as an electoral promise).*

Tariffs of the SEBs by and large have remained below cost. In particular, the supply of power to the agricultural sector for pumpsets is a single major factor which totally erodes the financial viability of the SEBs. It has been said that

".....the State Governments do not have either the will or the wherewithal to subsidise to the SEBs fully." There is also a thinking of late, that since the supply of power for agriculture is for sustaining food production, the Centre should bear atleast a portion of this cost in just the same manner as the Centre bears the subsidy for fertilisers. The Central government has an altogether different view.

Financial distress of the SEBs arising out of low tariff is so acute that they are highly 'cash starved' and have not been able to pay for power generated and supplied by the Central generating stations, coal mines for the coal supply, railways for transportation of coal etc. This in turn has led to serious problems for organisations like NTPC whose credibility with the major international institutional lenders including the World Bank has become very low. This in turn has often resulted in serious difficulties in obtaining loans for financing central sector power projects, and, ***often have led to suspension/cancellation of loan agreements already signed and in operation.*** Coal India Ltd. has been taking the view that the Board should pay for coal before it is lifted.

Another fall-out is that the SEBs themselves are not able to fund their own expansion programmes. The ***Boards' credit-worthiness being very low***, they are unable to obtain loans; where they are obtained, the Boards find it difficult to service them. Also the ***funds get spread thinly resulting in project slippages, cost over-runs and non - fructification of benefits.***

It may be highlighted that even as recently as in the Budget speech while presenting the Budget for 1995-96, the Finance Minister emphasised the need for setting up power ***Tariff Commissions with adequate statutory powers*** to review the operations of the Board and suggest tariff levels which should, by convention or law, be binding on the State Governments. ***The discretion of the State Government to moderate tariffs would come into play only if the Government pays for the difference.*** Its implementation, both in regard to the timing and nature of tasks to be assigned to the Power Tariff Commission when set up, remains to be seen.

The inability of the SEBs to pay for the power purchased from central sector stations has itself led to a variety of problems:

a) Central sector generating stations have taken the stand that unless power is paid for by the Board, the supplies would be discontinued. The ***ultimate***

sufferer in the process is the consumer who has been regularly paying for the power at the tariff prescribed. Again, such a course of action has its *'political overtones'*, often affecting the Centre and State relationships. Decisions also tend to be made depending upon the parties in power.

b) There has been a tendency on the part of some consumers to seek direct supply of power from agencies like NTPC. This includes the Indian Railways and some private industries located in various parts of the country. The position all along has been that it is the SEBs which supply power to the ultimate consumers but with the support of Central Government, NTPC has been making plans to make direct supplies to consumers and at the same time asking the SEBs to 'wheel' the power to consumers over their transmission systems. The net result will be that *NTPC will be benefited by receiving a tariff at levels higher than what the SEB pays; the industry would be receiving power at tariff less than what the SEB may have charged and the SEB will be losing remunerative customers who pay tariffs higher than the costs.* Such a trend is likely to vitally affect the financial interests of the SEBs as remunerative customers are progressively weaned away, ***leaving the SEBs with customers who pay significantly less than costs.*** While the SEBs are totally opposed to this approach, Centre sees nothing wrong in this type of arrangements.

A major lacuna in the existing power systems is the inability to deliver power to the respective States from Central generating stations in strict conformity with their respective entitlements. Since Boards upstream in the transmission systems can tap the power before it reaches the tail-end States, the latter are to placed in a very *'unenviable'* position. ***Firstly,*** they do not get the power when they need it; ***Secondly,*** *they are dumped with power when they do not need it.* No satisfactory regulatory mechanism which ensures flow of power according to entitlements exists and the only means appears to be persuasions for *"good behaviour"* by the Boards responsible for tapping power beyond their entitlement.

A major aspect is the massive plans for rural electrification and extension of supply of power to agricultural pumpsets. While the REC ***funds the investments required for creating necessary transmission lines*** etc., they do not seem to be *"bothered"* about the impact such large scale programmes have on the finances of the SEBs in terms of its operational financial viability. Thus, *while the objective of the REC may be to accelerate village electrification and increase the number of agricultural pumpsets, this directly conflicts with the financial interests of the*

SEBs in the absence of a satisfactory mechanism to take care of the Board's financial interests.

The advent of Independent power producers [IPPs] is likely to create a host of problems unless appropriate policy decisions are taken and implemented regularly. For one thing, they could wean away remunerative customers from the SEBs. Another aspect is the high cost at which such power may be made available to the Grid and provisions in the purchase agreement [PPA] for buying all the power that may be generated irrespective of whether the Board may have other cheaper sources available to them alternatively. **Increased dependence on petroleum based fuels by IPPs would also substantially increase the cost of generation in addition to drain on country's Foreign Exchange resources.** In the matter of decision making, it is not clear as yet as to how much effective role the respective SEBs would have vis-a-vis the Central Government and State Government.

Privatisation of distribution is also being considered as a possible answer to the present problems of SEBs. The criticism towards such an approach is that *it is only the remunerative sector that they will be interested in and will not undertake to distribute power to areas which generate substantial losses.* Unless adequate care is taken, attempts to 'privatise' distribution could lead to a situation where the SEBs would only be left with rural/agricultural sector for supply of power, with no avenues for cross-subsidisation.

While use of indigenous natural gas for power generation was adjudged to be the best use among various alternatives such as production of fertilisers etc., and was in National interests, the pricing of the gas insisted upon by the petroleum ministry on the basis of petroleum equivalent resulted in a situation where costs of such gas based power generation would be too prohibitive for the SEBs to absorb.[1]

The financial structure of the SEBs is somewhat peculiar. From inception, they had ***no equity capital and are given funds for financing projects only in the form of interest bearing repayable loans.*** The interest burden on the total capital funds on the Boards is heavy and places the SEBs in an adverse position when comparisons of profitability are made with organisations like NTPC. *Introduction of equity capital for SEBs could result in improved presentation of the Boards financial performance, but,* ***"is not preferred by the State Governments since***

[1] See chapter on Financial performance.

profits of the Board could, in the longer run at least, attract income tax which accrues to the Central Government." State Governments are keen that fund should not flow out in this manner to the Centre and do not seem to mind if the Boards exhibit losses.[@] Nor is the Central Govt willing to exempt the SEBs from applicability of Income Tax although no Board has ever been liable to any income tax not is likely to be so.

On the whole, the Power Sector represents an interesting inter-relationship between the various players in the field, with several associated conflicts of interest, and this Sector can only prosper when solutions are found to make the interests concrete.

[@] In fact, in 1987-88, when the Finance Bill contained a provision that book profits would be taxed, one of the State Governments (Tamil Nadu) refused to pay TNEB subsidy for power supply to the agricultural sector on the grounds that taxes on book profits would accrue to the Centre and the State Government was not interested in enriching the Central coffers, even if it meant the Board running into losses. Subsidy was thus denied. Centre was quick to perceive the pattern of conflict and promptly exempted SEBs from the purview of application of *Sec 115 J of the Income Tax Act.* (minimum tax of 15% on book profits irrespective of whether there was taxable income or not is payable under Sec 115 J). However, Centre is still unwilling to grant exemption from income tax to SEBs.

SPECIAL FEATURES OF POWER SECTOR

The unique properties of power lead to certain special features in the power sector viz.,

a) Unlike other engineering industries, it is not possible to generate power whenever possible with the objective of storage and use at a later time when the demand arises. At any point of time, the generation has to match the demand at that instant, every minute and every hour of the day. This is a very distinctive feature which makes a significant difference to power industry compared to the other engineering or chemical industries.

b) Due to variations in the load during the day, the demand for power is not uniform. There are times of the day when the demand peaks up, eg., morning between 7 AM to 9 AM and evening between 6 PM to 10 PM. There are also periods when the demand becomes very low eg., between 11 PM to 5 AM. The peak and off-peak demands of the daily load curves form a distinctive characteristic feature of power industry and cause considerable problems in management of supply to meet the demand.

c) In order to meet the peak demand, the generating capacity established has to be well above the anticipated peak demands. Otherwise the peak demand cannot be met leading to load shedding. At the same time, since the demand during the rest of the day is significantly less, the generation has to be brought down to match the demand during the remaining periods of the day. This calls for an effective control on the generation from minute to minute to meet the demand. Failure to do so would lead to grid disturbances, voltage fluctuations and grid collapse.

d) The nuclear power stations are not capable of taking large variations in generations during different hours of the day. They have to therefore run on a continuous basis, with a steady output.

e) Thermal power stations using coal or lignite as input involve a long lead time for initial generation of steam for startup and therefore cannot be switched on and off as per the fluctuating load. Once started, the units have to run and any variations can be of the order of 30%. In other words, a thermal generating station based on coal/lignite could operate between

100% and 70% of its capacity, but not less. In case it becomes necessary to operate the stations at a lower capacity, oil will have to be used to stabilise flame which is a highly expensive proposition and is usually avoided.

f) Hydro generation itself is of three types.

(i) There are situations when water inflows are surplus to the storage capacity and has to be released in any case:
In such a situation, since power generation involves no incremental cost and waters go waste if power is not generated, whether the system needs it or not it is the practice to generate hydro power from surplus waters and back down other more expensive sources (eg., thermal plants). This power needs to be absorbed first. This would also apply to what may be called 'run of the river' schemes.

(ii) Water may be stored in reservoirs and released only when power generation is needed, mainly to meet the peaking requirements. While the cost of generation of such power is no different from the cost of power generated under (i) above, this power has a very high value to power supply industry, since this will enable meeting the peaking demands which occur only for a few hours each day. This is called 'PEAKING-POWER'. Availability of "peaking-power" in a system will enable meeting more demands during the day than otherwise and enable better utilisation of installed generating capacities.

(iii) While storage facilities may be available at hydro-electric stations, it sometimes becomes necessary to release the water to meet the irrigation requirements, although, purely from the power generation point of view, the water could better have been conserved and used for meeting peaking power requirements.

g) Thermal generation stations of the gas turbine type using diesel/gas/LNG as fuel can be switched on and off as required and are thus capable of meeting the peaking power requirements. This is an expensive option keeping in view of the high price of oil/gas. While the fixed costs may be treated as sunken costs, the high fuel costs necessitate the plants

being run only when absolutely necessary and power requirements cannot be met from cheaper alternate sources.

h) Gas based generation again falls under two categories.

(i) An open cycle system, in which the exhaust gases are not recycled for power generation. While this system has the advantage of being switched on and off as required and thus is capable of meeting peaking requirements, this is also an *inefficient* way of using gas, since exhaust gases of very high temperature are allowed to go waste.

(ii) A combined cycle gas plant is one in which the exhaust gases are recycled to heat water to generate steam and produce additional power without having to consume additional fuel. A broad indication is that for the same amount of fuel used, a combined cycle plant could generate 50% more power than when used in an open cycle plant. However, a combined cycle plant cannot be used in that mode for peaking requirements since it takes considerable time to generate steam by recycling heat from exhaust gases.

Section III

GROWTH OF POWER DEMANDS AND REQUIREMENTS OF INSTALLED CAPACITY

The installed capacity in the country as on 1950 was 1712.52 MW. Table 2.2 below compares the targets for various plan periods and the actual achievement there against upto 1992:

TABLE 2.2

PLANWISE TARGETS AND ACHIEVEMENT

Period	Target	Achievement	Slippages
	Mws	Mws	%
Ist FYP [51-56]	1300.00	1100.00	-15.38
IInd FYP [56-61]	3500.00	2250.00	-35.71
IIIrd FYP [61-66]	7040.00	4520.00	-35.80
Annual Plans [66-69]	5430.00	4120.00	-24.13
IVth FYP [69-74]	9264.00	4579.00	-50.57
Vth FYP [74-79]	12499.00	10202.00	-18.38
Annual Plans [79-80]	2945.00	1799.00	-38.91
VIth FYP [80-85]	19666.00	14226.00	-27.66
VIIth FYP [85-90]	22245.00	21402.00	-3.79
Annual Plans [90-92]	7823.00	5804.00	-25.81
Eighth Plan [92-97]	30538.00	12000.00*	------

Source: Five year plan documents and CEA, Government of India.

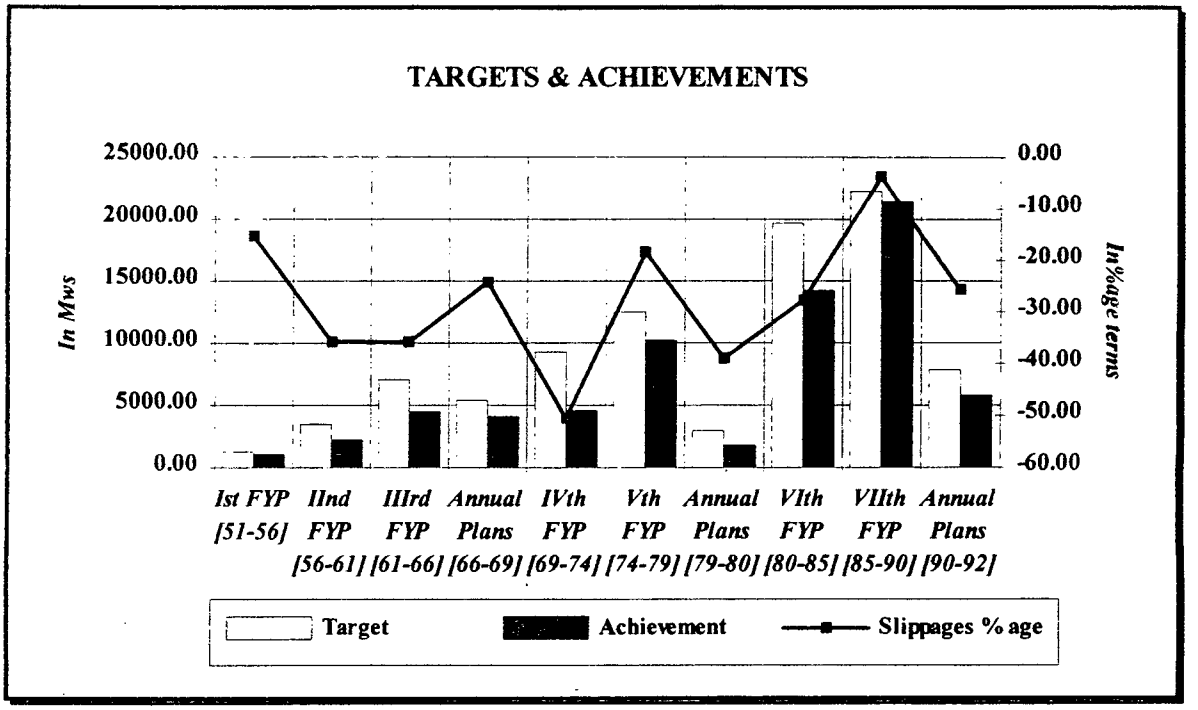
It will be seen from the above table that, had the plans been strictly implemented as per targets, the installed capacity by March 1992 would have reached approximately 93,435 MW as against 69065.19 MW capacity achieved by March 1992. In no plan period have targets been achieved. On the other hand, there have been massive slippages between the planned capacity addition and actual capacity added, ranging from 3% to over 50%. (See Fig 2.4). The Eighth Plan target is placed at 30538 Mws. Over the first three years of the VIII five year plan only about 12000 Mws were added - which means almost 18538 Mws have to be added in the next two years. Past plan periods would show that additions of this order have never been

* Upto 1995

achieved. *Had the slippages been avoided, the installed capacity would have been adequate to meet a peaking demand of the order of 50431 MW as per 14th Power Survey.*

FIGURE 2.4

TARGETS, ACHIEVEMENTS AND SLIPPAGES IN CAPACITY ADDITION



Source: Five year plan documents and CEA, Government of India.

As per indications, a very steep growth in the installed capacity is envisaged to meet the growing demands for power. The addition in the next ten years is expected to exceed **1 lakh MW**. Seen in the context of past achievements, this seems to be a colossal task. Also, the investments that may be associated with such a large scale expansion may be of the order of Rs 4000 billion (at Rs 4 cr/MW) and a like amount for transmission and distribution totalling to Rs 8000 billion. Funds of this order would be extremely difficult to find. There is therefore a need to examine in depth the ***technical performance*** of the existing facilities and identify for implementation, measures which could add to availability of power without additional investments or with marginal additional investments.

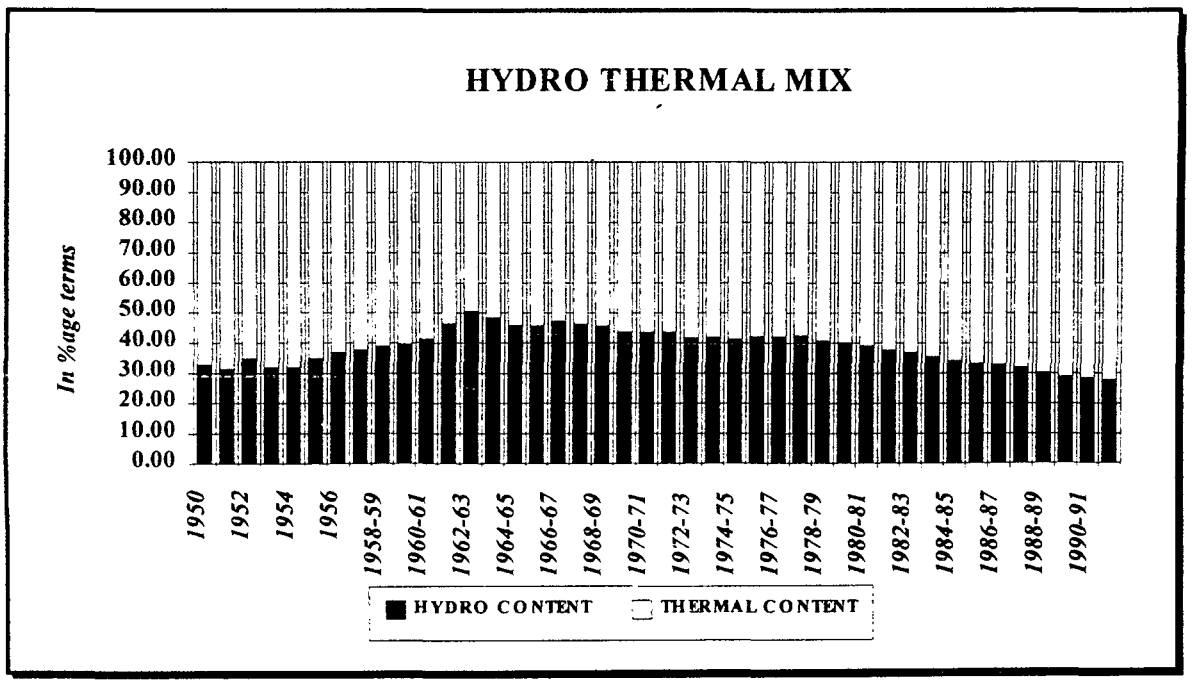
Some of the salient features of the past trends in growth of installed capacity and performance are outlined below:

a) In the early 50s, the hydro-thermal mix (ratio of installed hydro capacity to installed thermal capacity) was approximately 3:7 (30% hydro and 70% thermal). Progressively, this increased to 50% in mid 60s, thus substantially increasing the hydro content. There after, expansions of thermal installed capacity have been at a larger scale as compared to additions to hydro capacity, ultimately leading to the hydro capacity being about 28% of the installed capacity today.

Fig 2.5 below shows that the hydro content (hydro thermal mix) is declining progressively. The optimal Hydro:Thermal ratio is said to be 40:60 (which was also stressed in the VII Plan as an objective).@ Since 1979-80 (when hydro content was 40% of total installed capacity) this ratio has progressively come down and stood at 28% in 1991-92.

FIG 2.5

TRENDS IN HYDRO THERMAL MIX



Source: Public Electricity Supply: All India Statistics: General Review; CEA.

@ The VII Plan stressed that "without adequate hydel back-up, the overall cost of meeting the power demand would be very expensive." It was hence suggested that from the VII Plan onwards, efforts should be made to move towards the optimal Hydro:Thermal mix.

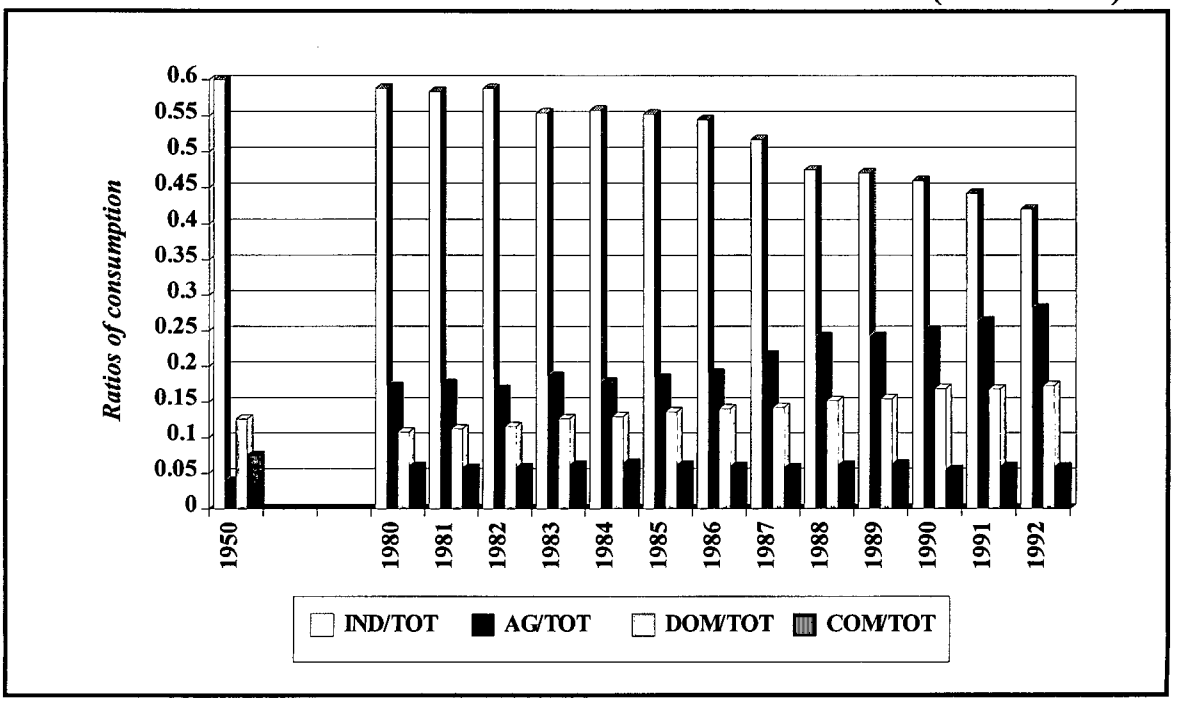
b) There is a vast hydro energy potential estimated at 84044MW*. The installed capacity as of today is only about 20829* MW forming **24.78%** of the available potential. Of all forms of energy, hydro energy forms the *cheapest* in the sense that ***there are hardly any recurring costs*** as against thermal electrical energy which entails substantial consumption of fuels (coal. oil. etc.). Besides, the hydro projects are pollution free and have the capacity to provide peaking power. Adequate peaking power enables better utilisation of existing thermal plants' capacity by appropriate balancing between base load and peak load operations. This will enable better meeting of demands for power. Besides, hydro power plants enable meeting irrigation requirements as well. The importance of achieving an optimal hydro thermal mix cannot be over-stated.

Category-wise consumption of power shows that the quantum of consumption of power supplied to agricultural pumpsets is increasing rapidly not only in absolute terms but also if we take the share of such supplies out of total energy sold, whereas the share of the consumers including industrial has been decreasing . Figure 2.6 shows (on an all India basis) that the share of industrial consumption has steadily declined from almost 60% in 1950 to about 42% in 1992. Meanwhile, the share of agriculture has increased from less than 5% to almost 29% during the same time period. This aspect has lot of implications which would be dealt with in this section later and in chapter IV .

* CMIE: India's Energy Sector; July 1995

FIGURE 2.6

SHARE OF CONSUMPTION OF DIFFERENT CATEGORIES (ALL INDIA)



Source : General Review - CEA

ASSESSMENT OF POWER REQUIREMENTS

Assessment of power requirements in the country are made through Annual Power Surveys launched by the CEA who collect data at grass-root level on the present levels of consumption, and the expected increases in the requirements and numbers in various categories of consumers and the expected load factor*. The requirements of peak load and energy are assessed on this basis covering the next eight to ten years. In each successive power survey, the requirements are updated keeping in view the past actuals and other changes that come to light. Table 2.3 below compares the projections made from time to time and the actual peak loads noticed against the projections through Annual Power Surveys. The methodology adopted for power surveys indicates that estimates covering longer time frames are

* Load factor represents what percentage of the connected load draws power at any point of time.

some what inflated whereas these requirements come down as we approach the concerned periods. For example, for the year 1985-86, the peak requirements for All India were assessed at 34,112 MW in the 13th Power Survey whereas in the 14th Power Survey, these came down to 27,033 MW. Likewise, the requirements for 1989-90 which were placed at 49,278 MW in the 13th Power Survey came to be re-assessed at 41,902 MW in the 14th survey. The variation between initial projections and actuals are about 20% to 25%.

The projection of requirements of peak demand and energy form the basis for power planning. The installed capacity requirements are worked backwards from the estimated requirements of demand/energy by applying factors to compensate for transmission and distribution losses, auxiliary consumption, as also the 'availability' of the power stations. Without going into the finer details of planning, it suffices to note that to meet a given peak demand, the installed capacity required can be arrived at by the following:

Installed capacity requirement =

$$\frac{\text{Peak Demand}}{[1 - \%\text{ of T\&D losses}/100]\times[1 - \%\text{ of Aux.cons.}/100]\times[\%\text{ availability of power plant}/100]}$$

Assuming transmission and distribution losses to be 22%, auxiliary consumption at 10% and availability factor at 75%, the requirement of generating capacity to meet 10,000 MW of peak load would be 18993 MW. The above is a ball park estimate and the requirement would vary from State to State and region to region depending upon variations in the factor values, availability of peaking hydro stations and thermal stations.

Thus, in this context, to make a proper estimation of the power requirements, it is essential to look at the actual performance of the plants and make a proper assessment of the T&D losses. Reduction in T&D losses and improvement in availability will reduce the need for capacity addition to meet a given demand.

TABLE 2.3

COMPARISON OF PEAK POWER DEMANDS AS PROJECTED IN SUCCESSIVE POWER SURVEYS *(In Mws)*

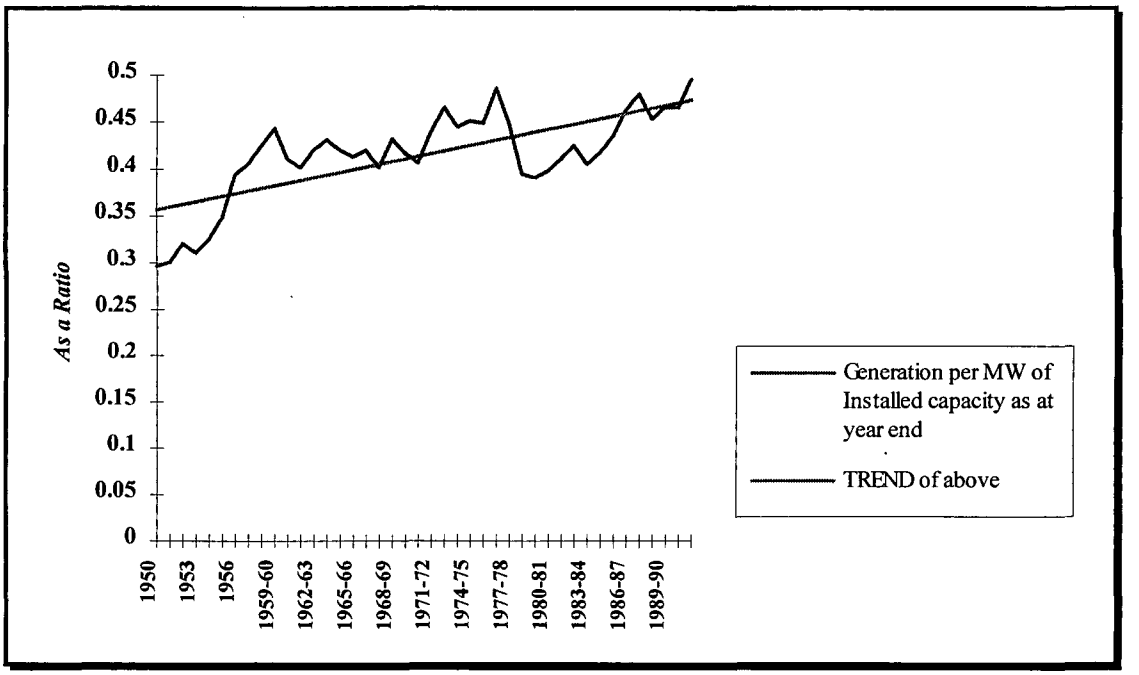
	NR				WR				SR				ALL INDIA			
	Projections 12	Projections 13	Projections 14	Actuals	Projections 12	Projections 13	Projections 14	Actuals	Projections 12	Projections 13	Projections 14	Actuals	Projections 12	Projections 13	Projections 14	Actuals
78-79				5024				4740				4479				17028
79-80				5474				4883				4387				17481
80-81				5883				5383				4908				19089
81-82				5694				5806				5509				20126
82-83	6550			6556	6118			6115	5590			5588	21492			21527
83-84	6790			6784	6942			6938	5872			5874	23005			23077
84-85	6959			7037	7317			7398	6809			6812	24681			24971
85-86	10850	7821		7896	9355	7950		7951	8787	7060		7120	34112	26777		27033
86-87	11975	8634		8702	10220	8738		8741	9707	7810		7468	37580	29574		29206
87-88	13179	11991		9650	11245	11060		9557	10620	10377		8148	41293	39660		31933
88-89	14455	13161	10481		12273	11981	10632		11534	11282	8903		45136	43308	34822	
89-90	15825	14474	12742		13459	12956	11828		12485	12189	11022		49278	47014	41902	
90-91		15805	14908			13994	12763			13172	11979			50945	46509	
91-92		17375	16259			15289	13709			14426	12980			55800	50431	
92-93		19089	17721			16538	14720			15647	13973			60832	54634	
93-94		20966	19240			18059	15875			17177	14985			66699	59122	
94-95		23068	20814			19416	17109			18688	15986			72711	63760	

Source: Annual Power Surveys: CEA.

It will be seen from Fig.2.7(i) that generation per Mw of Thermal capacity as at year-end has progressively gone up. Also, PLF has gone up from 52% in 1985-86 to 61% in 1993-94. See Table 2.4.* Further improvement are also possible. At the same time, the generation from hydro-electric plants per Mw of installed capacity is coming down. (Fig 2.7(ii))

FIGURE 2.7 (i)

TREND IN THERMAL GENERATION PER MW OF INSTALLED CAPACITY

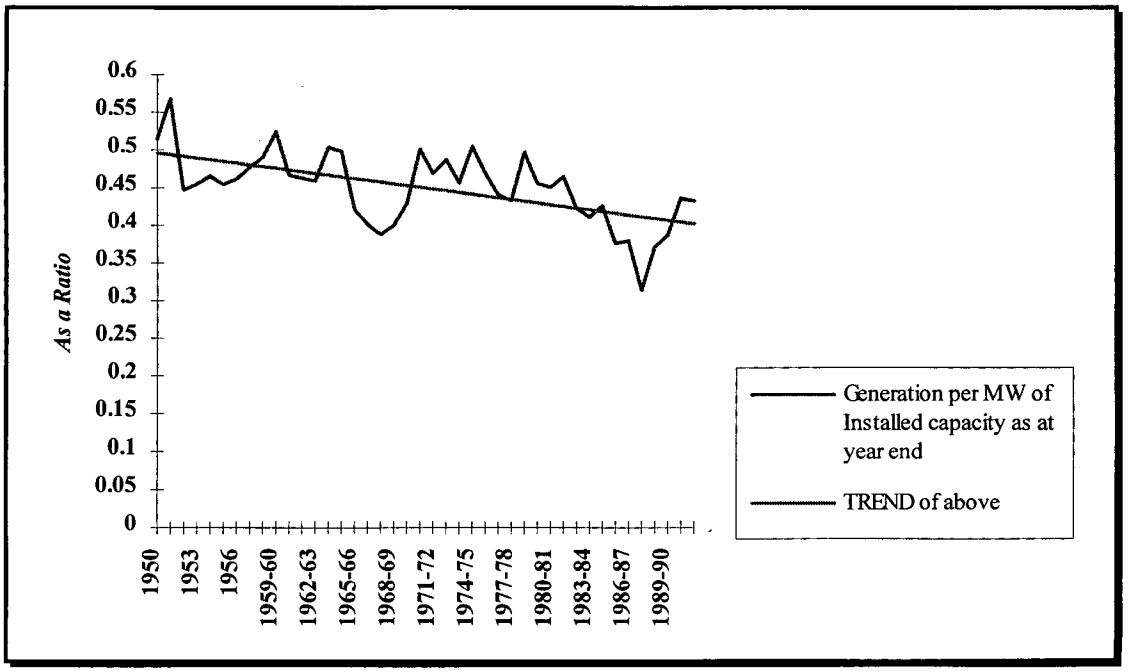


Source for figure 2.7 (i &ii) : General Review - CEA

* The figures in Table 2.4 differ from PLF figures in Figure 2.7(i) owing to difference in methodologies of computation. While the former is calculated by dividing total thermal generation in a year by installed capacity (thermal) at year end, PLF is calculated taking into account the exact date of commissioning of and synchronisation of a Plant.

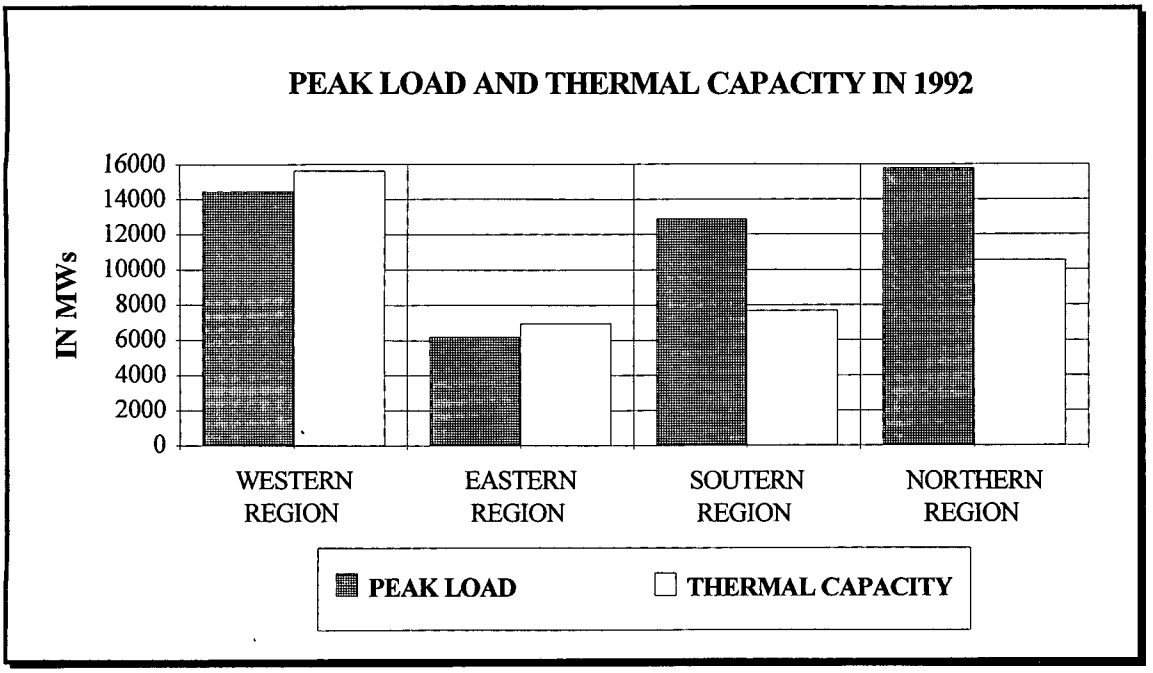
FIGURE 2.7 (ii)

TREND IN HYDRO GENERATION PER MW OF INSTALLED CAPACITY



The declining trend of output per MW can be attributed to reasons such as silting of the dam and the reservoir areas, ageing of the hydel plants or/and/availability of water.

FIGURE 2.8



Source : CMIE and Thermal perfomance review - CEA

It will be of interest to note that in some Boards/Regions the installed capacity of even thermal generating plants is much higher than the peak load of the system and yet there are peaking shortages. This prima facie, is somewhat incongruous but is the result of high Transmission and Distribution losses, lower plant availability etc. Similar position exists in the Western and Eastern regions. See figure 2.8 above.

Improvements in the performance of the existing generating capacities and reduction of transmission and distribution losses could contribute in a big way to meet a significant portion of the additional capacity requirements that are projected. For example, if T&D losses are pegged at 15% and availability factor increases to 85%, the requirements to meet a peaking load of 10000 MW would be 15378 MW, as against 18993 MW needed if T&D losses are 22% and availability 75%. In terms of investments, the former may need Rs 123 billion whereas the latter would need Rs 153 billion, assuming Rs 4 crore/MW for capacity addition, and a like amount for transmission and distribution. These aspects therefore need meticulous attention for constant improvement. Besides, the benefits of reduction in T&D losses will be available on a faster time frame, as and when improvements are effected progressively. Also, additional operating costs in generation of power would be avoided.

Even assuming that such improvements are effected, the balance requirements to meet the demand in the next ten to fifteen years will still be quite high compared to the past growth rates that have been achieved. This in itself brings a variety of issues such as -

i) the extent to which such additional capacities can be set up through internal resource generation;

ii) whether additional funds through budgetary/extra budgetary support can be made available to meet the demands; and if not

iii) how to motivate private sector to take an active part in the power industry to bridge gap.

TECHNICAL PERFORMANCE OF THE STATE ELECTRICITY BOARDS AND THE POWER SECTOR

Efficient technical performance of the power sector is vital in more than one way. ***Firstly***, it will enable the demands being met better with the existing generating and transmission systems very efficiently and would contribute to elimination of / reductions in the investments for installed capacities that are otherwise called for. ***Secondly***, efficient performance would lead to decrease in the losses suffered by the Electricity Boards and contribute to additional revenues and thus improve the financial performance of the Electricity Boards.

The following are some of the important aspects of technical performance that are going to be studied:

a) Plant Load Factor and
b) Plant Availability for thermal stations
c) Transmission and distribution losses

PLANT LOAD FACTOR (PLF)

The PLF of a generating station is defined as the ratio, in percentage terms, *of the actual generation of a generating unit to the total possible generation of the plant running throughout the year without interruption and generating power*. For example, a generator with 1 Mw capacity is expected to produce a maximum of 8.76 million KWH per year, if it runs non stop. This is taking into account 8760 hours in a year (24 x 365) and the output at the rate of 1000 Kw (i.e. 1 Mw) per hour giving 8760000 Kwh or 8.76 m units in a year#. It is significant that in reckoning the PLF, no allowance is made to any maintenance whatsoever. This is in contrast to the methodology adopted for computing machine utilisation in engineering industry where the theoretical machine availability is calculated ***after excluding*** the down time for scheduled maintenance, unforeseen breakdowns, non-availability of tools etc. In other words, machine utilisation is compared with what is reasonably possible & not, with the *maximum theoretically possible utilisation* as in computing the PLF.

The table below (2.4) indicates the Boardwise and all-India trend in the PLF of thermal generating stations in the country.

If the actual generation from a "α"Mw station in a year is "β" million units, the PLF is [β/8.76 x α] x100

STATEWISE AND REGIONWISE PLF (TABLE 2.4)

SEBs.	*1980-81*	*1982*	*1983*	*1984*	*1984-85*	*1985-86*	*1986-87*	*1987-88*	*1988-89*	*1989-90*	*1990-91*	*1991-92*	*1992-93*	*1993-94*	*1994-95*
HAR	31.70	37.30	32.20	31.10	34.70	32.80	33.80	40.60	41.20	44.10	34.50	45.80	49.90	40.50	44.70
PUN	37.60	41.60	51.00	57.00	64.30	58.90	68.30	71.70	56.10	60.80	52.90	52.80	58.30	63.50	56.80
RAJ	0.00	0.00	0.00	41.20	57.20	57.60	54.80	71.50	50.20	57.70	42.80	65.70	77.00	81.00	75.70
*UP**	36.50	37.60	39.60	35.10	31.60	37.30	***40.80***	***47.10***	***54.20***	***48.90***	***52.10***	44.30	50.50	50.30	44.10
N'THN RGN. AVG.	N.A	N.A	N.A	40.90	47.50	48.90	52.80	58.30	58.20	58.20	55.20	58.80	62.00	64.00	59.30
GUJ	50.00	53.60	57.90	55.30	54.00	53.30	54.00	60.00	56.10	60.40	57.70	56.90	61.60	60.40	60.40
MP	52.40	49.90	58.50	53.10	51.70	53.30	53.80	53.30	50.10	50.90	52.70	49.20	52.50	56.10	58.20
MAH	52.60	49.40	50.20	51.00	46.60	54.80	50.70	57.00	53.50	58.60	58.10	61.30	59.70	64.10	61.30
WEST'RN RGN. AVG.	N.A	N.A	N.A	N.A	53.00	55.80	55.40	59.80	56.60	60.30	57.70	59.60	59.70	63.40	63.80
AP	36.30	46.80	51.10	54.60	54.40	64.80	69.70	76.20	69.40	66.10	65.80	62.10	65.00	68.70	70.20
TN	34.50	37.80	44.00	39.40	49.00	56.50	64.70	68.70	66.70	64.30	58.30	55.70	65.20	69.00	68.30
KA	0.00	0.00	0.00	0.00	0.00	33.50	45.60	64.50	66.20	76.90	76.30	59.10	49.40	66.90	64.80
S'THN RGN. AVG.	N.A	N.A	N.A	N.A	57.00	64.60	69.50	71.80	69.30	66.60	61.70	60.80	62.60	68.30	69.00
BI	31.40	35.50	38.50	32.60	30.50	34.10	33.30	33.00	37.10	31.90	21.30	21.30	25.20	24.40	20.10
ORR	34.00	35.90	35.20	33.30	32.20	31.70	31.70	32.50	31.00	35.60	34.00	30.20	34.50	35.50	29.00
WB	42.10	37.60	39.60	35.10	36.50	40.50	42.10	38.60	35.70	34.80	30.80	30.70	31.10	40.50	41.20
E'RN RGN. AVG.	N.A	N.A	N.A	N.A	40.80	42.00	40.10	38.70	38.60	38.70	36.50	37.30	39.80	44.80	43.70
ASS	36.50	34.60	36.90	34.20	29.60	27.50	18.50	31.00	27.90	27.80	24.60	24.60	24.30	19.90	26.80
N.E'THN RGN. AVG.	N.A	N.A	N.A	N.A	29.60	27.50	18.50	31.00	27.90	27.80	24.60	24.60	24.30	19.90	26.80
TOTAL AVG for SEBs.	43.00	44.00	47.10	44.30	45.00	49.20	49.80	53.50	51.60	53.00	51.30	50.60	54.10	56.60	55.00
ALL INDIA	44.20	N.A	N.A	N.A	50.10	52.40	53.20	56.50	55.00	56.50	53.90	55.30	57.10	61.00	60.00

See below

Source : Planning Commission, Power and Energy Divn and CEA: Govt of India

The above table (2.4) indicates a gradually increasing trend in the PLF. Despite this, there is considerable scope for further improvement as can be seen from the following:

a) A state-wise, regional wise analysis of the PLF shows that there is a significant variation in the performance achieved in the different states and different regions of the country. While some regions/states have achieved a PLF in excess of 60% in several states like Assam, UP, Bihar etc., the PLFs achieved are significantly lower, ranging from 26% to 44% in 1994-95.

b) (i) Sudden increases in PLF as in the case of U.P (1986-87 to 1988-89) where the PLF increased from 40.8% to 54.2% should be looked at more cautiously. Even though this increase might prima facie reflect increasing efficiency in plant operation, it need not mean additional availability of power/energy. The SEBs are tempted to indicate higher PLFs by manipulating data as this in turn would earn them *'laurels of efficiency'* and also cash awards.

What happened in UP during that period was that even though the PLF 'increased', the T&D losses during the same period also increased dramatically from 20.6% to 26.1%. The national average was 20.0% in 1986-87 and 20.3% in 1988-89. *See table in footnote**. Thus, as against an increase of 6.3% in PLF in 1987-88, T&D losses increased by 5.4-6 % in the same year. Thus, the T&D losses in UP suddenly increased and stood at 6% over the all-India average whereas, prior to this period, such losses were either equal to or even below the national average). Again, with an installed capacity of 3000 MW, a 6% increase in PLF means 1419 MU at bus bar after reckoning 10% auxiliary consumption.

Further, the higher T&D losses also apply on power purchases. On energy available at the bus from purchase/generation of the order of 30000MU in 1988-89, the extra losses amount to about 1800MU at 6%. Thus, there was net shortfalls in availability by about 381 MU despite "increase" in PLF. At the same time, this implies a revenue loss of the order of Rs.142 Crores per annum reckoned at the average realisation rate of 78.2ps/unit with no additional power available for sale. Also, the Board incurred fuel costs of the order of Rs 80 cr.

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* T&D LOSSES UP & ALL INDIA AVG

	1981	*1982*	*1983*	*1984*	*1985*	*1986*	*1987*	*1988*	*1989*	*1990*	*1991*	*1992*
UP	15.80	18.80	18.80	18.20	18.20	20.60	20.70	26.10	26.50	26.10	26.10	26.10
ALL INDIA	18.60	18.90	19.50	19.20	20.10	20.20	20.00	19.60	20.30	19.60	19.70	NA

Source : CEA, Govt. of India

In fact the Board's saving/additional revenue could be much higher if the additional energy generated was not 'lost' through increase in T&D losses by 6%. This would have also led to avoiding import of power of about 2400MU to meet 1800MU requirement after 26% T&D losses (Rs.182 Crores @ 76.3/unit). The increase in PLF thus resulted in a loss of Rs 404 cr!

(ii) Looking from another angle, energy of this order, available through new generating capacity , would mean an additional 500Mw capacity, operating at 62% PLF requiring an investment of Rs. 875 crores (1 Mw at about Rs. 1.75 Cr) besides a time lag of about 4 years and linkages of coal. Even if such capacity were installed there may be no incremental revenue as the tariff (78.92ps/unit) were well below the costs(137.73ps/unit). On the other hand there would be a net recurring loss of about Rs. 105Cr/annum even after reckoning revenue from sale (1800MU @ 58ps/Kwh.)!!

From the above it is evident that the Board was a net loser despite the fact that it had improved its efficiency in operation by 'increasing' the PLF.

AVAILABILITY

While Plant Load Factor is a measure of ***actual*** generation at a generating station, 'availability' of the plant is an indicator of its 'capacity and readiness to generate'. Considering that actual generation and hence PLF depend on a variety of conditions including existence or lack of System demand, backing down in merit order operation etc., plant availability is a much better measure or indicator of a plant's performance compared to PLF.

An overall analysis of the PLF on all-India basis for the year 1991-92 indicates that while the PLF achieved is 55.5 %, the following are the causes for the lower level of generation.

a)	Planned maintenance	12.00 %
b)	Forced outages (FO)	15.19 %
c)	Partial outage/non-availability	14.10 %
d)	Lack of system load	3.21 %
	TOTAL	44.5 %
	PLF	100-44.5= 55.5%

Thus, Plant Availability (what later is termed "net availability") was 58.71% [PLF plus backing down due to lack of system load (as at 'd' above)]* and non-availability was 41.29% (a+b+c).

The PLF of thermal stations is a measure of *actual generation*. Situations do arise when a generating station is in a position to generate power but the system does not need the power, hence there would no generation. This means that the plant is "available" for generation but does not generate due to system conditions. One of the draw-backs in using PLF as an indicator of efficiency is that it does not reflect the "availability" of the plant to generate but only what is *actually* generated. This is an important aspect and has several connotations - A low PLF (say 50%) with high availability (85%) is good sign of the plant having reserve capacity. However, a higher PLF of say 65% accompanied with a lower availability of say 65-70% is not a good sign as this would indicate that the plant has a high "down" time and has virtually no reserve capacity. The international figures as a comparison indicate a very low PLF (50-58%) but show very high "Availablity" of 75-80% and even higher.

The published reports of Central Electricity Authority on *"Performance Review of Thermal Stations"* published annually, contain a detailed analysis of performance of thermal stations including generation, plannned maintenance, forced outages, analysis for reasons for forced outages, unit wise, age wise etc. In these reports, the term "operational availability" has been used to denote the figure arrived after excluding planned maintenance and forced outages from total availability of 100%. The Plant Load Factor (PLF) is computed taking into account the total generation. The difference between the "operational availability" and PLF is further analysed into various factors "partial unavailability" and "non-generation due to lack of system demand/maintenance of reserve". The term "partial unavailability" covers a large number of contingencies including plant imbalance, non-availability of evacuation facility, non-availability of fuel etc. The generation during partial non-availability would be nil. Thus, for the reason that in computing "availability" for generation only the PLF + 'non generation due to system demand' are to be reckoned. Viewed from another angle, this represents the complement from 100% after excluding "planned maintenance", "forced outages" and "partial unavailability" (during which there is no generation). We may call this ***"Net availability"***. The figures for "operational availability" are

* This is different from "Operating Availability" as represented by the Boards in table 2.5 below. Operating Availability there is represented by Net Availability + (c) i.e. Partial Availability.

of the order of 70 to 72% which are low compared to international levels of 80 to 85%. If we take into account "net availability" for the Indian power sector, it would be about 55 to 60% which represents the net availability of the plant for power generation. This is quite low and capable of being improved. It is also significant that out of a "partial unavailability" of the order of 15%, about 11% would be attributable to the reasons internal to the plant and the balance 3% for the reasons external.

The region-wise distribution is as under:

TABLE 2.5

REGIONWISE BREAKUP OF THE PERFORMANCE FACTORS FROM *1985-86 TO 1991-92*

		NR	WR	SR	ER	NER	ALL INDIA
A	**Capacity at the end of the year in Mws**						
	1985-86	6126.50	9758.50	3712.50	4983.00	180.00	24760.50
	1986-87	6446.50	10918.50	4102.50	5513.00	240.00	27220.50
	1987-88	7174.50	11128.50	4732.50	6103.00	300.00	29438.50
	1988-89	8094.50	12588.50	5442.50	6313.00	300.00	32738.50
	1989-90	9154.00	13786.50	6352.50	6170.00	330.00	35793.00
	1990-91	10041.50	14926.50	6552.50	6447.50	330.00	38298.00
	1991-92	10541.50	15630.70	7682.50	6935.40	330.00	41120.10
B	**Planned maintenance %**						
	1985-86	8.80	9.88	7.60	13.68	6.50	10.03
	1986-87	10.47	10.76	10.25	12.19	5.69	11.07
	1987-88	7.24	11.45	9.57	10.18	11.22	9.87
	1988-89	8.70	14.60	13.76	9.30	2.35	11.85
	1989-90	9.00	12.91	11.44	11.40	4.24	11.35
	1990-91	9.22	12.47	8.57	16.78	25.68	11.28
	1991-92	10.10	9.98	12.31	19.17	18.36	12.01
C	**FO Loss in %**						
	1985-86	26.01	13.17	16.40	20.53	70.33	18.71
	1986-87	23.28	17.54	10.60	23.96	65.09	19.28
	1987-88	21.51	12.67	8.52	27.22	54.01	17.65
	1988-89	16.10	10.80	9.29	28.85	58.29	15.89
	1989-90	16.23	10.55	10.91	26.40	51.05	15.32
	1990-91	18.50	11.33	17.31	23.89	28.26	16.49
	1991-92	17.04	11.78	12.42	22.41	34.39	15.19
D	**Operating Avail. %**						
	1985-86	65.19	76.95	76.00	65.79	23.17	71.26
	1986-87	66.25	71.70	79.15	63.85	29.22	69.65
	1987-88	71.25	75.88	81.91	62.60	34.68	72.48
	1988-89	75.20	74.60	76.95	61.85	39.36	72.76

table continues.....

		NR	WR	SR	ER	NER	ALL INDIA
	1989-90	74.68	76.54	77.65	62.20	44.71	73.33
	1990-91	72.28	76.20	74.12	59.33	46.06	71.71
	1991-92	72.86	78.24	75.27	58.42	47.25	72.80
E	**PLF %**						
	1985-86	49.24	57.10	65.34	41.98	13.53	53.00
	1986-87	52.42	55.38	69.34	39.77	18.36	53.32
	1987-88	58.32	59.75	71.76	38.71	21.97	56.46
	1988-89	58.18	56.57	66.01	38.59	24.48	54.93
	1989-90	57.97	60.14	65.62	38.46	26.81	56.22
	1990-91	55.28	57.69	61.69	36.51	24.62	53.89
	1991-92	58.12	59.59	60.77	37.29	25.48	55.50
F	**Energy not utilised for want of load and reserve shut down %**						
	1985-86	0.92	3.93	1.96	1.89	0.00	2.46
	1986-87	2.00	2.63	1.25	1.84	1.36	2.10
	1987-88	0.91	2.47	0.82	1.70	1.18	1.66
	1988-89	3.20	2.02	0.56	1.10	0.34	1.88
	1989-90	2.18	2.95	0.88	1.24	3.82	2.16
	1990-91	4.39	2.34	1.02	1.53	4.61	2.40
	1991-92	3.96	3.74	3.21	1.37	1.71	3.22
G	**Partial Unavailability %**						
	1985-86	15.03	15.92	8.75	21.90	9.64	15.81
	1986-87	11.83	13.78	8.43	22.24	9.50	14.71
	1987-88	11.90	9.27	9.26	22.19	11.52	14.36
	1988-89	13.81	16.00	8.38	22.11	14.52	15.45
	1989-90	14.33	13.44	11.14	22.50	14.08	14.95
	1990-91	12.83	16.46	11.57	21.40	17.70	15.52
	1991-92	10.80	15.15	11.23	19.76	20.06	14.10

Source: Performance Review of Thermal Power Stations; CEA.

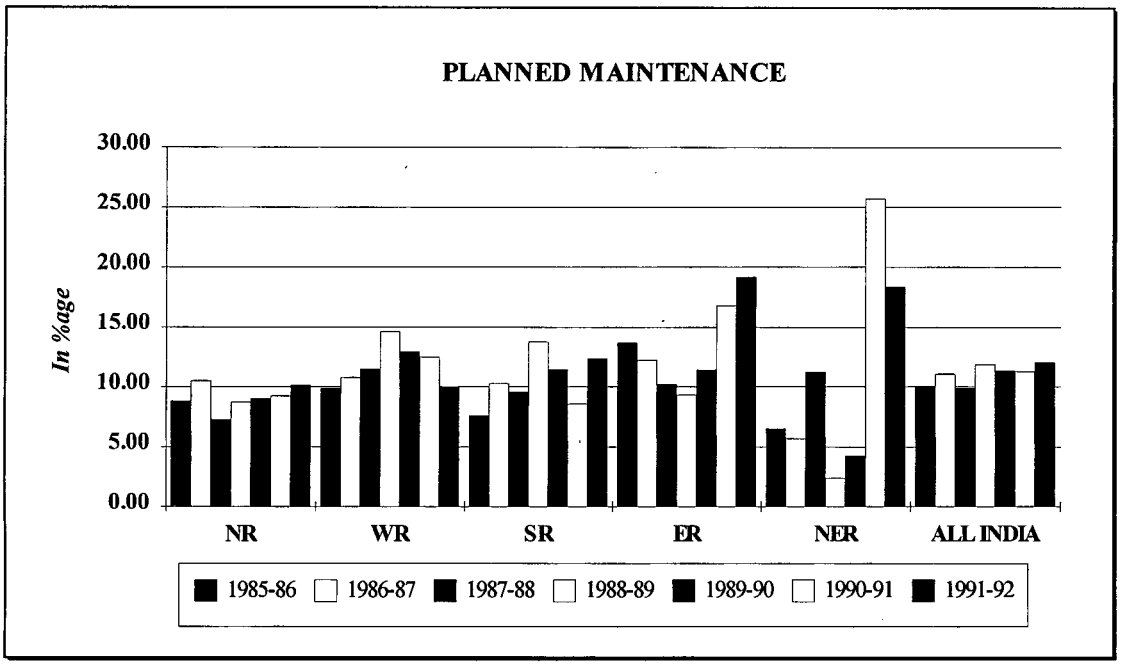
H **Net Availability % = 100 - {B+C+G}**

1985-86	50.16	61.03	67.25	43.89	13.53	55.45
1986-87	54.42	57.92	70.72	41.61	19.72	54.94
1987-88	59.35	66.61	72.65	40.41	23.25	58.12
1988-89	61.39	58.60	68.57	39.74	24.84	56.81
1989-90	60.44	63.10	66.51	39.70	30.63	58.38
1990-91	59.45	59.74	62.55	37.93	28.36	56.71
1991-92	62.06	63.09	64.04	38.66	27.19	58.70

The regionwise/yearwise (1985-92) performance of thermal stations and "availability" after excluding partial unavailability is depicted below.

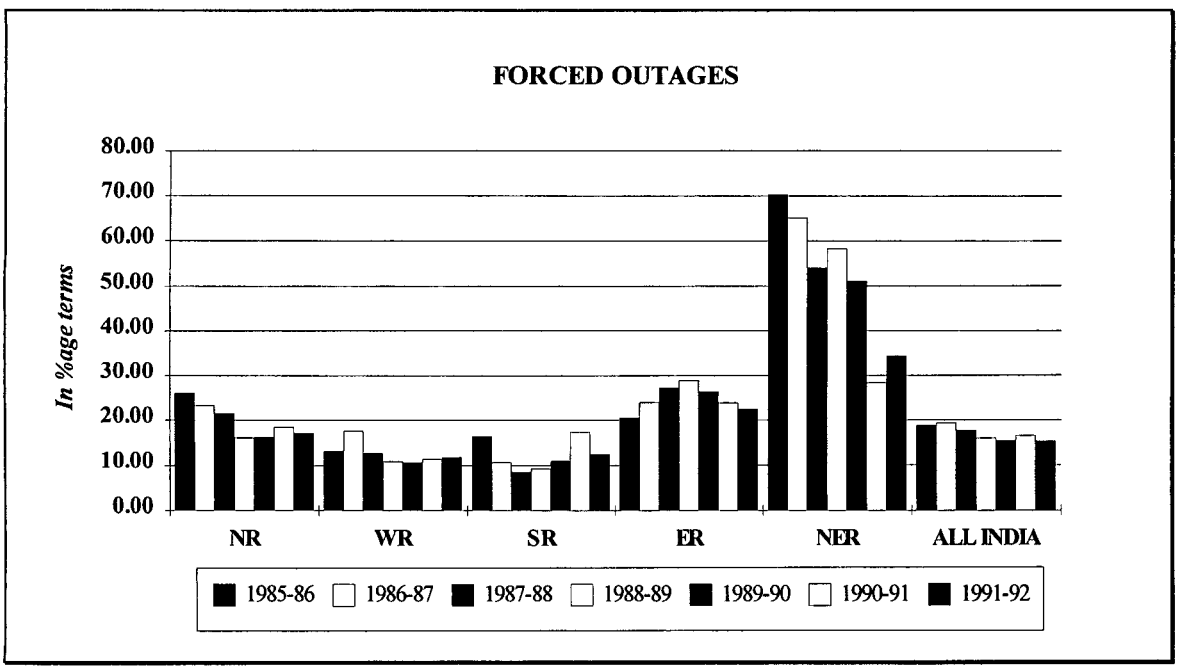
REGIONWISE VARIATIONS IN PERFORMANCE FACTORS

FIGURE 2.9



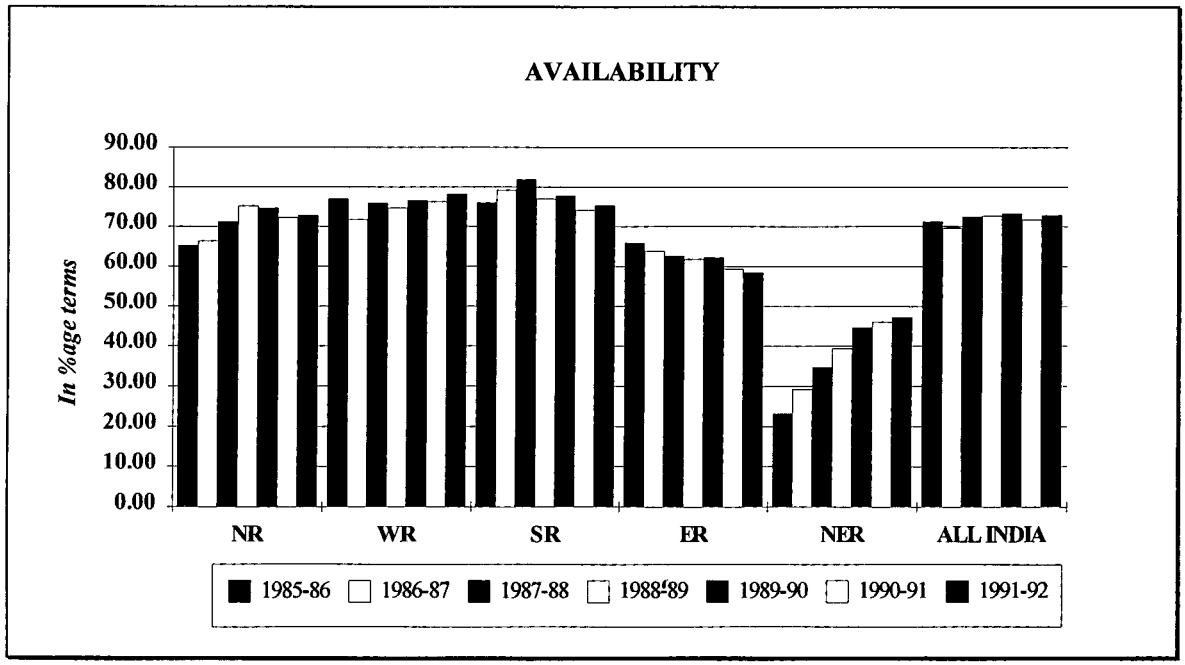
Source: Performance Review of Thermal Power Stations; CEA.

FIGURE 2.10



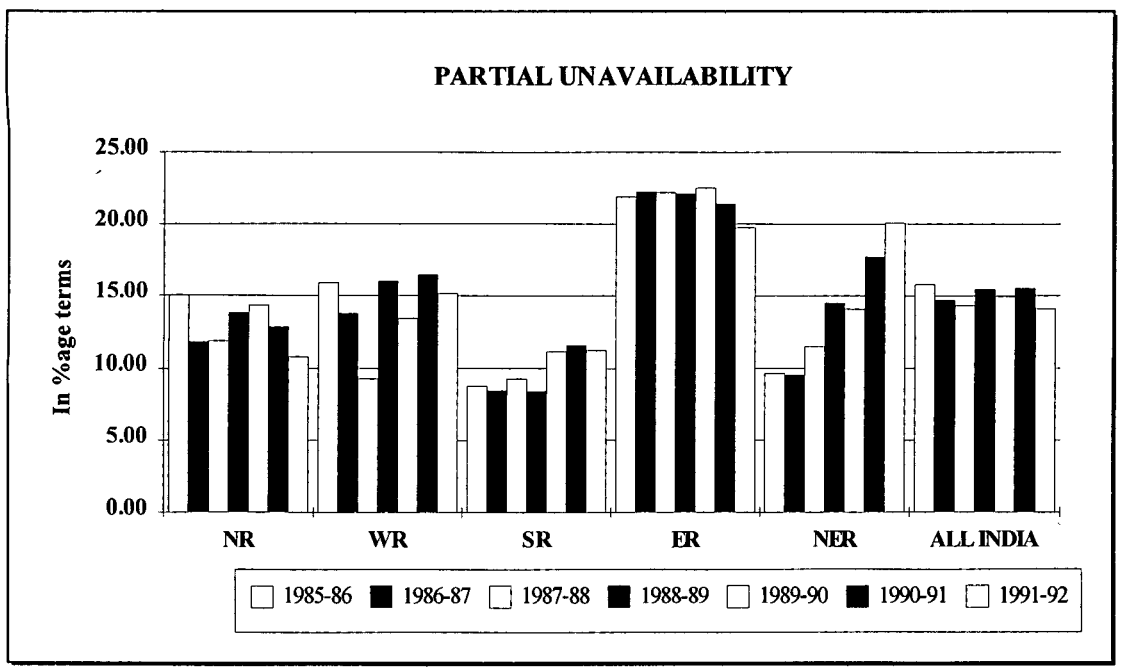
Source: Performance Review of Thermal Power Stations; CEA.

FIGURE 2.11



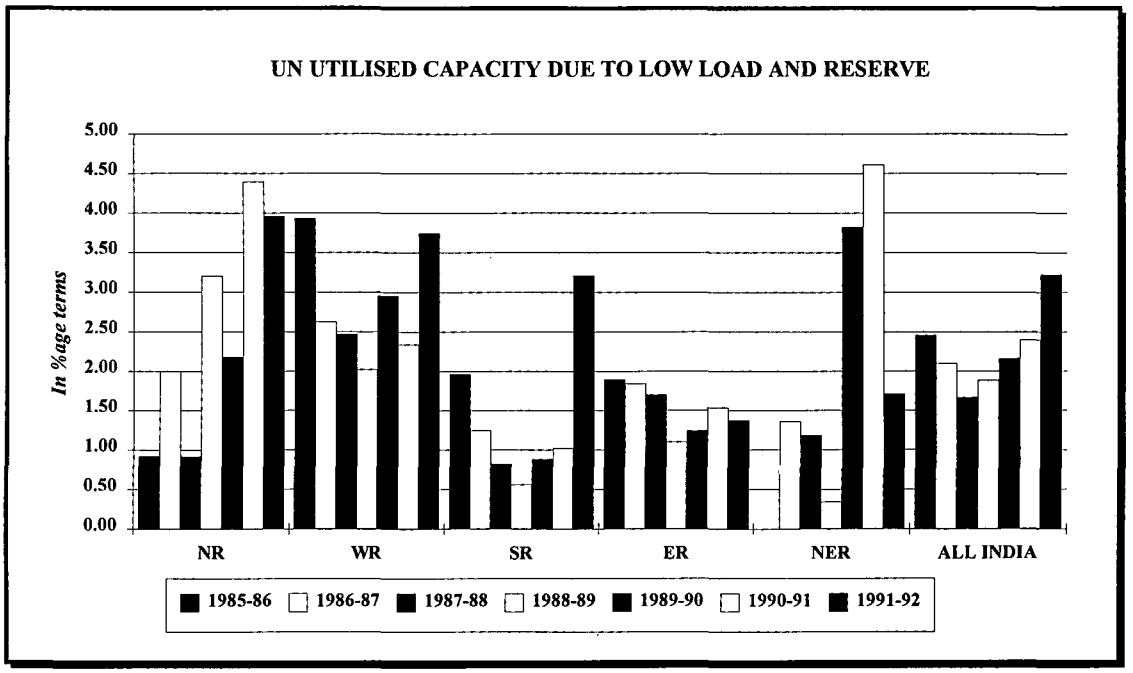
Source: Performance Review of Thermal Power Stations; CEA.

FIGURE 2.12



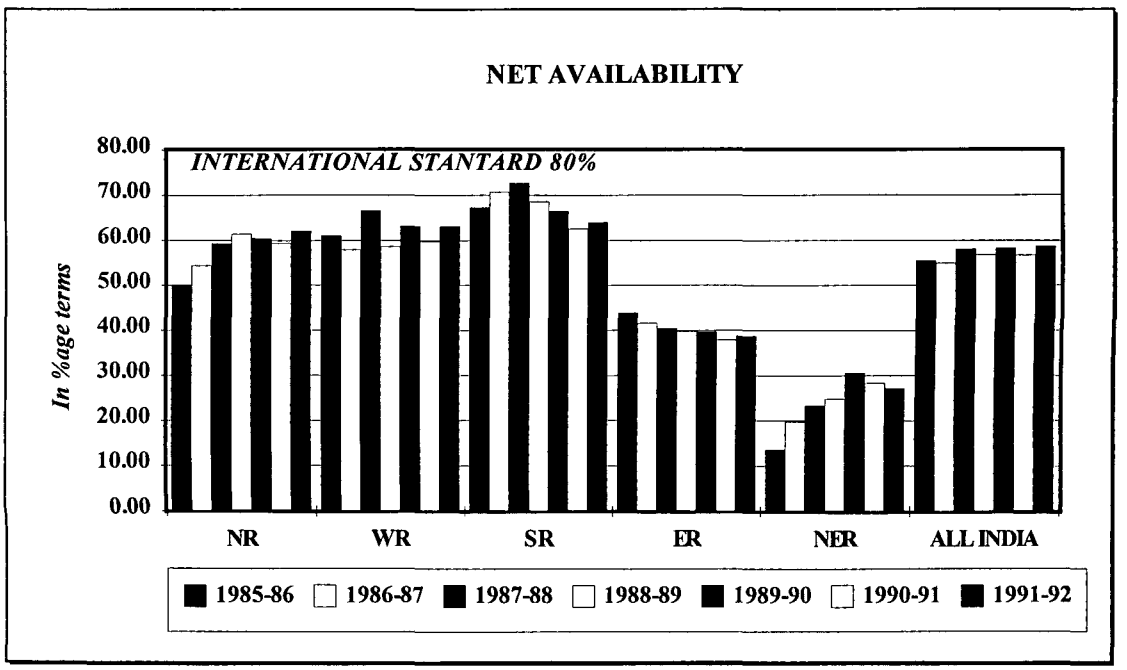
Source: Performance Review of Thermal Power Stations; CEA.

FIGURE 2.13



Source: Performance Review of Thermal Power Stations; CEA.

FIGURE 2.14



Source for International Stantards: Energy : Needs and Expectations; World Energy Conference(Cannes France 1986)

The following observations can be made.

(i) As seen from the above table (2.5), forced outages are significantly high in eastern region - 22%; northern region - 17%; north-eastern region - 28% to 70%;

and are relatively less in the western region - 11.78% and southern region - 12.5%; and all-India 15.19%. The net availability ranges from 13% (northern eastern region) to 70% (southern region) against an international performance level of 75 - 80%[1] .

(ii) While planned maintenance is an acceptable factor. a high incidence of forced outages and partial unavailability are indicative of inadequate planned/ preventive maintenance and should have been eliminated.

(iii) Partial unavailability includes unavailability due to internal constraints ***arising out of the deficiency in achieving full rating of the units either in equipment or auxiliaries as a result of which the operating units could not deliver the rated output.*** The partial unavailability due to internal constraints during 1990-91 was 11.60% which increased to 12.43% during 1991-92, but on all India basis it has remained stable. On the other hand fig. 2.12 shows that the Eastern and the North Eastern States show a high level of Unavailability with the North Eastern States exhibiting an increasing trend. There is unavailability due to external constraints arising out of the causes external to power station equipments such as shortage of fuel and cooling water or absence of adequate power evacuating capacity. This resulted in reduced generation or complete shutdown of one or more of the units in the station. The partial unavailability due to external constraints during 1990-91 was 4.37% which decreased to 1.67% during 1991-92.

(iv) The forced outages have been analysed due to the following causes:

TABLE 2.6
CAUSES FOR FORCED OUTAGES *(Figs in %)*

Cause of Outage	*1986-87*	*1987-88*	*1988-89*	*1989-90*	*1990-91*	*1991-92*
Boiler & Boiler auxiliarie	39.04	42.90	50.46	44.08	39.81	45.27
Turbine & Turbine auxil-iaries	29.23	26.18	26.75	17.63	16.20	17.83
Generator	20.00	18.19	10.76	21.29	18.37	8.45
Other (Elec.& Mech.)	11.71	12.70	11.97	16.95	25.62	28.44
F.O. loss as % of Max. possible generation	19.28	17.60	15.89	15.32	16.49	15.19

Source: Performance Review of Thermal Power Stations; CEA.

[1] World Energy Conference: Energy : Needs and Expectations, XIIIth Congress Cannes France 1986.

(v) From the table above the following observations can be made:-

a) There is a gradual decline in the extent of the Forced Outages (F.O.).

b) Most of this decline is due to decrease in Turbine & Generator outages.

c) Boiler outages continue to be high and have a tendency to increase and, along with increased Electrical and Mechanical (E & M) problems maintain the level of Forced outages at a high level.

d) E & M outages have increased from a low level of 11.71% to 28.44% meaning that it has increased about 2.5 times over its lowest level. This is highly unjustified on the part of the plant managers and would only reflect that maintenance and certain minimum standards are not maintained. Poor quality of fuel, wet coal being supplied and lack of proper maintenance which cause Grid system faults are some of the main causes for such outages. On the other hand the main problems that the boilers face are from the operation side. Fireouts, Abnormal furnace draft and the level of the drum contribute most to the Boiler related outages.

(vi) The total net availability, which is about 58% in 1991-92 is very low by international standards which are about 75 - 80% (fig 2.14). If the gap could be reduced by about 50%, this would mean an increase of 8% in availability equivalent to about 3300 MW. Forced outages and partial unavailability account for about 27% which is also high. If these can substantially be reduced, say by 50%, this can contribute to an increase in the availability by about 15% equivalent to about 6600 MW which is significant.

(vii) Figure 2.10 and Table 2.5 would indicate that it is the North Eastern and Eastern states that have the highest level of Forced Outages and very low plant availability. Even though they are gradually declining, their level in 1991-92 remain rather high.

(viii) Figure 2.13 and Table 2.7 shows that there is an increasing trend (all India) in non utilisation of energy due system load variations including backing down. While, non utilisation due to reserve shutdown has declined.

TABLE 2.7

FACTORS FOR NON UTILISATION OF CAPACITY

Non utilisation due to.... (%)	*1988-89*	*1989-90*	*1990-91*	*1991-92*
System load	0.99	1.35	1.08	2.04
Reserve shutdown	0.89	0.61	1.32	1.18

Source: Performance Review of Thermal Power Stations; CEA.

INCREASING TRENDS IN PLF

The ***increasing trend in PLF (seen since the late 70s) can be attributed to an increasing share of generating sets of 200 MW and above and not so much to better performance of the existing sets of lower capacity***. It is relevant that introduction of 200 MW started only in late 70s and has been sustained till date whereas 500 MW sets were introduced in the mid eighties. Historically, the low PLF was due to units of less than 200 Mws capacity with an inappropriate boiler design (Czech) of 110/120 Mws which could not handle coal of high ash content. The ***designs were later modified to Fluidised bed boilers (FBB)* suited to Indian coal quality, after which generation levels increased.*** These units were mainly 500/200 MW generating sets. Table 2.8 below shows that the 500/200 Mws opertionalised have much higher PLF and 'Availability' figures than those of lower capacity (less than 200 Mws). Thus, the increasing share of 500/200 Mw sets in the total installed capacity is one of the main reasons behind the increasing trends in PLF.

[P.T.O]

* The fluidised bed combustion (FBC) boilers was best suited for Indian coal, which is of a very high ash content. FBC provides much higher efficiency of combustion than the conventional manual or stroker firing thereby reducing the quantity of fuel needed. At the same time it maintains a low fuel bed temperature preventing the formation of lumps of molten ash which was a regular problem with the burning of Indian coal. The FBBs today easily achieve an efficiency of around 86%.

TABLE 2.8

UNITWISE PERFORMACE OF THERMAL PLANTS

	500 Mw Units	*89-90*	*90-91*	*91-92*
1	Units Commissioned by the end of the year			
a.	No.	12	13	14
b.	Capacity (Mws.)	6000	6500	7000
2	Planned Maintenance (%)	6.65	5.36	6.54
3	Forced Outage (%)	15.17	7.13	7.13
4	Partial unavailability	10.73	16.85	11.86
5	Availability (%)	**67.45**	**70.66**	**74.47**
6	Plant Load Factor (%)	**70.03**	**61.02**	**68.42**
	200/210 Mw Units	***89-90***	***90-91***	***91-92***
1	Units Commissioned by the end of the year			
a.	No.	93	101	107
b.	Capacity (Mws.)	19410	21090	22350
2	Planned Maintenance (%)	6.65	5.36	9.67
3	Forced Outage (%)	11.55	12.25	13.83
4	Partial unavailability	12.73	13.58	12.66
5	Availability (%)	**69.07**	**68.81**	**63.84**
6	Plant Load Factor (%)	**61.71**	**60.24**	**60.89**
	140/150 Mw Units	***89-90***	***90-91***	***91-92***
1	Units Commissioned by the end of the year			
a.	No.	9	9	9
b.	Capacity (Mws.)	1270	1270	1270
2	Planned Maintenance (%)	17.46	13.72	9.43
3	Forced Outage (%)	8.38	18.22	18.61
4	Partial unavailability	22.12	25.12	22.73
5	Availability (%)	52.04	42.94	49.23
6	t Load Factor (%)	49.24	40.94	44.28
	120 Mw Units	***89-90***	***90-91***	***91-92***
1	Units Commissioned by the end of the year			
a.	No.	20	20	20
b.	Capacity (Mws.)	2400	2400	2400
2	Planned Maintenance (%)	10.34	14.85	26.55
3	Forced Outage (%)	28.84	24.54	12.74
4	Partial unavailability	18.04	18.13	19.36
5	Availability (%)	42.78	42.48	41.35
6	Plant Load Factor (%)	41.62	41.86	42.38

table continues....

	110 Mw Units	*89-90*	*90-91*	*91-92*
1	Units Commissioned by the end of the year			
a.	No.	36	37	38
b.	Capacity (Mws.)	3960	4025	4135
2	Planned Maintenance (%)	13.1	16.68	19.5
3	Forced Outage (%)	20.14	26.34	27.08
4	Partial unavailability	18.40	16.02	14.74
5	Availability (%)	48.36	40.96	38.68
6	Plant Load Factor (%)	45.92	37.98	35.9
	100 Mw Units	*89-90*	*90-91*	*91-92*
1	Units Commissioned by the end of the year			
a.	No.	11	11	11
b.	Capacity (Mws.)	1210	1042	1042
2	Planned Maintenance (%)	13.23	14.79	16.09
3	Forced Outage (%)	14.4	12.27	13.76
4	Partial unavailability	18.16	14.87	14.83
5	Availability (%)	54.21	58.07	55.32
6	Plant Load Factor (%)	53.56	57.61	54.76

table continues....

Less than 100 Mw Capacity Sets

		85-70 Mw			*67.5-62.5 Mw*			*60 Mw*		
		89-90	***90-91***	***91-92***	***89-90***	***90-91***	***91-92***	***89-90***	***90-91***	***91-92***
1	Units Commissioned by the end of the year									
a.	No.	7	8	9	20	22	23	25	25	25
b.	Capacity (Mws.)	540	610	680	1259	1375	1447	1500	1485	1485
2	Planned Maintenance (%)	4.53	9.22	9.80	11.88	11.22	9.27	11.94	14.01	15.51
3	Forced Outage (%)	26.52	34.46	29.98	13.44	16.31	13.68	24.13	22.61	21.58
4	Partial unavailability	29.39	25.89	25.54	17.80	18.34	18.92	16.84	17.62	17.05
5	Availability (%)	39.56	30.43	34.68	56.88	54.13	58.13	47.09	45.76	45.86
6	Plant Load Factor (%)	35.56	27.34	29.97	54.23	51.70	55.54	45.78	44.57	43.13

		55-60 Mw			*40-20 Mw*		
		89-90	***90-91***	***91-92***	***89-90***	***90-91***	***91-92***
1	Units Commissioned by the end of the year						
a.	No.	28	28	28	26	23	22
b.	Capacity (Mws.)	1405	1225	1225	752	606	576
2	Planned Maintenance (%)	7.96	15.38	9.27	13.34	17.27	15.81
3	Forced Outage (%)	23.80	22.03	0.56	28.50	21.44	26.88
4	Partial unavailability	16.52	11.03	12.98	8.43	17.54	19.19
5	Availability (%)	51.72	51.56	77.19	49.73	43.75	38.12
6	Plant Load Factor (%)	51.52	51.52	46.42	36.18	36.66	35.65

Source: Performance Review of Thermal Power Stations; CEA.

TRANSMISSION & DISTRIBUTION LOSSES

The growth rate of power generation and supply has been quite high whereas, Transmission and Distribution[1] (T&D) systems have, by and large, lagged significantly behind. What eventually transpired was that there was an emphasis to achieve maximum growth of power generation and supply neglecting corresponding additions to T&D network, leading to an overloaded system involving longer lengths of distribution lines. This in turn has given rise to much higher T&D loss figures in the network than what may be considered reasonable. Also, other than technical losses in transmission, energy theft in the distribution system also adds significantly to the T&D loss figures.

It is technically assessed that transmission losses i.e. losses involving transmission above 11 KVA contribute to less than 20% of the total T&D losses, which means that 80% of the T&D losses are in the distribution mains (11 KVA and below). Accurate estimation of unmetered supply through "test meters" have revealed that 40-50% of the distribution losses can be attributed to theft of electricity*. This would mean that, but for theft, the T&D losses could be about 13% (4% towards transmission and 9% towards distribution losses) instead of present level of 22%. In comparison, foreign utilities have the T&D losses within about 8%. The difference of 5% could be attributed to avoidable losses arising out of inadequate transmission & distribution systems. Indian figures do not compare well with western countries' figures for the reason the latter figures do not camouflage pilferage and have remained low due to a strongly meshed transmission and distribution network.

Planwise trend of T&D losses reveals that upto the III FYP, they were contained upto 15%. But, during IV Plan period, T&D losses increased from 15% to 18% and for the V Plan period it touched 23%. While these are national averages, increases in some of the Boards are even steeper. Interestingly, these were the plan periods during which India went in for *'Green Revolution'* and there

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[1] A transmission & distribution consists of
110 kV and above classifies as transmission
33kV and 66 kV classifies as sub transmission
11 kV and below classifies as distribution.

* The Power Minister confirmed the fact in a place like Delhi where there is no agricultural consumption, the T & D losses are to a tune of 42 - 50% ! Almost all this can be attributed to theft of power and illegal connections. (Seminar on International Standards on Excellence in T & D at CII, New Delhi)

were massive schemes of village electrification and energisation of pumpsets most of being unmetered. During this period, planners and energy managers started dumping unaccounted energy, pilferage and a percentage of T&D losses as agricultural consumption. This was mostly done to hide high and excessive T&D losses and pilferage.

A change in the demand pattern has also affected the extent of T&D losses.

(i) The percentage of HT consumption out of total has gradually been decreasing, from 52% in 1979 to 32% in 1993 and this rate of decline, it is forecasted, is going to increase. Supply to bulk & HT consumers does not entail high T&D losses as it does not require LT lines to supply power to them. The share of connected load of HT consumers over the same period has also declined quite rapidly - from 25% to 19% whereas the supply to agricultural sector has increased from 10.2% to 28% (1993-94) and has since risen further to 31% (1993-94).

TABLE 2.9

CHANGING SHARE OF HT AND AGRICULTURAL CONSUMPTION

	AGRICULTURE				HT		
Year	*Cons. [MU.]*	*%age*	*Con. Load [Mws]*	*All India Kwh/Kw*	*%age of connected load*	*Cons. Kwh/Kw*	*%age consumption*
1970-71	4470.00	10.20	6225.00	755.00	-	-	-
1978-79	13851.00	15.56	12028.00	868.00	25.00	3371.00	52.00
1985-86	23422.00	19.04	22605.00	1036.00		-	-
1986-87	29444.00	21.66	24289.00	1212.00		3086.00	39.00
1990-91	50251.00	26.44	32511.00	1546.00		2971.00	35.00
1992-93	63328.00	28.70	36400.00	1740.00	19.00	2700.00	32.00
1993-94	70000.00	31.00	37920.00	1846.00		-	-
1996-97	110000.00	40.00	43000.00	2558.00		-	-

Source: Government of India-CEA.

It is also significant that while consumption per KW of HT consumers was about four times that of agricultural consumers in 1978-79, the present position is that this works out to about to 1.55 times of what is consumed per KW on the agricultural side (1992-93). Most of the HT consumers are also shifting towards captive generation because of the unreliable supply from the grid. It is also forecasted that their share out of the total demand is likely to decrease further. The shift of supply pattern from EHT/HT to LT contributes to increase in distribution losses.

(ii) The plan allocation towards T&D works has remained stagnant at around 30% against the accepted norm of 50% of the total plan outlay (see Table 2.10 below). There has been a 5 fold increase in the length of the distribution system from 1970 to 1993 i.e. from 9.4 lakh ckt kms to 43 lakh ckt kms.

TABLE 2.10

ALL INDIA OUTLAY FOR T&D WORKS (INCLUDING RE.)

Period	*Amount in Rs Crores*	*% In Total*
Ist FYP [51-56]	140.00	54.00
IInd FYP [56-61]	190.00	41.00
IIIrd FYP [61-66]	454.00	36.00
Annual Plans [66-69]	528.00	43.00
IVth FYP [69-74]	1385.00	47.00
Vth FYP [74-79]	2963.00	39.00
Annual Plans [79-80]	998.00	40.00
VIth FYP [80-85]	6320.00	33.50
VIIth FYP [85-90]	12360.00	32.00
Annual Plans [90-91]	3317.00	26.60
Annual Plans [91-92]	3542.00	26.00
Eighth Plan [92-97]	26281.00	33.00
Total/Avg.	**58478.00**	**33% [Average]**

Source: Government of India-CEA.

On the other hand, the increase in the sub-transmission system comprising of 132 & 33 KV lines to provide new step down sub stations has only doubled*! (See Table 2.11 below.) The larger lengths in the distribution system has only resulted in overloading and poor voltage to consumers and this has added immensely to losses. Inter country comparison shows that while India requires, on an average, 100 km of LT lines per MW of demand, (because of inadequate HT/EHT systems) this figure is 4-5 times higher than that of Japan, where the T&D losses are about 5.8%. This, is one very important factor for high T&D losses.

* Almost 13% of the 22% i.e 60% of the T&D losses occurs at levels below 132/33 kV.

TABLE 2.11

POOR GROWTH OF 132 KV AND 33 KV SYSTEM [ckt.kms.]

Voltage	*1992-93*	*1978-79*	*1970-71*	*%age Increase during 1971-93*
HV DC	1667	-	-	-
400 KV	23886	718	-	-
220 KV	68688	27196	11211	-
132 KV	88186	54186	46160	191
66 KV	36020	26594	25769	140
33 KV	224685	151579	95073	236
11 KV	1434367	671801	362628	396
LT	2848195	1213845	576323	494
TOTAL	**4725694**	**2145919**	**1117164**	

% age increase in Installed capacity from 14,709 Mws in 1970-71 to 72,330 Mws in 1992-93. 492

Source: Government of India-CEA.

(iii) One must remember that the consumption in the agricultural sector is not metered; it is only 'estimated'. The SEBs find it convenient to hide their inefficiencies by manipulating figures of agricultural consumption. A major portion of the T&D losses and pilferage finds its way into the agricultural consumption figures. Agriculture being a politically sensitive area to touch, policy makers have never questioned the unprecedented increase in the consumption attributed to the agricultural sector. At the same time, since it is universal knowledge that the actual supply to the agricultural sector would be much less, State Governments are reluctant to concede the claims of SEBs for subsidy for power supplied to the agricultural sector. It is noteworthy that the SEBs put in claims for subsidies to the tune of Rs.5000 crore per annum to their State Governments for the power ostensibly supplied to agricultural sector which would include excessive T&D losses and pilferage of electricity. However, these claims have largely remained unaccepted, for the very same reasons.

AGRICULTURAL CONSUMPTION AND T&D LOSSES

Manipulation of the agricultural power consumption figures can better be illustrated through the following:

The agricultural consumption/kW of connected load has increased from 755 units in 1970 -71 to 1846 units in 1993 and with a present growth rate in excess of

12% is likely to cross 2558 units/kW by 1996-97. This means a more than three fold increase in agricultural consumption per KW, and usage of all pumpsets for about 7 hours/day right through the year including monsoons. Such high consumption appears to be not plausible. On the other hand, due to shortage of power - the duration of supply is gradually decreasing to about 10 to 12 hours a day or less. The average consumption of all sectors per KW has remained constant at 1500 units during the same time period!

EVALUATION OF ACTUAL T&D LOSSES

S N Roy has made the following assessment of elements of theft and pilferage of energy that are possibly being counted as agricultural consumption.

The average agricultural consumption per Kw of connected load in 1970-71 is about 755 Kwh/Kw. Presently this is around 2400 units/KW. The supply is unmetered and hence the assessment quite subjective. S N Roy has compared the position obtaining in Tamil Nadu where the supply to the agriculture is mostly metered. The average consumption for the year 1992-93 was 1129 units/Kw. Taking this as base and assuming 1200 Kwh/Kw as a reasonable consumption, he concludes that roughly 50% of the consumption of 2400 units/Kw that is attributed to the agricultural sector would represent what could correctly be termed T&D losses (which the Boards would not like to show as such) and theft of power. Considering that about 40% of the overall consumption is attributed to agricultural sector in several states, this would imply about 20% of the total energy sales are actually T&D losses and theft but shown as agricultural consumption. SN Roy also concludes that, at best, half of this could be theft and at least half could be T&D losses. On this basis, he concludes that the actual T&D losses would be at least about 10% more than what is stated, that is in the region of 32% or even higher.

IMPACT OF INCENTIVE ON LOSS REDUCTION

The Government has introduced incentive schemes for reduction of T&D losses and even awards are being given. Instead of providing technical remedies to such high T&D losses, the SEBs carry out greater manipulations to win the awards[1]. The guidelines of using modern computer aided technique for planning,

[1] This aspect was highlighted (for increases in the PLF level) in the case of UPSEB to earn meritorious awards .

design and control of distribution systems have, merely remained on paper and cannot be made effective unless the root causes are eliminated with a firm hand. The theft of energy has been made a cognizable offence under the amended provisions of Section 39 of I.E.Act, 1910, but in actual practice it does not have any impact on the reduction of theft of electricity due to difficulties in the implementation of the above provision either due to socio-political pressures or collusion of SEB staff. While the pilferage of electricity results only in loss of revenue to SEBs, the excessive T&D losses are a national loss which the country can ill-afford under the prevailing situation of financial crunch. The problems are well known but everybody tries to evade the main issues. How long this menace can be postponed remains a big question.

HIGH T&D LOSS AND AGRICULTURAL CONSUMPTION - ITS FINANCIAL IMPACT

Exact quantification of T&D losses is not possible in the absence of proper metering. The figures of percentage T&D loss and agricultural consumption as reported by SEBs have been compiled below (Table 2.12) for selected SEBs. It may be very evident from this Table that in the states of Haryana, Punjab, UP, Gujarat, AP and Karnataka, the percentage today is 40% or more and may even exceed 60%-70% during the Ninth Five Year Plan at the present high growth rate in agricultural consumption. The SEBs may thus hardly be earning revenue by selling to others only about 40% of the saleable energy. Since the tariffs for agricultural supply are very low, the SEBs do not derive any reckonable revenue despite steep growth in consumption by this category. Such a situation is bound to drag the SEBs into deeper financial crisis.

TABLE 2.12

STATE-WISE AGRICULTURAL CONSUMPTION AND T&D LOSSES

HA	*1978-79*	*1986-87*	*1990-91*	*1992-93*
T&D(%)	21.68	21.87	27.49	26.78
Ag. Con.(%)	38.00	42.19	44.82	50.22
PUN				
T&D(%)	19.41	18.75	18.97	19.24
Ag. Con.(%)	46.65	45.04	44.11	45.50
RAJ				
T&D(%)	26.60	24.92	25.92	22.74
Ag. Con.(%)	19.69	29.45	29.25	29.30
UP				
T&D(%)	18.53	21.00	26.93	24.43

table continues.....

Ag. Con.(%)	31.59	36.96	40.00	39.04
MAH				
T&D(%)	17.74	14.52	18.06	17.83
Ag. Con.(%)	20.78	25.42	28.21	30.15
AP				
T&D(%)	20.54	20.62	22.43	19.88
Ag. Con.(%)	18.92	29.44	41.62	42.26
KA				
T&D(%)	21.94	24.05	20.11	19.55
Ag. Con.(%)	6.84	28.93	36.21	41.40
KE				
T&D(%)	11.39	26.40	21.67	21.95
Ag. Con.(%)	3.55	3.60	3.95	4.17
TN				
T&D(%)	18.63	17.40	18.74	17.50
Ag. Con.(%)	27.29	27.50	25.42	28.00
BI				
T&D(%)	23.70	21.81	21.09	22.00
Ag. Con.(%)	7.36	25.17	28.65	27.74

Source: General Reviews and other unpublished data from CEA.

Unmetered supply implies flat rate tariffs unrelated to consumption. This provides for uncontrolled excessive consumption with no incentive to bring down the same. This also provides a suitable alibi for dumping unaccounted energy (eg. theft, T&D losses) as consumption attributed to such consumers.

THE NEED FOR PROPER METERING AND ANALYSIS OF T&D LOSSES

The power planners have indicated that ***1% reduction in T&D loss may save roughly 4000 million units of energy***. In 1996-97 this would correspond to an installed capacity of over 1000MW or a investment saving of over Rs 4000 crores. In view of the enormous advantages in reducing T&D losses, it is necessary that the SEBs install meters at various points in the system for correct evaluation of the T&D losses taking place in different voltage systems. This would also enable the identification and location of high pilferage areas and bring out the extent of pilferage taking place in Industries, towns and rural areas. The importance of correct analysis is inescapable and preferably the work of energy audit may be entrusted to independent agencies. Once the areas of high technical T&D losses are known, the SEBs may find it feasible to initiate corrective measures by implementing system improvement schemes to get an optimal solution.

At the same time, there is an increasing reluctance on the part of Boards to provide meters. ***This in turn is attributed to violent resistance on the part of consumers who are accustomed to unmetered supply.*** An underlying factor could be apprehension of upward revision of tariffs based on recorded consumption in case meters are installed.

The objective of reducing T&D losses to a level of 15% by end of the Ninth Five Year Plan, was set in the Eighth Plan document and in order to achieve this objective, corrective measures were to be started during the Eighth Five Year Plan itself. It appears however, that unless there is a strong political will, it may not be achieved and the losses may further go up, which will accelerate the process of financial bankruptcy of the SEBs. High T&D losses and pilferage of electricity may continue to be the area of greatest concern for power planners in the foreseeable future.

SUMMARY OF CHAPTER II

The main findings of the above analysis indicate the following:

Plan-wise targets have never been achieved nor have the slippages been contained to a reasonable level. The power sector does not have an optimal hydro-thermal mix (as was stressed in the Seventh Plan) and the trends show that the extent of hydro capacity as well as generation from hydel stations per Mw of Installed capacity is also decreasing. Estimation of power demands through Annual power surveys have projected higher demands in longer time frames and also has also not been accurate. The PLF of Indian thermal power stations is very low (55.5%) with almost 41% of its rated capacity being unavailable for generation. In the statistics published by the Central Electricity Authority, it is noticed that "partial unavailability" is not excluded in calculating "operational availability". Only planned maintenance and forced outages are excluded. On this basis, the overall "operational availability" as per CEA published data, would be around 72%. If "partial unavailibility" (which represents to the extent to which the plant is not in a position to generate power, whether the factors be internal to the plant or extenal) is excluded, ***the real availability (net availability) would be much less, of the order of 55 to 58%***. While inclusion of "partial unavailability" in the overall "operational availability" may enable better comparison with international performance, this would not be justified simply for the reason that plant would not be in a position to generate the power at full capacity. The increasing trend in the PLF that is noticed since the 80's was more due to the introduction of 500 and 210 MW sets rather than better operation of the existing plants. Also, increasing trends in PLF by themselves should not be interpreted to mean better operations of the Board (as was seen in the case of UP). For the time period in which the PLF was increasing, we saw the T&D losses were concomitantly increasing, leading to a situation where instead of having increased power availability from the Board's own stations operating at a 'higher' PLF the increase in T&D losses may more than offset the additional generation by the Board. The high T&D losses can be attributed to three important factors;

(i) the share of HT consumers is on the decline,
(ii) the All India outlay for T&D works is on an average only 33% and the 132/33 KW lines have only doubled while the total length of the distribution system has increased five times since 1970.

(iii) Agricultural consumption is unmetered and highly over estimated, with almost 50% of the agricultural consumption being T&D losses (inclusive of theft).

(iv) Actual T&D loss figures can be more reasonably to placed at 32% rather than 22% as is represented.

All in all, the above indicates that there has been a lack coordination between the various organisations and strict adherence to plans. The inability of the Boards' to achieve recommended standards (eg. T&D losses, PLF, Availability), and large scale unmetered supplies, particularly for agricultural pumpsets ,forces them to manipulate data and present more acceptable levels of performance.

CHAPTER III

FINANCIAL PERFORMANCE OF THE STATE ELECTRICITY BOARDS

The vital role which the Power sector has to play in economic development of our country was recognised by the Government immediately after independence in 1947. The Electricity (Supply)[1] Act was enacted in 1948 providing for formation of State Electricity Boards [SEBs] with the required degree of autonomy and entrusted both the responsibility of planning and executing major power projects and operating them with a view to supply the growing demands of in a developing economy.

An important aspect is the Board's responsibility to supply electricity that may be required within the State *in the most economic manner*. Also, as per the E(S) Act, the Board has the first right to supply electricity to any consumer in the State. Initially, the concept was that the Boards should manage their operation, ***as far as possible***, in such a way as not to incur losses. The Act specifically stipulated in Sec 67 that ***provision for depreciation and interest on Government loans need be met by SEBs only to the extent the surplus, available if any, permitted this***.

In other words, the principles legislated were, at best, to break even, even ignoring the requirements of depreciation and interest on Government loans. There was a gradual change in the outlook. Keeping in view the growing demand for power in the years to come and the massive investments that may be involved, the Venkataraman Committee recommended in 1964 that the SEBs should generate a

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1 As per E(S) Act, vide Sec.18, SEBs were charged with the responsibility to:

a) arrange, in co-ordination with the Generating Companies, if any, operating in the State, for the supply of electricity that may be required within the State and for the transmission and distribution of the same in *the most efficient and economic manner* with particular reference to those areas which are not for the time being supplied or adequately supplied with electricity;

b) supply electricity as soon as practicable to a licensee or other person requiring such supply if the Board is competent under this Act so to do;

c) exercise such control in relation to the generation, distribution and utilisation of electricity within the State as is provided for by or under this Act;

d) collect data on the demand for, and the use of, electricity and formulate perspective plans in co-ordination with the Generating Company or Generating Companies, if any, operating in the State, for the generation, transmission and supply of electricity within the State;

e) prepare and carry out schemes for transmission, distribution and generally for promoting the use of electricity within the State; and

f) operate the generating stations under its control in co-ordination with the Generating Company or Generating Companies, if any, operating in the State and with the Government or any other Board or agency having control over a power system.

surplus of 3% after providing for an interest liability on loans assumed at 6%, the then existing rate, and 1/2% towards reserves and 1-1/2% towards the then existing State Electricity Duty. In other words, the SEBs were expected to generate a surplus of 11% after depreciation, but before providing for interest and before deducting State Electricity Duty. This was on the Capital Base of average the Net fixed assets in use as at the beginning and end of the financial year plus 1/6 of the annual administrative and operating expenses towards working capital. The recommendations by the Venkataraman Committee were accepted by the Central Government in March 1965.

In 1978, the E(S) Act, 1948, was further amended to provide that the SEBs should generate such surplus as may be prescribed by the State Governments, after taking into account all operating expenses, depreciation, interest & taxes. The Act specifically stipulated that , in specifying the surplus to be generated, the State Government shall provide for a reasonable contribution towards capital works and loan amortisation, after meeting all operating expenses including depreciation & interest. The statutory provision seems to be less demanding than the recommendations of the Venkataraman Committee, in that no specific minimum return was prescribed after reckoning interest/depreciation. Further, no State Government fixed a target of Surplus to be achieved by the Boards. The E(S) Act was therefore again amended in 1983 to provide that ***the surplus to be generated by the SEBs from 1985-86 should be such as may be prescribed by the State Governments but not lower than 3% of the net fixed assets*** (less consumer's contribution) as at the beginning of the year. Even today, no State Government has yet fixed a rate of surplus higher than 3%. The Boards are thus under a Statutory obligation of generating a 3% surplus as per the E(S) Act, 1948.

The above is indicative of the somewhat 'luke warm' approach then adopted by the State Govt./Central Govt. at least till 1983 as well as the State Electricity Boards to profitability/Resource generation by State Electricity Boards. Any current criticism of the Boards on their losses has to take into account the above background.

The paramount need for sound financial performance of the SEBs and the compliance with the provisions of the E(S) Act is evident from the following:-

(a) As commercial ventures[1], the SEBs should not be losing concerns, and expect to operate on budgetary supports from their Governments Such an approach would result in the SEBs subsidising supply of Power; the consumers meanwhile remain unaware of the actual costs of supplying power generation and supply ; and above all subsidised power supply below cost leads to uncontrolled growth of demand which the Boards would be hard put to meet. Besides, no State Government can afford to provide budgetary support for the operations of the Boards.

(b) There should be no undue strain on the liquidity of the Boards and the Boards should be able to meet their commercial obligations to the suppliers of coal, power from the CGS, Railways etc., failing which they may refuse to make supplies/ render services.

(c) Lack of adequate internal resources affects the maintenance of the equipment very badly owing to a tendency to economise or postpone expenditure even on essential repairs. This leads to increase in the down time of the plant through unforeseen outages resulting in inability to meet the power demands.

(d) Any *'healthy'* commercial organisation has to generate reasonable internal resources to finance expansion programmes, at least in part, as has indeed been stipulated in the E(S) Act (Sec 59). It is expected that at least 20-30% of the expansion programmes should be financed by the Board's internal resources. If this is not done, the Boards would have to borrow additional funds at high rates of interests, which would inflate the capital costs and costs of generation of power. This, in turn, has a two-fold impact - ***Firstly,*** in a situation where tariffs have reached very low levels and increase in tariffs being very difficult, this would lead to recurring losses to the Boards. ***Secondly,*** the cost of power supply to the consumers keeps increasing, and, power being a basic input to industry this has a

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[1] The State Electricity Boards are supposed to be commercial entities as was outlined above. The term "commercially oriented" according to the World Bank applies to public sector enterprises and is not limited to private companies only. The former can be commercially oriented by seeking to:

i) recover costs by selling their products and services; and

ii) earning a satisfactory return on invested capital, and make a reasonable contribution to expansion after meeting their operating costs and debt service obligation.

cascading inflationary effect. One of the prime objectives of the SEBs is to ***keep the costs of electric supply as low and economical as possible***. Avoidable escalations in power costs should be eliminated as these have a cascading effect on prices .

(e) Keeping in view the statutory obligations imposed on the Boards by the E(S) Act , the World Bank has been insisting that the Boards should achieve, as a minimum, the Statutorily prescribed levels of surplus failing which the Boards are liable to be considered ineligible for World Bank assistance for Power projects in the State / Region. Internal funding agencies like Power Finance Corporation also stipulate this as a precondition for grant of loans.

THE CONCEPT OF SOUND FINANCIAL PERFORMANCE AND VIABILITY

In the light of the above, it is obvious that the concept of sound financial performance and viability should cover the following aspects:

(a) Achieving the prescribed surplus under section 59(a) of the E(S) Act, after taking into account full liability of depreciation, interest etc.

(b) Ensure adequate liquidity to be able to promptly discharge all its obligations to suppliers of equipment, coal, power from CGS etc.

(c) Ability to meet full debt servicing and debt redemption obligation from the resource generated. This includes payment in full of due to State Govt/other financing agencies by way of interest/repayment of loans.

(d) Generation of reasonable contribution for meeting expenditure on expansion programmes.

(e) The State Governments should themselves take a considered view on the minimum return the Board should achieve, and also enable the Board to do so.

DIVERSE ACCOUNTING PRACTICES

It will be of interest to note that the accounting in Electricity Boards hitherto had been on diverse patterns, some of them not strictly conforming to the

concepts of Commercial Accounting. The principles and formats for maintenance of accounts were not uniform between the Boards. Electricity Boards, in general, continued to have an accounting system based on ***cash concept***. In practice, the cash approach had somewhat been modified in the later years by including in the accounts some items on an accrual basis. It was also not the practice nor was it required under the E(S) Act to provide in the Profit and Loss Account, full provision to meet the liability on account of interest and depreciation of assets [Sec 67 E(S) Act]. Where the revenue surplus before depreciation and interest was not adequate, provision towards interest and depreciation was being limited to the extent of the surplus available and the balance was shown as 'contingent liability' either in the foot notes or carried forward to next year's accounts. In some Boards, appropriations from surplus to reserves were being made although the full liability for depreciation and interest was not provided for. Reserves were being created although there was no surplus, by inflating the losses. Some Boards were capitalising interest on capital works in progress while others were charging the same to the Profit and Loss Account. In the absence of a uniform and proper commercial accounting system based on the accrual concept, modifications to cash amounts made at the year-end have not improved matters to any significant extent. The variations in the accounting principles and formats rendered financial appraisals of individual Boards, as also inter-Board comparison, difficult.

It was only in 1985 and under pressure from World Bank that a uniform common accounting practice based on standard commercial accounting concepts was prescribed, and after approval by the C&AG, was adopted by the SEBs for the period from 1.4.1985. All the Boards were required, under statutory instructions, to prepare an Annual Statement of Accounts, including the Profit and Loss Account and the Balance Sheet on forms prescribed by the Central Government. The respective State Governments were also required under the Act to cause the accounts of the SEB to be published in the prescribed manner and make available copies thereof on sale - at a reasonable price.

The above exposition brings out certain important but little *known* factors governing the concepts of financial viability as legislated viz.,

(i) There was no compulsive requirement of breaking even, till late seventies. The Boards were to attempt this as far as possible.

(ii) There was no requirement of providing for full depreciation or interest payable on Government loans. These could, under the statute, be provided only if there were surpluses after meeting other obligations.

(iii) The concept of Board contributing internal resources to expansion programmes did not seem to exist till late seventies even as a thought.

Any criticism of the financial performance of the Boards should not ignore the above guiding principles which were the statutes of the day which may indeed be responsible for the present distressing position.

To sum up, at one time it was considered adequate if the State Electricity Boards just break-even. Later on, the Venkataraman Committee recommended that the Boards should achieve a 9.5% return after depreciation, but before interest and without reckoning electricity duties. This criterion did not appear good enough or adequate as the interest burden in several Boards came to be far in excess of the 6% norm assumed by the Venkataraman Committee, with the result that some of the Boards, which had achieved the prescribed return of 9.5%, still incurred commercial losses if actual interest liability was reckoned. Another criterion brought in by the World Bank was of contributing not less than 20% to investment on the basis of average asset formation for preceding, current and following years. It was soon realised that this was also not a good indicator of sound financial performance since Boards which incurred commercial losses and had no expansion plans / programmes could easily satisfy this criterion while Boards generating considerable surplus but at the same time having extensive expansion programmes did not fulfil this criterion. The absence of uniform and standard accounting practices led to serious deviations from internationally adopted accounting practices rendering the Boards' Annual Accounts incomplete and making inter-Board comparisons difficult. This was remedied only in late 1980s.

The present criterion of surplus is what is laid down in Sec 59 of the E(S) Act, of generating such surplus as may be prescribed by the State Government but not less than 3% on a capital base consisting of net fixed assets at the beginning of the year (less consumer's contribution). The idea is that the Boards should not only meet in full its revenue obligations (operating expenses, depreciation, interest, taxes etc.), but also contribute to expansion programmes. For this purpose, amongst other things, it is essential that firstly, the tariffs prescribed are adequate and are reviewed periodically and revised as necessary, keeping in view the changes in the operational parameters and efficiency and increase in the costs of inputs, etc., in order to achieve these objectives. Secondly, the Boards should ensure that these revenues are collected regularly and the outstanding dues kept to the barest minimum, not exceeding two months' sales. Unless this is done, high tariffs alone do not provide the Board with the necessary funds to meet its commercial obligations.

Another important factor is that improving profitability of the Boards well in excess of the prescribed minimum of 3% under the E(S) Act should not lead to pressures for reduction in the tariff. On the contrary, efforts should continue to be made to improve resource generation so that borrowings for expansion programmes are reduced and resort to loans from financial institutions at very high rates of interest and having heavy redemption liability are avoided. The State Governments should prescribe a suitable rate of return (higher than the minimum 3% statutorily provided), commensurate with the level of surplus that may be generated, keeping in view the requirements of resource generation to finance power projects. It is possible that, in the absence of such provisions, consumers can legally press for refunds, should a Board show a surplus of more than 3%.

The position of cumulative profit/loss of all SEBs is shown below (Table 3.1). Also shown are the amounts of RE subsidies provided in the Accounts as due from the State Government, whether they are paid or not.

TABLE 3.1
CUMULATIVE PROFIT AND LOSS OF SEBs

Period	(Losses)/Surplus [Rs.Crore] inclusive of RE subsidy	Cumulative [Rs.Crore]	RE Subsidy assumed [Rs.Crore]	(Losses)/Surplus for the period if RE subsidy is not reckoned [Rs.Crore]
1985	-257.5	-1330.4	850.6	-2181
1986	-523.7	-1854.1	1009.1	-2863.2
1987	221.2	-1632.9	773.9	-2406.8
1988	-115.7	-1748.6	1272.2	-3020.8
1989	-396.2	-2144.8	1317.4	-3462.2
1990	-974.7	-3119.5	1289.8	-4409.3
1990-91 *	-196.49	-3315.99	2680.54	-5996.53

*** unaudited**

Source: Government of India-CEA.

It will be seen that in the year ending March 1987, the SEBs 'generated' profits while in all other years, the Boards showed losses. This is attributed to change in accounting practices, and more particularly capitalisation of interest on loans for projects in progress (Interest During Construction - IDC).

FINANCIAL PERFORMANCE OF SEBs

The financial performance of the SEBs and their financial viability have been matters of considerable concern all round. In spite of the criteria for profitability as mentioned earlier the SEBs have been running into substantial commercial losses on a continuing basis. The position is summarised below. Table 3.2 which gives the State-wise profit and loss of all the Boards indicates that only AP, KA , MP, MAH and TN have shown overall profits during the period 1975 to1990.

TABLE 3.2
BOARD-WISE PROFIT AND LOSS AFTER (INCLUDING RE. SUBSIDY) (Rs. Crores)

	SEBs	*1975*	*1976*	*1977*	*1978*	*1979*	*1980*	*1981*	*1982*	*1983*	*1984*	*1985*	*1986*	*1987*	*1988*	*1989*	*1990*
1	*AP*	-0.30	2.80	5.10	6.70	4.90	6.00	8.30	13.00	10.30	10.70	49.70	14.40	40.80	37.90	39.80	57.90
2	*BI*	-12.50	1.70	2.30	12.80	10.90	-17.00	-37.60	-8.50	9.10	-12.70	-9.70	-121.10	4.20	-110.50	-48.40	-8.30
3	*GUJ*	-4.80	-6.30	-9.20	-2.20	-3.90	-8.70	3.70	7.80	-12.00	14.90	36.10	-1.70	13.40	34.90	-171.50	-239.90
4	*HAR*	-9.80	-7.90	-11.90	-9.70	-3.70	-11.00	-30.60	-48.30	-55.20	-40.70	-74.00	-61.50	-70.20	-163.60	-25.10	-20.10
5	*HI*	-2.80	-3.10	-4.40	-4.80	2.80	-5.80	-11.80	-10.20	-7.30	-11.10	-22.40	-8.30	-11.30	-16.60	-14.90	-13.40
6	*KA*	0.90	6.20	12.00	1.20	14.60	8.50	15.90	17.90	28.40	13.30	10.80	20.70	-60.00	-86.10	37.10	38.00
7	*KE*	-7.50	-8.60	-1.70	3.60	22.10	11.40	12.50	0.80	-3.80	-11.70	9.70	4.80	7.60	6.80	-37.10	-23.70
8	*MP*	2.30	1.90	3.30	-0.50	0.70	6.50	-22.20	-32.70	2.00	-1.50	-18.20	21.10	126.80	64.40	80.00	82.60
9	*MAH*	13.70	10.90	13.30	29.10	12.00	-27.50	-20.10	-28.70	-20.60	-28.00	-33.10	-36.30	64.50	73.10	54.20	37.60
10	*ORR*	-6.20	-1.00	-4.80	-11.80	-9.80	-12.30	7.70	-4.30	-4.50	-1.70	-12.50	-10.20	2.50	-31.60	-3.00	27.10
11	*PUN*	-18.80	-11.20	-11.10	-3.00	7.00	9.70	6.40	-7.90	-3.30	-16.40	-6.60	-6.40	-19.80	-1.30	-38.90	-538.30
12	*RAJ*	-3.30	-0.40	10.90	21.40	9.50	16.10	-8.20	-37.10	-31.50	-46.30	-73.50	-47.80	-13.70	-77.70	-29.50	-117.30
13	*TN*	8.10	11.00	10.80	6.10	5.30	8.90	4.40	0.90	5.30	-11.80	8.70	27.90	96.80	33.10	136.70	32.60
14	*UP*	-54.20	-45.90	-43.10	-92.00	-91.40	-70.50	-21.00	59.40	-46.60	-32.20	-42.00	-152.30	109.70	129.70	-231.80	-204.40
15	*WB*	-2.70	-1.20	1.50	-4.80	-1.00	-1.80	-12.90	-28.50	-34.50	-68.80	-35.20	-72.00	-18.30	6.60	-25.40	-8.80
16	*ASS*	12.30	-1.40	-1.00	-3.70	-11.50	-11.70	-10.20	-10.40	-23.40	-36.40	-43.40	-92.60	-51.30	-17.20	-119.90	-87.10
17	*MEGH*	-12.20	-1.90	-1.00	-1.20	-1.90	-1.60	-1.90	-1.90	0.00	-0.50	-1.90	-2.40	-0.50	2.40	1.50	10.80
	LOSSES	-135.10	-88.90	-88.20	-133.70	-123.20	-167.90	-176.50	-218.50	-242.70	-319.80	-372.50	-612.60	-245.10	-504.60	-745.50	-1261.30
	SURPLUS	37.30	34.50	59.20	80.90	89.80	67.10	58.90	99.80	55.10	38.90	115.00	88.90	466.30	388.90	349.30	286.60
	NET	**-97.70**	**-54.40**	**-29.00**	**-52.80**	**-33.40**	**-100.80**	**-117.60**	**-118.70**	**-187.60**	**-280.90**	**-257.50**	**-523.70**	**221.20**	**-115.70**	**-396.20**	**-974.70**

Source: Government of India-CEA.

A further classification by dividing the total time period from 1975-90 as 1975-85 and 1986-1990[5] shows that some Boards have improved their performance after the statutory requirement of generating 3% surplus came into effect. However Boards like BI, GUJ and PUN have only worsened their position after 1985. KA stands apart as the only Board which shows profits for the period 1975-1990 but shows overall losses during 1986-1990. The performance of all the Boards is summarised in table 3.3 and figure 3.1 below.

TABLE 3.3

FINANCIAL PERFORMANCE OF THE SEBs'

ALL YEARS DURING THE PERIOD 1975-1985 and 1986-1990

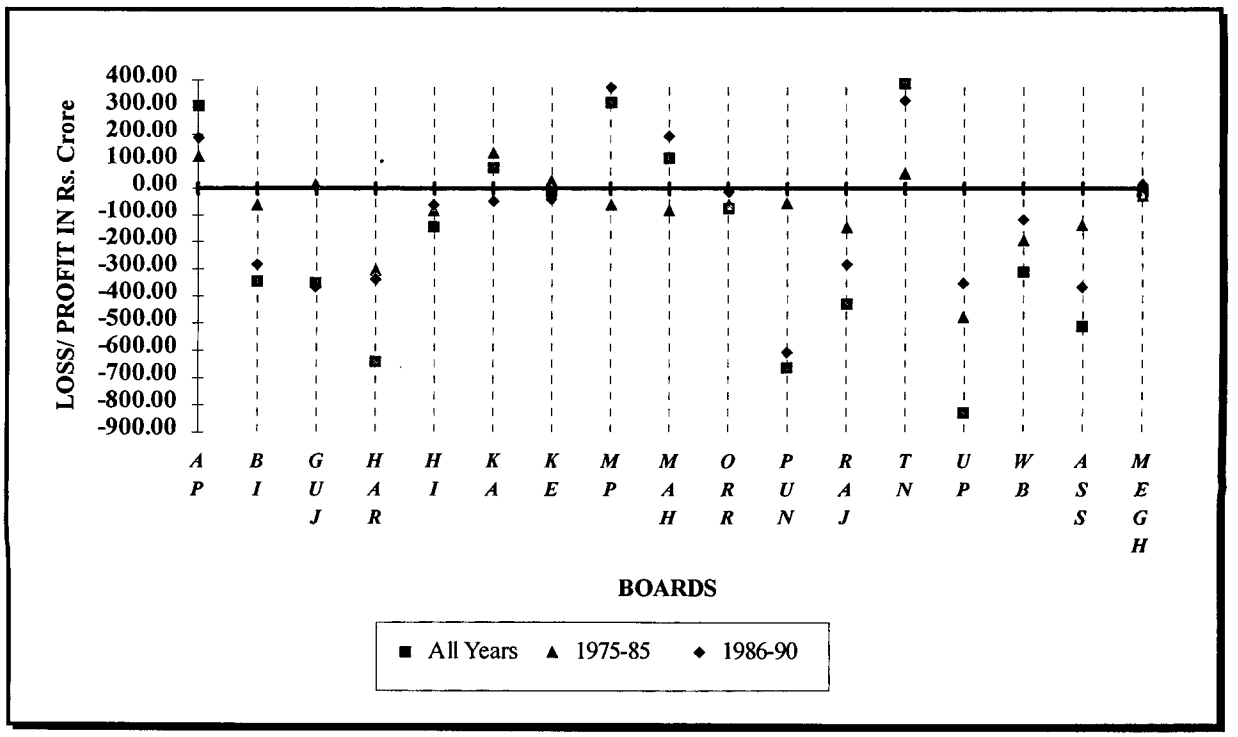
CONSISTENTLY PERFORMING WELL	IMPROVED PERFORMANCE	DETERIORATED PERFORMANCE
AP,KA,MP,MAH,TN.	AP,MP,MAH,ORR,TN,HI*,UP*, WB*MEGH.	BI,GUJ,HAR,KA,KE,PUN ,RAJ,ASS.

Note 1 : Performance here in terms of overall Profit/Loss of the Boards.

Note 2 : (*) indicates that these Boards have reduced their level of overall losses only.

FIGURE 3.1

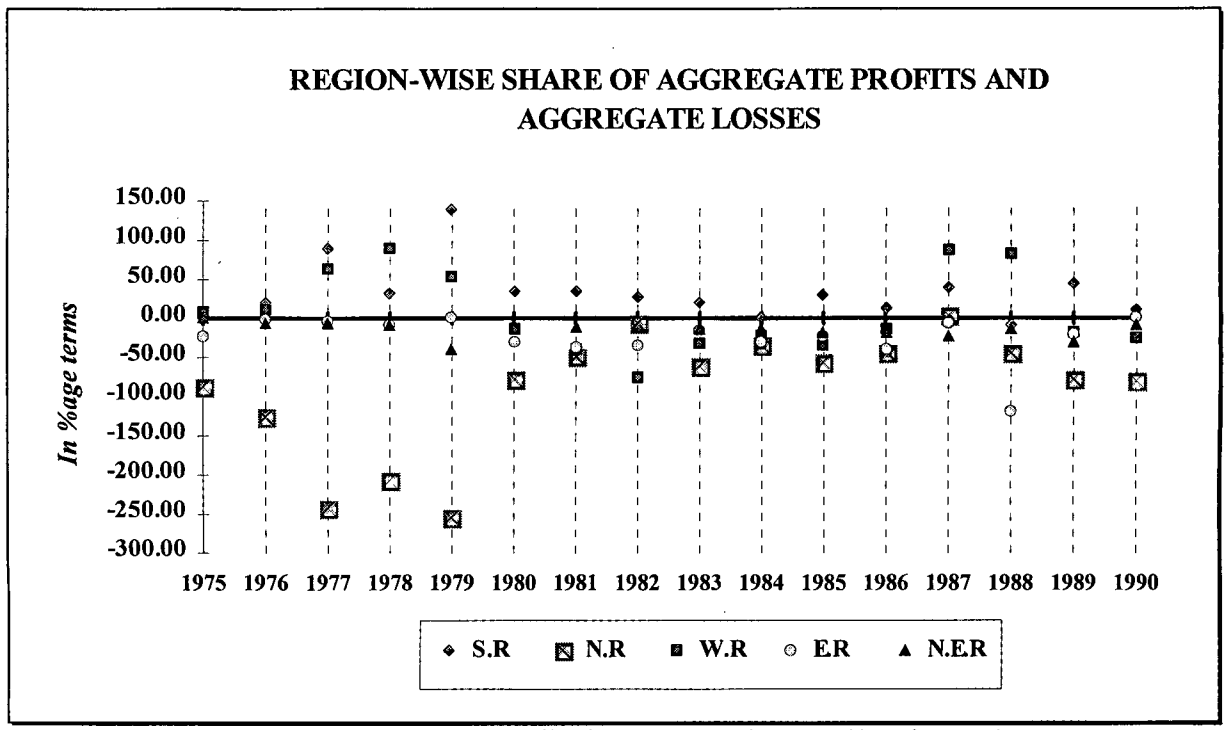
FINANCIAL PERFORMANCE OF THE SEBs' FROM 1975-1990 & DURING 1975-85 TO 1986-1990



[5] The rationale for selecting such a time period is that it was only in 1983 that the E(S) act was amended so that ***the surplus to be generated by the SEBs from 1985-86 should be such as may be prescribed by the State Governments but not lower than 3% of the net fixed assets.***

Boardwise, regionwise yearwise percentage shares of aggregate profits and aggregate losses of all SEBs are shown in Annexure II. Figure 3.2 depicts the regionwise percentage share of aggregate profits and aggregate losses .

FIGURE 3.2



Note: Percentage shares represent the contribution made by the Board/Region to the aggregate profits or aggregate losses for that year.

The table in Annexure II shows that Boards like that of UP, Rajasthan, Bihar, Haryana, West Bengal and Assam contribute most to the Net losses of the Boards . Andhra Pradesh ,Tamil Nadu and Karnataka have contributed to aggregate profits of the Boards (over the last sixteen years) with the exception of 1975 and 1984 for AP and Tamil Nadu respectively and 1987 and 1988 for Karnataka. Maharastra on the other hand initially showed positive contribution upto 1980. Thereafter it contributed to the overall loss figures for seven years after which it showed a turn-around. Region-wise breakup of the share of aggregate profits and aggregate losses shows that it is the Northern region that contributes most to the overall losses of the Board followed by the Eastern region and the Western region. The contribution towards losses of the Northern region had started declining from the 80's but has remained far above the other regions except for a couple of years i.e 1987 & 1988. In 1987 the Northern region shows a positive contribution to the overall figure which is mostly because of UP showing profits. It can be seen from

the table that it is UP that contributes most to the losses of the region. On the other hand the Southern region has consistently shown a positive contribution (except in 1988, when KA contributed substantially to the aggregate losses) .

FACTORS THAT AFFECT FINANCIAL PERFORMANCE OF THE BOARDS

The profitability of the Boards is the culmination of diverse activities of the Boards covering efficient generation, operation, transmission, distribution and management - financial and otherwise, and would also very largely be dependent upon sound accounting and financial policies prescribed for the Boards. An analysis of the causes for the losses for the Boards indicates that there is scope for improvement in the technical performance of the Boards in matters such as levels of generation, efficiency of operation, control of Transmission & Distribution losses, etc. (as was seen in the previous chapter), a substantial portion of the losses can be attributed to factors beyond the control of the board*. While the Boards are expected to function autonomously as per the E(S) Act, the State governments have a considerable and final say in many matters including tariffs. The factors beyond the control of the Boards' **include low and inadequate tariffs for some categories and more particularly for agricultural sector as a State policy and non-payment of RE subsidies by the State governments, to cover losses in supply of power to agricultural sector.** Another aspect is that while on the one hand, the Boards' tariffs are fixed at levels which do not allow the Boards to break-even, at the same time, the Boards generate and pass on substantial revenues to the State Governments through Electricity Duty.

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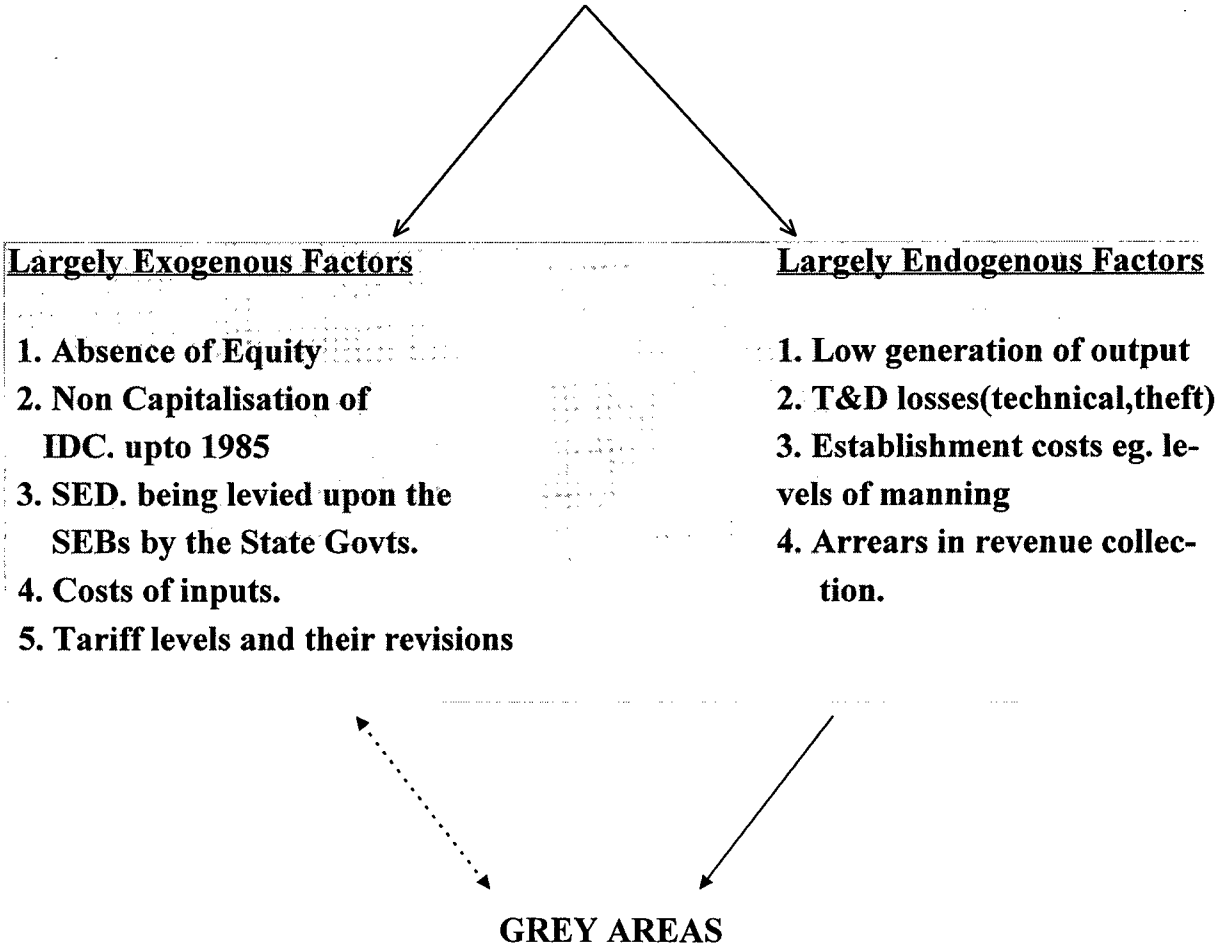
* KP Rao Report on ***Cost of Generation and Supply of Electricity and Losses Sustained by UPSEB at Ideal, Reasonable and Actual Parameters of Operation*** estimated the degree of improvent of the Board's financial performance factors that will arise, separately with reference to factors that lay in the control of the Board and those under the control of Central and State Governments. For instance, in the year 1991 - 92, of the total loss in UPSEB was of the order of Rs.1278 million. Of this, approximately Rs.1096 million are attributed to inadequate tariffs and Rs.182 million are attributed to operational inefficiencies such as lower generation, higher T&D losses etc. This is assuming parameters of operation which correspond to ***national average*** and after reckoning certain recurring inherent plant deficiencies when generating sets were indigenously developed for the first time. If *ideal* parameters of operation are taken into account, approximately Rs.944 million are attributed to inadequate tariffs and Rs.333 million are attributed to inefficiencies such as lower generation, higher T&D losses, fuel inefficiency and higher cost of establishment. The conclusion therefore is that about 15 to 25% of the losses can *at best* be attributed to inefficient operations of the Board and the balance 75 to 85% of the losses arise out of inadequate tariffs and mainly in the agricultural sector. The losses in the agricultural sector alone represent about 70 to 75% of the total loss .

The reasons for high losses in the SEBs may be broadly ascribed to the following:

FINANCIAL PERFORMANCE OF THE SEBs DEPENDS UPON



A part of the endogenous factors are to some extent exogenous to the Boards' operation

1. **Low generation of output can be due non availability of fuel/Water**
2. **Despite theft of power being a cognizable offence, thefts take place with the connivance of politicians. The same argument holds for levels of manning and arrears in revenue collection. Litigations and court disputes are some causes for large arrears in revenue collection.**

The above mentioned factors can be elaborated as :

(a) EXOGENOUS FACTORS (Factors beyond the control of the Board):

i) Heavy interest burden arising from present capital structure[1], there being no equity participation.
ii) Non-capitalisation of interest during construction (IDC) and funding the same out of current revenue till 1985.
iii) While on the one hand the Boards tariffs are fixed below break-even levels and the Boards continue to exhibit losses, substantial sums of revenue are collected by the State Governments as State Electricity Duty (SED).
iv) Tariffs in general and their revisions.
v) Costs of inputs for power generation

Additionally, factors such as, unmetered supply which is extended at flat rates as a political policy, welfare schemes such as *Kutir Jyothi,* emphasis on energisation of agricultural pumpsets and village electrification programmes[2] .

(b) ENDOGENOUS FACTORS (Factors within the control of the Board) :

i) Low generation of output
ii) High T&D losses (technical losses)
iii) High establishment costs (resulting from excessive levels of manning), and
iv) Large arrears in revenue collection

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[1] The liabilities side of a balance sheet generally represent the financial structure of an enterprise and includes all sources of financing for assets acquired and for working capital. Sources of financing might / can be separated into long term financing including equity capital and long term debt (the capital structure) and short term financing, which usually consists of short term loans or notes and accounts payable to the creditors. Historically, the Boards did not have any equity capital and all funds were provided through interest-bearing loans. In contrast, PSUs like NTPC/NHPC in the power sector enjoy equity funds with a debt:equity of 1:1, thereby having lower capital cost under this type of capital funding (as the interest burden is lower), thus, showing better profits and internal resource generation. Most of the Boards' to date do not have equity funds and are at a disadvantage.

[2] A very important aspect that has the most *crippling* effect on the financial viability of the Board is the policy followed and the thrust given to energisation of agricultural pumpsets and the fall out thereof on the financial health of the State Electricity Boards. Please chapter IV on Supply of power to the Agricultural Sector.

(c) Grey Areas

The inability to curb theft in the case of T&D losses, linkages of coal involving long haulage and quality of coal, equipment design, availablity of water etc. which have a bearing on the generation of output, the extent of manning, and, even payments due to the Boards but held up due to litigations etc., are, to an extent beyond the the Boards' control, thus could be termed as grey areas.

The above categorisation shows that the number of factors that affect the Boards' operations and finances are much more than what falls within the Boards' control. The chapter on technical performance (page 49) had demonstrated that ***mere increases in the level of output generation does not lead to better performance of the Boards***. That particular example on UP had demonstrated that despite increases in PLF, increase in T&D losses simultaneously, implied that the Board was an overall loser. Also, technical performance factors such as low generation of output contribute very less to the Boards' overall losses (as was mentioned in page number 84).This suggests that the causes underlying the Boards' bad financial performance is more due to the exogenous factors than endogenous factors. It is for these reasons and the far greater affect of the exogenous factors on the profitability of SEBs that such as low generation of output, T&D losses have not been attempted in this part of the study.

The following study would only concentrate on some of the most important factors that were highlighted earlier. These include,

- ⇨ Absence of equity
- ⇨ Non-Capitalisation of IDC
- ⇨ Payment of SED to the State governments
- ⇨ Manning
- ⇨ Revenue outstandings
- ⇨ Costs of Inputs with respect to coal, railway freight for coal transportation and pricing of gas, and finally,
- ⇨ Tariffs prescribed and their impact on the Boards (especially with respect to the agricultural sector). Tariffs for the agricultural sector is dealt with in both in chapter III and IV.

CAPITAL STRUCTURE AND THE NEED FOR EQUITY PARTICIPATION

RISKS

The capital structure should be so designed to minimise the overall risk faced by the enterprise. The risks can be divided into Business and Financial risks. Even though the SEBs do not face any business risk i.e., risk arising out of trading in a free market economy with fluctuating demands for its output, but it does have an uncertainty attached around its quantity of cash flow. It is in this regard that there arises a need for a conservative financial structure based on low fixed financial obligations i.e., minimum debt, with adequate equity (risk capital) to sustain operations.

To ensure the long-term financial viability of a borrower, its capital should be such that it reduces the risks and helps sustain operational performance. For this, three forms capital structure covenants are in common use:

a) Debt service coverage ratio
b) Debt equity ratio
c) Dividend limitation

The debt service coverage ratio and debt:equity ratio covenants limit the volume of debt incurred and thus, effectively shape the capital structure whereas the dividend limitation covenant limits the distribution of surpluses with the objective of strengthening the capital structure by increasing the equity (retained reserves) and diminishing the need for external finance for expansion.

The Debt Equity ratio is a key indicator of the soundness of the capital structure of a borrower viz., that the structure enables debt redemption capacity; and hence his credit worthiness.

Presently, all capital expenditure of the SEBs is financed through interest bearing repayable loans. Even when the Boards were initially formed, the value of the assets of the State Electricity Boards which were transferred to the SEBs was treated as a loan in perpetuity and bearing interest. Although the E(S) Act provided for equity participation and conversion of loans into equity, most of the State Governments have yet to resort to equity participation.

Power sector is capital intensive. It is common that a debt equity ratio of 1:1 is adopted for such capital intensive industries. This is the practice obtaining, in

general, in public undertakings that are capital intensive. The same is also adopted for organisations like NTPC, NHPC etc., which are operating in the power sector. In fact, in some of these organisations like NTPC, full recourse to equity component of a project is resorted to before loans are obtained. This is with a view to reduce the interest burden and capital costs. Organisations like NTPC etc., are expected to generate a return of 10% - 12% on the equity component of the project costs and in fact, do generate higher profits. Non-availability of equity to the SEBs throws a relatively heavier interest burden on the Boards chargeable to profits and correspondingly deflates their profits / profitability. The Boards are thus placed in a position of disadvantage vis-a-vis other PSUs like NTPC/NHPC etc. in power sector. If there is equity participation, the Boards performance at the existing levels would show significant commercial profits instead of losses as at present. This single factor alone (i.e., absence of equity participation) has a significant impact on the commercial profitability of the Boards, and places them in a position of dis-advantage when comparisons are made of relative profitabilities of Boards and organisations such as NTPC/NHPC etc.

There are several advantages that accrue to the Boards through introduction of equity participation. There would be increased profitability for the Boards, making the presentation of performance relatively better. There would be increased internal resource generation, better liquidity (there being reduced outflow by way of interest), etc.(See section on resource generation). The need for external borrowings for capital programmes would also reduce, thereby decreasing future interest burden and problems of debt redemption. Also, with a good equity base better profitability and reduced debt redemption obligation, the Boards would be able to attract funds from external agencies like World Bank, Asian Development Bank etc., and also suppliers' credits. The Boards would also be able to attract public investments through debentures, bonds etc., by presenting a better track record of performance. This is a very important factor in the present context of shortage of resources for funding expansion programmes of the power sector. Equity participation would also place the Boards on a comparable footing in the matter of capital structure with other organisations in the power sector with whose profitability the financial performance of the SEBs is often compared.

At the same time, the State Governments have a strong apprehension that introduction of equity participation would imply exhibition of increased commercial profits which would attract corporate income tax. Since Corporate income tax accrues to Central Government, (though it is later on shareable with

the States on the basis of principles for determining devolution of the resources.), the State Governments would not like to be placed in a position where resources flow from State / State Electricity Board to Central Government. In the case of loans. interest accrues to State. which the State Governments obviously prefer despite the impact on the presentation of Boards' depressed profitability.

Court decisions also insist that State Electricity Boards, like State Road Transport Corporation, should be exempt from the purview of Income Tax** but Central Government does not agree. This is one area where there is a conflict of interests between that of the Board, the State Government and the Central Government. While immediately the Boards may not be attracting income tax (and hence Central Government does not lose any revenue), the very fact that the Board's profits would be liable for income tax would inhibit equity participation by State Governments. As stated earlier, ***the State Governments do not seem to mind the Boards exhibiting losses in their Accounts but certainly would not like the Boards to lose some of their revenues by way of paying income tax to the Central Exchequer***. It would be necessary for the Boards to be exempted from income tax if equity participation is to be motivated and Boards' handicap in this respect is removed.

STATE ELECTRICITY DUTY (SED)

Under the Constitution, the State Governments are competent to levy duty on electricity generated, consumed or sold.. **This is a revenue of the State Government and is collected by the State Electricity Board along with tariff and passed on to the Government.**

TABLE 3.4
REALISATION OF STATE ELECTRICITY DUTY AND THE COMMERCIAL LOSSES OF THE BOARDS (ALL-INDIA)

YEAR	AMOUNT OF SED (Rs. Crores)	COMMERCIAL SURPLUS/LOSSES OF THE BOARDS *WITHOUT SED.*	COMMERCIAL SURPLUS/LOSSES OF THE BOARDS *WITH SED. INCLUDED*
1985	309.10	-257.50	**51.6**
1986	445.80	-523.70	**-77.9**
1987	545.10	221.20*	**766.3**
1988	617.50	-115.70*	**501.8**
1989	735.70	-396.20*	**339.5**
1990	882.00	-974.70*	**-92.7**

**After Capitalising IDC*

Source : Govt of India - CEA

** This aspect was brought out in the ***"Report of the working group for suggesting steps for strengthening the finances of State Electricity Boards"*** ; Government of India.

The amounts collected by way of electricity duty have been progressively increasing, both because of increase in rates of duty as well as increase in the generation of electricity / sales. Table 3.4 compares the realisation of State Electricity Duty on all-India basis and the commercial losses of the Boards. The table 3.4 shows that if SED was retained by the Boards, they would have shown overall profits or very minimal losses as compared to the present position. It is a highly untenable situation that the Board is not allowed a tariff which is adequate to break-even and meet its commercial obligations and, at the same time, the State Governments raise and receive substantial revenues through levies on electricity generation / sales. It may be a different matter that the proceeds are partly or fully ploughed back to power sector by the State Government to finance capital programmes. The fact, however, remains that there is a large revenue deficit which causes considerable problems in meeting the commercial obligations. There is therefore, a need for each Board and the State Govt concerned to review the position with a view to merge an appropriate portion of duties with tariffs so that Board's overall tariffs are adequate for the Board to break-even and generate the prescribed surplus. It is only thereafter that duties should accrue to the State Government. This dispensation implies reduction of the rates of duty and simultaneous raising of tariffs. **Alternately, the State Governments should pass on as grants (and not as loans), an appropriate portion of the revenues from SED as Boards' revenue income, through budgetary provisions.**

INTEREST DURING CONSTRUCTION (IDC)

It is a common practice in commercial system of accounts that interest on funds borrowed and utilised during the construction stage of projects is capitalised and treated as a part of project cost*** . On the other hand, for some reason, the practice in the SEBs for a very long time has been to treat IDC as a current revenue expense and charged to Profit and Loss Account. The inappropriateness of this arrangement was accepted by the Government in early 1980s only under pressure of World Bank and the position was set right while introducing Uniform Commercial Accounting in the SEBs in 1985, when it was decided that IDC should be capitalised and treated as a part of capital project cost. This also implies that IDC should be funded as project cost, as in all other sectors including

The E(S) Act treated ***all interest chargeable to the revenue account. But common accounting principles state that *"....interest on capital paid during construction of works or buildings or plant may be capitalised and thus be added to the cost of asset concerned."* The Planning commission always objected to capitalising IDC as it meant an additional burden to them, but, after persistent insistence from the CEA/Boards they acceded to provide for these funds (arising out of capitalising IDC) from the VIIIth Plan onwards.

organisations like NTPC etc. This gave relief to the Boards in the interest liability on projects in progress, as such interest would specifically be funded as project costs.

The profitability of the Boards improved once IDC was capitalised (even though for a short period) but, had this and the above mentioned criteria of merger of SED with SEBs' income and introduction of equity been done long back the picture would have different.

RESOURCE GENERATION/AVAILABILITY FOR THE BOARDS.

An interesting analysis of the performance of the Boards emerges if one were to hypothetically assume that the Boards had a debt equity ratio of 1:1, had capitalised Interest During Construction and also that State Electricity Duty recovered remains with the Board. Thus, owing to the peculiar capital structure and the proceeds of State Electricity duties accruing to of the State Governments, which are not necessarily ploughed back into the Boards, the internal generation of resources by the Boards remains quite low. As outlined in the thesis, if the Boards are given a debt-equity ratio of 1:1 and the State Electricity duty generated by the Boards is taken as Boards' resource generation, ***the Boards would be generating over 50% of the annual capital outlays***. If interest payable to the State Governments is also reckoned and ploughed back, the resources would be of the order of 60%. This is of course, without reckoning debt-redemption obligations.

On the other hand, the ground position is that the Boards do not get back the *resources generated* for ploughing into their capital needs; subsidies due are not paid; and capital funds are diverted to meet revenue gaps leading to a serious debt trap. Power sector being a vital area for National development, it is necessary that resources generated by the Boards, both internal and for the State Govt, are invariably ploughed back to meet the capital requirements of the Boards. This includes interest as well as duties generated by the Board. The IXth Finance Commission had recommended merger of SED with the Boards' resources. In addition, it is imperative to ensure that the Boards' overall tariffs are, at all times, commensurate with the costs.

If the above measures are implemented, the **Boards would make profits and would be financially viable organisations**, contributing significantly to the healthy growth of the power sector.

The table below shows the increased profitability for APSEB with the introduction of 1:1 debt equity and if SED is retained by the board. (See Annexure III for the financial statement of APSEB.)

TABLE 3.5
INCREASED PROFITABILITY AFTER INTRODUCTION OF 1:1 DEBT EQUITY
(For APSEB)

(figures in Rs. Million)

A. ***As at present***

		1993-94	*1992-93*	*1991-92*	*1990-91*
1	Capital base as per E(S) Act	27257.02	24369.12	22605.85	17200.13
2	Total Capital expenditure during the year	10136.85	9655.10	7825.05	4790.39
3	Total interest burden	4116.76	3970.93	3025.56	2699.66
4	...less interest capitalised	1096.60	837.30	510.60	582.60
5	Interest to Revenue account (3-4)	3020.16	3133.63	2514.96	2117.06
6	SURPLUS/(DEFICIT) as per accounts	869.90	794.48	844.41	809.90
7	Depreciation.	1729.74	1475.24	1152.50	944.45
8	Internal resource generation {6+7}	2599.65	2269.72	1996.91	1754.36

B. ***If 1:1debt equity ratio is introduced....***

9	Interest burden if 1:1 debt equity is introduced	**2058.38**	**1985.47**	**1512.78**	**1349.83**
10	...less interest capitalised after considering 1:1 debt equity participation	548.30	418.65	255.30	291.30
11	Interest to Revenue account (9-10)	1510.08	1566.82	1257.48	1058.53
12	SURPLUS/(DEFICIT) if (9) is reckoned **[6+(5-11)]**	2379.98	2361.30	2102.22	1869.46
13	Resource generation{12+7}	4109.73	3836.54	3254.72	2813.91

table continues....

C. **Also,** ***If SED is also taken as boards revenue along with debt equity....***

14	SED	514.99	421.30	400.15	364.43
15	SURPLUS/(DEFICIT) if (14) is also reckoned **[12+14]**	2894.98	2782.60	2502.37	2233.89
16	Resource generation{15+7}	4624.72	4257.83	3654.87	3178.34

PERFORMANCE INDICATORS

	1993-94	*1992-93*	*1991-92*	*1990-91*
Return as %age of Capital base as per E(S) act.				
Under A	3.19	3.26	3.74	4.71
Under B	8.73	9.69	9.30	10.87
Under C	10.62	11.42	11.07	12.99
Internal resource generation as a %age of capital expenditure				
Under A	25.65	23.51	25.52	36.62
Under B	40.54	39.74	41.59	58.74
Under C	45.62	44.10	46.71	66.35

Source : Annual Accounts of APSEB

The above table shows two very important factors

1. Introduction of equity increases the profits of the Boards, and along with SED being retained with the Boards the returns on the Capital base increases to almost 13% (prior to which it was only 4.71%).

2. **The fact that the a Board generates 3% return as permitted by the E(S) act by itself does not mean that capital expenditure can be substantially met from internal resources. The above shows that only about 25-30% can be met, leaving the Boards to borrow the balance requirements.** This inturn throws additional interest burden and loan redemption liability which can be avoided to some extent by the introduction of equity participation and SED being retained by the SEBs.

REVENUE OUTSTANDINGS

No amount of increase in tariffs on achieving commercial profits or a good rate of return would improve the liquidity of the State Electricity Boards if the collection of revenue remains in arrears. Prompt collection of revenues is a matter of *vital importance* for the financial well being of the State Electricity Boards, as otherwise they cannot discharge their commercial obligations to agencies like NTPC, NHPC, CIL, Railways etc. Usually, in Power Sector, the revenue outstanding should not exceed two months' revenue or 16.6% of the sale. The table below compares the revenue outstanding of different Boards as a percentage of Sales revenue.

TABLE 3.6
REVENUE OUTSTANDINGS AS A PERCENTAGE OF VALUE OF SALES FOR THE YEAR

	S E Bs	1983	1984	1985	1986	1987
1	AP	17.43	20.42	19.70	21.29	23.37
2	BI	51.67	69.45	70.64	70.37	43.80
3	GUJ	12.44	12.09	13.49	18.51	20.06
4	HA	22.06	25.85	25.28	51.88	49.28
5	HIM	63.64	48.33	28.57	28.61	64.81
6	KA	24.49	31.49	33.21	46.46	52.57
7	KE	33.06	31.33	30.97	24.91	23.88
8	MP	24.85	25.00	25.11	27.98	-
9	MAH	17.80	19.24	20.73	21.79	23.14
10	ORR	37.20	39.18	36.73	35.18	35.55
11	PUN	14.24	13.86	13.62	16.15	18.77
12	RAJ	25.58	23.39	29.30	26.07	21.58
13	TN	19.48	13.72	9.86	14.04	12.82
14	UP	23.58	27.35	33.52	35.95	31.01
15	WB	14.96	21.28	20.87	24.20	25.48
16	ASS	204.73	18.84	24.63	-	-
17	MEG	87.23	78.81	93.24	-	-
	TOTAL	24.46	23.50	24.54	27.63	24.71

Source : Govt of India - CEA

It will be seen therefrom that while a few Boards have maintained their revenue outstanding at fairly reasonable levels, in some of the Boards the outstandings are well

in excess of 40% and go upto 70% or more of the annual sales. Also, the outstandings are progressively increasing in several Boards.This causes undue strain on the ways and means position of the Boards.

The Boards do take action from time to time to reduce the revenue outstanding. From some of the details available for the study in a large number of cases, the outstandings pertain to other Government Departments, both Central and State, public sector organisations etc. Some of the dues are also the result of litigations in courts against tariff revisions or disputes in billing. Also, despite the low agricultural tariffs, outstandings in this Sector seem to be high. Some details are given below in table 3.7

TABLE 3.7

REVENUE OUTSTANDINGS FROM VARIOUS CATEGORIES *(Rs. in crores)*

	Sales	Net Rev'n. out-standing	%age of outstndg to sales	STATE Govt. Depts..	CENTRAL Govt. Depts..	Under litigations	Agriculture	Others
UPSEB	938 (848)	380 (276)	40.5 (32.5)	94 (67)	- (-)	25 (13)	84 (60)	177 (136)
BIHAR	349 (300)	230 (161)	65.8 (53.6)	56 (17)	15 (9)	45 (36)	56 (43)	58 (56)
ORISSA	245 (213)	79 (74)	32.1 (34.9)	14 (13)	3 (-)	35 (38)	- (-)	27 (23)
KARN-ATAKA	557 (449)	277 (208)	49.8 (46.4)	143 (120)	2 (-)	NA (NA)	2 (NA)	130 (88)

Source : Govt of India - CEA

Dues as on 31/3/1989. *Figures in brackets represent previous year position.*

This is a very important area that needs to be constantly monitored so as to bring the outstandings to a reasonable limit not exceeding two months' revenue. At the same time, some special measures are also needed to improve matters. These include ways and means of quick settlement of legal disputes through a separate Tribunal and a mechanism by which the litigant consumer is obliged to pay his dues "under protest" and subject to refund. It will also be necessary to undertake from time to time systematic study, including age analysis and determine the reasons for the increase in outstandings and the remedial measures that need to be introduced*.

* This study has not been undertaken in this Thesis as this would require Boardwise details.

The inability of the Boards to meet their obligations to their suppliers is one of the major planks of criticism by the Independent Power Producers (IPPs) who seek a sovereign guarantee from State and Central Governments for realisation of their dues. This, in turn, has several far reaching implications including an unreasonably heavy commitment on the part of Central Government leading to a serious adverse impact on the Government's own credit worthiness in national and international circles. Situations have also arisen when the Central Government had adjusted dues to agencies like NTPC etc. against plan allocations of the States. While these measures may have temporarily brought down the SEB dues to agencies like NTPC, this has set off ripples in political circles and has in any case not contributed to eliminating the underlying causes.

The following is a summary of some opinions collected to reduce the extent of revenue outstandings:

a) A good portion of the outstanding arises due to disputes and prolonged litigation and stay orders of courts. It is desirable to have a procedure whereby disputes in tariffs or billing do not result in accumulation of revenue outstanding for long time. The normal arrangement should be that bill should be paid first (or at least deposited in the Court adjudicating the case) and disputes settled separately. Depositing the disputed dues with Court will eliminate 'frivolous' complaints. Also, cases of tariff revision should be kept outside the purview of local courts.

b) In order to ensure that disputes are settled promptly and not subjected to prolonged litigations through various courts, it may be appropriate to set up a tribunal on the pattern of Income Tax / Excise / Gold (Control) Tribunals etc., so that disputes could be promptly heard and directions binding on both parties given. Any issues of law could be subject to the overall jurisdiction of the Supreme Court which is the highest legal authority in the country. This may reduce large outstandings which arise out of litigation brought up by consumers with a view to delay payment of the Board's dues.

In some cases of industrial reconstruction of sick industries, the Board for Industrial and Financial Reconstruction (BIFR) directs SEBs amongst others, to forego dues with a view to bale out the sick industry. In a situation where the Board is itself sick, foregoing revenue dues would be disastrous. Many experts are of the opinion that

this should not be done, and, where inescapable the Boards should be compensated by State/Central Government.

ADMINISTRATION AND O&M EXPENSES

There is no precise norm to determine administrative expenses or O&M expenses which may be considered reasonable. Administrative expenses, which basically consists of manpower costs, the universal belief being that the Boards are in general over-staffed*. Ratios such as number of employees per MU sold or number of employees for 1000 consumers are calculated but these are not conclusive enough indicators. For eg., in the case of UP 27 employees per 1000 consumers were in employment against an average of 17.1 for all Boards. However, out of 101034 employees on rolls of the Board, a good proportion of them are engaged on capital works in progress, and expenses on them are capitalised. If we take the ratio of employees per MU sold, the figures show that for 1988-89 it was 6.3, which is 10% higher than the All India average. Even here, the computations do not exclude employers engaged on projects.

Employment depends on the number of projects, number of generating stations, the hydro-thermal contents, the length of the transmission lines and also the density of population and the area involved number of consumers etc.

In UP a review undertaken in May 1991 by the Board brought out a surplus of 18417 employees against a sanctioned strength of 1,11,243 and actual employment of 101034 on 1/4/90. The additional burden to the Board on this amount was to the tune of Rs 62 crore per annum. Since this was an internal study, actual surplus could be much more. The Boards find it difficult to reduce manning levels because of its political implications. For instance, in UP where power houses had closed down over a decade back, the Board continued to employ staff for 'watch & ward' purposes, or for the reason that they cannot be administratively transferred or discharged. The number of such employees is understood to be over 1100. On the basis of a salary of Rs 30,000/annum, the annual figure would work out to be Rs 3.3 crore/annum on this account only[1].

* This can be concluded from the responses that were received for the Questionnaires.

[1] Desai (1982) had brought forward the argument of excessive manning in the public sector attributable to the burgeoning class of 'petty proles' or the petty bourgeoisie. This argument is also put forward by Ahluwalia with reference to infrastructure and power. The above example fits into the argument put forward by Desai.

The heavy over-staffing of Boards is a major deterrent to achieving reasonable levels of efficiency. As often happens, too little work often produces more operational problems than too much. The number of persons employed per MW of power varies with various stations/units. There were norms that were specified by the Power Economy Committee (PEC) (1971) wherein it was suggested that recruitment should stop until the surplus is absorbed (via growth). The PEC also recommended a system of incentives especially to the O&M staff to achieve higher plant availability, based on past/international norms - whichever is higher. This suggestion, while it had led to some units such as the VTPS to achieve high levels of PLF availability, in the case of Uttar Pradesh, in spite of 'increase' in the PLF this achievement was nullified by increases in T&D losses. Thus, what should be done is that the Boards should earn awards for overall achievement rather than for a single factor. The Rajadhyaksha Committee Report called for a more participative approach to problem solving, setting up objective mechanisms for awarding rewards and penalties and creating *'esprit de corps'*.

COST OF INPUTS FOR POWER GENERATION

COAL

Power sector consumes annually about **120 million tonnes of coal.** By the end of the 8th Plan, the coal consumption by power sector is expected to be 194 million tonnes. **A significant portion of the coal use in the Power Sector is from low grades E, F and G forming 70% of the total consumption in the Power Sector.** By and large, except for Power Sector there are no other users for lower grades of coal. Besides, indigenous coal contains very high ash content in excess of 30%. The use of low grade coal in Power Sector implies substantial additional costs to the Power Sector in the coal handling plant, conveyers, MGR[+] systems, coal mills, ash handling facilities, electrostatic precipitators and ash dykes etc. It was, therefore, necessary that in pricing coal, due cognisance is taken of these aspects and a suitable concession given in the pricing of lower grade coal with high ash content so that the cost per Million kilo calories (M.Kcal) of useful heat value from the lower grades of coal is less than the corresponding figure for the superior grades. [*]

While this principle was accepted and the price structure for the different grades of coal prescribed in 1985 provided for a taper in the price per million calories in the lower grades of coal, during the subsequent revisions of coal prices in Dec 1987 and 1989, these have been virtually nullified. In fact, in some of the lower grades, **the price per M.Kcal is higher than that for higher grades of coal .** While it is readily accepted that the coal sector should not run into losses by under-pricing coal, at the same time it is necessary that the inter se prices of different grades of coal take into account the financial burdens thrown upon the power sector in using lower grades of coal and provide for a price concession to compensate for this and at the same time, the desired overall rate per ton could be achieved. See Table 3.8 below.

[+] Merry-go-round

[*] This is also necessary and justified if we take into account the fact that the lower grade of coal and transportation of larger quantities over long distances entailing extra costs.

TABLE 3.8

CHANGES IN COAL PRICES OF VARIOUS CATEGORIES

[1] Grade	[2] Range of Useful heat (Kcal/kg.)	[3] Usage in power sector (%age to total cons.)	[4] Price per tonne (in Rs.)...before 1/84.	[5] Price per tonne (in Rs.)...from 1/84.	[6] %age inc. over col [4]	[7] Price from 1/86.	[8] %age inc. over col [5]
A	Above 6200		200.00	264.00	32.00	299.00	13.26
B	5600-6200 (Mean 5900)		179.00	237.00	32.40	272.00	14.77
C	4940-5600 (Mean 5270)		160.00	203.00	26.88	238.00	17.24
D	4200-4940 (Mean 4570)	12%	139.00	177.00	27.34	212.00	19.77
E	3360-4200 (Mean 3780)		115.00	125.00	8.70	141.50	13.20
F	2400-3360 (Mean 2880)	80%	87.00	95.00	9.20	111.50	17.37
G	1300-2400 (Mean 1850)		56.00	61.00	8.93	77.50	27.05

[9] Price from 12/87.	[10] %age inc. over col [7]	[11] %age inc. from 1/84. to 18/87.	[12] Price from 1/89.	[13] %age inc. over col [9]	[14] %age inc. over col [5]
354.00	18.39	34.09	399.00	12.71	51.14
323.00	18.75	36.29	364.00	12.69	53.59
283.00	18.91	39.41	318.00	12.37	56.65
225.00	6.13	27.12	252.00	12.00	42.37
179.00	26.50	43.20	200.00	11.73	60.00
144.00	29.15	51.58	160.00	11.11	68.42
103.00	32.90	68.85	114.00	10.68	86.89

Price per M K Cal. (In Rs.)

[15] Before 1/84.	[16] From 1/84.	[17] From 1/86.	[18] From 12/87.	[19] On 1/89.
32.31	42.58	48.23	57.10	64.35
30.34	40.17	46.10	54.75	61.69
32.94	38.52	45.16	53.70	60.34
30.42	38.73	47.48	49.35	55.14
30.42	33.07	37.43	47.35	52.91
30.21	32.99	40.10	50.00	55.65
30.27	32.97	41.89	55.68	61.92

Source : Govt of India - CEA

RAILWAY FREIGHT FOR TRANSPORTATION OF COAL

For several years, until 1981-82, the average freight for coal transportation for use in power sector was lower than the average cost of transportation of goods in the Railways. However, over a period of time, the preferential tariff prescribed for transportation of coal had progressively been withdrawn and presently the average freight prescribed for coal used in the power sector is significantly higher than the average cost of transportation for other goods. Thus, from an earlier situation wherein transportation of coal for power generation was subsidised by other categories, the present position is that coal transportation for power subsidises the transportation of other goods. This can be seen from the details given in table 3.9 below (Data available upto 1987):

TABLE 3.9

RAILWAY FREIGHT FOR TRANSPORTATION OF COAL AND OTHER GOODS

Year	Avg. cost of transportation per tonne/km [All goods,all gauges]	Avg. freight realised from coal [per tonne/km]	Subsidy to coal transportation by other freight	Subsidy of coal transportation to other freight
	(Paise per tonne / Km.)			
1970-71	5.70	3.42	40%	
1971-72	5.74	3.63	37%	
1972-73	5.92	3.79	36%	
1973-74	6.99	3.80	46%	
1974-75	7.95	5.51	31%	
1975-76	8.39	6.16	27%	
1976-77	8.34	6.76	19%	
1977-78	8.16	6.77	17%	
1978-79	8.60	6.84	21%	
1979-80	9.64	7.45	23%	
1980-81	10.90	8.25	24%	
1981-82	12.39	11.50	7.80%	
1982-83	13.95	15.10		8.20%
1983-84	16.62	17.20		3.50%
1984-85	17.56	19.10		8.80%
1985-86	17.63	21.20		20.20%
1986-87	18.61	23.50		24.10%
1987-88	20.29	26.10		28.60%

Source : Govt of India - CEA and Railway Board

While the cost of transportation has increased by 7.8-12% per annum over last 20 years, the coal freight has been increasing at 17.7% per annum. This is a highly untenable position, particularly in the context that the Boards themselves are incurring substantial losses.

GAS

In the recent years, use of gas for power generation has been progressively advocated. Gas based power stations can be set up in relatively shorter time frames; they can be operated either to meet peaking requirements or as base load stations; environmental problems are minimised; and so on. Gas is an excellent fuel for power generation and studies carried out have established that between using gas for generation of power and gas for other uses including for the production of fertilisers, the option for generation of power is a better alternative[$]. However, the policy adopted by the Central Government in pricing gas has not been favourable to motivate power sector to resort to more extensive use of gas for power generation. This can be seen from the following:

With a price of Rs 2464/1000M^3 (1988-90) along the HBJ pipe line and a specific consumption of 0.22M^3/Kwh in the combined cycle, and 0.32M^3/Kwh in the open cycle/Kwh, the fuel costs work out to respectively 55 p/Kwh and 79 p/Kwh in the two modes of generation. Also included in these fuel costs are 28.8 paise and 20 paise per Kwh of towards transportation of gas. These fuel costs are substantially higher than fuel cost for pithead based thermal power stations[1]. Additionally, these costs are far too high compared to

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[*] It was recommended that coal for power generation be given preferential treatment and that this be coal transported at a tariff which is lower than the average cost of transportation of goods as was the position upto 1981-82. In any case, the freight for coal should not exceed the average cost of transportation and the power sector should not be made to subsidise transportation of other goods. In this context, it may be noted that when the Railway Ministry made a plea that the tariffs for supply of power for railway traction should be cost-related, the Dept. of Power rejected the demand of the Railways on the plea that the tariff formulation for different categories including extent of cross-subsidisation between various categories are a matter for the Boards to decide. In this context, it would not be fair to demand that the Railway freight for coal should be cost related.

[$] Study commissioned by the Ministry of Finance in 1987/88, to study the optimal use of gas.

transmission costs had power been generated at source of gas availability (like pit head located STPS) and transmitted power through transmission lines. The SEBs are thus called upon to pay for a very uneconomical way of generating power by transporting gas to the load centres rather than generating power at the source of availability of gas and transmitting the power which is more economical. Again since the fuel costs for gas based stations are higher than corresponding costs of coal, the gas stations should, normally speaking, be the first to back down in merit order operation. This is, however, not easy since GAIL commit the power plants for uniform drawal of gas. This implies base load operation, which in turn means expensive power generation for the grid as coal based generation (and some time even hydro generation) has to back down. Thus the pricing of gas does not make it attractive for the power sector to maximise power generation from gas based stations as the price prescribed for off-shore gas along HBJ pipeline is much higher than the coal equivalence[*].

An unduly high price of gas for power generation, while it may generate substantial profits to the GAIL/ONGC, places the Boards in a very difficult position. If the pricing policy followed was ***based on the heat value through coal equivalence then, the use of gas for power generation would be far more economical and attractive for the Boards.***

POWER TARIFFS

Power tariffs may broadly be divided into two categories.

a) Tariffs for bulk supply of power to the grid from various generating stations external to the system. In other words, the rates at which power is purchased by the system should be priced.

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[1] Compared to a variable cost of about 30 ps per KWH for generation through coal at pit-head location. absorption of power from gas based generation by ignoring cheaper source of power would place heavy and avoidable financial burden on the SEBs.

[*] The need for a review of the gas prices was emphasised in the *Power Ministers' Conference* in January 1989. The existing price of gas was to be reviewed for refixation at levels which are fair to both parties.

b) Retail tariffs i.e. tariffs to individual categories of consumers like domestic, commercial, industrial, agricultural pump sets, railway traction, municipalities etc.

Proper and fair tariffs are essential from several points of view. Over pricing of tariffs for supply of power to the Boards can provide better profitability to power supply companies but places the Boards in a difficult situation. Similarly inadequate tariffs for retail supplies by the Board also leads to Boards' financial losses and liquidity crunch. The present study addresses some of these aspects.

OBJECTIVES OF POWER TARIFFS

The main guiding principles in formulation of a good tariff policy may be summarised as under:

a) The tariffs, taken as a whole should produce revenues adequate to cover the operating expenses, the profits designated either as a corporate policy or applicable legislation etc.

b) The tariffs should also generate resources to meet a portion of the cost for future expansion plans, to an extent as legislated or laid down in corporate policies.

c) The computation of tariff should be simple and easy to operate.

d) It should provide for better visibility and transparency.

e) The tariff structure should be such as to encourage economic and optimal utilisation of scarce national resources, foster economic generation of power at all points of time and generate appropriate signals therefor. In other words, when decisions have to be taken about backing down generations due to reduction in System load in some types of generating stations, the tariff structure should be such as to provide clear signals as to the order in which stations should back down and to what extent, in order to achieve maximum reduction in the cost of generation. 'Economic merit operation' of an integrated

power system is a fundamental requirement and the tariff structure should enable this being done by providing correct signals by separating fixed and variable costs.

f) As far as possible, tariffs for each category of consumers should reflect the total costs of supply to that category *. This implies that there should be no cross-subsidisation.

g) Tariffs should be fair and equitable i.e., the allocation of costs among consumers should be according to the burdens they impose on the system and should also afford a certain degree of price stability without large price fluctuations. Also, it should provide a certain minimum level of service to consumers who may not be able to afford the full cost.

h) Tariff should discourage avoidable and excessive consumption. For this purpose, *"inverted block"* tariffs are used, where the rates are low initially and increase steeply as consumption goes up. This will enable a "lighter" bill for average customer and a *"stiff"* bill for a person who consumes electricity excessively. This is particularly adopted for domestic supply. Also flat tariffs, unrelated to consumption should be avoided. All supplies should be metered and charged for, to discourage excessive consumption.

i) Tariff may also have to meet States' political or social objective eg. benefit weaker sections of society.

j) In the present context of the financial situation of the SEBs, the tariff for power purchase by the SEBs should not place an undue and avoidable burden on the SEBs.

k) The principle of what the 'traffic can bear' is relevant and cross subsidisation between weaker and affluent sectors is a normal practice.

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* 'No piggy ride' or 'free lunch' for "anybody" as stressed by World Bank.

It will be noted that as the above multiple objectives are, to some extent, mutually inconsistent and are in conflict with one another. Hence it is necessary to accept certain trade-offs between them.

DIFFERENT CONCEPTS OF TARIFF

There are several possible approaches to tariff.

The LONG RUN MARGINAL COST (LRMC) APPROACH

Strict LRMC may be defined practically as the incremental cost of optimum adjustments in the system expansion plan and system operation attributable to a small increment in demand which is sustained into the future. The term long run incremental cost may also be used interchangeably with reference to LRMC, because the changes refer to small but finite variations. Under this concept, power pricing is done not on the basis of historical cost but on current replacement cost of setting up a new power plant to generate an additional unit of energy in the margin. This implies that while a plant may have been set up at Rs.2 Cr/MW, for Tariff (LRMC) purposes, current cost (eg Rs.4 Cr/MW) is adopted. Necessarily the tariff becomes nearly double in this case and even higher since the average historical cost is less than 1/8 to 1/4 of current replacement cost. Supporters of this approach argue that this represents the economic cost and should be used to generate signals for efficient use of different forms of energy, (of which electricity is one). As against this, it is also argued that this concept cannot be applied in isolation only to power sector and has to be viewed in the overall context of industrial pricing as a national policy. Also, it will be difficult to raise tariffs to this level as this makes the cost of power unaffordable by a large section of consumers nor will this politically be acceptable.

The Long Run Marginal Cost (LRMC) Approach to price setting can provide a tariff structure which can incorporate these basic objectives :

- In the first stage of calculating LRMC, the economic (first best) efficiency of tariffs are satisfied as the method of calculation involves

calculating future economic resources rather than sunk costs taking into account shadow prices and externalities as well.

- In the second stage of developing LRMC based tariff, deviations from the strict LRMC are considered to meet social, political and economic (second best) criteria.

If departures from the strict LRMC are required for non-economic reasons - then the cost of these deviations may be estimated with reference to the strict LRMC which serves as a bench-mark. Since in-depth calculations have already been made to arrive at the cost structure for the strict LRMC, this could help the policy makers to pinpoint on the inefficiencies such as over-investment, unbalanced investment, losses at generation, transmission and distribution levels and so on.

One must keep in mind that there is no 'ideal' tariff as any LRMC based tariff is a compromise between many different objectives. Thus, by using the LRMC approach, it is possible to revise and improve the tariff on a consistent and ongoing basis and thereby approach the optimum price over a period of several years, without the consumers being subjected to "abrupt" price increases.

Coming to the Indian context where no LRMC is calculated to arrive at an optimal price, one finds that trend in tariffs to be rather disconcerting. The average cost of generation & supply, which is basically an accounting way of arriving at the cost is not being met. As explained below, even the 'paying' category of consumers are not meeting the required cost and neither does the trend imply that this is likely to be done in the future. Considering that this category is supposed to cross-subsidise the agricultural sector, there has to be an 'abrupt' price hike to meet the board's costs so that they generate adequate revenue, both to meet costs and for future expansion.

UNIFORM TARIFFS

Power from Central generating stations supplied to SEBs should be UNIFORMLY PRICED. In support, it is argued that the variations in

investment costs and availability/non-availability of natural resources in a region should not be reflected in the power pricing to the SEBs from Central Govt units. Such an argument may, prima facie, be reasonable but has several other implications - technical and political and hence this concept was discarded after due consideration* .

There are some who advocate that tariffs for any particular category of consumers should be uniform throughout the country. In support, it has been argued that different levels of tariffs generate pressures for downward revisions. Often, such pressures are to draw considerable political mileage as in the case of progressive reductions in tariffs for power supplied to agricultural pumpsets, particularly when changes in Governments take place. This again while seemingly justified has practical difficulties to implement since the cost of generation and supply vary from State to State depending on the hydro thermal mix and other factors hence not feasible.

An alternative is to go by historical costs based on normative/actual levels of parameters of operation. This is what is currently in vogue.

TARIFF FOR BULK POWER SUPPLY FROM CENTRAL GENERATING STATIONS

Presently about 25% of the installed capacity is owned by the Central Generating stations. However, distribution and sale to the ultimate consumers rests with the SEBs. The SEBs have to balance between the costs of making power available - and tariffs for bulk purchases from Central Generating stations is an important ingredient in this - and revenues from sale of power to the consumers - a subject which is fraught with problems of a different type. There has been a growing feeling in the Boards that the prices for power purchases from Central Generating stations are higher than necessary. The succeeding paras analyse this aspect.

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* This was examined by an inter-ministerial committee headed by Shri VB Eswaran in late 80s.

For quite some time the tariff for Central Generating Stations such as NTPC were calculated adopting normative approach. Briefly the elements consisted of the following.

ELEMENTS OF FIXED COSTS

i. Interest on loan capital
ii. Designated return on equity capital (10/12%)
iii. Operation and Maintenance (O&M) expenses
iv. Depreciation, at rates laid down in the Electricity (Supply) Act
v. Interest on working capital requirements

ELEMENTS OF VARIABLE COSTS (covering fuel costs)

1. Primary fuel (coal, lignite, gas etc)
2. Secondary fuel (oil)

The fixed costs were estimated on an actual basis for the year and these form the total fixed expenses to be recovered during the year. Assuming an operational level (Planted Load Factor - PLF) of 62.78%, annual fixed expenses are pro-rated over the expected generation at this level to arrive at a fixed cost per unit. In doing so, power consumed for generating power (called auxiliary consumption) is deducted.

In addition to this is an element to cover variable costs (namely cost of primary fuel, secondary fuel oil required for generation of 1 unit (KWH) of electrical energy is added (which proportional to the extent of generations). The estimate of variable cost per unit of electricity generated is added to fixed charges per unit covering items of expenditure described above to form a composite 'single part tariff' payable by the SEBs for each unit (KWH) of energy purchased by them from the Central Generating thermal power stations.

A typical calculation is given below:

1.	Station Capacity		500 MW
2.	Capital cost	:	Rs 1000 cr

3. Financed by

Equity	:	Rs 500 cr
Loan @ 15% int	:	Rs 500 cr

4. Annual generation gross at 62.78% PLF : 2946.86 M KWH

5. Net energy at 'bus bar' after 10% auxiliary consumption : 2652.18 M KWH

6. Annual Fixed costs : (Rs in million)

a)	Interest on loan	750
b)	Prescribed return on equity (12%)	600
c)	Depreciation @ 2.6%	260
d)	Operation & Maintenance exp (2.5%)	250
e)	Interest on working capital	100
	Total Annual Fixed Expenditure	1960·····**(A)**

7. Fixed costs per unit **(A) / 5** **73.90 ps/KWH**

8. Fuel costs per 1 KWH of gross generation :

0.70 kg of coal at Rs 400/M ton	28.00 ps
3.5 ml of oil @ Rs 5000/KL	1.75 ps
Total	29.75 ps

9. Fuel costs per unit (KWH) at bus bar (after deducting auxiliary consumption) **8 / 0.9**
33.00 ps / KWH

10. Total Tariff :

Fixed costs	:**73.90**
Variable costs	:**33.00**
	106.90 p/unit at bus bar

In regard to hydro stations a similar calculation is done, the difference being that there are no fuel costs. The annual fixed expenses are divided by the estimated generation of power to based on expected availability of water on 90% probability to arrive at a unit cost which is applied for each unit of power supplied from a central hydro station.

The pricing of nuclear power is made also on line similar to thermal station except for a suitable addition for cost for decommissioning the plant,

disposal of nuclear waste and heavy water used for moderation of nuclear reaction.

PROBLEMS

The above system of tariff formulation has been in vogue for some time and this was found to be inadequate and raised some problems. Some of them are outlined below:

a) The SEBs had their own generating capacity and had made necessary investments on the generating stations which are sunken costs. The cost of generating additional unit of power (KWH) at any point of time from their generating stations is only the fuel cost. In a situation when there is a shortage in the States' capacity to meet the demands of power, the Board has no option but to buy power from the Central Generating stations. But at times when the States' generating capacity itself is more than the demand, the question arises whether the Central generating stations eg, NTPC should reduce its generations or whether SEB should reduce its generations. NTPC have strongly been of the view that their stations were more efficient, using the latest technology, and consume less fuel than those of the SEBs which were relatively inefficient. They accordingly argued that the SEB's generating stations should back down and take power from the Central Generating stations. The SEBs however argue that for each unit of power purchased from a Central Generating station, they have to pay the single part tariff (eg 106.9 P/KWH) which is much more than what they have to incur for their fuel costs (eg 30 -50 P) had the same power been generated in their own generating stations. Thus according to the Boards, purchase of power from central generating stations in a surplus situation in the state was commercially detrimental to their own interests. The disputes became interminable in view of conflicts of commercial interests of the Boards/NTPC.

b) All the SEBs of the region need to draw power from Central generating stations when their capacities were not adequate to meet the load in their systems. The Central generating stations are often unable to meet the full requirements in times of peak demands. Some States, which are politically and geographically better located used to over-draw power in times of peak demand and correspondingly under-draw in off peak times. The tariff and

metering systems do not distinguish between the drawal of power in peak time and off peak time from central generating stations. This leads to a situation in which some states used to be denied power when they were most in need but were dumped with excess power when there was no need. There was no system of regulating and ensuring power flows according to the respective entitlements of the SEBs nor was there any arrangement to distinguish the cost of power supplied during peak time and off-peak time.

c) There were also interminable disputes in the matter of fixation of tariff as the norms adopted were rather lax compared to actual performance, leading to complaints of profiteering by Central generating stations at the expense of Electricity Boards which were financially hard up. To illustrate, as seen above, if the plant operates at 62.78% PLF, it generates an income of Rs.1960 Million towards fixed expenses of Rs 1360 Million and Rs.600 Million as profit. If the same plant operates at 85% PLF, which is not unusual, the generation would be 3723 M units (gross) or 3350.7 M units at bus bar.

Revenue towards recovery of fixed expenses would be :

3350.7 M units (MU)× 73.90= Rs 2476.17 Million

which means a total profit of Rs 1317.21 Million against Rs 600 Million prescribed by the Government. This extra profit is the direct result of taking a low norm of 62.78% PLF. This over recovery of fixed expenses is an avoidable financial burden and loss to the Boards.

Placed in distressing financial situation, the Boards felt and perhaps justifiably that they were being bled white to make for fat profits of a central sector organisation like NTPC. The irony was that while the Central Government had prescribed a return of 12% on equity and thereafter reduced it to 10% on representation of the SEBs, the return computed as a percentage of equity ranged to as much as 28% to 30% owing to the operation of Single Part tariff through over recovery of fixed costs at high levels of PLF.

While NTPC claimed that this was the result of efficiency of their operation, SEBs claimed that they were 'cheated' into adopting a very low PLF as norm for tariff fixation.

THE TWO-PART TARIFF

To resolve some of the issues the Govt in the Ministry of Power appointed an expert Committee to study the subject and a new concept of "two part-tariff" was evolved[3] . Under this system, the SEBs of the region were to *collectively* reimburse the Central generating station of the annual fixed expenses and designated profit **provided** generation ***availability*** was assured above an accepted level. In addition, fuel charges were payable for each unit of energy drawn. Realistic norms to be adopted for various parameters were laid down with a provision for review at periodic intervals based on actual levels of operation. With these modifications, the conflict that existed between the commercial interest of the Board and Central generating stations were largely eliminated and it was easy to decide as to which of the two (Central station or a station of the SEB) should operate based on considerations of variable cost associated with the generation of power either at the central generating station or a unit owned by the SEB. At the same time, this also promoted generation of more power at the Central generating stations which consumed less coal, and also avoided transportation of coal over very long distance in view of the nearer locations.

Some problems however still continue. These are -

a) There is no system of time-of-the-day tariff for central generating stations nor is there a system of measurement of power/energy drawn during peak time and off-peak time. Such metering is fundamental for any grid operation and it is a sad commentary that the Indian power sector has not thought of this from inception and is yet to plan and implement a suitable system and associated tariffs even after two decades of operation!

b) A system of pricing peak power at a higher rate than off-peak power and for deterrent penalties for overdrawing from the grid in peak times need to be introduced.

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[3] ***"Report of the Committee on the fixation of tariffs for Central Sector Stations"***:CEA, Government of India.

c) Some gas based power stations have been set up in the combined cycle mode, with a view to optimise power generation vis-a-vis gas consumption. The arrangements for supply of gas have been that the drawal has to be *continuous and uniform* throughout the 24 hours of the day round the year. In such a situation the generation in these stations has to be maintained at a constant level continuously irrespective of the system demand. At the same time the variable cost in such generation at the gas stations is far higher than the variable cost when the SEB has to incur in generating power in its own system. Yet the Boards are forced to absorb such costlier power. One of the solutions to this problem is for Govt to have a relook at the pricing mechanism for gas.

TARIFF FOR THE STATE ELECTRICITY BOARDS

While the Central Generating Stations account for about 20% of the total generating capacity, the entire supply to the retail consumers in the country is done by the State Electricity Boards which had been formed for each State, and by the Govt Departments/undertakings in Union Territories. Although the SEBs statutorily enjoy powers of fixation of tariff to retail consumers this power is only on paper and tariff decision are taken by the State Govts often involving political expediencies.

TARIFFS (GENERAL)

Tariffs for power sold is the only source of revenue to the Board. It thus becomes imperative that the regulation of tariff should be such that it invariably secures to the Board, under all circumstances, a revenue which is adequate to meet in full its operational expenses, interest, depreciation, taxes if any on profits and leave such surplus as prescribed under Sec 59 of the E(S) Act. While prescribing the surplus to be generated, the State Governments are required to keep in view the requirement of resource generation for expansion programmes, debt redemption etc. The Act specifically enjoins on the Boards to review its operations and readjust the tariffs from time to time to achieve the above. However, as already stated, in practice the tariffs have remained below the cost of generation and supply. Further, the gap between the cost of generation and supply and the average realisation for units sold (all categories

combined) have been progressively widening as can be seen below (figure 3.3). The figure also shows that the tariff from the agricultural sector is showing a declining trend (all India). Statewise details contained in Annexure IV show that some states (Karnataka, Bihar, Madhya Pradesh, Mahrashtra, Orissa, West Bengal and Rajasthan) have moved from a situation where the tariffs from the agricultural sector were above the average cost of generation and supply to a situation where they are far below the average cost of generation and supply.

In the above, while computing total revenue from sale of electricity, Rural Electrification subsidy (as provided in the accounts) has not been considered for the below two reasons.

i) **This is because by and large they have remained unpaid** and
ii) Subsidies are only transfers and do not add to the overall resource generation.

Another alarming fact is that the average realisation even from consumers ***other than the agricultural sector*** taken as a whole is also below the average cost of generation and supply, both on all-India basis, and in a large number of Boards as shown below in figure 3.4. ***This dispels the general impression that non-agricultural consumers as a class, are providing cross-subsidisation for losses sustained by Boards in supplying power to the agricultural / rural sector at low tariffs.*** This may be partly true, only in a few Boards.

CERTAIN SPECIAL FEATURES OF AGRICULTURAL TARIFFS

There are some special aspects of agricultural tariff which need to be highlighted.

i) The tariffs are far less than what it costs to supply power to the agricultural sector; they are much less than the average[1] cost of supply in the Board (See fig. 3.2). In most states it is even less than the cost of collection.

ii) There is a progressively decreasing trend of average realisation to the Board per unit sold to the agricultural sector despite substantial increase in the cost of generation and supply.

iii) Even from the point of view of the consumer, there is a wide variation in the flat rates/tariffs prescribed in different States. The tariff varies from Rs 310 to Rs 1800 per 5 HP set/annum. It is necessary to eliminate such wide variations if pressures for reduction in agricultural tariffs are to be avoided.

iv) The major reason for losses sustained by the SEBs is the low tariff prescribed for the agricultural sector. The progressive reduction in the average realisation per unit sold is the combined effect of introduction of flat tariffs instead of metering the supply and increased utilisation of pumpsets (increased hours of operation) without a corresponding increase in the revenue to the Board, progress made in energisation of pumpsets far in excess of planned targets, inefficiency of the pumpsets and possible misuse either by sale of water to neighbouring farmers or using for other purposes eg. cooking, heating etc..***

v) The system of flat tariffs and unmetered supply has not, in any manner, helped the SEBs to conserve energy or accurately assess and control the transmission and distribution losses. On the other hand, there appears to be a convenient means of covering up high T&D losses, pilferage of power etc.

Keeping in view the above factors, the following can be said:

a) Irrespective of whether the tariffs are on flat basis or for metered supply, the supply to agricultural pumpsets should be metered. In fact, as a general policy no category of consumers should have unmetered supply, as this encourages excessive consumption of power which is to be avoided under all circumstances in a situation of power shortage.

b) Attempts should be made to arrive at a National consensus with a view to prescribe a minimum tariff for the agricultural pumpsets aimed at securing

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1 **Here Average cost and realisation refers to the weighted average.**

*** Given the significance of Power supply to agriculture the following chapter deals with the above mentioned factors and its impact on the SEBs in greater detail.

to the Board either a minimum average tariff per unit sold or a prescribed percentage of average cost of generation and supply. If the tariffs are on the basis of flat rate / HP, the tariffs could take into account, if necessary the varying load factors in different States. The agricultural tariff so determined should be indexed either to the cost of living or the procurement prices fixed by the Agricultural Price Commission so that a concordance is established between the procurement prices and the tariffs for the power supply to the agricultural sector.

c) Even where there is a national consensus about a minimum tariff, there is no political will to implement the same particularly as elections are always round the corner. [eg. It was repeatedly affirmed in State Power Ministers' Conferences held twice a year that agricultural tariffs should fetch not less than 50 ps/unit. It is not implemented in a majority of the States even after five years.]

d) It should be made mandatory for all the Boards / State Govts to prescribe tariffs which are not lower than the tariff on the basis of national policies as outlined in (b). The question however is how to make it mandatory when the States do not want to implement this and Centre cannot enforce the same.

e) The difference between the tariff so prescribed and average cost of generation and supply to the Board should be made good partly through cross-subsidisation and partly through State subsidy as the State Govt may decide.

f) Suitable incentives in the shape of cash subsidy / concessional rates of interest for PFC / REC loans etc., can be given to States which follow the above discipline.

REVISION OF TARIFFS

Despite the mandatory provisions in Sec 59* in the E(S) Act, there is no systematic procedure for ensuring that tariff revisions are made as and when necessary and to the required extent to ensure that the directions of Sec 59 of the E(S) Act are compiled with. Although ***the Boards are autonomous and are competent to prescribe adequate tariffs and revise the same as necessary***, State Governments impose political constraints on the revision of tariffs thereby making changes in tariff almost impossible. ***Proposals submitted for tariff revisions are often made on a conservative basis***, assuming improvements in future performance to near ideal conditions of efficiency. These do not fructify for various reasons including inability to invest required sums for efficient distribution systems etc. Further, the tariff proposals remain under discussion for quite some time and when they are approved, further cuts are made in the proposals. By then, the tariffs already become out of date and do not secure to the Boards the targeted revenue that would enable the Boards to break even and meet its commercial as well as statutory obligations. Where concessions are made in tariff on social grounds for the benefit of weaker section, there is no agreement or arrangement as to how the loss would be made good to the Board concurrently.

On the other hand, ***the SEBs have virtually no control on the cost of inputs such as coal, oil, gas, railway freight, capital related costs like interest etc***. Costs of power purchase by the SEBs keep increasing from month to month owing to variations in cost of fuel to Central Generating stations, distress purchases. The share of such costly power in the Board also increases from what is assumed when tariffs are formulated. Nor can a drastic

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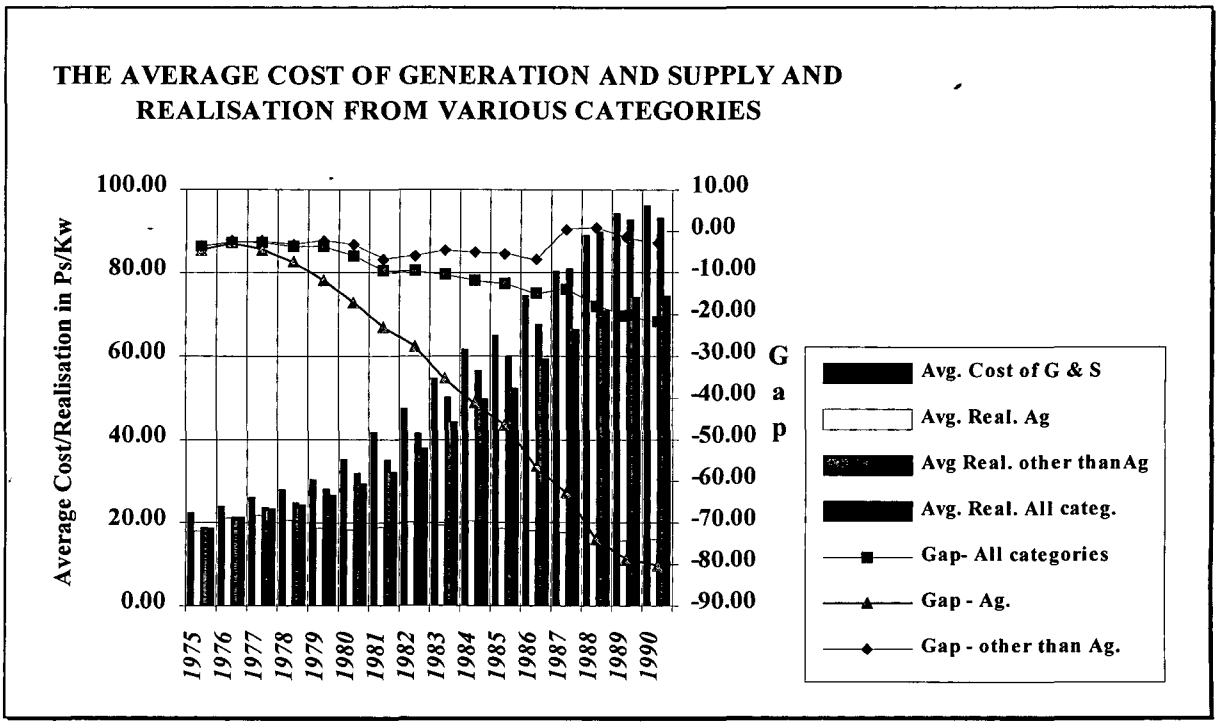
* Sec 59 of the E(S) Act imposes a statutory obligation on the SEBs to manage their operations and adjust their tariffs so that the total revenue in any year of amount shall, after meeting all expenses properly chargeable to revenues including operations, maintenance and management expenses, taxes, if any on income and profits, depreciation and interest payable on all debentures, bonds and loans and leave such surplus as is ***not less than 3% or such higher percentage***, as the State Govt may By notification in the official gazette specify in this behalf, of the value of the fixed assets in service at the beginning of the year. The Act also provides that in specifying any higher percentage, the State Govt shall have due regard to the availability amounts accrued by way of depreciation and the liability for loan amortisation and leave a ***reasonable sum to contribute towards the cost of capital works and reasonable return*** on the capital provided by the State Govt or the loans converted into equity. But no State Govt has prescribed any return in pursuance of the provisions of the above section and hence the minimum rate of return remains at 3%.

improvement be expected in matters such as levels of PLF, improvement in T&D losses, fuel consumption or substantial reduction in manpower etc. While these are important areas in which possible cost reductions can be made and economies of scale can be reaped, it should be remembered that tariffs are the only source of revenue and unless the tariff is adequate in all respects to meet its costs in full, it is futile to expect the Boards to meet their commercial obligations to various organisations* .

FIGURE 3.3

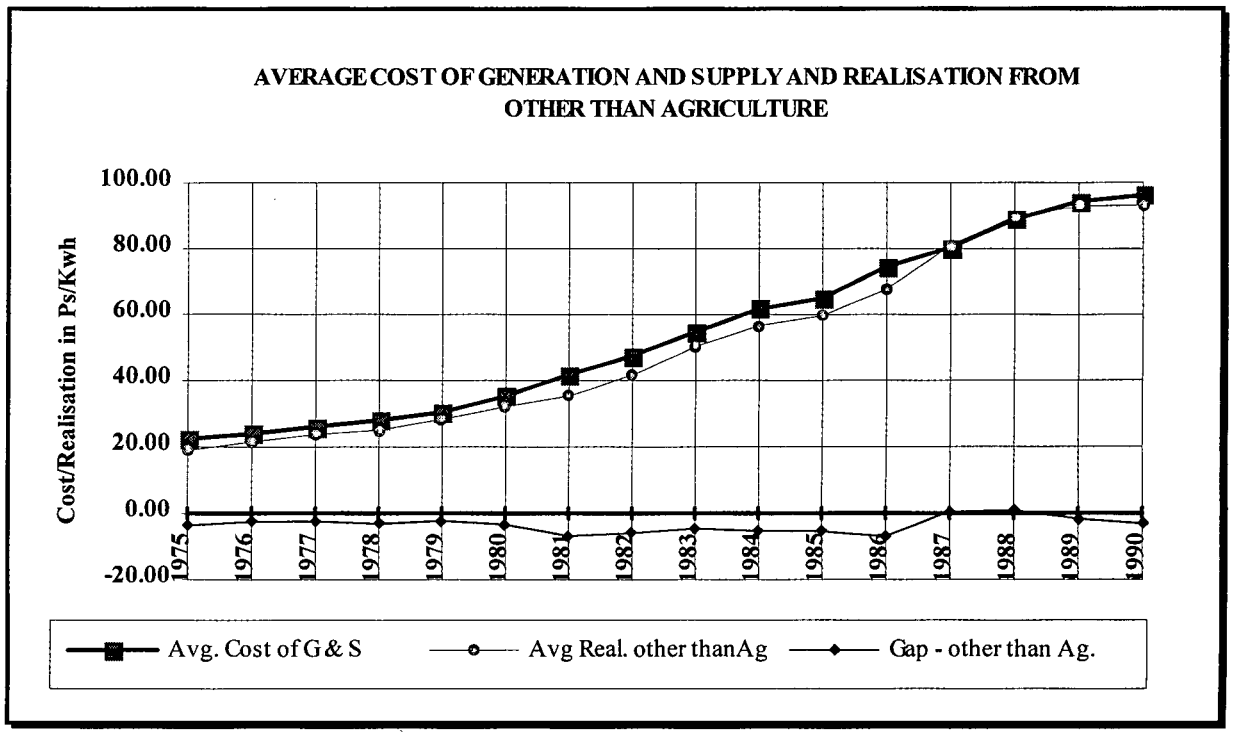


Source : Govt of India - CEA and Annual Accounts of various Boards

Note 1: "G&S" signifies generation and supply. "Ag" stands for agriculture.
Note 2: The categories mentioned here are consumers from Ag. sector & all other consumers that don't fall under the Ag. sector.

* In certain States, tariff revisions are treated as measures of Additional Resource Mobilisation (ARM) for meeting the plan expenditure, even though the Boards continue to be suffering from revenue deficits. It is understood that in some States, 50% of the revenues arising out of tariff revisions are appropriated for meeting plan expenditure and are treated as loans advanced to the SEBs and/or adjusted against RE subsidies due to the Board. In a situation where tariffs of the Boards do not fetch adequate revenue to meet their commercial obligations the above would further hurt/impair the Boards' functioning.

FIGURE 3.4



IMPORTANCE OF ADEQUATE TARIFFS

In summary, it is to be stressed that it is an accepted economic principle that the tariffs prescribed for various categories are adequate and reflect as nearly as possible the cost of generation and supply to that category. This is necessary to ensure that the consumption in each sector bears the true costs of the power consumed by that sector. Besides, concessions in tariff to any category encourages excessive consumption, unmindful of cost implications. Despite these general principles, it is also conceded that there could be tariff concessions to certain special categories of consumers on socio-economic considerations as a State Policy and such concessions have to be made good by loading the tariffs for other consumers in the same category (inverted block tariff) or consumers in other categories through Government subsidisation between categories. The State Government may also directly subsidise the loss of revenue arising out of low tariffs prescribed for any particular category of consumers (eg: agricultural consumers).

However, it should be realised that ***there is a limit upto which the concept of cross-subsidy can be extended***. If the entire loss of revenue owing to concessional tariff is to be made good only through cross-subsidisation, the results could sometimes be disastrous to the Board. This is for the reason that if the tariffs have to be constantly increased for those categories (eg. industry) who are in a position to pay. This can set off a chain of undesirable reactions. These reactions would mainly come from power intensive industries such as aluminium, cement, steel etc., - they may either choose to migrate, shut down or even go in for captive generation (if this is a cheaper option). We are fast reaching a stage when tariff for some industries is nearly equal to the cost of captive generation through diesel. It would also detract new industries from coming to a State despite availability of other natural resources. In fact, in A.P(1993-94), while two thirds of the energy supply is for LT, the revenue contribution from this category is only one third of the total revenue*. On the other hand, the HT consumers who account for one third of the energy consumption provide two thirds of the revenue. The average realisation from a HT consumer is four times that of the average realisation from the LT category (including agricultural sector). The tariffs for some categories of HT consumers range well above Rs 2/- upto Rs 2.5 per Kwh. Also, average tariffs for HT have been increasing at a much faster pace (76% between 1990 and 1994) compared to average costs of supply (50%) and average tariffs for LT (46%) in the same period. It is seen that in some States, the Rs 3/- mark is also reached in certain HT categories.

The high tariffs for HT and their faster rise, coupled with uncertainty in supplies, does not augur well both to the HT consumers as well as for the future of the power sector in general, and SEBs in particular. This is for the reason that a large number of private entrepreneurs are willing to set up captive generating plants using diesel, and supply reliable power to nearby industries at tariffs which may be less than what the SEBs are presently charging. If this were to happen in a big way, the HT industries which contribute to two thirds of the Boards' revenue will be weaned away, leaving the Boards in greater financial distress. An additional fallout would be that ***the basic fundamentals***

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* Tariffs for HT consumers are significantly higher than the average tariffs for the LT consumers including agricultural sector.

of economic power planning on a national basis including economies of scale, fuel, transportation/transmission costs etc., to which planners in India have long been committed would be given a clean go-by, since a large number of captive generators using inefficient plants and expensive fuel will mushroom all over the country to meet local demands of nearby industries. Such an event, when it happens, would throw substantial additional burden on the economy through higher costs of fuel for power generation and foreign exchange outgo, inefficient generation and a catastrophic future for the Boards who would be left with only those who are collectively receiving power at half of what it costs to supply. Unless these aspects are set right, several unhealthy trends will set in in the Power Sector and the future of the SEBs will become more uncertain.

SUMMARY OF CHAPTER III

Under the statutes, SEBs were merely required to even break-even ***as far as possible*** upto the early 1980s. It was only after the mid 80's that the Boards were required to generate a surplus of 3% and contribute to the expansion programmes. There are some Boards that have improved their profitablity, while others have worsened their position after the statutory requirement of generating a surplus of 3% came into affect. The factors that affect the financial performance of the SEB's can be divided into endogenous and exogenous factors. ***It was demostrated that the Boards can show lower losses and even profits, if, even some of the exogenous factors were removed.*** The exogenous factors include, low levels of tariffs (including agriculture and other categories); inadequate capital structure of the SEB's which does not include any equity and interest during construction (IDC) not being capitalised until 1985 (once this was done, the Boards overall profitability increased) ; on the same lines after introducing equity it is shown that the Board's overall profitability would further increase. One also finds that if SED was retained by the Boards and not passed on to the State government, they would be exhibiting profits (or very low losses) instead of the very high losses. Other significant exogenous factors that affect the finances of the SEBs are the unfavourable pricing of coal, gas and railway freight for the transportation of coal. The price of coal is not based on its calorific content and eventually in some lower grades of coal the price per M.Kcal is higher than that for higher grades of coal. The fact that more coal has to be transported for the same power output has been ignored. In the case of rail freight, the changes in rail freight tariffs have progressively led to the average freight prescribed for coal used in the power sector being much higher than the average cost of transportation. As a result transportation of coal for power now subsidises other categories, whereas earlier, other categories subsidised transportation of coal for power. On the pricing of gas, the pricing based on HBJ pipeline instead of coal equivalent makes use of gas for power generation uneconomical. Such a situation arises inspite of Finance Ministry's recommendation in 1987/88 on the optimal use of gas, that gas for power generation is in best national interests vis-a-vis other uses such as fertiliser production. Also among the exogenous factors are, massive energisation of pumpsets and village electrification programmes, for which the SEB's are not compensated adequately by the Governments (State and Central).These have been discussed in chapter IV.

Coming to the aspect of tariffs we find:

i. The all India average realisation from the ***other than agriculture*** category is below the average cost of generation and supply. This dispels the general impression that non-agricultural consumers as a class, are providing cross-subsidisation for losses sustained by Boards in supplying power to the agricultural/ rural sector at low tariffs. This may be partly true, only in a few Boards.

ii. The average realisation from the agricultural sector is not only far below the average cost of generation and supply **but is moving away from it.** On a statewise basis we find that some states (Karnataka, Bihar, Madhya Pradesh, Mahrashtra, Orissa, West Bengal and Rajasthan) have moved from a situation where the tariffs from the agricultural sector were above the average cost of generation and supply to a situation where they are far below the average cost of generation and supply.

The factors that are endogenous or within the Board's control are, low generation of output, high T&D losses, heavy arrears in revenue collection and high establishment costs. As these factors also include within them some exogenous factors (grey areas), it was concluded on the basis of previous studies and some examples that their(endogenous factors) contribution to the losses of the Boards' was not as significant as that of exogenous factors'. However, data across the Board's reveals that the revenue outstanding varies as much as 204% to 9.8% of the annual sale of power while the stipulated limit is 16.6%. The overall average in 1987 was around 25%. The general feeling about the SEBs is that they are overstaffed, even though there are no norms of calculating the appropriate levels of manning in the SEB's. There are instances when the Boards are subject to political pressures to continue employ staff beyond their requirements, (as was shown in the case of Uttar Pradesh) which in turn effects the efficiency and finances of the Boards. In this context, the study suggests a measure for calculating the appropriate levels of manning.

CHAPTER IV

SUPPLY OF POWER TO THE AGRICULTURAL SECTOR

Introduction:

A very vital (but less recognised) role played by the State Electricity Boards is in the area of supply of electricity to the villages and in particular, the agricultural pumpsets. Since independence, 495,508 villages have been electrified out of a total of 540811 villages[1], working out to more than 91%, adding on an average about 11267 villages per year. In 7 states 100% electrification has already been achieved. Table 4.1 gives the actual , targeted and the cumulative figures of the number of villages electrified over the last five years.

TABLE 4.1

VILLAGES ELECTRIFIED (All India)

YEARS	*TARGET*	*ACTUAL*	*CUMULATIVE*
1990-91			481,124
1991-92	5337	6046	487,170
1992-93	4240	3669	490,839
1993-94	3210	3352	494,191
1994-95 (Apr - Nov)	3708	1317	495,508

Source:Centre for Monitoring Indian Economy (CMIE): India's Energy Sector; July 1995.

This goes to improve the quality of life in the rural sector. The number of pumpsets energised has increased from 4330453 in 1980-81 to 11.76 million in 1995-96. The total connected load and installed capacity compare as under in March 1992.

Total installed generating capacity.....69,065 MW
Total installed capacity generating of Boards.....52,567 MW
Connected load of agricultural pumpsets.....35,462 MW
Percentage of all-India installed capacity.....51.34%
Percentage of SEB's installed capacity.....67.46%
Total energy consumption.....207,644 MU

[1] For 15 major States.

Consumption by agricultural pumpsets.....58,577 MU

Percentage of total consumption.....28.21%

Thus, the installed capacity of agricultural pumpsets works out to 68% of the Boards' total installed capacity and 51% of the installed capacity of the nation. In the same year, in terms of energy consumption, this accounts for 28% of energy sales. In some States, this is in excess of 40% of the total energy sales.

GROWTH OF AGRICULTURAL PUMPSETS AND CONSUMPTION

The growth in the installed capacity, consumption, No. of hours of running and consumption/KW of connected load are tabulated in table 4.2 below:

TABLE 4.2

GROWTH IN THE INSTALLED CAPACITY, CONSUMPTION, NO. OF HOURS OF RUNNING OF AGRICULTURAL PUMPSETS

SEB's	No. of pumpsets energised	Agricultural connected load (Kws)	Avg. capacity per pumpset (Kws)	Annual consumption (in MU)	Avg. consumption per pumpset (Kwh)	Consumption per unit connected load (Kwh/kw)	Avg. No. of Hours the Pumpsets are kept running (per day)
				1980-81			
HA	225461	1034172	4.59	954.00	4230.00	922.19	2.53
UP	402865	1892147	4.70	2792.00	6930.00	1475.50	4.04
GU	231226	1502001	6.50	1334.00	5769.00	888.11	2.43
MA	668058	2260376	3.38	1724.00	2581.00	762.82	2.09
AP	446493	1679381	3.76	977.00	2188.00	581.72	1.59
KA	308719	1037346	3.36	393.00	1273.00	378.85	1.04
KE	91389	262103	2.87	80.00	873.00	304.39	0.83
TN	919162	3033143	3.30	2367.00	2575.00	780.33	2.14
BI	159732	496057	3.11	435.00	2721.00	876.17	2.40
WB	24886	142472	5.72	72.00	2908.00	507.95	1.39
ALL INDIA	4330453	16489187	3.81	14489	3345.84	878.70	2.41

table continues.....

SEB's	No. of pumpsets energised	Agricultural connected load (Kws)	Avg. capacity per pumpset (Kws)	Annual consumption (in MU)	Avg. consumption per pumpset (Kwh)	Consumption per unit connected load (Kwh/kw)	Avg. No. of Hours the Pumpsets are kept running (per day)
1991-92							
HA	382161	1766185	4.62	3535.49	9251.31	2001.77	5.48
UP	677027	2935476	4.34	8229.49	12155.34	2803.46	7.68
GU	486494	3346358	6.88	6976.58	14340.53	2084.83	5.71
MA	1703161	6033174	3.54	8406.46	4935.80	1393.37	3.82
AP	1273972	4220763	3.31	7218.94	5666.48	1710.34	4.69
KA	816924	2940875	3.60	4558.63	5580.24	1550.09	4.25
KE	243224	469140	1.93	224.13	921.50	477.75	1.31
TN	1359748	4466061	3.28	4509.84	3316.67	1009.80	2.77
BI	258508	796037	3.08	1644.11	6360.00	2065.37	5.66
WB	92394	300264	3.25	651.86	7055.22	2170.96	5.95
ALL INDIA	9391108	34562321	3.68	58557.2	6235.38	1694.25	4.64

Source:General Review various Issues:CEA.

The following observations can be made regarding the supply of power to the agricultural sector:

a) The total share of electricity consumed by agricultural pumpsets on an All-India basis is about 28% (1992) (as was mentioned in chapter II, section III). In some of the states, the share of sale of electricity to agricultural pumpsets is as high as 42%. The table at Annexure V shows the state-wise position over a period of fifteen years.

b) The consumption per KW of connected load or per pumpset is also constantly increasing. The following table (4.3) illustrates the All-India statistics of consumption of power per KW connected load of agricultural pumpsets. The increased consumption per KW of connected load can be attributable to a variety of factors, ranging from inefficiency of pumpsets, lowering of ground water table, cropping patterns, diversion of water to other farmers, misuse through diversion of electricity to other uses such as heating etc. and results in steep reduction in the revenue realised per KWH of consumption of power supply to agricultural sector.

TABLE 4.3

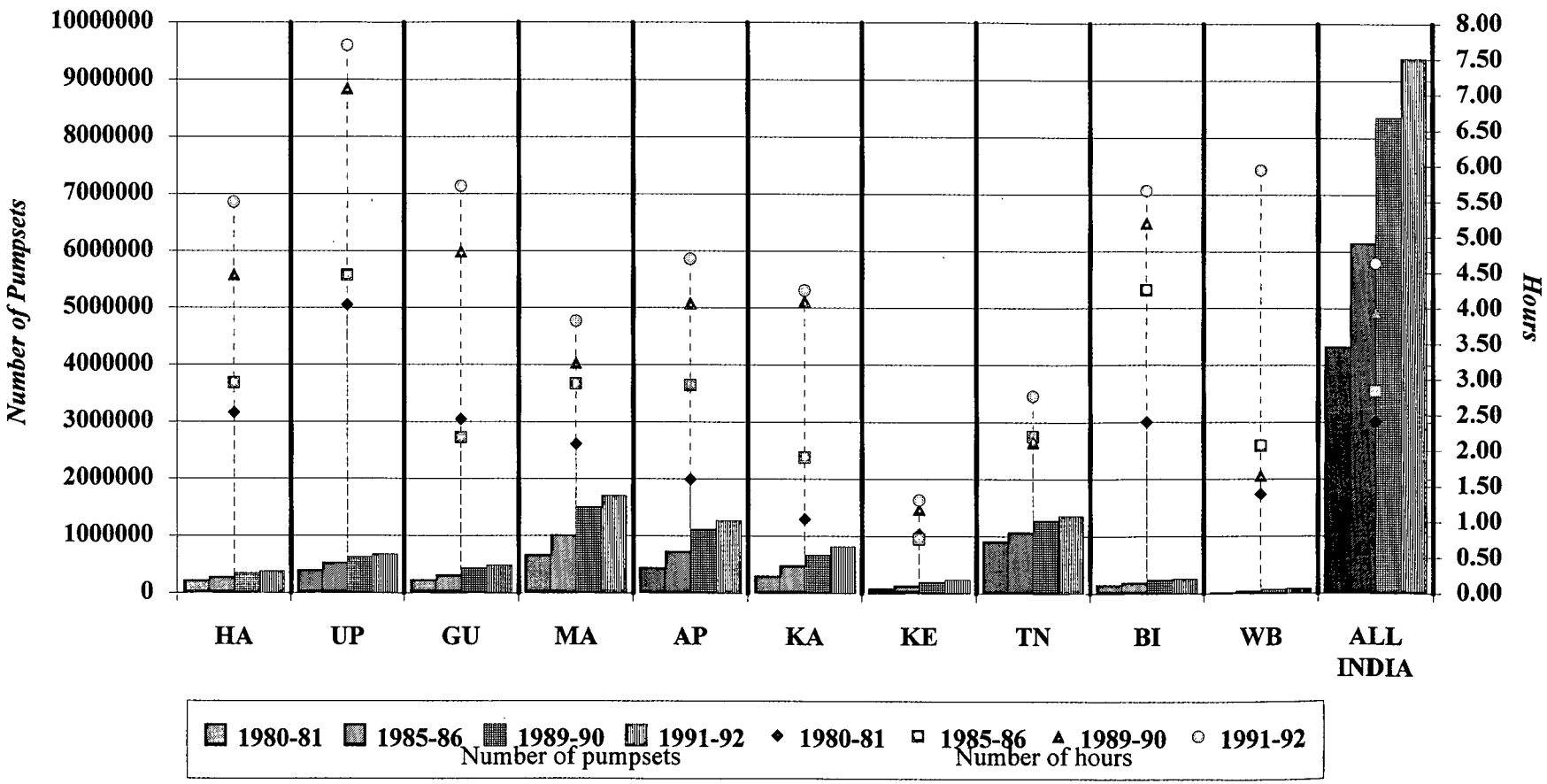
CONSUMPTION OF POWER PER KW CONNECTED LOAD OF AGRICULTURAL PUMPSETS (ALL INDIA)

YEARS	KWH/KW
1980 - 81	878
1985 - 86	1037
1989 - 90	1440
1991 - 92	1694

Source:General Review various Issues:CEA.

c) The average number of hours of usage varies significantly from State to State and has increased steeply over years. For example, in UP, it has increased from 4.04 hours in 1980-81 to 7.68 hours in 1991-92. In Tamil Nadu, the corresponding figures are 2.14 hours and 2.77 hours. In this background, ***questions arise as to how far the consumption attributed to agricultural sector in states like UP is genuine.*** The figure 4.1 below shows the rapid growth of agricultural pumpsets and the steep rise in the use of pumpsets across some states and on an all India basis .

FIGURE 4.1
GROWTH IN THE NUMBER / USAGE OF PUMPSETS



SIGNIFICANCE AND ROLE OF THE SEBS IN THE SUPPLY OF POWER TO AGRICULTURE

The SEBs have been playing and would continue to play for the foreseeable future, a significant role in extending power supply to the rural sector, village electrification and energisation of the pumpsets. These are programmes of vital importance to the economy and have made significant contribution to the quality of life in the rural sector. In particular, energisation of pumpsets have helped considerably in the production of food grains. The role played by State Electricity Boards in the year 1986-87 and 1987-88 when the country had faced unprecedented conditions of drought is highly commendable. It would be difficult to imagine what would have happened if the SEBs had not come to the rescue of the agriculturists by imposing substantial power cuts on other consumers to meet the demands of agriculture, thereby foregoing revenue from remunerative categories of consumers such as industrial sector and maintaining long hours of supply to the agricultural pumpsets, although this diversion of power meant no additional revenue to the Board. This was despite the situation that, in order to meet this demand, the Boards had to generate more thermal power, which is costlier, due to lack of hydro power. Thus, the SEBs have helped in trying to maintain the agricultural production even in very trying conditions of drought and in the process have incurred substantial commercial losses which today has become a subject matter of criticism.

The following factors should be taken into cognisance with matters relating to supply of power to the agricultural sector:

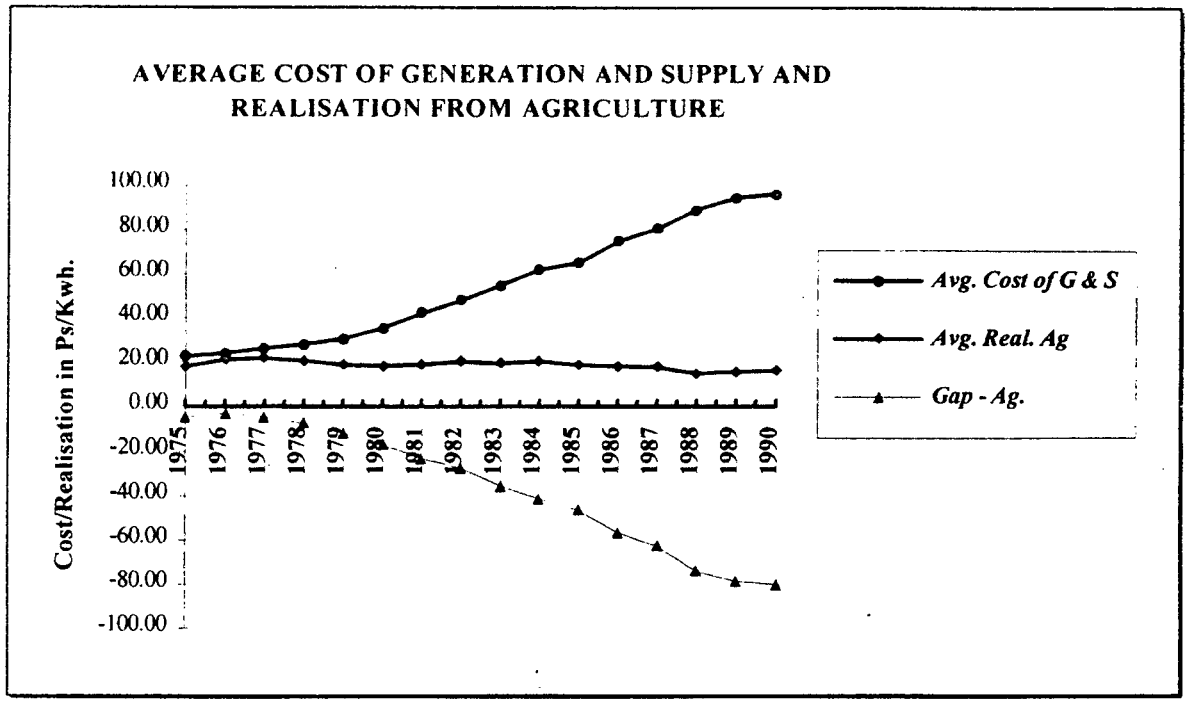
i) Extension of power supply to the rural sector / agricultural sector and pumpsets is a highly expensive proposition to the SEBs. It involves extension of lengthy distribution lines entailing high T&D losses. The cost of generation and supply to the consumer in such cases would be significantly higher than the average cost of generation and supply in the Board.

ii) Even compared to the average cost of generation and supply, the revenue per unit sold to the agricultural sector has been very low. Further, ***the gap between the average cost of generation and supply of power and average realisation from the agricultural sector is widening significantly***. All India comparison of the cost of

generation and supply and realisation from the agricultural sector is shown in figure 4.2 below. (See table in Annexure IV)

iii) Energisation of pumpsets costs about Rs 15000 each. These are financed through loans which bear an interest at 10.6% and generally repayable in 8 to 12 years. The annual interest burden works out to be around Rs 1590/annum/pumpset. In addition, the annual instalment for repayment would be Rs 1500; assuming an average of 10 years repayment making a total of Rs 3090/annum. On the other hand, in most of the States, the tariffs realised by the Boards are well below this figure and are even as low as Rs 310 - Rs 50 for a 5 HP pumpset (per annum). Thus, the revenue realised by the SEBs for energisation of pumpsets does not cover even a meagre amount / portion of the interest liability on such loans. As such and the question of Boards receiving any revenue towards the cost of power supplied does not arise in a large number of Boards. This is a highly untenable position and is the root cause of all the financial problems of the Boards. Even assuming a 10% load factor and an average fuel cost of 25 p/unit the minimum tariff for the agricultural ***pumpsets should provide a recovery of about 119 p/unit even if the Boards were to recover only the interest on the investment and repayment liability for the REC loans and the fuel cost for power***. The tariff, on the other hand, averages around 17p / unit.

FIGURE 4.2



Source : Govt of India - CEA and Annual Accounts of various Boards

iv) The share of the agricultural consumption out of the total sales of the Board has been rising. Commencing from 7569 million units in 1975 representing 16.5% of the sale, in 1987-88 it stood at 25.06% (34689.14 MU) and rose to 28.2% in 1992 (58557.17) (See figure 2.4). See Annexure V for State-wise detail of Agricultural Consumption

The growth of sale of power to agricultural sector (table 4.4) has been faster (12 %) than the average growth of total sales (9.64 %) and of the installed capacity during 1975-1990. In some of the states like Uttar Pradesh, Haryana, Punjab, the share of agricultural consumption is around 35% - 40%. It would be of interest to note that in states like Bihar, Orissa, West Bengal, Karnataka and to an extent in Madhya Pradesh and Maharastra, the growth in agricutural sales has far outstripped the average growth of total sales of power. While in states like Gujarat and Kerala the two growth rates are roughly the same. Tamil Nadu stands apart as the only state where the growth in agricultural sales is lower than the average growth of total sales of power during the period 1975-1990. See figure 4.3 below.

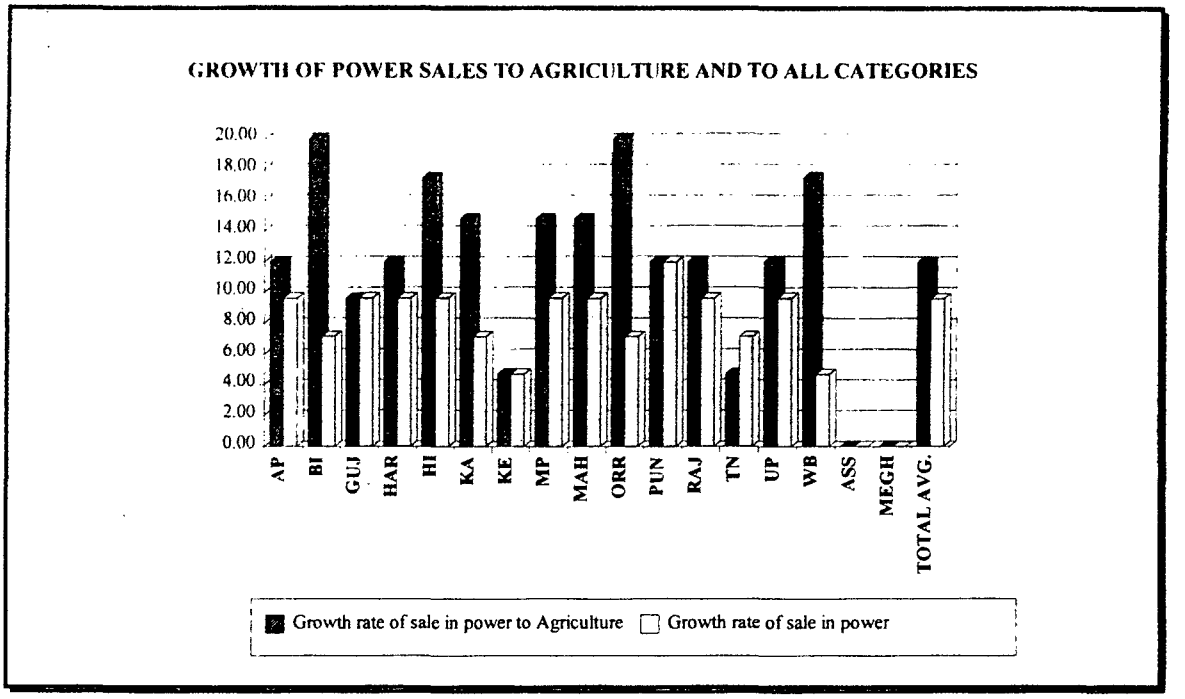
TABLE 4.4
GROWTH OF SALE OF POWER
(AGRICULTURE AND ALL CATEGORIES)
(1975-1990)

STATES	GROWTH RATE OF SALE OF POWER TO AGRICULTURE	GROWTH RATE OF SALE OF POWER
AP	12.00	9.64
BI	20.00	7.15
GUJ	9.60	9.64
HAR	12.00	9.64
HI	17.48	9.64
KA	14.82	7.15
KE	4.71	4.71
MP	14.82	9.64
MAH	14.82	9.64
ORR	20.00	7.15
PUN	12.00	12.00
RAJ	12.00	9.64
TN	4.71	7.15
UP	12.00	9.64
WB	17.48	4.71
ASS	-	-
MEGH	-	-
TOTAL AVG.	12.00	9.64

Note1: The figures represented above are compound growth rates.

Note 2: The above have been compiled utilising figures of power consumption by the agricultural sector as reflected by the Boards' in their annual accounts.

FIGURE 4.3

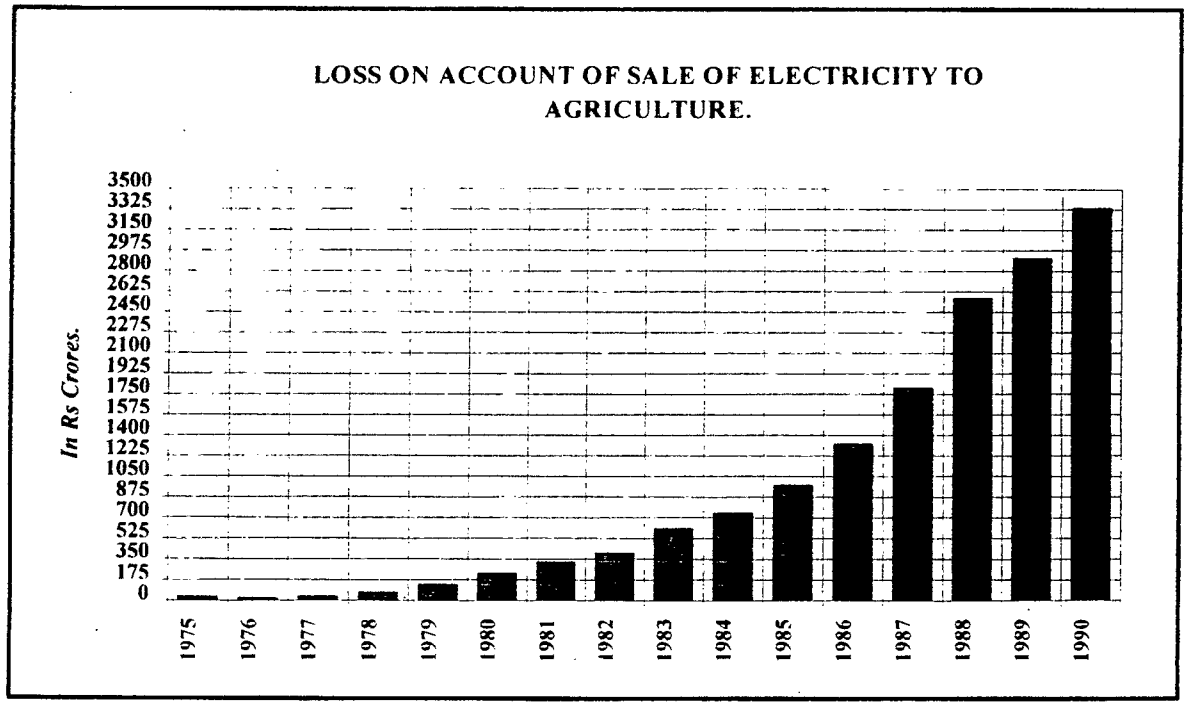


LOSS ON ACCOUNT OF SALE TO THE AGRICULTURAL SECTOR

Owing to the rise in consumption of power in the agricultural sector and the very low tariff levels, this sector has contributed tremendously to the Boards' overall losses. The table below (4.5) shows the growing losses that SEBs have incurred on account of sales to agriculture sector.The losses are calculated based on the average cost of generation and supply for all categories and the realisation from the agricultural sector. From table 4.5, one can see that in mid-seventies, states like Karnataka, Maharashtra, Orissa, Madhya Pradesh, Rajasthan, West Bengal and for a year even Bihar had shown profits on account sale of power to the agricultural sector. On the other hand, states like Andhra Pradesh, Gujarat, Haryana, Punjab and Uttar Pradesh that have progressively increased their contribution to the overall losses on account of sale to the agricultural sector. Maharashtra stands out as the prime example of contributing third highest loss figures to the overall losses after Uttar Pradesh and Punjab despite the fact that Maharashtra had shown profits during 1975-78. Figure 4.4 ***shows that over the past fifteen years the loss borne by the Boards (all India) has increased from***

roughly 35 crores to almost 3500 crores which implies an increase of almost 100 times.

FIGURE 4.4



Compensation for the Supply of power to the SEBs

There are no satisfactory arrangements to compensate the SEBs for the losses incurred on account of supply of power to the agricultural sector at highly concessional rates of tariff. Although the State Government /SEBs are committed to the World Bank during the operation of RE-II & RE-III credit agreements that their Governments would compensate the Boards to the extent of loss of revenue due to sale of power to the agricultural sector or the additional revenue needed to maintain the prescribed rate of return, whichever is less, such assurances have been practically ignored. In practice, only a few Boards are claiming RE subsidy, even these are not paid. A large number of Boards are not claiming RE subsidy on the ground that the State Government does not entertain such claims (eg., Rajasthan, Gujarat etc). One probable reason for the non payment is that the subsidy is claimed on account of sale of power to the agricultural sector, which is not metered but ***"estimated"***. These figures may not be acceptable to the Irrigation department on the ground that a part of the "agricultural consumption" figures

include T&D losses, the respective State Governments turn down the claims for RE subsidy made by the Boards .

There are other problems also. The State Governments argue that ***while subsidy may be payable to the SEBs, the SEBs themselves owe interest to the State Governments and that they should be off-set.*** The fact that the overall tariffs prescribed are themselves well below the cost and do not enable the interest liability being met, is just ignored. In some States, interest due and also repayment of loans, if due, are also offset before releasing further loans for capital projects. Sec 67 of the E(S) Act which **stipulates that the payment of interest to the State Government for its loans is the last priority out of *available* cash generation.** Where there is no cash surplus, the interest is not payable in the year and the liability is to be deferred until the Board is in a position to generate adequate surpluses from which this can be met. Adjustment of claims for RE subsidy against interest on State Government loans contravenes the provisions of Sec 67 of the E(S) Act but is often resorted to and some State Governments offset interest due / repayment if any, falling due against RE subsidies and release of capital funds.

The preceding paras outline the fundamental causes for the financial distress of the Boards. On the one hand there is an increasing pressure to supply more and more power to the agricultural sector, there is stress on acceleration of pumpset energisation programmes, extension of supply to remote villages etc., while funding of the projects is taken care of by agencies like REC, the Board is not assured of an adequate tariff to recover the cost of supply, or even the interest on the investments which the Boards are called upon to pay to REC, nor is there any satisfactory arrangement by which the State Governments compensate the Boards for the loss of revenue.

The above happens inspite of the accepted fact that SEBs are commercial concerns and should be allowed to conduct their operations on a strictly commercial basis. It is agreed that the prerogative for prescribing concessional tariffs to any category of consumers rests with the State Government, Sec 78 A(i) of the E(S) Act provides that the State Government may issue such directions to the SEBs on policy matters as deems fit and these are binding on the Boards. At the same time, keeping in view the provisions of Sec 59 of the Act, the State Government should compulsorily compensate the SEBs on account of losses sustained by the Board for supply of power at a concessional rate/tariff as a matter of State Policy.

LOSS ON ACCOUNT OF SALE TO AGRICULTURAL SECTOR

TABLE 4.5

LOSS IN Rs.CRORES

	1975	*1976*	*1977*	*1978*	*1979*	*1980*	*1981*	*1982*	*1983*	*1984*	*1985*	*1986*	*1987*	*1988*	*1989*	*1990*
AP	3.88	1.11	4.07	7.52	9.18	14.71	16.97	21.08	41.45	60.92	88.67	122.63	169.83	228.93	200.08	258.34
BI	0.91*	8.64	9.54	4.81	5.93	14.87	18.36	26.11	42.28	50.25	56.27	92.23	120.09	145.22	156.74	173.45
GUJ	5.51	3.49	4.69	3.69	7.02	12.52	24.12	15.35	28.00	31.57	49.17	69.05	94.71	297.22	371.61	412.30
HAR	5.35	3.59	6.65	7.06	12.01	23.30	22.65	38.12	49.33	51.00	67.25	70.54	99.77	199.36	161.40	190.15
HI	0.05*	0.03	0.00	0.10	0.33	0.52	1.29	1.26	1.03	1.10	0.84	1.28	1.75	1.72	2.60	2.04
KA	2.62*	3.37*	3.99*	1.17*	1.44*	0.27*	1.48	10.03	8.76	14.43	49.11	102.94	143.43	189.76	129.55	132.84
KE	0.63	1.13	0.65	0.11	0.37	0.48	0.58	0.49	1.53	3.23	1.50	2.10	4.51	6.91	4.96	10.88
MP	1.44*	1.80*	0.74*	0.28*	1.18	3.49	6.03	10.66	20.83	21.42	29.71	34.61	51.07	63.43	75.55	85.71
MAH	4.03*	3.03*	4.06*	1.56*	12.88	18.21	33.78	48.52	80.75	101.52	164.51	211.03	271.65	320.82	391.31	435.56
ORR	0.07*	0.08*	0.04*	0.14	0.61	1.09	0.97	1.26	1.92	2.10	2.20	3.56	9.75	6.73	9.24	9.16
PUN	7.78	5.16	6.96	14.21	18.13	31.17	40.44	35.71	60.13	67.14	90.73	122.39	205.18	318.51	386.41	471.99
RAJ	6.63	2.02*	0.92*	1.61	0.08	10.74	20.03	24.87	39.76	55.09	67.44	75.04	78.34	133.94	121.01	148.67
TN	20.76	13.12	18.89	16.70	29.72	39.36	64.96	83.03	110.23	129.51	130.41	182.88	203.13	227.65	277.28	346.80
UP	11.61	15.14	19.06	42.19	51.36	76.30	105.46	121.09	151.58	164.40	187.09	215.15	287.53	373.91	507.43	621.74
WB	0.10*	0.03	0.24	0.00	0.23	0.55	1.20	0.52	2.95	4.73	6.11	8.23	9.30	20.15	35.62	45.29
ASS	0.00	0.07	0.01*	0.07	0.14	0.01	0.31	0.19	0.28	1.48	1.82	1.04	1.79	2.30	2.69	3.19
MEGH	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.08	0.07	0.09	0.11
TOTAL	34.21	24.34	41.73	73.51	137.84	232.30	327.59	405.90	610.66	739.55	974.52	1330.70	1806.31	2569.33	2911.61	3338.75

Note: Figures with (*) represent profits for that year on account of sale to the agricultural sector

FINANCIAL IMPACT OF ENERGISATION OF PUMPSETS

It would be worthwhile to analyse the contributions the Boards have made in the field of agricultural pumpsets for boosting agricultural production and the losses the they have to suffer as a direct consequence. This could be best illustrated by the following data collected from APSEB who have added approximately 16.5 lakh pumpsets to date and their annual plan is to add about 1 lakh pumpsets a year.

Contributions made by the Board : The State brought under cultivation 99 lakh acres under agricultural pumpsets. This as compared with about 41 lakh acres irrigated under major irrigation projects like Nagarjuna sagar, Godavari and Krishna deltas. Increase in agricultural production in the state was estimated at Rs.3960Cr per annum. Employment opportunity of the order of Rs.105.6 Cr man days involving an average earning of Rs.2100 Cr per annum at Rs.20/day. Thus the contribution to the SDP is of the order of Rs.6000 Cr per annum.

Financial burden to the Board

Adding additional pumpsets of 1 lakh entails the following capital investment:

a) Pole/Line costs/proportional Transformer costs at Rs.23000/pump set **Rs.230 Cr**

b) Additional generating capacity of 120 (2) MW at Rs.4 Cr/ MW and HV/EHV transmission line (Rs.2 Cr/MW assuming a diversity of 1:2 i.e. only 1/2 the number of pumpset working at any given point of time) **Rs.720 Cr**

c

c) Interest burden on the above

on Rs.230 Cr at 15%	34.5 Cr	
on Rs.720 Cr at 15%	108.0 Cr	**Rs.142.5 Cr**

d) Debt Redemption liability

REC loan of 230 Cr in 5 year	46.0 Cr
Loan for generating sets of Rs.720 Cr	

in 10 years 72.0 Cr **Rs.132.0 Cr**

e) Loss incurred on account of sale of power on the basis of average 5 HP pumpsets running for 1800 hours a year and consuming approximately 6714 units per annum
Total consumption 671.4 M units at Rs.1.73/unit (average cost of generation and supply at 180 p/unit less 7Ps per unit recovered) **Rs.116.15 Cr**

From the above it would be seen that the financial burden to the SEBs by way of adding 1 lakh pumpsets would be a loss of Rs.116.15 by way of loss on account of sale of power and interest and redemption burden of Rs.274.5 Cr totalling Rs.390.65 Cr per annum. If one were to compute the additional financial burden of SEBs owing to installation of 16.5 lakh pumpsets and a plan of adding 1 lakh pumpsets per annum, the loss even from one Board will run into tens of thousands of crores for which the Board is not at all appropriately compensated.

It is also of interest to note that schemes for additional agricultural pumpsets are given utmost importance and *"special"* measures are undertaken to achieve the targets. It is also a matter of record that the ***targets set for agricultural pumpsets have substantially been exceeded***, as the table below (4.6) will show, although the targets for addition of generating capacity remain substantially unachieved. This only exacerbates the power supply and demand situation.

TABLE 4.6

TARGETED AND ACTUAL ADDITIONS OF PUMPSETS FOR ALL INDIA

	Number		Cumulative
	Target	**Actual**	
1990 - 91			8,909,110
1991-92	234,530	481,998	9,391,108
1992 - 93	256,750	460,046	9,851,154
1993 - 94	275,580	424,890	10,276,044
1994 - 95	280,119	194,177 Apr - Nov	10,470,221

Source:CMIE: India's Energy Sector; July 1995.

At the same time, there appears to be no awareness of what it means to the SEBs. Nor do the Central Governments, State Governments or the Planning Commission ensure that sufficient corrective actions are being simultaneously put in force to see that the Board does not move from a position of financial distress into further deeper and deeper positions of financial insolvency.

In particular, while the Rural Electrification Corporation takes special care (& trouble) to grant loans for extension of village electrification/agricultural pumpset programmes (funding for these being the prime activity of REC) and ensures that their loans are appropriately serviced/redeemed, they do not attach any importance whatsoever to the impact the schemes have on the SEBs. Often, this leads to a situation where the loans sanctioned by the REC are offset against earlier outstanding repayments, leading the Boards to have to complete additional programmes with no inflow of funds.

The above presentation highlights the colossal problems the Boards have had to face in supplying power to the agricultural sector for the production of food grains. Members of SEBs and Power sector feel that despite several discussion in various forums no concrete solution has been found to resolve these problems. The boards are doing their best to survive on a day-to-day basis despite these handicaps. It is in this process that Boards are, at times, unable to pay for power purchase, coal etc.

There are several hidden facets of the supply of power to the agricultural sector which need to be mentioned:

a) The supply is unmetered and hence there is no incentive for saving on energy drawal. On the other hand, every opportunity is built in for excessive use of power, resale of water to other neighbouring farms who may not have their own pumps and in turn maximise on the drawals at the expense of the boards;

b) There could be several unauthorised tappings for purpose other than pumping for irrigation (like electrification of rural households); Several houses have total electrical kitchens!

c) The ***farmers do not care about the efficiency of the pumpsets since the supply of power is unmetered.*** This adds to increased consumption. Over-consumption or excessive usage of pumpsets not only leads to ground water depletion but also results in increased power consumption for pumping the same quantity of water following years;

d) Also inefficient pumps add to reactive power thus increasing T&D losses and adversely affecting the voltage profile. There has been no way of motivating the farmers for taking effective action for procurement of energy-efficient pumpsets, adopting efficient foot valves, frictionless suction pipes etc to reduce electrical consumption or for installing suitable capacitors for providing reactive power compensation.

e) With a view to obtain lower tariffs, the farmers resort to changing of name plates to much lower ratings than what the pumpsets really are.

f) There is a demand from the farmers that supply of power should be made only during day light hours and not night times when the system has suitable surplus generating capacity. Such requests have the *"best"* political support. This adds to the strain on the SEBs of having to add additional generating capacity when, in fact the same load can substantially be met with the existing capacity. There has been a consensus for several years that un-metered supply is a bane to power industry and should stopped forthwith. It has also been accepted universally that unmetered supply results not only in uncontrolled and excessive consumption of electricity but also serves as a dumping ground for unexplained consumption elsewhere. The actual T&D losses are under-played by clubbing a part of the actual T&D losses along with the actual consumption of this sector. Yet, providing meters is not being attempted on an apprehension that this could lead to violent reactions from the farmers particularly, as this may be taken as a first step for curbing excessive consumption and may lead to billing on the basis of the **metered consumption.** Even at a tariff of Re.0.50/per unit, this could lead to a bill of Rs.900 p.a. for 1800 units, against a current liability of Rs.250 p.a. for a 5 HP set.

TARIFF FOR POWER SUPLIED TO AGRICULTURAL PUMPSETS

This has one of the most sensitive political issues since this affects the agriculturists, marginal, rich and very rich, who control a substantial chunk of the vote banks. The following are some of the important aspects:

a) Although the tariffs are on a flat basis, the flat tariffs have often undergone a **substantive downward revision from time to time** either as a result of electoral promises or with a view to vote catching. For example the reductions in Andhra Pradesh are as under:

November 1982	Rs.50/HP/year
November 1990	Upto 5 HP nil; 5 HP - 10 HP - Rs.100/HP/Year above 10HP 0.50 Ps/unit subject to a min. of Rs.150/HP/year
January 1992	Upto 5 HP Rs.100/HP/Year 5 HP - 10 HP Rs.250/HP/Year above 10 HP Rs.400/HP/Year
December 1992	Upto 5 HP Rs.75/HP/Year above 5 HP - No change
April 1995	All pumpsets Rs.50/HP/Year

b) Some states even provide totally free supply. (eg., Tamil Nadu)

c) The prescribed tariffs vary widely from state to state and political parties find it expedient to adopt tariffs which are uneconomical. Pressure are therefore generated both by the farmers as well as political parties (both ruling and opposition) to adopt lower tariffs prevailing elsewhere. This sets in a constant race for downward revision of the prescribed flat tariffs, perhaps until free supply.

d) Figure 4.2 indicates the trends of average cost of supply and average realisation per unit of electricity supply to the agricultural pump sets. It may be added here that the average cost of generation of power supply shown in the graph is the average for the entire country. ***Considering that the cost of generation of power supply to industrial consumers at EHT/HT and for urban consumption would be substantially less than for supply in remote villages involving extended transmission and distribution lines, the actual gap would indeed be much higher and the extent of losses also would be much higher.***

e) One of the recommendations Sharad Pawar Committee is prescribing a minimum of 0.50 Ps per unit as realisable revenue for supply of power for agricultural pumpsets. While exhortations to this effect has been made in several forums and several states also confirmed having implemented this, this does not appear to be true. Also several states are yet to agree to implement this[3]. The exceptions by way of implementation by any rate are singular. The projected average realisation (1995-96) in respect of some of the larger boards which reflects the current status, is given below in table 4.7:

TABLE 4.7

PROJECTED AVERAGE REALISATION (1995-96)

Andhra Pradesh	7.4
Bihar	14.8
Gujarat	27
Karnataka	20.5
Kerala	22
Madhya Pradesh	6
Tamil Nadu	0
West Bengal	26.9
Maharashtra	24.4
All India	**24.5**

Source: CEA and Planning Commission

[3] A minimum tariff of 50p/unit was agreed upon both by the NDC and in the power ministers' conference. However, the State Governments fear that implementing this minimum tariff would prove to be very *"unpopular"* for them. This is despite the study by CPU that such an increase in tariff (at 1989-90 tariff and cost levels for power) would not only cover two-thirds of the SEBs' cost of power but would only result in a rise of 30p/Kg of the foodgrain prices sold in the open market or through the PDS.

Sunil Mukhopadhyay: ***"Turning the SEBs Around"*** : Financial Express, June 18,1996.

The above figures are the latest projections for 1995-96 to the Planning Commission. In some of the states, the actual realisation in the preceding year is far less than what is shown above; e.g. Karnataka 3.2 Ps/unit; Punjab 27 Ps/unit

f) Upward revision of tariff for the agricultural sector is indeed an uphill task and would largely depend upon the political strength and determination of the Govt in power. In the not-so-distant-past, demonstrations at Shamli led by the farmer leader Tikayat against a minor increase in the tariffs by UP Govt, led to destabilisation of the State Govt in power, a further decrease in tariffs, accompanied by non-payment of the dues of the order of Rs.150 Cr by the Kissans as a protest. This loss had to be borne by the UPSEB.

ENERGY LOSS DUE TO INEFFICIENT PUMPSETS

At present there are about 11.6 million pumping sets in the country and their aggregate installed capacity is 41000 MW. The annual energy consumption of the agricultural sector is about a third of total energy sales. Field experiments conducted by SEBs over the past 15 years have revealed wide variations in overall efficiency figures across the states. But the average efficiency is about 25 per cent. Also, while the efficiency level of pump sets manufactured in the organised sector is reasonable, it is poor for sets manufactured by the small sector. After allowing for the inefficiency of generating plant/pumping sets, auxiliary consumption, T&D losses and others, the utilisation of energy from thermal power stations by agricultural consumers is hardly 8 per cent. That is the magnitude of the inefficiency built into the present system.

Agricultural sector power tariff, being fixed on the basis of BHP rating of sets, also vitiates the incentive to procure the somewhat more costly - but more energy efficient - pumping sets. Nor is there any optimum use of the water for irrigation purposes, and there is friction loss through foot valves and piping.

According to S.N. Roy[1] the average cost of a 5 BHP pumping set is about Rs 10,000 and free replacement of the inefficient 11.6 million pumping sets may

[1] This section is a summary of S.N. Roy's article *: **Debating power saving possibilities in agriculture:*** Economic Times 19th January 1996.

involve a capital outlay of about Rs 12,000 crore. The average efficiency can easily be doubled from 25 per cent to 50 per cent. By this change, an agriculturist can cover double the irrigated area with a 5 BHP pumping set, or for the same area the electricity consumption can be reduced by half by using a 2.5 BHP set.

The connected load of the agricultural sector is about 25 per cent of the total connected load. Power shortages in some states mean that pumping sets are normally operated in two shifts and are disallowed at peak time. Even with a diversity factor of 3, the demand of the pumping sets in the morning peak is about 14000 MW which corresponds to about 24000 MW at the power station after allowing for heavy peak T&D losses at about 35 per cent and auxiliary consumption at 7 per cent. The country is meeting a gross system demand of 48000 MW and the maximum demand of the pumping sets at the power station is thus about 50 per cent of gross system demand.

In short, 50 per cent of the installed capacity of about 81000 MW is required to meet this demand. Also, during peak irrigation months, monthly consumption in several states exceeds even 50 per cent, although the annual average energy consumption of agricultural is 33 per cent. Thus about 50 per cent of the installed capacity is exclusively utilised to meet pumping demand; so if efficiency levels are raised from 25 to 50 per cent, the installed capacity requirements will go down by about 20000 MW. The investment requirement for creating 20000 MW of generating capacity, with matching transmission and distribution system, works, at present day prices to Rs 120,000 crore.

In a nutshell .....

- To achieve the objective of meeting power requirements of the pumping sets, the two available options are :
- free replacement of existing inefficient sets by efficient ones at a cost of about Rs 12000 crore.
- installation of new capacity at a cost of Rs 120,000 crore.

The first option involves only 10 per cent of the outlay needed for the second; it should be the obvious choice.

Other options can also be explored, beginning with a flat rate of power for the agricultural sector. That provides perverse incentives and only when costs rise will the private sector introduce energy conservation measures.

SUMMARY OF CHAPTER IV

Chapter IV shows that the single factor that has effected the SEBs finances most is the massive energisation of agricultural pumpsets and the rise in agricultural power consumption. Figures show that the ***loss on account of sale to the agricultural sector has increased almost a hundred times*** in a time period of 15 years (from 1975). In the process of providing power to the agricultural pumpsets the Boards have not been compensated either by the consumer (in this case the agricultural producer in the form of tariffs) nor have the State Governments provided adequate amount of subsidy to the Boards. A poignant fact is that while the Central government subsidises fertilisers it does not feel compelled to do so in the case of sale of power to the agricultural sector nor does the Centre compel the State governments to compensate the Boards. Chapter IV also shows the cost that the Board incurs in installing a single pumpset and when targets of massive energisation of pumpsets are not only completed but substantially exceeded year after year this only adds to the Boards losses. Tariffs for agricultural pumpsets are revised only downwards, and with increasing agricultural consumption this is bound to put the Boards in further distress. Upward tariff revisions are almost impossible for this sector, thus, what needs not be done is to curb the misuse of power in the agricultural sector, and encourage the use of more efficient pumpsets. As shown in this chapter, a raise of 25-50% in the efficiency levels would mean that the installed capacity requirements would come down by 20,000Mws and an investment of Rs.1,20,000 crores can be avoided.

CHAPTER V

SUMMING UP

The study in the preceding chapters outline the problems faced by the Indian power sector in general and the SEBs in particular.

In the second chapter, the section on conflict of interests indicates a lack of coordination among the organisations that form the power sector. This is because electricity being a subject in the Concurrent List under the Constitution, the responsibilities in looking after this element of infrastructure falls both on the Central and State Governments. ***Because of the dual responsibilities involved with the Centre and State, there are instances***[1] ***in which the perspectives of the Central Govt and State Govts are always not congruent.***

In the following section on the technical performance of the power sector, the following aspects come to light.

a. Plan-wise targets have never been achieved nor have the slippages been contained to a reasonable level. The power sector does not have an optimal hydro-thermal mix as was stressed in the Seventh Plan and the trends show that the extent of hydro capacity as a ratio of total capacity is decreasing and also that the generation from hydel stations per Mw of Installed capacity is also decreasing. Alongside, the share of agricultural consumption is on the rise while industrial consumption is on the decline. Estimation of power demands through Annual power surveys have projected higher demands in longer time frames and also has also not been accurate. Accepting the fact that estimation of demands is a very difficult task, one must recognise the importance of estimations with a certain degree of accuracy well in advance keeping in mind the gestation time of power projects, as this is very important to meet the demand without hampering supply to consumers.

b. The PLF of Indian thermal power stations is very low (55.5%) with almost 41% of its rated capacity being unavailable for generation. We also

[1] As was shown in that section

found that the published statistical reports of CEA indicate an "operational availability" of thermal plants at about 70 to 72%. However, this included "partial unavailability", during which there is no generation, estimated at about 11%. If we exclude, as it should be, the net availability of thermal plant for power generation would be only of the order of 55 to 58% which is low by international level. The increasing trend in the PLF that is noticed since the 80's was more due to the introduction of 500 and 210 MW sets rather than better operation of the existing plants. This finding is also supported in the responses to the questionnaires. Finally, it was also shown in the case of UP, how increasing trends in PLF by themselves should not be interpreted to mean better operations of the Board. For the time period in which the PLF was increasing, we saw the T&D losses were concomitantly increasing, leading to a situation where instead of having increased power availability from the Board's own stations operating at a "higher" PLF the increase in T&D losses more than offset the additional generation by the Board.

c. In the section on T&D losses, there were three important factors that were highlighted, viz., the share of HT consumers is on the decline, the All India outlay for T&D works is on an average only 33% and the 132/33 KW lines have only doubled while the total length of the distribution system has increased five times since 1970 - which, in-turn has lead to an overloaded transmission system. Agricultural consumption is unmetered highly over estimated, with almost 50% of the agricultural consumption being T&D losses (inclusive of theft). Over-estimation of agricultural consumption is merely a ploy not to show high T&D losses. From this, the actual T&D loss figures were recalculated to being 32% rather than 22% as is represented.

The next chapter, which deals with the financial performance of the SEBs highlights the following facts :

a. It was not until the late 70's / early 80's that the Boards were required to break even. Under the then existing statutes, they were merely to attempt this ***as far as possible.*** Also, it was only after the early 80's that the Boards were required to generate a surplus of 3% and contribute to the expansion programmes. Thus, what follows from the above is that for about three decades (since independence) there no clear compulsion for the Boards to generate a surplus-a concept quite consistent with the objectives of a utility service, nor was there a clear concept of

financial viability for the sound financial performance of the State Electricity Boards.

b. Acknowledging the fact that the SEB's have been incurring huge losses and the cumulative loss figures of the Board's (excluding RE subsidy) in 1990-91 was almost 6000 crores, the question then raised was regarding the factors that affect the financial performance of the SEB's. These can be divided into endogenous (which includes, low generation of output, T&D losses and heavy arrears in revenue collection & high establisment costs) and exogenous factors. It was demonstrated that the Boards can show lower losses and even profits ,if, even some of the exogenous factors were removed. As most of the endogenous factors also include within them some exogenous factors (grey areas), it was concluded on the basis of previous studies and some examples that their (endogenous factors') contribution to the losses of the Boards' was not as significant as that of exogenous factors. It is for this reason that the study had paid more attention towards the financial impact of some of the important exogenous factors on the SEBs . Some of the endogenous factors that have studied are, arrears in revenue collection and levels of manning.

The exogenous factors include, low levels of tariffs (including agriculture and other categories); massive energisation of pumpsets and village electrification programmes, for which the SEB's are not compensated adequately by the governments (State and Central). Also among the exogenous factors are, inadequate capital structure of the SEB's which does not include any equity and interest during construction (IDC) not being capitalised until 1985. After this was done, the Boards overall profitability increased. On the same lines, it is shown that the Board's overall profitability would further increase if equity participation is introiduced. One also finds that if SED was retained by the Boards and not passed on to the State government, they would be exhibiting reasonably good profits (or very low losses) instead of the very high losses and contribute to capital formation by about 50%. Another significant exogenous factor that affects the finances of the SEBs is the unfavourable pricing of coal ,gas and railway freight for the transportation of coal. The price of coal is not based on its calorific content and eventually in some lower grades of coal the price per M.Kcal is higher than that for higher grades of coal. The fact that more coal has to be transported for the same power output has been ignored, in detriment to the Board's interests. In the case of rail freight, the changes in rail freight tariffs have progressively led to the

average freight prescribed for coal used in the power sector being much higher than the average cost of transportation. As a result, transportation of coal for power now subsidises other categories, whereas earlier, other categories subsidised transportation of coal for power. On the pricing of gas, the pricing based on HBJ pipeline instead of coal equivalent makes use of gas for power generation uneconomical. Such a situation arises inspite of Finance Ministry's recommendation in 1987/88 on the optimal use of gas, that gas for power generation is in best national interests vis-a-vis other uses such as fertiliser production.

Coming to the aspect of tariffs for use of power we find a lot of alarming facts:

i. The average realisation from the agricultural sector is not only far below the average cost of generation and supply but is moving away from it.

ii. The all India average realisation from the 'other than agriculture' category is below the average cost of generation and supply.

iii. On a statewise basis we find that some states (Karnataka, Bihar, Madhya Pradesh, Mahrashtra, Orissa, West Bengal and Rajasthan) have moved from a situation where the tariffs from the agricultural sector were above the average cost of generation and supply to a situation where they are far below the average cost of generation and supply.

iv The above dispels the general impression that non-agricultural consumers as a class, are providing cross-subsidisation for losses sustained by Boards in supplying power to the agricultural / rural sector at low tariffs. This may be partly true, only in a few Boards, or for some specific category of consumers like HT.

Data across the Board's reveals that the revenue outstanding varies as much as 204% to 9.8% of the annual sale of power while the stipulated limit is 16.6%. The overall average in 1987 was around 25%. The general feeling about the SEBs is that they are overstaffed, even though there are no norms of calculating the appropriate levels of manning in the SEB's. There are instances when the Boards are subject to political pressures to continue employ staff beyond their

requirements, (as was shown in the case of Uttar Pradesh) which in turn affects the efficiency and finances of the Boards.

Chapter IV shows that the single factor that has effected the SEBs finances most is the massive energisation of agricultural pumpsets. Figures show that the ***loss on account of sale to the agricultural sector has increased almost a hundred times*** in a time period of 15 years (from 1975). In the process of providing power to the agricultural pumpsets the Boards have not been compensated either by the consumer (in this case the agricultural producer in the form of tariffs) nor have the State Governments provided adequate amount of subsidy to the Boards. A poignant fact is that while the Central government subsidises fertilisers it does not feel compelled to do so in the case of sale of power to the agricultural sector nor does the Centre compel the State governments to compensate the Boards. Chapter IV also shows the cost that the Board incurs in installing a single pumpset and when targets of massive energisation of pumpsets are not only completed but substantially exceeded year after year this only adds to the Boards losses. Tariffs for agricultural pumpsets are revised often downwards, and with increasing agricultural consumption this is bound to put the Boards in further distress. Upward tariff revisions are almost impossible for this sector, and hence, what needs not be done is to curb the misuse of power in the agricultural sector, and encourage the use of more efficient pumpsets. Also as shown in this chapter, a raise of 25-50% in the efficiency levels would mean that the installed capacity requirements would come down by 20,000Mws and an investment of Rs.1,20,000 crores can be avoided.

Finally, several experts whose opinions have been obtained via questionnaires have expressed the view that the performance of the SEBs is really outstanding considering the circumstances under which they are placed. It would be in the overall national interest to recognise the problems faced by the Boards and find solutions therefor.

PRIVATE SECTOR PARTICIPATION AND THE ELECTRICITY BOARDS

Electricity Boards stand condemned for their inefficiencies and without an understanding of the underlying causes therefor. Even when the causes for the losses are fully known, there has been no concerted effort or will to set right matters. Other easier options are freely talked about, and taken in hand without making sure of long-term interests.

A series of developments have taken place in the recent past and such developments will continue in future in total disregard to the long term interests of the SEBs. These are briefly enumerated below:

i) The policy of private sector participation in power generation and supply legislated by the Central Government provide undue and unwarranted advantages to Independent Power Producers (IPP) on plea of having to attract investments on a larger scale. These include a high rate of return of 16% on equity, the non-competitive approach to selection of IPPs, the Central Government guarantee/counter-guarantee for recovery of dues from the Electricity Boards or establishment of *'ESCREW'* accounts to ensure that the IPPs receive their dues in time irrespective of Boards' other ever pressing financial commitments. Thus, revenues of the Boards are automatically locked in until dues to IPPs are paid fully. While this may relieve Central Government of having to stand guarantee, the Boards' position in regard to liquidity grows worse.

ii) New power projects are being allowed to be set up using petroleum based fuels like diesel, NAPTHA, gas and LNG all of which have to be imported by the country. Using petroleum base fuels for power generation was a thing unheard of in the history of power generation in India owing to limited petroleum product availability within the country, the foreign exchange implications and also the high cost of power generated using this source. Dependence on the petroleum products for power generation would have a telling effect on the foreign exchange position as the recurring outgo at the current levels project planning may involve an outgo of the order of $1 billion a year[1] . Also, small increases in the prices of crude and changes in the rupee can lead to steep escalation in power costs.

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[1] This aspect also comes out of the Newspaper articles by K.P Rao and Arun Ghosh :
"Review of the ENRON project- Some suggestions" : Business Line May 23rd 1995
"Private participation in power generation: Aspects needing review" Hindu, December 6th 1995.

iii) An added handicap to the Boards is the commitment to buy all the power that is generated, eg. Dabhol Power Corporation, resulting in a situation in which the Boards have to back down their cheaper source of power and absorb costlier power from a vendor.

iv) Indigenous coal, though of poor quality, has been successfully used to operate a high level of PLF above 90% consistently over a number of years through specially designed boilers. Vijayawada Super Thermal Power Station (VTPS) is a glaring example of this. Adequate resources of coal are available, unlike petroleum products whose reserves are expected to last a couple of decades. As such planning for base load power projects on petroleum based fuels does not seem to be wise, even conceding that gestation periods are shorter and environmentally better.

v) The advent of IPPs ignores the usage of indigenous equipment and leads to purchase of equipment from foreign sources while indigenous industry starves for orders. (eg. BHEL)[2]

vi) The depreciation rates have been specially raised by about 100 to 150% to accommodate the IPPs in their cash flows. Whatever be the justification, it only increases the cost of power and hence the losses to the Boards unless tariffs are substantially raised.

vii) Although after considerable deliberations, it was accepted all round that two-part tariff approach should be adopted* for pricing power from IPPs and this recommendation was also evaluated by the Consultants (ECC)[3] appointed by Asian Development Bank and the requirement was statutorily notified, the Central Government themselves, and with their support some State Governments, have *grossly* violated this statutory requirement and have concluded Power Purchase Agreements with the single-part tariff adopting very high levels of PLF, to bring down tariff levels artificially to make them look reasonable. Of course, coupled with this goes the commitment to buy ***all*** the power that is generated which increases losses to Boards.

"The sell-out to MNCs in Infrastructure" : Financial Express, November 11th 1994. (Arun Ghosh)

[2] Inspite of BHEL's cost per MW being the lower than the other contenders(Co-gentrix), it was not given the deal. Financial Express ***"Policy bias against BHEL alleged"*** : 10th June 1994.

* ***"A Raw deal to the State Electricity Boards"***: Financial Express, 19th Dec 1995.

3 ***Study of bulk Power and transmission tariffs and transmission regulations*** for the Government of India and the Asian development Bank in cooperation with the World bank.

viii) With the advent of IPPs and the liberal measures that have been adopted to attract foreign investments into power sector, claims have been made by public sector organisations within India like, NTPC, NHPC etc. to obtain similar benefits for themselves in the shape of increased rates of depreciation, raising the rate of return from 10 to 12% and then to 16% and these organisations have also been pressing for counter guarantees/appropriations from Plan allocations of the States to liquidate their dues from the Boards.

ix) Non-payment for power from Central sector generating units has led to a re-thinking in the Government and organisations like NTPC to bring in a philosophy that only Boards which pay for power would get it. While, it may, prima facie, look reasonable, this does not take into account the reasons underlying the Boards' inability to pay. NTPC's interests lie in selling the power at as high a rate as possible to States which are very needy, depriving the Boards for whom the power was really intended for. This could also lead to a possible power cut off by the Centre (on grounds of non-payment) where the parties in power at the Centre and State belong to different affiliations. This could thus lead to a sinister situation of political blackmail.

x) Yet another facet is the thrust given by IPPs and Central sector organisations of their plans, intentions and rights to sell power directly to the remunerative customers namely, HT consumers and industrial consumers. It will be a mutual convenient arrangement both for IPPs and Central Sector generating stations as well as industries if such an arrangement is finally concluded, but this would mean total disaster to the SEBs.

Having concluded that SEBs are irredeemable and can never be set right, there is a fresh thinking that the SEBs should be ***"restructured"***, ***"abolished"*** and ***"partially privatised"***[*]. The Hiten Bhaiyya Committee appointed to make

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[*] The Central Government along with the World Bank had suggested 5 models for the restructuring of the SEBs. The objective of the restructuring programme were reformation of the SEB into a commercially viable outfit, regularisation and rationalisation of tariff and improving the Transmission and Distribution network.

The first model (known as the Orissa model) involves unbundling of generation, transmission and distribution and introducing multiple players in generation and distribution. This model brings in competition and improves efficiency to reach a stage where individual generation, transmission and distribution companies would be in a position to resolve the legal, financial (asset transfer) and staff matters. Distribution inefficiencies and tariff issues are the main reasons for the poor performance of SEBs and only independent functioning of these entities could resolve the problems.

recommendations in Andhra Pradesh submitted a Report[4], wherein the thrust of the recommendations was to separate generation and transmission into one Corporation, and distribution into regional corporations. It was expected that this would substantially improve operations and profitability. An under-lying assumption, is that the ***Committee assumed that the State Government would prescribe 50 Ps of tariff for power sold to agricultural sector and balance of the cost would be subsidised by Central Government, an assumption which is, prima facie, not valid.*** Again, Orissa Government has recently decided to do away with Electricity Boards altogether and appoint a Regulatory Authority and privatise generation, transmission and distribution on regional basis. Here again, it has not been brought out how transfer of control from a Government sector to private sector would substantially improve matters. ***It is implicit in arrangements that the private sector, when it gets into stride, will press for substantial tariff revisions and full payment of subsidies and the Government/Regulatory Authority would, by and large, find them reasonable and accept such revisions. If such decisions can be taken by a Regulatory Authority, why should Government itself not take such decisions directly or via Power Tariff Commissions.*** An experimentation in private distribution has been carried out in Noida under UPSEB and the results are

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Model II relies entirely on performance improvement of SEBs as they exist today by distancing the government and the SEBs and introducing a regulatory commission. This model would, however, not guarantee total autonomy in respect of tariff fixation which is the main difference between the present and the visualised SEB.

In Model III, the present SEBs are left with the ownership of the transmission system and entrusted with the grid control responsibility, while generation and distribution are separated first as in the first model. Since the workforce in the transmission sector are very small, as compared to that of the generation or distribution sector, this model is likely to face opposition from the workers.

Model IV is structured to avoid confrontation with the SEB establishment. It allows the SEB to continue all current operations but additional generating capacity would be introduced by competitive bidding. The distribution function now attended to by SEB on a state-wide basis would gradually be split into region-wise and formed into independent companies over a period of time. All new transmission lines would be constructed by a new company which will have the grid operating responsibility, own old lines and construct new lines..

The fifth model will involve splitting the SEB into different regional companies with responsibilities of transmission, generation and distribution.

Among the various states that have agreed to take up to restructuring of the SEBs are Orissa, Haryana, Rajasthan, Gujarat and Andhra Pradesh.

[4] Report of the High level Committee: ***"Guidelines on restructuring and privatisation of Power Sector and Power Tariff"***. Hyderabad, April 1995.

reported to be disastrous, with no improvement in the quality of power supplied and distributor pressing the Government hard to raise tariffs.[1]

In the circumstances, it is a moot point whether such privatisations will only be convenient rent seeking arrangements. While monopoly is bad, private monopoly is worse than Government monopoly .

[1] ***"UPSEB serves notice to NPCL" :*** Financial Express January 17, 1996.

APPENDIX & ANNEXURES

APPENDIX

RESPONSES TO QUESTIONNAIRES

Some of the major issues that were raised and dealt with in this thesis were also put forward to some distinguished experts[1] intimately associated with Power Sector.

The main issues broadly concern :

i) T&D losses; how far they are reasonable, and whether they can be reduced.

ii) Low PLF; the reasons therefor and whether it can be improved.

iii) Tariffs and their adequacy

iv) The recent changes that have been brought about in the Power Sector including private sector participation in generation and distribution.

From the responses that were received, the following can be concluded:-

T&D LOSSES : On T&D losses, all the experts agree that T&D losses in India can be brought down to a reasonable level of 15%. They also felt that the root cause for persistently high T&D losses and Boards not being able to do anything about it, is the lack of political will to pay sufficient attention to the large scale power theft-of 10% -12%, a severe shortage of funds to strengthen distribution systems and lack of motivation on the part of the SEBs. They

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[1] The addressees were the following :

1. Dr N.Tata Rao, former Chairman of APSEB, Member CEA.
2. Shri M.K.Sambamurthy, former Chairman CEA
3. Shri SN Roy, former Chairman CEA
4. Dr Kirith Parikh, Director, IGIDR
5. Shri Arun Ghosh, former Member-Planning Commission
6. Shri J C Gupta, former Chairman UPSEB and former Member CEA
7. Shri J V Sastry, former Member CEA
8. Shri S.Venkitaramanan, former Secretary Power, Fin. Secy and Governor - Reserve Bank of India
9. Shri T L Shankar, former Chairman APSEB, presently Principal of ASCI, Hyderabad
10. Shri M K Ganesan, Member-Finance, APSEB
11. Shri K.P.Rao, former Member (E&C), CEA.

unanimously agree that the theft of power, along with unaccounted energy drawals are the major contributing factors for high T&D losses. They are also of the opinion that the T&D losses shown by the Boards were "under-played" and a part of the 'actual' losses find their way into agricultural consumption figures, which are estimated and not metered.

ii) Over the past few years, there has been a tremendous increase in the usage of agricultural pumpsets. Based on the connected load and the consumption attributed, the average hours of usage works out to an unreasonably high level of over 7 hours in some States against 3 to 4 hours in other States. Not all of the consumption is therefore genuine usage for agriculture, and may be due to power meant for the pumpsets being used for light industries, cold storage, heating of water (even for washing cattle in UP!) and cooking.

LOW PLF : On the low level of PLF of Thermal plants, the primary reason given by the experts is the sub-standard /inappropriate quality of equipment which frequently breaks down. Another reason is the poor quality of coal that is supplied/used for generation, which leads to the damage of equipment and plant outage.

The view also emerged that the PLF levels can be increased with the introduction of more 200/500 MW sets, and better quality of coal being used including imported coal. Historically, the low PLF was due to units of less than 200 Mws capacity, and inappropriate boiler design (Czech) of 110/120 Mws which could not handle coal of high ash content. According to Mr.M.K.Sambamurthy, the initial phase indigenisation - where the PLF was low - can be treated as a learning experience. The designs were later modified to fluidised bed boilers suited to Indian coal quality, after which generation levels increased to levels of 90% and above .

According to Arun Ghosh, bad maintenance is a major factor for low PLF. Further, he says that lack of a proper generating capacity mix for supplying base load demand and peak load demand also adds to the low PLF. The demand for continuous power is only from a few industries and domestic demand for power is only for a few hours during peak time and the evening. Meeting peak load demand through base load stations would mean that the plant would have to back-down in

off-peak hours. Thus, we have a situation where the boiler has to be kept hot and yet reduce the flame in off-peak hours - implying high costs. What all this adds upto is that plants have to reduce generation by a considerable amount during off-peak hours - leading to a low PLF. Thus PLF is a wrong indicator of efficiency. The real test should be 'availability' of plants.

He specifically mentions ENRON (gas based station). According to him, this is one classic example wherein it was contracted for a base load station with commitment on ***"must run"*** basis, (90% off-take) in spite of power from this plant being more expensive than from other base load stations, eventually leading to the more economic stations backing down. This would be totally disastrous to the Board.

A view also emerged that improving the quality of coal supply through usage of washed coal, better coal handling plants (CHPs), standardising the quality of coal supply and/or using an appropriate blend of imported and indigenous coal can improve the PLF. Mention has been made of Renusagar Thermal Plant (a private plant) ensuring good quality of coal supply by taking "appropriate" steps. The Power Sector should also force CIL to ensure some minimum quality and ensure it is implemented.

TARIFFS: All the experts agree that political pressure is the most important cause for tariffs both for agricultural and non-agricultural consumers being low i.e., below average cost of generation and supply and at times even below fuel costs. Equally important is the inadequacy of the tariff revision mechanism to ensure absorption of the rising costs automatically.

According to Mr Sambamurthy, the SEBs are not allowed to operate with any autonomy (despite statutory provisions) and basically serve as the "*golden goose*" for the ruling Governments for bestowing patronage and largesse despite the Boards' deteriorating financial health.

MANNING: On Boards being overstaffed, all respondents again agree unanimously but are unable to suggest ways and means to determine the optimal employment or the extent of over-staffing. Arun Ghosh says overstaffing is one of the minor reasons for the Boards' inefficiency, but adds that a corrupt system

abetted by political leaders is a major reason for the inefficiency of the Boards. According to Tata Rao, who was the Chairman of APSEB from 1974-88 , there were 60,000 employees in the Board with an installed capacity of 700 MW and a turnover of Rs 60 crores at the beginning of his tenure. By 1988, there were about 56000 employees for a capacity of 4000 MWs with a turnover of Rs 1000 crs. This gives an idea of the extent of overstaffing in the Boards. He says that there are a lot of political favours that have to be catered to - which in turn make the Boards overstaffed. An example in,UP where a power station in Kanpur was totally closed down and staff of 1100 continuing for several years is indicative of the malaise.

OVERALL PERFORMANCE: On the aspect of overall performance of the Boards, the following can be concluded from the responses.

i) Most of the experts feel that the Boards' performance has been most creditable under the constraints they operate in.

ii) The relative performance of the Boards varies from State to State and Region to Region. For eg., the North-eastern and Eastern, the performance of the Boards is not all satisfactory, while the Southern Boards have been, by and large, either good/excellent. Dr Kirith Parikh feels that almost 80% of the reasons of the Boards losses due to inefficiency are beyond the control of the Board, while only 20% are within the Boards' control (eg. PLF, T&D losses etc.)

PRIVATE SECTOR IN POWER:

i) On the question whether Privatisation of Boards would make them more efficient - in all aspects - technical, financial and administration - five replied in the negative, 3 responded positively. While 6 of the experts believed that the Boards should not be totally privatised, 4 held the view that they should be. Those in support of privatisation are of the opinion that, by fully privatising the SEBs, there would be considerable autonomy, less political pressures and targets would be set and achieved with greater commitments.

Arun Ghosh, who says that the Boards should not be totally privatised, says that they should be made into autonomous Corporations with loans being converted into equity and with a mandate to manage tariffs and their finances. This

according to him would improve the Boards performance dramatically. Many SEBs such as Andhra Pradesh, Tamil Nadu, Maharashtra etc. do perform well technically but not financially - which depends very much on tariffs.

Mr Sambamurthy who also believes that privatisation would not help much says that the existing private sector units have not shown any outstanding performance which is better than or even comparable with that of the good Boards. He adds that privatisation in the transport sector has not been such a success. According to him, the manner of privatisation is important - he believes the SEBs can be reformed but the proposals suggested by the Government are just skirting the issue. He further adds that so much adverse opinion is whipped against the SEBs, that it is difficult to stop the current reforms (particularly since the Government is under World Bank - ADB pressure).

ii) On Area Licenses for distribution of power, most of the respondents believe that it would accentuate the Boards' losses. This is because the Private Licensees take away important urban loads/industrial areas. The Boards would have only the non-paying rural/agricultural sector as private sector would not be interested in rural areas. Kirith Parikh while agreeing to private licensees on area basis, suggests that privatisation of distribution should be accompanied by a social surcharge to be given to the Boards to meet social obligations.

According to Mr.Sambamurthy, such an argument is not valid in the present context as there is a limit upto which the policy of cross-subsidisation (which includes surcharge of the type suggested by Kirith Parikh) can be followed. The losses on account of sale to agriculture are so high (as tariffs are low) that surcharge to the other consumers would eventually turn out to be so high (as much higher as tariff itself), that the consumers would find it viable to go in for smaller captive generation plants. Also, such high levels of cross subsidy/surcharge levy could itself be the subject matter for seeking judicial intervention.

iii) On NTPC/private sector supplying power directly to selected industries including railways, 7 respondents believe that this should not be done at all. Only 2 agree that this should be done. The supporters of this latter view believe that an assured supply of good quality power would fetch the supplier a higher tariff from the consumer and would be a motivation for private sector to come into power

sector. According to Mr.Sambamurthy, maintaining high quality and reliability in Power supply to a linked selected consumer is not technically possible in an integrated system. He concedes that while attempts in this respect have been made in certain pockets (export oriented units) of Andhra Pradesh/Karnataka, he is cautious that if this continues, i.e., selective supply to specific consumers, it would split the integrated system - which is a retrograde step for the power sector.

iv) Boards, according to most of the responses can supply good and reliable supply at a higher tariff - but again, this should not be higher than the cost of unit from diesel pumpsets or captive generation. Otherwise, this could lead to multiplication of small diesel based captive/standby units which are not economical.

v) Seeing the present position of the Boards and the shortages in power sector vis-a-vis demand, all the experts feel that private sector participation in power generation is necessary. But they all believe that inadequate Government guidelines, deviations from guidelines by some independent power producers, non-competitive bidding leading to higher capital costs, non-backing down and not adhering to Two Part tariff concepts and padding up of tariffs are the contentious issues that have arisen after the entry of the private sector - which in turn has resulted in the first three years of the Eighth Plan not witnessing a single MW of private power has been added through this route (nor is it possible for the next 2 years).

The views of Arun Ghosh are on the following lines:

On private sector in power, he says that privatisation has become the 'buzzword'. He reminds that there are a lot private industries that are sick. In sharp contrast, many Public Sector undertakings such as HZL, NALCO and IPCL which are performing better than their private counterparts. What is required is labour discipline, which it is wrongly believed can be maintained only in private enterprises. He emphasises that this can also be maintained by Public Sector undertakings through better management and lesser political pressures/intervention. A.B.B Babcock (a private boiler manufacturer) is one example where the company is kept 'alive' by subsidy and forced placement of orders by BHEL, a public sector undertaking.

What is called for is innovative decentralisation when it comes to area licenses for supply of power as in the case of West Bengal SEB, but has not been followed up in other States because of the ease with which power is stolen.

All in all, he says, we must have a proper balance of thermal and hydro power instead of a very large thermal power station (1000 MWS) as they have their own problems of T&D, cooling water shortage, ash and lack of demand at off-peak times. He further adds that there are diseconomies of large power stations which arise because of high capital servicing charges and T&D losses. In such a situation, capital servicing costs would be a major problem with the new official policy. A 3:1 Debt:Equity ratio or a higher one, raises capital servicing costs; and with interest rates at absurdly high levels in India today, would pose major problems to the power sector. Highly efficient plants like that of NTPC etc. dictate terms to the SEBs, forcing them to back-down and do not stick to merit-order-operation. He further adds that SEBs' importance cannot be overlooked as they own 55000 MWs of the 80,000 MWs of installed capacity and the total distribution and sales to ultimate consumers. We have to raise the overall efficiency of the power sector rather than throwing the SEBs to the wolves.

According to him, we have to look at the following things with regard to the changes in the SEBs :

1. Regional demand and supply
2. Mix of thermal:hydro and peaking power requirements
3. Proper financial restructuring of SEBs
4. Proper monitoring of losses and thefts
5. Modernisation of existing plants.

He adds that private power has always existed in the form of Tata Power, CESC, AESC etc., but if the new private power plants go the ENRON way, then it only means doom for the power sector and the SEBs.

FUEL FOR POWER GENERATION: On the question of choice of fuel that is to be used by the private sector, the following is the consensus.

i) Petroleum based fuels should be used ***selectively***, such as for peaking purposes for generation of power. There are some who believe that petroleum products should not be used at all.

ii) Almost all (9 out of 11) believe that indigenous coal should be used or should be given top priority for power generation. SN Roy points out that if Indian coal is washed and treated properly, this would vastly increase the plant's PLF and would be a more economical option than importation of coal.

iii) Also, according to the responses, imported coal can be used but again selectively (by mixing with indigenous coal) and as long as it commercially and economically viable. In fact, SN Roy says that power plants in coastal areas can use imported coal to generate power instead of transporting it to various parts of the country and Indian coal should be used for the other plants as was earlier suggested.

Many of the experts believe that major hydel power plants, wind energy, solar energy and other renewable sources of energy can be tapped (given the fact that they have no variable costs). This energy can then be sold to the agricultural/rural sector. This however seems to be a long distance away as cost-effective technologies have yet to emerge.

It was also mentioned that if irrigation was based on diesel pumpsets, this option would be more viable than pumpsets based on electricity (considering the costs involved in supplying power to the pumpsets).

ANNEXURE I

The RE subsidies reckoned in table 3.2 are as follows:

RE SUBSIDY TAKEN INTO ACCOUNT (Rs. Crores)

	SEBs	*1975*	*1976*	*1977*	*1978*	*1979*	*1980*	*1981*	*1982*	*1983*	*1984*	*1985*	*1986*	*1987*	*1988*	*1989*	*1990*
1	***AP***	0.00	0.00	0.00	4.30	4.30	9.50	11.70	4.20	4.70	14.20	0.00	24.00	62.80	3.90	0.00	0.00
2	***BI***	0.00	13.30	12.20	12.80	17.20	26.10	36.30	49.10	64.40	71.30	84.10	50.60	127.10	134.80	148.20	163.00
3	***GUJ***	0.30	0.50	-0.60	0.00	0.00	0.30	40.00	0.00	14.60	1.90	46.80	107.70	74.70	165.70	0.00	0.00
4	***HAR***	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	20.00	0.00	64.80	30.00	33.00
5	***HI***	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.30	0.00	0.00	0.00	10.20	7.50	0.00	0.00
6	***KA***	0.00	0.00	0.00	0.00	0.00	0.00	1.80	0.00	0.00	22.10	12.10	33.60	0.10	0.20	0.00	0.00
7	***KE***	2.90	4.40	3.30	5.00	5.40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8	***MP***	5.00	5.50	8.10	10.70	19.10	25.10	28.00	22.90	40.00	54.80	57.00	64.00	66.00	73.00	84.50	97.00
9	***MAH***	4.20	5.70	0.70	0.30	-0.30	23.60	75.30	60.60	30.30	47.10	129.00	102.40	0.00	0.10	109.20	169.00
10	***ORR***	3.40	4.50	6.70	5.00	6.50	6.20	5.80	0.00	8.80	7.50	11.70	12.50	14.70	15.00	15.50	16.00
11	***PUN***	0.00	0.00	0.00	17.10	23.00	46.20	73.30	53.80	62.40	67.40	106.30	124.50	138.40	192.80	330.10	0.00
12	***RAJ***	6.80	7.00	7.20	12.60	14.60	19.00	24.70	0.00	0.00	0.00	0.00	15.00	4.80	0.00	19.60	0.00
13	***TN***	19.20	5.30	31.40	21.70	26.40	30.00	113.60	177.60	216.20	213.40	146.70	210.80	24.30	263.70	342.20	451.80
14	***UP***	0.00	0.00	0.00	0.00	0.00	101.00	144.70	159.40	175.10	204.80	222.50	198.20	198.80	279.00	193.90	228.60
15	***WB***	0.00	0.00	3.20	6.60	8.40	17.00	14.70	13.20	13.20	13.20	13.20	20.90	20.00	20.00	38.90	47.70
16	***ASS***	0.00	0.00	0.00	0.00	1.80	2.00	12.10	8.80	11.40	15.00	21.20	24.90	28.50	48.70	1.30	78.50
17	***MEGH***	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.50	3.00	4.00	5.20
	TOTAL	41.80	46.20	72.20	96.10	126.40	306.00	582.00	549.60	643.40	732.70	850.60	1009.10	773.90	1272.20	1317.40	1289.80

Source : Govt of India - CEA

ANNEXURE II

BOARD-WISE SHARE OF THE NET PROFIT AND LOSS

SEBs	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
AP	-0.31	5.15	17.59	12.69	14.67	5.95	7.06	10.95	5.49	3.81	19.30	2.75	18.44	32.76	10.05	5.94
KA	0.92	11.40	41.38	2.27	43.71	8.43	13.52	15.08	15.14	4.73	4.19	3.95	-27.12	-74.42	9.36	3.90
KE	-7.67	-15.81	-5.86	6.82	66.17	11.31	10.63	0.67	-2.03	-4.17	3.77	0.92	3.44	5.88	-9.36	-2.43
TN	8.28	20.22	37.24	11.55	15.87	8.83	3.74	0.76	2.83	-4.20	3.38	5.33	43.76	28.61	34.50	3.34
S.R	***1.23***	***20.96***	***90.34***	***33.33***	***140.42***	***34.52***	***34.95***	***27.46***	***21.43***	***0.18***	***30.64***	***12.95***	***38.52***	***-7.17***	***44.55***	***10.75***
HAR	-10.02	-14.52	-41.03	-18.37	-11.08	-10.91	-26.02	-40.69	-29.42	-14.49	-28.74	-11.74	-31.74	-141.40	-6.34	-2.06
HI	-2.86	-5.70	-15.17	-9.09	8.38	-5.75	-10.03	-8.59	-3.89	-3.95	-8.70	-1.58	-5.11	-14.35	-3.76	-1.37
PUN	-19.22	-20.59	-38.28	-5.68	20.96	9.62	5.44	-6.66	-1.76	-5.84	-2.56	-1.22	-8.95	-1.12	-9.82	-55.23
UP	-55.42	-84.38	-148.62	-174.24	-273.65	-69.94	-17.86	50.04	-24.84	-11.46	-16.31	-29.08	49.59	112.10	-58.51	-20.97
N.R	***-87.53***	***-125.18***	***-243.10***	***-207.39***	***-255.39***	***-76.98***	***-48.47***	***-5.90***	***-59.91***	***-35.74***	***-56.31***	***-43.63***	***3.80***	***-44.77***	***-78.42***	***-79.63***
GUJ	-4.91	-11.58	-31.72	-4.17	-11.68	-8.63	3.15	6.57	-6.40	5.30	14.02	-0.32	6.06	30.16	-43.29	-24.61
MP	2.35	3.49	11.38	-0.95	2.10	6.45	-18.88	-27.55	1.07	-0.53	-7.07	4.03	57.32	55.66	20.19	8.47
MAH	14.01	20.04	45.86	55.11	35.93	-27.28	-17.09	-24.18	-10.98	-9.97	-12.85	-6.93	29.16	63.18	13.68	3.86
RAJ	-3.37	-0.74	37.59	40.53	28.44	15.97	-6.97	-31.26	-16.79	-16.48	-28.54	-9.13	-6.19	-67.16	-7.45	-12.03
W.R	***8.08***	***11.21***	***63.10***	***90.53***	***54.79***	***-13.49***	***-39.80***	***-76.41***	***-33.10***	***-21.68***	***-34.45***	***-12.35***	***86.35***	***81.85***	***-16.86***	***-24.32***
BI	-12.78	3.13	7.93	24.24	32.63	-16.87	-31.97	-7.16	4.85	-4.52	-3.77	-23.12	1.90	-95.51	-12.22	-0.85
ORR	-6.34	-1.84	-16.55	-22.35	-29.34	-12.20	6.55	-3.62	-2.40	-0.61	-4.85	-1.95	1.13	-27.31	-0.76	2.78
WB	-2.76	-2.21	5.17	-9.09	-2.99	-1.79	-10.97	-24.01	-18.39	-24.49	-13.67	-13.75	-8.27	5.70	-6.41	-0.90
E.R	***-21.88***	***-0.92***	***-3.45***	***-7.20***	***0.30***	***-30.85***	***-36.39***	***-34.79***	***-15.94***	***-29.62***	***-22.29***	***-38.82***	***-5.24***	***-117.11***	***-19.38***	***1.03***
ASS	12.58	-2.57	-3.45	-7.01	-34.43	-11.61	-8.67	-8.76	-12.47	-12.96	-16.85	-17.68	-23.19	-14.87	-30.26	-8.94
MEGH	-12.47	-3.49	-3.45	-2.27	-5.69	-1.59	-1.62	-1.60	0.00	-0.18	-0.74	-0.46	-0.23	2.07	0.38	1.11
N.E.R	***0.10***	***-6.07***	***-6.90***	***-9.28***	***-40.12***	***-13.19***	***-10.29***	***-10.36***	***-12.47***	***-13.14***	***-17.59***	***-18.14***	***-23.42***	***-12.79***	***-29.88***	***-7.83***

ANNEXURE III

FINANCIAL STATEMENT OF APSEB

		1993-94	*1992-93*	*1991-92*	*1990-91*	*1989-90*
1	**Income [in Rs. Million]**					
a.	i) Income from Sales of power	21727.85	18868.46	15309.79	12436.75	9990.79
	ii) Less State Electricity Duty.	514.99	421.30	400.15	364.43	340.11
	iii) Net	21212.86	18447.17	14909.64	12072.32	9650.68
b.	R.E. subsidy	-	-	694.97	386.33	-
c.	Other subsidy/Grants	1.26	0.76	0.68	1.30	1.02
d.	Miscellaneous income	1302.38	485.81	328.62	193.65	169.04
e.	**Total**	**22516.50**	**18933.74**	**15933.92**	**12653.60**	**9820.74**
2	**Expenditure [in Rs Million]**					
a.	Total cost of generation	6350.81	5063.47	3972.00	3111.78	2526.37
b.	Purchase of power	7427.53	5914.56	3975.87	2215.62	2843.17
c.	Depreciation	1729.74	1475.24	1152.50	944.45	714.26
d.	*O & M expenses:*					
	i] Repairs and Maintenance	965.13	803.73	730.30	571.46	462.11
	ii]Employee costs	2980.97	2676.42	2359.64	1983.48	1653.71
	iii] Administration and general expenses	763.09	644.34	532.07	430.32	344.27
	Total of O&M expenses	4709.19	4124.48	3622.02	2985.26	2460.09
e.	*Interest break-up.....*					
	Interest on State Govt. loans	1345.57	1761.84	1348.19	1100.56	820.34
	Interest on loans from REC	364.92	379.58	364.92	334.99	326.56
	Interest on loans from PFC	641.65	452.39	300.10	210.31	131.92
	Interest on loans from IDBI	143.39	166.83	111.98	109.61	123.19
	Interest on loans from ICICI	46.61	27.03	31.58	30.15	4.59
	Interest on loans from other sources	1574.61	1183.26	868.79	914.05	730.28
	Total Interest	**4116.76**	**3970.93**	**3025.56**	**2699.66**	**2136.88**
e.*	***INTEREST WITH 1:1 DEBT EQUITY***	**2058.38**	**1985.47**	**1512.78**	**1349.83**	**1068.44**
f.	Interest capitalised	1096.60	837.30	510.60	582.60	568.80
	Interest capitalised after debt equity	548.30	418.65	255.30	291.30	284.40
h.	**Total [a+b+c+d+e]**	**24334.03**	**20548.69**	**15747.95**	**11956.78**	**10680.77**
*h**	**Total [a+b+c+d+e*]**	**22275.65**	**18563.22**	**14235.17**	**10606.94**	**9612.33**
	Less..... other expenses Capitalised					
j	Other expenses capitalised	613.07	515.69	410.16	319.07	265.93
k	**Total of capitalised expenses**	**1709.67**	**1352.99**	**920.76**	**901.67**	**834.73**
*k**	**Total of capitalised expenses after debt equity**	**1161.37**	**934.34**	**665.46**	**610.37**	**550.33**

l	***Sub-total {h-k }..To Rev'nue a/c***	**22624.36**	**19195.70**	**14827.19**	**11055.11**	**9846.04**
*l**	***Sub-total {h*-k* }..To Rev'nue a/c***	**21114.28**	**17628.88**	**13569.71**	**9996.58**	**9062.00**
m	Other debits/extra-ordinary items	21.55	10.14	210.38	422.38	17.53
n	**Total**	22645.91	19205.84	15037.56	11477.48	9863.56
n*	**Total**	**21135.83**	**17639.02**	**13780.08**	**10418.95**	**9079.53**
o	**Profit/(Loss) before Tax**	**-129.41**	**-272.11**	**896.02**	**1175.09**	**-43.85**
*o**	**Profit/(Loss) before Tax (after 1:1)**	**1380.67**	**1294.71**	**2153.84**	**2234.65**	**741.21**
p	Provision for Income Tax	-	-	-	-	-
q	**Profit/(Loss) after Tax (o)**	-129.41	-272.11	896.02	**1175.09**	**1175.09**
r	Net Prior period Credits/(Charges)	999.31	1066.59	-51.62	-365.19	69.02
s	**SURPLUS/(DEFICIT)**	**869.90**	**794.48**	**844.41**	**809.90**	**1244.11**
t	NET FIXED ASSETS [as at the begining of the year]	30046.81	26543.73	24178.71	18388.70	14650.86
u	***Less consumer contribution***	2789.79	2174.61	1572.86	1188.57	934.12
	Capital base i.e. [3-4]	27257.02	24369.12	22605.85	17200.13	13716.73
w	***SURPLUS/(DEFICIT) as a % of Capital Base***	**3.19**	**3.26**	**3.74**	**4.71**	**9.07**

ANNEXURE IV

AVERAGE[1] COST OF GENERATION AND SUPPLY AND AVERAGE REALISATION FROM AGRICULTURE, NON AGRICULTURE, AND ALL CATEGORIES FOR SUPPLY OF POWER (STATE WISE)

(FIGURES IN PS./ KWH)

SEBs		1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
AP	*Avg. Cost of G & S*	27.46	30.27	29.64	30.55	31.12	35.75	37.80	41.97	44.19	48.33	47.39	53.27	55.60	62.02	54.52	66.01
	Avg. Real. Ag	21.40	28.36	24.03	20.59	19.42	19.22	19.77	20.17	15.14	9.60	6.62	5.54	4.87	4.50	4.50	4.50
	Avg Real. other thanAg	27.80	30.51	31.54	32.27	32.97	38.14	41.00	46.02	50.87	55.78	63.33	65.08	66.58	88.36	90.79	89.69
	Avg. Real. All categ.	26.31	30.06	30.03	30.00	30.67	34.56	37.30	42.22	44.00	42.00	50.86	51.00	49.41	60.02	63.85	64.61
	Gap- All categories	-1.15	-0.21	0.39	-0.55	-0.45	-1.19	-0.50	0.25	-0.19	-6.33	3.47	-2.27	-6.19	-2.00	9.33	-1.40
	Gap - Ag.	-6.06	-1.91	-5.61	-9.96	-11.70	-16.53	-18.03	-21.80	-29.05	-38.73	-40.77	-47.73	-50.73	-57.52	-50.02	-61.51
	Gap - other than Ag.	0.34	0.24	1.90	1.72	1.85	2.39	3.20	4.05	6.68	7.45	15.94	11.81	10.98	26.34	36.27	23.68
BI	*Avg. Cost of G & S*	29.67	31.86	32.82	34.97	48.33	53.68	67.68	74.69	85.65	96.34	106.56	127.83	135.42	137.02	126.35	121.41
	Avg. Real. Ag	41.75	11.29	11.63	18.88	18.25	19.88	24.99	21.30	16.34	17.94	12.47	11.43	10.61	9.41	9.41	9.41
	Avg Real. other thanAg	22.91	28.71	33.32	32.93	35.93	43.73	46.43	58.52	70.06	77.61	82.31	89.57	94.09	93.16	102.67	104.53
	Avg. Real. All categ.	23.53	26.09	30.09	31.51	34.79	40.01	43.21	52.72	60.09	65.74	69.69	73.20	74.68	73.72	80.97	81.60

[1] Here Average cost and realisation refers to the weighted average.

	Gap- All categories	-6.14	-5.77	-2.73	-3.46	-13.54	-13.67	-24.47	-21.97	-25.56	-30.60	-36.87	-54.63	-60.74	-63.30	-45.38	-39.81
	Gap - Ag.	12.08	-20.57	-21.19	-16.09	-30.08	-33.80	-42.69	-53.39	-69.31	-78.40	-94.09	-116.40	-124.81	-127.61	-116.94	-112.00
	Gap - other than Ag.	-6.76	-3.15	0.50	-2.04	-12.40	-9.95	-21.25	-16.17	-15.59	-18.73	-24.25	-38.26	-41.33	-43.86	-23.68	-16.88
GUJ	*Avg. Cost of G & S*	24.09	25.91	29.99	29.56	33.24	38.27	46.01	50.16	62.10	67.10	76.32	92.31	100.56	99.39	108.63	113.28
	Avg. Real. Ag	18.44	21.74	24.72	25.81	26.71	27.95	27.43	38.12	41.69	44.77	45.95	51.78	57.25	22.05	20.82	21.86
	Avg Real. other thanAg	23.43	24.16	28.20	29.18	33.33	38.24	43.25	52.44	65.61	73.24	80.52	86.91	103.06	118.30	122.92	124.58
	Avg. Real. All categ.	22.10	23.65	27.54	28.54	32.14	36.24	40.10	49.85	61.08	68.27	73.99	79.93	93.12	88.84	91.67	93.14
	Gap- All categories	-1.99	-2.26	-2.45	-1.02	-1.10	-2.03	-5.91	-0.31	-1.02	1.17	-2.33	-12.38	-7.44	-10.55	-16.96	-20.14
	Gap - Ag.	-5.65	-4.17	-5.27	-3.75	-6.53	-10.32	-18.58	-12.04	-20.41	-22.33	-30.37	-40.53	-43.31	-77.34	-87.81	-91.42
	Gap - other than Ag.	-0.66	-1.75	-1.79	-0.38	0.09	-0.03	-2.76	2.28	3.51	6.14	4.20	-5.40	2.50	18.91	14.29	11.30
HAR	*Avg. Cost of G & S*	26.59	22.70	26.02	28.88	26.58	29.40	40.39	47.27	53.07	57.40	68.35	71.57	78.34	106.55	84.56	85.98
	Avg. Real. Ag	16.60	16.83	17.03	18.67	13.82	12.14	17.09	15.45	16.53	18.20	19.44	19.95	16.91	16.87	20.00	20.00
	Avg Real. other thanAg	19.91	18.20	20.99	24.25	27.98	33.07	33.98	40.54	48.34	57.39	60.67	63.61	71.99	82.17	81.10	86.76
	Avg. Real. All categ.	18.87	17.84	19.83	22.68	23.83	24.46	29.52	32.76	37.46	44.50	45.45	49.58	52.71	54.02	59.75	64.57
	Gap- All categories	-7.72	-4.86	-6.19	-6.20	-2.75	-4.94	-10.87	-14.51	-15.61	-12.90	-22.90	-21.99	-25.63	-52.53	-24.81	-21.41
	Gap - Ag.	-9.99	-5.87	-8.99	-10.21	-12.76	-17.26	-23.30	-31.82	-36.54	-39.20	-48.91	-51.62	-61.43	-89.68	-64.56	-65.98
	Gap - other than Ag.	-6.68	-4.50	-5.03	-4.63	1.40	3.67	-6.41	-6.73	-4.73	-0.01	-7.68	-7.96	-6.35	-24.38	-3.46	0.78
HI	*Avg. Cost of G & S*	25.98	31.70	32.55	40.32	32.93	40.00	59.71	53.75	53.49	53.98	75.11	81.07	96.83	105.22	119.79	93.07
	Avg. Real. Ag	50.00	15.00	33.33	20.00	12.50	11.11	8.00	10.34	8.69	11.54	28.44	19.98	19.83	31.90	11.55	11.60

	Avg Real. other thanAg	12.23	21.69	18.34	22.62	25.98	28.88	31.38	35.03	34.59	38.17	41.09	50.90	64.30	58.73	62.69	59 29
	Avg. Real. All categ.	15.46	21.65	18.48	22.58	25.55	28.21	29.98	33.75	36.77	37.31	40.76	50.19	63.15	58.15	61.73	58 61
	Gap- All categories	-10.52	-10.05	-14.07	-17.74	-7.38	-11.79	-29.73	-20.00	-16.72	-16.67	-34.35	-30.88	-33.68	-47.07	-58.06	-34 46
	Gap - Ag.	24.02	-16.70	0.78	-20.32	-20.43	-28.89	-51.71	-43.41	-44.80	-42.44	-46.67	-61.09	-77.00	-73.32	-108.24	-81.47
	Gap - other than Ag.	-13.75	-10.01	-14.21	-17.70	-6.95	-11.12	-28.33	-18.72	-18.90	-15.81	-34.02	-30.17	-32.53	-46.49	-57.10	-33.78
KA	*Avg. Cost of G & S*	13.38	13.69	14.78	20.46	21.14	25.56	26.26	30.49	31.87	41.59	47.57	63.98	74.86	88.13	81.74	79.24
	Avg. Real. Ag	22.38	24.63	25.01	23.73	25.45	26.31	22.40	16.67	15.21	14.92	8.19	7.01	8.03	11.52	22.04	21.98
	Avg Real. other thanAg	12.91	13.85	15.78	19.25	23.29	25.07	28.57	34.06	36.25	40.47	37.27	69.77	83.57	103.46	100.28	95.31
	Avg. Real. All categ.	13.61	14.57	16.52	20.10	23.43	25.16	28.22	32.96	34.60	38.90	46.03	58.10	62.87	75.73	82.62	79.80
	Gap- All categories	0.23	0.88	1.74	-0.36	2.29	-0.40	1.96	2.47	2.73	-2.69	-1.54	-5.88	-11.99	-12.40	0.88	0.56
	Gap - Ag.	9.00	10.94	10.23	3.27	4.31	0.75	-3.86	-13.82	-16.66	-26.67	-39.38	-56.97	-66.83	-76.61	-59.70	-57.26
	Gap - other than Ag.	-0.47	0.16	1.00	-1.21	2.15	-0.49	2.31	3.57	4.38	-1.12	-10.30	5.79	8.71	15.33	18.54	16 07
KE	*Avg. Cost of G & S*	17.93	19.52	18.17	16.00	16.27	19.68	22.38	22.52	31.33	45.44	34.17	35.64	59.28	69.29	73.36	72.11
	Avg. Real. Ag	11.79	10.10	11.89	14.57	11.97	13.72	15.17	17.00	17.00	16.08	17.82	14.87	24.89	24.71	22.04	21.98
	Avg Real. other thanAg	12.71	13.48	16.03	15.34	19.62	21.83	24.57	25.39	31.70	41.04	35.39	35.64	54.68	65.53	60.01	64 68
	Avg. Real. All categ.	12.66	13.30	15.86	15.32	19.46	21.68	24.40	25.25	31.21	39.99	34.95	35.29	53.63	63.78	59.15	62.85
	Gap- All categories	-5.27	-6.22	-2.31	-0.68	3.19	2.00	2.02	2.73	-0.12	-5.45	0.78	-0.35	-5.65	-5.51	-14.21	-9.26
	Gap - Ag.	-6.14	-9.42	-6.28	-1.43	-4.30	-5.96	-7.21	-5.52	-14.33	-29.36	-16.35	-20.77	-34.39	-44.58	-51.32	-50.13

	Gap - other than Ag.	-5.22	-6.04	-2.14	-0.66	3.35	2.15	2.19	2.87	0.37	-4.40	1.22	0.00	-4.60	-3.76	-13.35	-7.43
MP	*Avg. Cost of G & S*	20.31	23.11	26.66	29.05	35.13	42.50	52.44	61.92	63.97	68.72	71.32	73.30	76.49	83.75	90.02	91.26
	Avg. Real. Ag	29.21	33.69	29.91	30.16	30.89	31.83	34.27	33.41	26.30	28.69	26.57	26.39	25.02	24.64	24.61	24.66
	Avg Real. other thanAg	18.13	20.17	23.31	24.58	29.35	36.79	40.63	50.30	57.31	60.49	62.34	73.31	78.34	80.23	87.27	87.39
	Avg. Real. All categ.	18.76	21.36	23.71	24.92	29.45	36.38	40.17	49.05	54.41	58.21	59.51	69.44	73.20	75.02	81.25	81.17
	Gap- All categories	-1.55	-1.75	-2.95	-4.13	-5.68	-6.12	-12.27	-12.87	-9.56	-10.51	-11.81	-3.86	-3.29	-8.73	-8.77	-10.09
	Gap - Ag.	8.90	10.58	3.25	1.11	-4.24	-10.67	-18.17	-28.51	-37.67	-40.03	-44.75	-46.91	-51.47	-59.11	-65.41	-66.60
	Gap - other than Ag.	-2.18	-2.94	-3.35	-4.47	-5.78	-5.71	-11.81	-11.62	-6.66	-8.23	-8.98	0.01	1.85	-3.52	-2.75	-3.87
MAH	*Avg. Cost of G & S*	16.41	20.14	21.22	22.60	26.76	31.17	36.52	43.37	49.39	55.30	60.90	69.25	77.63	83.26	91.73	95.54
	Avg. Real. Ag	22.78	24.11	25.89	24.15	16.85	16.84	15.64	15.58	12.72	13.00	9.73	8.99	7.80	8.65	9.00	9.00
	Avg Real. other thanAg	16.34	19.40	21.71	24.08	28.19	26.81	30.18	39.99	50.61	56.01	60.51	73.86	90.97	96.21	100.19	101.50
	Avg. Real. All categ.	16.91	19.91	21.64	24.09	26.82	25.66	28.41	36.99	45.17	49.93	51.01	62.88	76.38	80.28	82.97	83.97
	Gap- All categories	0.50	-0.23	0.42	1.49	0.06	-5.51	-8.11	-6.38	-4.22	-5.37	-9.89	-6.37	-1.25	-2.98	-8.76	-11.57
	Gap - Ag.	6.37	3.97	4.67	1.55	-9.91	-14.33	-20.88	-27.79	-36.67	-42.30	-51.17	-60.26	-69.83	-74.61	-82.73	-86.54
	Gap - other than Ag.	-0.07	-0.74	0.49	1.48	1.43	-4.36	-6.34	-3.38	1.22	0.71	-0.39	4.61	13.34	12.95	8.46	5.96
ORR	*Avg. Cost of G & S*	16.19	16.68	19.85	21.58	26.87	33.11	37.86	36.80	44.24	46.29	49.05	69.83	77.27	81.15	83.25	77.94
	Avg. Real. Ag	24.09	25.34	22.70	15.06	8.85	8.88	18.13	17.12	18.00	17.97	18.53	22.44	18.97	19.45	22.05	22.07
	Avg Real. other thanAg	10.67	14.07	14.83	14.94	20.49	24.74	32.25	35.57	40.70	45.21	41.69	62.50	73.66	68.57	77.92	78.83
	Avg. Real. All categ.	10.73	14.10	14.86	14.93	20.35	24.43	31.99	35.17	40.07	44.59	41.22	61.60	71.27	67.34	76.17	77.14

	Gap- All categories	-5.46	-2.58	-4.99	-6.65	-6.52	-8.68	-5.87	-1.63	-4.17	-1.70	-7.83	-8.23	-6.00	-13.81	-7.08	-0 80
	Gap - Ag.	7.90	8.66	2.85	-6.52	-18.02	-24.23	-19.73	-19.68	-26.24	-28.32	-30.52	-47.39	-58.30	-61.70	-61.20	-55.87
	Gap - other than Ag.	-5.52	-2.61	-5.02	-6.64	-6.38	-8.37	-5.61	-1.23	-3.54	-1.08	-7.36	-7.33	-3.61	-12.58	-5.33	0.89
PUN	*Avg. Cost of G & S*	24.54	20.58	24.69	26.29	24.78	29.84	36.46	39.29	44.43	48.54	57.00	60.45	66.48	83.89	98.40	102.76
	Avg. Real. Ag	13.36	14.80	17.49	13.24	13.79	13.40	14.60	16.40	16.00	17.80	18.54	16.52	9.02	8.84	9.18	8.40
	Avg Real. other thanAg	15.26	16.14	20.63	20.92	23.08	25.95	27.96	34.33	39.70	41.82	46.40	57.21	65.37	80.13	73.76	73.76
	Avg. Real. All categ.	14.69	15.77	19.72	18.58	19.91	21.30	23.29	28.43	31.71	34.25	37.18	43.74	44.90	50.56	48.29	48.29
	Gap- All categories	-9.85	-4.81	-4.97	-7.71	-4.87	-8.54	-13.17	-10.86	-12.72	-14.29	-19.82	-16.71	-21.58	-33.33	-50.11	-54.47
	Gap - Ag.	-11.18	-5.78	-7.20	-13.05	-10.99	-16.44	-21.86	-22.89	-28.43	-30.74	-38.46	-43.93	-57.46	-75.05	-89.22	-94.36
	Gap - other than Ag.	-9.28	-4.44	-4.06	-5.37	-1.70	-3.89	-8.50	-4.96	-4.73	-6.72	-10.60	-3.24	-1.11	-3.76	-24.64	-29 00
RAJ	*Avg. Cost of G & S*	23.85	22.79	24.83	30.82	29.95	30.94	39.12	43.79	54.02	61.50	67.58	76.38	77.04	93.95	92.42	97 91
	Avg. Real. Ag	4.64	28.50	26.98	27.23	29.79	19.22	19.19	19.55	20.35	19.19	19.27	24.77	27.46	22.40	29.46	29.46
	Avg Real. other thanAg	24.23	19.86	22.11	26.77	26.27	29.51	31.45	36.78	53.82	60.07	60.01	74.67	80.38	92.98	91.79	93.28
	Avg. Real. All categ.	20.91	21.07	22.88	26.85	26.81	27.08	28.01	31.98	43.17	48.31	47.83	60.40	66.06	70.22	74.15	74.91
	Gap- All categories	-2.94	-1.72	-1.95	-3.97	-3.14	-3.86	-11.11	-11.81	-10.85	-13.19	-19.75	-15.98	-10.98	-23.73	-18.27	-23.00
	Gap - Ag.	-19.21	5.71	2.15	-3.59	-0.16	-11.72	-19.93	-24.24	-33.67	-42.31	-48.31	-51.61	-49.58	-71.55	-62.96	-68.45
	Gap - other than Ag.	0.38	-2.93	-2.72	-4.05	-3.68	-1.43	-7.67	-7.01	-0.20	-1.43	-7.57	-1.71	3.34	-0.97	-0.63	-4.63

table continues.....

TN	*Avg. Cost of G & S*	24.57	24.97	32.05	29.42	30.48	34.54	43.82	50.39	63.68	73.12	66.24	76.42	76.78	84.72	86.14	97 96
	Avg. Real. Ag	13.35	17.21	20.90	20.08	16.46	16.40	16.34	15.12	14.25	14.25	12.24	11.20	11.55	11.78	11.20	11 26
	Avg Real. other thanAg	26.38	27.90	30.50	28.44	31.00	36.64	35.78	35.41	46.36	57.11	61.86	74.66	76.53	78.15	82.65	81 60
	Avg. Real. All categ.	22.11	25.01	28.03	26.44	27.31	31.15	30.42	30.18	37.89	44.72	50.74	57.53	59.29	61.62	63.73	63.73
	Gap- All categories	-2.46	0.04	-4.02	-2.98	-3.17	-3.39	-13.40	-20.21	-25.79	-28.40	-15.50	-18.89	-17.49	-23.10	-22.41	-34.23
	Gap - Ag.	-11.22	-7.76	-11.15	-9.34	-14.02	-18.14	-27.48	-35.27	-49.43	-58.87	-54.00	-65.22	-65.23	-72.94	-74.94	-86.70
	Gap - other than Ag.	1.81	2.93	-1.55	-0.98	0.52	2.10	-8.04	-14.98	-17.32	-16.01	-4.38	-1.76	-0.25	-6 57	-3 49	-16 36
UP	*Avg. Cost of G & S*	33.94	34.76	32.51	39.31	40.19	48.87	56.33	64.37	67.11	74.39	79.68	85.64	85.51	88.28	103.69	102 38
	Avg. Real. Ag	24.37	25.82	22.18	18.69	18.80	18.70	18.30	22.00	22.50	27.50	27.87	27.85	27.28	24.57	22.67	22 67
	Avg Real. other thanAg	20.69	26.19	26.59	28.05	31.30	39.23	44.63	49.34	55.14	62.96	67.30	66.62	86.70	92.18	95.17	101 69
	Avg. Real. All categ.	21.60	26.08	25.49	25.30	27.61	32.65	35.38	40.39	44.33	51.49	54.54	53.85	65.21	68.24	66.80	70 50
	Gap- All categories	-12.34	-8.68	-7.02	-14.01	-12.58	-16.22	-20.95	-23.98	-22.78	-22.90	-25.14	-31.79	-20.30	-20.04	-36.89	-31 88
	Gap - Ag.	-9.57	-8.94	-10.33	-20.62	-21.39	-30.17	-38.03	-42.37	-44.61	-46.89	-51.81	-57.79	-58.23	-63.71	-81.02	-79.71
	Gap - other than Ag.	-13.25	-8.57	-5.92	-11.26	-8.89	-9.64	-11.70	-15.03	-11.97	-11.43	-12.38	-19.02	1.19	3.90	-8.52	-0.69
WB	*Avg. Cost of G & S*	17.62	25.67	25.82	29.86	32.79	39.90	49.02	62.00	72.48	91.26	88.31	100.21	104.06	106.62	123.92	120.93
	Avg. Real. Ag	20.00	25.00	29.41	29.82	29.44	32.70	33.47	51.70	39.35	35.00	33.28	35.30	36.40	24.80	26.86	25.58
	Avg Real. other thanAg	16.10	24.63	24.67	25.29	29.02	33.13	41.53	49.63	57.42	65.63	67.20	76.53	83.04	92.59	101.67	99.60
	Avg. Real. All categ.	16.16	24.63	24.78	25.39	29.03	33.12	41.34	49.66	56.93	64.83	66.04	75.02	81.48	89.20	96.24	93.64

	Gap- All categories	-1.46	-1.04	-1.04	-4.47	-3.76	-6.78	-7.68	-12.34	-15.55	-26.43	-22.27	-25.19	-22.58	-17.42	-27.68	-27.29
	Gap - Ag.	2.38	-0.67	3.59	-0.04	-3.35	-7.20	-15.55	-10.30	-33.13	-56.26	-55.03	-64.91	-67.66	-81.82	-97.06	-95.35
	Gap - other than Ag.	-1.52	-1.04	-1.15	-4.57	-3.77	-6.77	-7.49	-12.37	-15.06	-25.63	-21.11	-23.68	-21.02	-14.03	-22.25	-21.33
ASS	*Avg. Cost of G & S*	0.00	28.90	37.81	44.01	60.40	61.51	76.46	78.56	93.30	108.53	122.17	164.39	191.81	208.89	236.83	257.67
	Avg. Real. Ag	0.00	14.80	44.50	26.50	32.20	57.33	37.50	60.00	62.22	34.50	39.55	29.83	29.14	30.30	30.00	30.00
	Avg Real. other thanAg	0.00	25.49	34.66	34.51	37.84	38.71	38.59	54.79	54.15	56.49	59.77	54.63	66.07	101.12	94.98	94.45
	Avg. Real. All categ.	0.00	25.37	34.70	34.46	37.79	39.24	38.58	54.84	54.75	56.04	59.34	54.15	65.71	100.40	94.34	93.82
	Gap- All categories	0.00	-3.53	-3.11	-9.55	-22.61	-22.27	-37.88	-23.72	-38.55	-52.49	-62.83	-110.24	-126.10	-108.49	-142.49	-163.85
	Gap - Ag.	0.00	-14.10	6.69	-17.51	-28.20	-4.18	-38.96	-18.56	-31.08	-74.03	-82.62	-134.56	-162.67	-178.59	-206.83	-227.67
	Gap - other than Ag.	0.00	-3.41	-3.15	-9.50	-22.56	-22.80	-37.87	-23.77	-39.15	-52.04	-62.40	-109.76	-125.74	-107.77	-141.85	-163.22
MEGH	*Avg. Cost of G & S*	0.00	25.15	22.15	25.12	36.27	39.38	27.99	38.36	34.47	42.41	47.50	53.20	89.22	78.73	85.96	103.36
	Avg. Real. Ag	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	40.00	21.05	24.79	22.06	21.43
	Avg Real. other thanAg	0.00	12.58	13.29	17.73	25.39	22.12	22.64	23.68	37.60	39.53	41.11	59.42	50.68	49.94	50.95	51.10
	Avg. Real. All categ.	0.00	12.58	13.29	17.73	25.39	22.22	22.64	23.68	37.60	39.53	41.11	49.42	50.56	49.84	50.84	50.98
	Gap- All categories	0.00	-12.57	-8.86	-7.39	-10.88	-17.16	-5.35	-14.68	3.13	-2.88	-6.39	-3.78	-38.66	-28.89	-35.12	-52.38
	Gap - Ag.	0.00	-25.15	-22.15	-25.12	-36.27	-39.38	-27.99	-38.36	-34.47	-42.41	-47.50	-13.20	-68.17	-53.94	-63.90	-81.93
	Gap - other than Ag.	0.00	-12.57	-8.86	-7.39	-10.88	-17.26	-5.35	-14.68	3.13	-2.88	-6.39	6.22	-38.54	-28.79	-35.01	-52.26

TOTAL AVG.	*Avg. Cost of G & S*	22.52	24.01	26.17	28.07	30.45	35.34	41.90	47.59	54.78	61.77	65.07	74.59	80.37	88.96	94.40	96.28
	Avg. Real. Ag	18.00	21.15	21.74	20.63	18.74	18.24	18.84	20.19	19.41	20.48	18.64	18.15	17.70	14.89	15.70	16 12
	Avg Real. other thanAg	18.93	21.48	23.77	24.93	28.32	32.07	35.26	41.64	50.22	56.60	59.71	67.70	80.94	89.88	92.87	93 32
	Avg. Real. All categ.	18.79	21.43	23.46	24.30	26.77	29.51	32.30	37.96	44.33	49.85	52.46	59.43	66.49	71.09	74.03	74 46
	Gap- All categories	-3.73	-2.58	-2.71	-3.77	-3.68	-5.83	-9.60	-9.63	-10.45	-11.92	-12.61	-15.16	-13.88	-17.87	-20.37	-21 82
	Gap - Ag.	-4.52	-2.86	-4.43	-7.44	-11.71	-17.10	-23.06	-27.40	-35.37	-41.29	-46.43	-56.44	-62.67	-74.07	-78.70	-80 16
	Gap - other than Ag.	-3.59	-2.53	-2.40	-3.14	-2.13	-3.27	-6.64	-5.95	-4.56	-5.17	-5.36	-6.89	0.57	0.92	-1.53	-2.96

Source : Govt of India - CEA and Annual Accounts of various Boards

ANNEXURE V

STATE-WISE AGRICULTURAL SALES AS WELL TOTAL SALES

	1975			*1976*			*1977*		
	Total sales	**Ag. Sales**	**%age**	**Total sales**	**Ag. Sales**	**%age**	**Total sales**	**Ag. Sales**	**%age**
AP	2737.00	640.00	23.38	2904.00	580.00	19.97	3633.00	726.00	19.98
BI	2214.00	75.00	3.39	2806.00	420.00	14.97	3028.00	450.00	14.86
GUJ	3678.00	976.00	26.54	3975.00	838.00	21.08	4692.00	890.00	18.97
HAR	1706.00	536.00	31.42	2354.00	612.00	26.00	2541.00	740.00	29.12
HI	304.00	2.00	0.66	328.00	2.00	0.61	341.00	3.00	0.88
KA	3932.00	291.00	7.40	4605.00	308.00	6.69	4916.00	390.00	7.93
KE	2203.00	102.00	4.63	2331.00	120.00	5.15	2680.00	103.00	3.84
MP	2925.00	162.00	5.54	3390.00	170.00	5.01	3741.00	227.00	6.07
MAH	7130.00	632.00	8.86	6995.00	763.00	10.91	8749.00	869.00	9.93
ORR	1995.00	9.00	0.45	2518.00	9.00	0.36	2584.00	15.00	0.58
PUN	2301.00	696.00	30.25	3253.00	892.00	27.42	3332.00	967.00	29.02
RAJ	2037.00	345.00	16.94	2387.00	353.00	14.79	2710.00	430.00	15.87
TN	5645.00	1850.00	32.77	6422.00	1691.00	26.33	6576.00	1694.00	25.76
UP	4949.00	1213.00	24.51	6246.00	1694.00	27.12	7433.00	1845.00	24.82
WB	2425.00	40.00	1.65	2332.00	52.00	2.23	2861.00	68.00	2.38
ASS	0.00	0.00	0.00	469.00	5.00	1.07	562.00	2.00	0.36
MEGH	0.00	0.00	0.00	159.00	0.00	0.00	158.00	0.00	0.00
TOTAL AVG.	46181.00	7569.00	16.39	53474.00	8509.00	15.91	60537.00	9419.00	15.56

	1978			*1979*			*1980*		
	Total sales	**Ag. Sales**	**%age**	**Total sales**	**Ag. Sales**	**%age**	**Total sales**	**Ag. Sales**	**%age**
AP	3900.00	755.00	19.36	4613.00	785.00	17.02	4710.00	890.00	18.90
BI	2977.00	299.00	10.04	3058.00	197.00	6.44	2839.00	440.00	15.50
GUJ	5155.00	984.00	19.09	5884.00	1075.00	18.27	6244.00	1213.00	19.43
HAR	2456.00	691.00	28.14	3218.00	941.00	29.24	3270.00	1350.00	41.28
HI	310.00	5.00	1.61	501.00	16.00	3.19	475.00	18.00	3.79
KA	4159.00	357.00	8.58	5131.00	334.00	6.51	5111.00	361.00	7.06
KE	3937.00	78.00	1.98	4516.00	86.00	1.90	4318.00	80.00	1.85
MP	4246.00	251.00	5.91	4292.00	279.00	6.50	4355.00	327.00	7.51
MAH	9934.00	1006.00	10.13	10811.00	1300.00	12.02	10994.00	1271.00	11.56
ORR	2719.00	22.00	0.81	2757.00	34.00	1.23	2268.00	45.00	1.98
PUN	3589.00	1089.00	30.34	4857.00	1650.00	33.97	5118.00	1896.00	37.05
RAJ	2469.00	448.00	18.14	3152.00	480.00	15.23	3878.00	916.00	23.62
TN	7484.00	1788.00	23.89	8359.00	2120.00	25.36	8028.00	2170.00	27.03
UP	6995.00	2046.00	29.25	8027.00	2401.00	29.91	7895.00	2529.00	32.03
WB	2833.00	57.00	2.01	2883.00	68.00	2.36	3028.00	76.00	2.51
ASS	621.00	4.00	0.64	643.00	5.00	0.78	647.00	3.00	0.46
MEGH	203.00	0.00	0.00	193.00	0.00	0.00	297.00	0.00	0.00
TOTAL AVG.	63987.00	9880.00	15.44	72895.00	11771.00	16.15	73475.00	13585.00	18.49

	1981			*1982*			*1983*		
	Total sales	**Ag. Sales**	**%age**	**Total sales**	**Ag. Sales**	**%age**	**Total sales**	**Ag. Sales**	**%age**
AP	5392.00	941.00	17.45	6578.00	967.00	14.70	7421.00	1427.00	19.23
BI	2881.00	430.00	14.93	3141.00	489.00	15.57	3282.00	610.00	18.59
GUJ	6517.00	1298.00	19.92	1747.00	1275.00	72.98	7240.00	1372.00	18.95
HAR	3391.00	972.00	28.66	3867.00	1198.00	30.98	3946.00	1350.00	34.21
HI	417.00	25.00	6.00	560.00	29.00	5.18	688.00	23.00	3.34
KA	5616.00	384.00	6.84	6460.00	726.00	11.24	6535.00	526.00	8.05

KE	4500.00	80.00	1.78	8689.00	88.00	1.01	3508.00	107.00	3.05
MP	4583.00	332.00	7.24	5034.00	374.00	7.43	5887.00	553.00	9.39
MAH	13247.00	1618.00	12.21	14223.00	1746.00	12.28	15346.00	2202.00	14.35
ORR	2610.00	49.00	1.88	2929.00	64.00	2.19	2690.00	73.00	2.71
PUN	5237.00	1850.00	35.33	5632.00	1560.00	27.70	6266.00	2115.00	33.75
RAJ	3574.00	1005.00	28.12	3674.00	1026.00	27.93	3704.00	1181.00	31.88
TN	8586.00	2364.00	27.53	9135.00	2354.00	25.77	8456.00	2230.00	26.37
UP	8119.00	2773.00	34.15	8637.00	2858.00	33.09	10272.00	3398.00	33.08
WB	3159.00	77.00	2.44	3270.00	50.00	1.53	3288.00	89.00	2.71
ASS	648.00	8.00	1.23	835.00	10.00	1.20	935.00	9.00	0.96
MEGH	318.00	0.00	0.00	342.00	0.00	0.00	375.00	0.00	0.00
TOTAL AVG.	78795.00	14206.00	18.03	84753.00	14814.00	17.48	89839.00	17265.00	19.22

	1984			*1985*			*1986*		
	Total sales	**Ag. Sales**	**%age**	**Total sales**	**Ag. Sales**	**%age**	**Total sales**	**Ag. Sales**	**%age**
AP	8273.00	1573.00	19.01	9933.00	2175.00	21.90	10860.00	2569.20	23.66
BI	3222.00	641.00	19.89	3309.00	598.00	18.07	3780.00	792.37	20.96
GUJ	8080.00	1414.00	17.50	8578.00	1619.00	18.87	9014.00	1703.61	18.90
HAR	3955.00	1301.00	32.90	3725.00	1375.00	36.91	4242.00	1366.50	32.21
HI	804.00	26.00	3.23	687.00	18.00	2.62	787.00	21.02	2.67
KA	6682.00	541.00	8.10	7273.00	1247.00	17.15	7427.00	1807.00	24.33
KE	2793.00	110.00	3.94	3705.00	92.00	2.48	4172.00	101.00	2.42
MP	7158.00	535.00	7.47	8385.00	664.00	7.92	9598.00	737.86	7.69
MAH	16970.00	2400.00	14.14	17183.00	3215.00	18.71	20833.00	3502.00	16.81
ORR	3285.00	74.00	2.25	3566.00	72.00	2.02	3315.00	75.21	2.27
PUN	6931.00	2184.00	31.51	7033.00	2359.00	33.54	8367.00	2786.00	33.30
RAJ	4495.00	1302.00	28.97	4667.00	1396.00	29.91	5088.00	1454.00	28.58
TN	8046.00	2200.00	27.34	10777.00	2415.00	22.41	10389.00	2804.00	26.99
UP	10828.00	3506.00	32.38	11159.00	3611.00	32.36	11887.00	3723.00	31.32

WB	3204.00	84.00	2.62	3251.00	111.00	3.41	3850.00	126.80	3.29
ASS	985.00	20.00	2.03	1033.00	22.00	2.13	1084.00	7.71	0.71
MEGH	382.00	0.00	0.00	360.00	0.00	0.00	344.00	0.05	0.01
TOTAL AVG.	96093.00	17911.00	18.64	104624.00	20989.00	20.06	115037.00	23577.33	20.50

	1987			*1988*			*1989*		
	Total sales	**Ag. Sales**	**%age**	**Total sales**	**Ag. Sales**	**%age**	**Total sales**	**Ag. Sales**	**%age**
AP	12030.00	3347.82	27.83	11775.00	3980.00	33.80	12810.00	4000.00	31.23
BI	4139.00	962.18	23.25	4905.00	1138.00	23.20	6039.00	1340.34	22.19
GUJ	10076.00	2186.80	21.70	12555.00	3843.00	30.61	13825.00	4232.00	30.61
HAR	4639.00	1624.05	35.01	5157.00	2223.00	43.11	6216.00	2500.00	40.22
HI	882.00	22.69	2.57	1092.00	23.51	2.15	1066.00	24.00	2.25
KA	7831.00	2146.14	27.41	8212.00	2477.00	30.16	10905.00	2170.00	19.90
KE	3716.00	131.04	3.53	3611.00	155.00	4.29	4294.00	96.64	2.25
MP	10282.00	992.21	9.65	11466.00	1073.00	9.36	12022.00	1155.00	9.61
MAH	22182.00	3890.18	17.54	23633.00	4300.00	18.19	25050.00	4730.00	18.88
ORR	3832.00	167.30	4.37	4351.00	109.00	2.51	4813.00	151.00	3.14
PUN	9827.00	3570.75	36.34	10233.00	4244.00	41.47	10982.00	4331.00	39.44
RAJ	5836.00	1580.00	27.07	5806.00	1872.00	32.24	6794.00	1922.00	28.29
TN	11737.00	3114.00	26.53	12526.00	3121.00	24.92	13972.00	3700.00	26.48
UP	13655.00	4937.80	36.16	16576.00	5869.00	35.41	16006.00	6263.00	39.13
WB	4109.00	137.43	3.34	4926.00	246.27	5.00	5050.00	367.00	7.27
ASS	1111.00	10.98	0.99	1260.00	12.87	1.02	1325.00	13.00	0.98
MEGH	269.00	1.14	0.42	315.00	1.21	0.38	356.00	1.36	0.38
TOTAL AVG.	126153.00	28822.51	22.85	138399.00	34687.86	25.06	151525.00	36996.34	24.42

table continues.....

1990

	Total sales	Ag. Sales	%age
AP	14265.00	4200.00	29.44
BI	6423.00	1548.68	24.11
GUJ	14736.00	4510.00	30.61
HAR	7373.00	2882.00	39.09
HI	1457.00	25.00	1.72
KA	12521.00	2320.00	18.53
KE	5063.00	217.00	4.29
MP	12979.00	1287.00	9.92
MAH	26553.00	5033.00	18.95
ORR	5513.00	164.00	2.97
PUN	12840.00	5002.00	38.96
RAJ	7544.00	2172.00	28.79
TN	15746.00	4000.00	25.40
UP	19762.00	7800.00	39.47
WB	5900.00	475.00	8.05
ASS	1441.00	14.00	0.97
MEGH	357.00	1.40	0.39
TOTAL AVG.	170473.00	41651.08	24.43

Source: Government of India: CEA

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