CHAPTER VIII

CONCLUSION

The main problem of power sector in India has been the gap between demand and supply. This gap has been increasing due to increase in the consumption of power. Consumption pattern shows that in the beginning power was mainly consumed by industrial sector and in urban areas, later on with rural electrification, its consumption has increased in rural areas for irrigation purposes, rural based industries and domestic use. This has led to increase in demand for power at a rapid rate outstripping the availability of power. As a result shortages of power in various parts of the country. Power shortage continue to prevail in the country despite increase in installed capacity and improvement in power generation. We have observed in our study that the gap between supply and demand has been widening affecting the regular supply of power. In this chapter an attempt has been made to summarise the study and a few suggestions have also been made.

8.1 SUMMARY OF THE STUDY

Power is the basic input for industrial and agricultural development and for overall economic growth
of a country. Power is the most preferred form of energy due to its versatility and convenience both in its use as well as its generation. Power industry in India has developed into one of the most important basic industries of our economy. It is one of the powerful vehicle of economic progress and social changes. In India, modernisation of industries, mechanisation of agriculture and urban progress call for a continuing increase in the availability of electric power.

Though transmission and distribution is an important component of power development programme, it has not been accorded the required priority by the power sector, with the result serious constraints in utilization of available power are being found in many areas. The low level of investment in transmission and distribution has resulted in severe imbalances in system performances compared to realisation of targets in generation. These imbalances resulted largely in poor quality of power supply in addition to higher line losses. It also caused bottlenecks in full utilization of the generated power.

We have observed from the study that hydro power had been the most preferred source of power development in the first three plans which accorded high priority for
River-valley developments. Hydro power development registered substantial increases in these plans (from 559 MW in 1950 to 5907 MW in 1968-69 of total hydro capacity). The decline in the contribution of hydro power to the overall capacity addition commenced in the Fourth Five Year Plan, reached a value of 28.9 per cent at the end of the Seventh Five Year Plan from 46.15 in 1966. The declining trend continues leading to sub-optimal operation. The contribution of hydro power declined considerably during the Sixth Plan and the Seventh Plan creating an imbalance in the hydro thermal mix. Though a judicious and optimal hydro-thermal mix for improved economics of system operation indicates a ratio of 40:60 for the Indian system.

The assessment made by Central Electricity Authority shows that 78 per cent of hydro potential still remains undeveloped in the country despite inherent advantages of hydro electric power plants over thermal and nuclear plants. The share of hydro power has slowed down considerably due to constraints of financial resources, longer gestation period in installing a hydro plant, environmental considerations as well as problems in acquisition of forest land.
Lack of adequate financial resources has been one major constraint in the matter of hydro power development in the country. The Central Electricity Authority was charged with the function of developing the national power policy and co-ordinating the power development particularly in relation to the control and the utilization of national power resources. In accordance of the provisions of the Act, the State Governments established electricity Boards in their respective areas during the period from 1950 to 1967. The State Electricity Boards are entrusted with the general work of promoting power generation, transmission and distribution facilities within their respective states in the most efficient and economic way. Development of power has been given high priority in the plan programmes. The main objective of power development has been to increase power availability and extend power supply to all the regions of the country.

The generation capacity determines the maximum limit of power generation available during a particular period. The total installed capacity in India has increased from 1,712 MW in 1950 to 69,025 MW in 1991-92 registering 9.2 per cent compound annual growth. The gap between hydel and thermal capacities was not very significant till 1965-66. From 1966-67 the gap in
electric power generation from thermal and hydel resources started widening. The situation had completely changed in the beginning of the Fourth Five Year Plan with greater emphasis on thermal projects. The total power generation has increased rapidly from 5,107 million units in 1950 to 286,711 million units in 1991-92 recording 11.3 per cent compound annual growth rate. Bulk of electricity generation has taken place from thermal power.

The consumption of power is one of the basic indicators of growth and productivity of national economy. It has increased in India at a faster rate over the decades. Its consumption has been increasing by various sectors of the economy. The consumption of electric power in agricultural sector has increased from 3.9 per cent in 1950 to 24.97 per cent in 1989-90 and in domestic sector it has gone up from 12.6 per cent in 1950 to 16.12 per cent in 1989-90. Consumption pattern shows that the demand for power is continuously increasing at a rapid rate outstripping the availability of power. This has resulted in continued shortages of power in various parts of the country. Power shortage prevails in the country despite increase in installed capacity. Power shortage hinders the economic growth of modern economy and affect industry, agriculture and household sectors adversely.
During five year plans emphasis has been laid to increase installed capacity and generation to meet the growing demand. During the First Five Year Plan the country's resources were mobilised in such a way that the impetus needed for power industry was available. The First Five Year Plan included a number of multipurpose river valley projects, with hydro electric power generation as an important component. The installed capacity of 1,100 MW was added to total installed capacity during this plan. The Second Five Year Plan was devised to produce rapid industrialisation, laid emphasis on the power sector. The main aim of the plan was to increase the installed capacity to meet the demand of power. The targetted growth of installed capacity could not be achieved during the plan, due to foreign exchange difficulties and delays in the execution of some projects. The Second Five Year Plan put a greater stress on the hydro electricity. As a result multipurpose projects and a number of single purpose hydro electric projects were taken up. The Third Five Year Plan laid emphasis on infrastructural facilities for industrial development. It gave priority to rural electrification to increase power supply to rural areas for energisation of pumpsets and domestic uses.
During the Third Plan, interconnection between state grid system was recognised to enable interstate transfer of electric power. For the formation of the grid system, the country was divided into five regions each with a Regional Electricity Board. The installed capacity of 4,052 MW was added to total installed capacity during this plan.

The development of power under three Annual plans was also rapid. The significant feature of these plans was initiation of nuclear power development at Tarapur. During these plans massive rural electrification programme had also been taken up.

During the Fourth Five Year Plan, the need for greater participation by the Central Government was realised to increase the power generation programme. Emphasis was also laid on interstate and inter-regional lines to reduce the imbalance between generating capacity and the transmission and distribution facilities. The rural co-operatives and Rural Electrification Corporation were also set up during this plan. The first nuclear power station in the country went into operation during this plan period. Despite increase in installed capacity power shortage was faced during this plan.
The Fifth Five Year Plan gave priority to speed up the construction programme and commissioning of power generation project and also maximising generation from the available capacities. Two central organisations, namely, National Thermal power corporation and National Hydro-electric Power Corporation were set up to increase power generation in the country during this plan. Nuclear power also progressed during this plan. The transmission voltage in commercial transmission of electricity went upto 400 KV in the country for the first time during this plan. The Sixth Five Year Plan gave high priority to increase power supply facilities in the country. The main emphasis of this plan was to improve the functioning of thermal power stations. At the end of the Sixth Plan, a comprehensive renovation and modernisation programme for poorly functioning thermal power plants was approved as a centrally sponsored scheme. Power shortage was experienced in many parts of the country during this plan due to shortfall in the capacity additions, unsatisfactory performance of the thermal stations and incomplete transmission lines.

The Seventh Five Year Plan laid emphasis on augmentation of power availability in order to achieve the generation target and construction of transmission and distribution facilities, besides, the Seventh Plan also
gave importance to the programme of renovation and modernisation, research and development and training in power sector. At the end of the plan 21402 MW of installed capacity was added to the existing capacity. High priority was given to reduce power shortage by improving the performance of the existing power plants in this plan period. The emphasis was also laid on small, micro and mini hydel units to maintain the balanced growth of power in the country.

The main features of the approved power programme during the Eighth plan are induction of additional generating capacity of 31,115 MW, shift away from thermal to hydro-electric power, renovation and modernisation of old power plants and strengthening of transmission and distribution system.

Power supply industry is a capital intensive industry and hence, a large chunk of national resources are allocated in every plan to add to the installed generating capacity and to create the complementary transmission and distribution facilities. The investment in power sector has increased from Rs. 260 crores in the First Five Year Plan to Rs. 34,273 crores in the Seventh Five Year Plan indicating a significant growth.
Transmission and distribution are important components of the power development in a country. With the increase in generation capacity, transmission and distribution networks have also increased throughout the country. The construction of transmission projects is also essential in the context of evacuation of power from generating stations to the beneficiary states. With the Central participation in power sector High voltage transmission lines are increasing in circuit kilometers.

There is a wide range of resources from which electric power can be generated. These resources include fossil fuels like coal, gas petroleum products, nuclear materials as well as renewable sources of energy such as biomass, geothermal, hydel and solar source.

Hydro power is an important primary and conventional energy source for generating electricity. Hydro power plants utilize a natural resource which is renewable and have a relatively long life. There is immense potential of energy produced from hydro power in India. The river systems provide plenty of scope for large scale hydro development. India is endowed with towering mountain ranges, rolling hills, lofty plateaus and extensive plains criss-crossed by rivers affording scope for hydro generation.
The first hydro electric power plant in India was set up in Darjeeling in 1897. This was followed by many hydro electric power plants during the early part of twentieth century. Inspite of an early start, the progress of hydro power was very slow and the total hydro installed capacity by the year 1951 was only 570 MW. During the first three five year plans emphasis was laid on hydro power development as a result, five major multipurpose projects were set up. The important multipurpose projects undertaken during this period were Bhakra Nangal Project and Chambal Valley project in the North, Hirakund and Damodar Valley in the East and Tungabhadra in the South. Besides, these projects several single purpose hydro electric projects were also taken during the first three five year plan period. At the end of the third plan, the total installed capacity reached upto 5900 MW. The need for central participation in hydro electric development was felt during the Fourth Plan period. The National Hydro Electric Power Corporation was set up during the Fifth Plan to enable greater central participation, particularly in regard to major projects in remote areas, but the emphasis shifted to thermal power projects after the Fifth Plan. This shift in favour of thermal power has been continuous. Towards the end of the
Sixth Five Year Plan the capacities in hydel stood at 11,384 MW and in thermal 16,424 MW. The hydro-thermal mix which was 40:60 during the Fifth Five Year Plan came down to 33.7:66.3 at the end of the Sixth Plan. According to Central Electricity Authority assessment more than 75 per cent of hydro potential still remains unharnessed despite inherent advantages of hydro electric power plants over thermal and nuclear plants.

Lack of adequate financial resources has been one major constraints in the matter of hydro power developments in the country. Since the short term solutions to mitigate the immediate power shortage have been getting priority over long-term solutions, thermal projects having substantially shorter gestation periods have been getting pushed up for early gains, leading to the deferring of benefits from hydro schemes and power development has moved along sub-optimal course. In India environmental clearances are given to hydro projects, after a lapse of considerable time which has resulted in substantial time and cost over-runs. These delays have been mainly due to various procedural constraints and delays in necessary studies required to be conducted for making an overall assessment of impact of the concerned power project on the environment. Differences and
disputes between riparian states on sharing of water resources have inhibited and delayed hydro-development in some major river systems. In fact inter-state disputes in the Narmada, the Godavari and the Krishna river basins were partly responsible for Madhya Pradesh, Maharashtra and Andhra Pradesh turning away from hydro after pioneering developments in the Chambal, the Koyna, the Sileru and the Tungabhadra Valleys. Most of the undeveloped sites in river systems require inter-state cooperation. Such co-operation would involve participation in completing investigation and project report preparation, project organisation and management and financing. Besides this, uncertainties in constructing civil works in difficult geological terrains and several administrative and managerial problems associated with specific hydro projects have also been contributing to the slow pace of hydro power development in the country.

Hydro-power is the cheapest among various available sources of power supply because in case of hydel power, the fuel cost component is nil as compared to other conventional options of power supply. Hydro power utilize natural resource which are renewable and the production of power does not consume water. Unlike coal it does not
involve transportation of raw materials by rail. Thus the effect of inflation on the raw material and the transport is not reflected on the cost of generation. Hydro-power projects have a relatively longer life and low depreciation, unforeseen breakdowns are less frequent and overhaul and maintenance require plan shutdowns of very short duration. Their operation and maintenance costs are low compared to other sources of power generation. Their ability for quick start and stop operation and varying their output make them eminently suitable for meeting peak loads. Therefore, hydro power needs to be harnessed to the maximum possible units.

Thermal power dominates the Indian power scene as it constitutes over 67 per cent of total installed capacity and contributes about 69.8 per cent of total power generation. It has a maximum share in the total power generation in India. The phenomenal growth of thermal power generation may be due to their low gestation period, flexibility of site selection, ease of augmentation of existing facilities etc. A modern thermal power plant is a highly complex marvel of engineering, built essentially of structural steel. A thermal power station will be able to generate electric power to its rated capacity only, if all its constituent sub units operate cooperatively.
Coal is an important resource for thermal power plants in India. It has been bearing the main burden of power needs of the country. India's coal resources have been assessed at one per cent of the world's total coal reserves. The Energy policy Committees (1980) has assessed that available coal reserves of India would be adequate to last for about hundred years. The main reserves of coal in India are concentrated in West Bengal, Bihar, Assam, Orissa, Madhya Pradesh, Maharashtra and Andhra Pradesh. Coal production in India has increased with the increase in industrial sector and generation of thermal power.

In India the thermal power programme was started in 1889. Thermal power plants were used for urban electrification in the earlier phase of power generation in India. When India became independent, the total thermal installed capacity was nearly 756 MW which has increased to 48,096 MW in 1991-92. There has been three fold increase in thermal installed capacity from 1975-76 to 1991-92. A note-worthy feature of this growth pattern is the quadruple increase in thermal capacity alone as compared to hydel and others. This has brought the thermal share to about 69 per cent in 1990-91 as compared to 54 per cent in 1976-77. The total power generation which was 2998 million units in 1951 increased to 1,73,728 million units in 1989 contributing around 72
per cent in overall electricity generation. The rapid growth of installed capacity made it imperative to adopt larger unit sizes to facilitate quicker capacity addition which provided added advantage of economy of scale and benefit of higher efficiency due to higher steam parameters. It is found that the larger sized thermal stations enjoy greater economy of savings in capital and fuel costs.

The performance of thermal plants can be examined through plant load factor. All India average plant load factor has remained almost constant between 44 to 47 per cent from 1979-80 to 1983-84. It improved since 1984-85, because a number of steps have been taken to achieve optimum utilization of the existing thermal capacity. With the implementation of renovation and modernisation schemes to overhaul the old thermal power units, plant load factor has improved. Plant availability factor has been low due to forced outages and planned outages. Due to excessive outages full generating capacity has not been utilised in thermal plants which results in large scale power disruption. The plant load factor varies between different units. It has been observed in India that larger plants have a better plant load factor than the smaller ones. Therefore, larger sets
have substantial savings in capital and fuel costs as well as they contribute to increase in power generation too.

State wise plant load factor shows that Andhra Pradesh, Rajasthan, Tamil nadu, Karnataka, Gujarat, Maharashtra, Madhya Pradesh, Delhi and Uttar pradesh achieved plant load factor higher than all India average (54.4 per cent) in 1991-92. The plant load factor is very low in the states of Haryana, West Bengal, Bihar, Orissa and Assam. The plant load factor in many states continue to remain low due to a number of techno-economic factors.

The thermal power stations in India face the problem of poor coal quality and inadequate supply of coal. The coal available for thermal power plants are generally characterised by high ash and high moisture content. The low calorific value of coal supplies to power plants harm the boilers. Many a time inferior grades of coal create serious problems to the machineries. The demand of coal to thermal power stations has increased tremendously. But the supply of coal to thermal power plants has been falling short of demand. Due to inadequate supply of coal many plants, located away from coal mines have to close down their operation. The problem of inadequate supply of coal is because of the shortage of railway wagons and outdated coal loading and unloading equipments.
The generation in thermal plants is also affected due to unavailability of spare parts and inadequate maintenance. Inadequate operation and poor maintenance lead to an adverse affect on the scientific operation and maintenance of the power stations.

The nuclear power was primarily used for military purposes. The atomic bombing of Hiroshima and Nagasaki in 1945 was the first use of nuclear power for military purposes. But in the early fifties of the twentieth century there was a talk of 'Atom for peace'. Nuclear energy became a definite source of power generation since 1950's when it was first utilized in the United States. It has gradually become an important source of generating electricity in addition to coal and hydro-sources. At present over 417 nuclear reactors with a total installed power generation capacity of nearly 2,97,000 MW are in operation in twenty six countries and generate more than 16 percent of the world's electricity.

The economic benefit of nuclear power has been well established in many countries. A study published in 1986 by the OECD Nuclear Energy Agency shows that, in most countries, electricity generation with nuclear power plants is cheaper than with coal fired plants. Several
other studies on the economics of electricity production from coal and nuclear sources have shown... that excepting for those regions where coal is readily available, nuclear power is substantially cheaper than coal based power. Nuclear power is also considered better source of energy over other forms of generating electricity because of its economy in fuel consumption.

The relevance of nuclear power as an important supplementary source to coal and hydro power in India, was realised nearly four decades ago. The coal resources in India are unevenly distributed with most of it deposits found in the eastern and central parts of the country far away from many of the major load centres. Environmental impact of bearing coal for power generation is a matter of great concern. Taking up of a new power scheme is getting difficult due to concerns of submerging valuable forest areas and problems posed by rehabilitation of relatively large population, within the prevailing constraints, hydel and coal will continue to play an important role in the energy scene of India. However, in addition to exploiting all available hydel and coal resources in the country, nuclear power to complement other sources for balanced power development is becoming very important. Among the developing countries in the world, India is in
unique position of having achieved significant progress in peaceful utilization of nuclear energy for electric power generation. The Atomic Energy Act was passed in Parliament soon after the country gained independence in 1947. In 1954 the Government had established a Department of Atomic Energy charged with the sole responsibility for all nuclear activities in the country. The installed capacity of nuclear power has increased from 420 MW in 1969-70 to 1565 MW in 1990-91. But its percentage share remained constant at 2 per cent of the total capacity.

The Department of Atomic Energy of the Union Government has drawn up a programme for implementation during 1985-2000 A.D. including opening of new uranium mines and augmentation of fuel fabrication facilities to meet the basic input for nuclear power generation. With currently known reserves an ultimate capacity of 3,50,000 MW could be attained by the second half of the 21st century using heavy water reactors followed by fast breeders. At present only small percentage of India's electric power is generated from nuclear sources.

Nuclear power development has received maximum attention from the point of view of safety. Beginning from the mining of uranium to the management of
radioactive effluent, safety has been the main concern in
the development of nuclear power. In India, the safety
aspects of the nuclear power plants are carried out during
all the stages commencing from site selection to
commissioning and also right through the operational life
time of the plant. Atomic Energy Regulatory Board reviews
the various safety aspects before a station is licensed.
At present there are four nuclear power stations in India
namely Tarapur Atomic power station, Rajasthan Atomic
power station, Madras Atomic power station and Narora
Atomic power station, which are producing electricity.
Nuclear power will play an important role in electric
power generation in the years to come. To a country like
India that has the constraints of limited fossil resources
and a large population, such a power can definitely yield
significant benefits during the coming decades.

By structure of power sector, we actually mean
its organisation i.e. how the power sector is being looked
after by different bodies involved in generation and
distribution of power.

The structure and power industry as we see it
today in India has emerged over a period of nearly hundred
years. At the beginning of the twentieth century a few
private companies were operating small power stations mainly catering to urban loads. Electric power was made available to the public by the beginning of twentieth century, though its generation was minimal. During 1930's few states (provincial) government and princely states expanded their activities not only to meet the urban loads but also to provide the inputs for industry and agriculture. Prominent among them was the former state of Mysore, which built a hydro power station that ushered in an era of Industrialisation in the state.

In 1910 the Indian Electricity Act was passed to govern the grant of licenses for electricity generation and distribution. The main aim of this Act was the issue of licences by the State Governments to the suppliers of electric power. A Central Electricity Board was also set up whose responsibility was to promulgate in the public interest, rules specifying service and safety conditions, as well as the manner in which licensees must make annual report. This Act of 1910 was more concerned with the regulatory and safety aspects of electricity than with the organisational structure of the Industry itself. The organisational structure of power industry has emerged only after the Electricity (supply) Act, 1948 was passed. Though governmental control on power sector started in
1940's when some Municipalities and provisional governments began dealing with this sector, but supply of power was not balanced throughout India.

After Independence the constitution of India put electricity in the concurrent list and it became possible for both the Union Government and State Governments to legislate on the subject. It therefore, came to fall under the control of both the central and the state Governments. In 1948, a new break-through came with the electricity supply Act, which enabled proper control of power. The Act provided the establishment of a new statutory organisation, the Central Electricity Authority and the state Electricity Boards which became the main supplying agencies for power throughout the country. The Electricity (supply) Act 1948 was passed on 10th September 1948. The objective of the Act was to "provide for the rationalisation of the production and supply of electricity, for taking measures conducive to power development". After Independence development and promotion of power came in the hands of the Government of India and private companies except Tata Electric Company, Calcutta and Ahmadabad Electricity Supply companies stopped to play any role in this sector.
The Electricity Act of 1948 laid down that a sound, adequate and uniform national policy should be developed coordinating the activities of planning agencies in relation to control and utilization of national power resources. It was in accordance with this Act, that autonomous electricity boards were set up in all the eighteen states except in some north-east areas and the union territories. These boards were entrusted with the responsibilities of promoting the coordinated development of generation, transmission and distribution of electricity within the state in the most efficient and economical manner. They were required to devote particular attention to power development in areas not being served with electricity by any licensee. The State Electricity Boards are charged with the responsibility of generation, transmission and distribution of power in the most efficient and economical manner with particular reference to those areas which are not for the time being supplied with electricity. State Electricity Boards play a major role in our country's power policy. The power supply industry is presently owned and operated by and large by the State Electricity Boards. In the States where they exist they are mainly responsible for supply of power to the ultimate consumers.
The Electricity (supply) Act, 1948 also envisaged creation to Central Electricity Authority under the Central Government with the responsibility to develop a sound, adequate and uniform national power policy and Co-ordinate the activities of the various planning agencies. A statutory organisation, the Central Electricity Authority remained only a part time body till 1974 with the setting up of a Separate Department of Power, the Central Electricity Authority became a full time body dealing with national power policy planning. The CEA is responsible for formulation of short term and respective plans for power development, techno-economic appraisal of power projects, advise State Governments, Electricity Boards and generating companies on operation and maintenance of the power system in an efficient manner, render consultancy services in different areas of electricity, promotion of research in matters relating to electricity and collection of data on generation, distribution and utilisation of power, study of costs, efficiency losses benefits etc. The Central Electricity Authority has become an important body in the power structure because it deals with policy planning, supervision, consultancy, coordination and research. Its functions have been increasing over the years and both the
State and Central Governments have used the body to the optimum.

The Damodar Valley corporation (DVC) was established in 1948 by the Central Government. It is a joint venture by the Government of India, West Bengal and Bihar. It is a multipurpose project and an autonomous body which is responsible for the integrated development of the Damodar Valley in relation to irrigation, flood control, generation and sale of power. Like DVC, Tungabhadra project is a multipurpose project, set up in 1953 under the Andhra Pradesh State Act. It is responsible for generation of Electricity in the Tungabhadra Dam and the Hampi power station. This power goes to the States of Andhra Pradesh and Karnataka. All policy planning and execution covering generation and distribution of this system is done by the Board. Bhakra-Beas Management Board was established in 1967 under the control of the Central Government, it manages the Bhakra Nangal and Beas projects and transmission system.

Mayvelli lignite Corporation was set up in 1956 under the Companies Act. It is a public sector undertaking. It controls both the open cost lignite mines and its associated thermal power station in Tamil Nadu.
North Eastern Electric Power Corporation was established by the Department of Power in 1976 to develop the electric power sector in the backward region of the North-east. This corporation is in the Central sector. Its main functions are the construction, generation, maintenance, transmission, distribution and sale of power in north eastern region.

Under the Atomic Energy Act of 1962, the sole responsibility of nuclear power development for electricity generation is vested with the Central Government. The function of establishing nuclear power plants and their operation is being discharged by the Department of Atomic Energy. With the passage of time the Department has acquired enough power and autonomy to not only lay down policy, but execute it as efficiently as possible. At present it can design, erect, commission and operate atomic power plants. It has developed its own fuel fabricating and heavy water plants and fuel disposal units. At present the Department is operating four atomic power plants including Tarapur, Rajasthan, Kalpakkam and Narora.

In the early sixties the advantage of integration of power systems at regional level and the limitation of
state as a spatial unit for power planning and operation was recognised. It was considered necessary to adopt regional approach in power planning and the operation of power systems in order to achieve economies in power supply. To promote such an approach the country was divided into five convenient regions and Regional Electricity Boards were created through Central government resolution in 1964. The Regional Electricity Boards are charged with the responsibility of coordinating the operation of power supply industry in the Northern, Western, Southern and North Eastern regions. This enable the power structure to be more efficient because while planning electric power generation, full advantage could be taken of the resources available in the region as a whole.

Rural electrification has been a priority area in power development in India. As the benefits of electricity supply was realised the State Electricity Boards started electricification of rural as well as urban areas. In the beginning electrification simply meant power for household in rural areas. With the result power generation and power consumption was confined to a small sector. During the mid sixties due to food shortage, the Government of India had provided its policy on rural
electrification. New diversification had taken place in the form of pump energisation to increase agricultural production. In 1969, the Rural Electrification corporation (REC) was established as a public sector undertaking. The main objective of this Corporation is to finance rural electrification schemes and promotion of rural electrification cooperatives all over the country.

In 1976 the Electricity (supply) Act, 1948 was amended to provide for establishment of generation companies under the authority of Central Government. The national company namely National Thermal power corporation (NTPC) was established. The NTPC was given the authority to establish regional thermal power stations and made responsible for bulk transmission from those units to the state power system. The NTPC is given the charge of planning promoting and organising the thermal power sector. The NTPC is supposed to investigate new sites, prepare project reports, construct, operate, generate and maintain transmission and distribution of power generated from thermal units. The NTPC has evolved its own management techniques in engineering, construction, finance, materials etc. It has also been able to install super thermal power projects in various regions within a short period of time. At present the NTPC is carrying out the
construction and operation of nine super thermal power projects, four combined cycle gas based projects and two transmission projects with a total approved capacity of 15767 MW and about 20200 circuit Kilometers (ckt kms.) of associated 400/220 KV transmission lines, widely extended all over India.

The total installed capacity of NTPC power Stations increased to 10125 MW in 1991 which constituted about 16 per cent of the total capacity spread all over the country.

The National Hydro Electric Power Corporation (NHPC) was established in 1976 to set up major hydro electric projects on regional and national consideration. The main objective of National Hydro Electric Power Corporation are to plan and organise integrated development of hydro-electric power. The gamut of NHPC activities includes investigation, planning, design, construction, operation and maintenance of hydro electric power projects and Extra High Voltage transmission systems.

The Department of power was created in 1974 by the Ministry of Energy. The Department of power is responsible to parliament for laying down national policy planning for the development and regulation of the power...
resources in India. The Department is also responsible for national policy planning for regulation and conservation of the country's total power resources. All national responsibility of formulating and promoting power sector is given to this Department. It controls the central autonomous corporated and statutory bodies of the power sector and coordinates the activities of the various agencies within the sector. It coordinates relations between the Centre and States, research and development activities including the coordination and development on non-conventional sources of energy to generate power such as solar and total energy. The Department also looks after the efficient working of thermal units especially in regard to supply of coal. It also manages energy supply in the Union territories and executes central projects. This organisation which heads the power sector is flexible in its attitude. This permit it to deal with both long term and short term problems. Since it is the coordinating body it has vast powers. Thus, while the Department is not directly involved in the operation of power plants, it does look after both short-term and long term problems of the power sector which ranges from policy planning to the operation of the plant.
The power Finance corporation was set up in 1986 as public limited company under the administrative control of the Department of power. It was established with the main purpose of providing term finance for power projects.

Power Grid Corporation was incorporated in 1989. It is responsible for carrying out the construction of extra high voltage and high voltage transmission lines, sub-stations, load despatch centres and communication facilities in a coordinated and efficient manner to transfer electric power from central generating stations to load centres, within and across the regions with reliability, safety and economy.

Rural electrification has become a very important element for social and economic improvement in the developing countries. It is essential for modernisation of rural areas, provide food, industrial raw material, labour etc.

The Indian economy is predominantly a rural economy as nearly 80 per cent of the population live in villages and the bulk of the rural population is engaged in agriculture. Therefore, villages are the focal points of development and rural electrification plays an important role in the development of the Indian economy.
Water is the primary need of agriculture, underground water for irrigation is very essential for those areas where rainfall is not sufficient. India has substantial potential of underground water which still remains to be exploited. Electric power makes it possible to maximise the use of underground water for irrigation. The most economical method of pumping out underground water is with the help of electric pumpsets. During the past few years energisation of a large number of pumpsets through rural electrification has boosted the agricultural production in the country. A study conducted by planning Commission in 1965 revealed that as a consequence of the installation of electric pumpsets on existing irrigation works, the area irrigated increased by 66 per cent for both kharif and rabi crop.

Rural electrification also plays an important role in the growth of rural industries. Electric power reduces labour and fuel cost and increase the productivity. Rural electrification has brought a basic change in the lifestyle of rural masses. It has provided modern amenities of life like light, fan, etc. in villages. Thus, rural electrification is not only an important infrastructure and input for the economic development of the rural areas but also plays a great role in social transformation.
There was no policy for rural electrification in India before independence. As a planned programme, rural electrification was started around fifties in the country. In the early years of planning, electric power for rural areas was treated as a special amenity rather than as an input into agriculture and industry. The progress made in rural electrification in the late 1960's was not satisfactory. India experienced a severe drought period from 1965 to 1967. After the drought emphasis was being laid on energisation of pumpsets to increase agricultural production. During the Fourth Plan, energisation of pumpsets were given high priority. During the Fifth Plan, the rural electrification programme was integrated with the Minimum Needs Programme and a target of covering at least 40 per cent of the rural population in each state was adopted. The Minimum Needs Programme for rural electrification was also given high priority during the Sixth and Seventh Five Year Plan. By the end of the Seventh Five Year Plan, nearly three-fourth of the villages had already been electrified, which resulted in energisation of around 80 lakhs electric pumpsets to meet the irrigation needs of farmers. Rapid augmentation of underground irrigation facilities resulted in manifold increase in agricultural production.
Rural Electrification Corporation (REC) came into existence in July 1969 as a government owned company with the primary objective of promoting extension of power supply to rural areas and financing of rural electrification schemes throughout the country. It aimed to administer the funds provided as central sector outlay for rural electrification in India, on one hand and on the other provide the needed direction and impetus to the concept of integrated rural development through massive exploitation of ground water resources and promoting rural industries. For improving the quality of rural life and to make village electrification meaningful to rural people, the Rural Electrification Corporation had launched a special drive for promotion of rural households electrification during 1989-90. About 4.30 million rural household connections were realised under this special programme till 1991-92.

The Rural Electrification Corporation also plays special attention on standardisation of equipment, materials and construction practices and also on introduction of innovative and cost effective technologies in rural distribution works.
The outlays on rural electrification have increased with more emphasis being laid on it in each successive Five Year Plan. Investment on rural electrification was Rs.8 crores in the First Five Year Plan it had increased to Rs. 2108 crores during the Seventh Five Year plan.

State wise rural electrification shows that electrification programme has been uneven among states and union territories, while some states have achieved cent per cent rural electrification in their respective territories, others lag behind. Eight States of Maharashtra, Andhra Pradesh, Gujarat, Himachal pradesh, Punjab, Haryana and Kerala have achieved 100 per cent rural electrification, several other states have achieved more than 80 per cent of rural electrification. The states of Eastern Region have very low percentage of rural electrification compared to other states of the North Western, Southern and Western States.

Rural Electrification Corporation undertook the task of energisation of pumpsets under a national programme known as 'special project Agriculture' which plays an important role in providing timely crops with the operational control in the hands of farmers. This
programme has benefitted the farmers who are affected by monsoon failure. In the wake of droughts, the Rural electrification Corporation has established large number of pumpsets and their energisation to provide electricity to rural areas in times of monsoon failure. The number of energised pumpsets were merely 21,008 in 1950-51, it increased to 89,09,110 in 1990-91. Agricultural output and potentiality of agro-based industries have increased due to availability of dependable means of irrigation.

In spite of heavy investment made by the Government and sizeable expansion taken in electrification of villages, most of the villages experience power cut or irregular supply of power specially during the peak period. Regular supply of power is essential for overall economic development of rural areas.

8.2 CONCLUSIONS

Power is an essential requirement for industrial and agricultural growth in particular, and in improving the quality of life in general has been given due recognition in India since independence. Energy in the form of electric power is essential for self-sufficiency in food production and virtual elimination of dependency on imports of essential commodities and industrial input.
Before independence there were very few and small power stations in India which were owned and operated by private as well as public establishments. The first hydro-electric plant in India was commissioned near Darjeeling in 1897 and the first steam power plant was set up in Calcutta in 1899. These were followed by several hydro-electric plants and thermal power plants mainly for serving the needs of urban population and industrial demand.

Before independence, the power generation and consumption situation was very poor in India, inspite of abundant resources and potential. What little development had taken place was confined to urban and industrial areas like Bombay, Calcutta, Ahmedabad, and Kanpur.

In 1910, Indian Electricity Act was passed to regulate the actions of individual private undertakings. Inspite of this Act, growth of power generation was very slow. In 1938, the National planning Committee of the Congress made a number of recommendations for the growth of electric power generation and consumption. These recommendations remained the guiding force behind the power policy after independence in India. Therefore, progress in this sector has been very impressive in the post
independence era. The first step that was taken soon after independence was to introduce a legislation to restructure the power supply industry to promote and rationalise power development in the country. The constituent (legislative) Assembly passed the Electricity (supply) Act on 10th September 1948 to provide for rationalisation of production and supply of electricity. This Act provides for the establishment of Central Electricity Authority and organisations in State known as State Electricity Boards.

Since the short term solutions to mitigate the immediate power shortage have been getting priority over long-term solutions, consequently thermal projects having substantially shorter gestation period have been getting pushed up for early gains, leading to the deferring of benefits from hydro schemes and power development have moved along sub-optimal course.

The delays in environment and forest clearance are also responsible for slow growth of hydro power in India. Environmental clearances have been given after a lapse of considerable time which results in substantial time and cost over-runs. These delays have been mainly on account of various procedural constraints and delays in necessary
studies required to be conducted for making an overall assessment of impact of the concerned power project on the environment.

Hydro power projects have been delayed due to differences and disputes between States on sharing of water resources. Inter-State disputes in the Narmada, the Godavari and the krishana river basins were partly responsible for Madhya Pradesh, Maharashtra and Andhra Pradesh turning away from hydro power after pioneering developments in the Chambal, the Koyna, the sileru and the Tungabhadra valleys. The gestation period of hydel project is dependant on several factors viz. geological conditions at site, features of the project and the method of construction etc. Since most of the sites are located in remote areas where infrastructural facilities for transportation and communications are lacking the same is resulting in prolonged period of initial site preparation. Besides this, uncertainties in constructing civil works in difficult geological terrains and several administrative and managerial problems associated with specific hydro projects have also been contributing to the slow pace of hydro power development in the country.
Though thermal power has a maximum share in the total power generation in India as it constitutes over 67 per cent of total installed capacity and contributes over 69.8 per cent of total power generation, but its performance has not been upto the mark due to various reasons such as low plant load factor in thermal station, high percentage of unforeseen outages, inferior quality of coal, unavailability of spare parts, short supply of coal, poor maintenance, outdated design of equipments etc.

Plant load factor, which provides an indication of performance of thermal plants is not satisfactory in Indian thermal power stations. Plant load factor has been low due to ageing of some of the thermal plants, higher incidence of outages, poor quality and inadequate supply of coal, non-availability of spares in stock, inadequate maintenance, inadequate training of staff, defective supply of equipments etc. All India average plant load factor has been low as against the plant load factor in National Thermal Power Corporation's plants. Some of the State Electricity Boards such as Haryana, Bihar, Orissa and Assam are operating at plant load factor as low as 30 per cent. It has also been observed that number of outages have been increasing in thermal plants. Due to excessive outages full generating capacity is not utilized
in thermal power plants, as a result large scale power disruption takes place. Forced outages have been more than planned outages. Forced outages contributes heavily to the rather gloomy picture of availability of power from thermal station. Coal is the vital input in thermal power stations and the coal as available for thermal power stations is generally characterised by high ash content. The low calorific value of coal supplies to power plants further harm the boilers. The use of inferior quality of coal has been resulting in fast wear and tear of various components and frequent outages leading to lower availability and less output from thermal power stations. Besides proper quality of coal, the problem of adequate quantity of coal to thermal power plants is also increasing. The coal reserves are located far away from load centres, therefore, transportation of bulk quantities of coal to the respective power stations is a serious problem. The Indian Railways is not able to transport the required amount of coal to the power stations in time due to many constraints like shortage of railway wagons, non availability of rail tracks etc.

The generation of electric power in thermal plants is also affected due to unavailability of spare parts and inadequate maintenance unforced outlays in the take place
because most of the State Electricity Boards do not assess the need of spare parts at the time of installation of the plant. Poor maintenance of the plants is another cause of low capacity utilization in thermal plants. Schedule maintenance of the plants have been delayed to maintain the level of power supply, which results in forced outages in the plant and affect machinery adversely.

Another problem of thermal power stations is related to the operation and maintenance which is not upto the mark due to poor technical knowledge of the personnel and lack of cooperation of the workers. Besides this, the practice of frequent transfers of workers from one division to other does not allow them to acquire efficiency in their jobs. All this leads to an adverse effect on the scientific operation and maintenance of the power stations.

The emission of various gaseous products like carbon dioxide, sulphur dioxide, oxides of nitrogen ($\text{NO}_x$), etc. and fly ash from thermal power stations create environmental pollution in the country.

India is producing only 2 per cent of electric power from nuclear sources, but radiation hazards and safety aspects associated with nuclear power plants create problems in installing a new nuclear power plant. Safety of
reactors is one of the main factors restricting the expansion of nuclear power. It has received maximum public attention especially after the Chernobyl accident in 1986.

In spite of heavy investment made by the Government and sizeable expansion taken in electrification of villages, most of the villages experience power cut or irregular supply of power specially during the peak period. Regular supply of power is essential for overall economic development of rural areas. It has become all the more important because the farmers have given up the traditional instruments of farming and have switched over to such equipments which are run by the electric power. Many a times they fail to run their pumpsets and machineries due to unavailability of power, which adversely affects the agricultural productivity.

It has also been observed that rural electrification has mainly benefitted large and medium farmers while small farmers are not getting full benefit of it due to inadequate credit facilities.

The capital and operating costs of rural electrification have been increasing due to unsatisfactory planning, execution, operation and development of rural electrification systems by State Electricity Boards.
Besides there is a poor management in rural electrification department as they do not have an affective ward and watch system. There are many unauthorised connections in the rural areas which lead to power failure due to heavy load on the line on one hand and on the other it causes loss of revenue to the government.

It has also been observed that State-wise rural electrification programme has been uneven among the States and Union territories, while some states have achieved cent per cent rural electrification in their respective territories, others lag behind. Electrification of villages has been low in the states of Bihar, Orissa, West Bengal, Tripura, Meghalaya and Manipur. Energisation of pumpsets in rural areas has also been uneven as small number of pumpsets have been energised in Bihar, West Bengal, Orissa and Rajasthan, while Maharashtra, Tamil Nadu, Andhra Pradesh, Madhya Pradesh, karnataka, Uttar Pradesh and Punjab have large number of energised pumpsets.

Many structural changes have taken place in the power sector in India since the beginning of this century.
After Independence the Government of India and State governments have established a number of Corporations and Boards to develop power industry efficiently. But we have observed that these Corporations and Boards have failed to achieve the desired objectives. It may be due to large bureaucratisation and red tapism. Another significant point that we have observed is the lack of co-ordination between these bodies. The electricity tariff varies from state to state. Most of the State Electricity Boards are having huge losses and they fail to make regular payments to power generating units and therefore, the power plants find it very difficult to run the show.

8.3 SUGGESTIONS

It has been observed in the study that the gap between demand and supply of power has been increasing at a faster rate. In the context of the present power shortage and resource crunch for implementation of new power projects, various measures to manage the supply and demand may help in bridging the existing gap.

The first measure to improve the supply is to get better output from the existing facilities. To increase the supply in a situation of resource constraints optimal
output from existing installed capacity is needed. To achieve these, the power generating units which were installed more than a decade back and were based on the outdated technology prevalent at that time, may be made to give better output by utilising the advanced technology available in the field through modification and renovation of the equipments. The plant availability factor in power stations is also very low. In this context greater emphasis should be given on training of operation and maintenance personnel. The State Electricity Boards should take all necessary steps to ensure that the statutory requirement of having all the operators trained is fully met.

The demand management consists of shifting system load from peak hours to the off-peak and thereby improving to power system load factor. The load management techniques create additional loads during off-peak hours by transfer from peak load to average load hours during the day. This kind of approach will be very beneficial for Indian systems which have power shortage during peak hours and energy surplus during off peak hours. Therefore, it is suggested that various options for reducing the peak demand to the extent feasible should be worked out.
Another option to manage the demand of power is through improvement in end-use efficiency or energy conservation. The energy conservation is seen as an indirect way of increasing the power availability. Analysis of the consumption pattern of electricity in different categories shows that the consumption of electricity in domestic as well as in the agricultural sector has been constantly increasing. The share of electric power consumption in the industrial sector, however, has declined from 63 per cent in 1950 to 46 per cent in 1989-90. The percentage share of consumption in other sectors have remained fairly constant. The analysis reveals that the major thrust areas for conservation of electricity are -
(i) domestic,
(ii) industrial,
(iii) agricultural sectors.

The Inter-ministerial Working Group on utilisation and conservation of energy set up by the Government has estimated the conservation potential at 25 per cent in the industrial sector and 30 per cent in the agricultural sector. In the case of electricity, the savings were estimated to be equivalent to installation of 5250 MW and 1870 MW in the industrial and agricultural
sectors respectively, pointing a huge potential for energy conservation in these two sectors in the country.

In the present context of increasing costs and endemic power shortage arising from difficulties of augmenting power supply facilities due to diverse reasons, energy conservation may be a solution to the problems of power shortage in India.

It has been observed in the study that transmission and distribution loss is high in the power sector in India. The growth of transmission and distribution system could not keep pace with the growth in generation capacity may be due to low level of investment in transmission and distribution during the five year plans. This has resulted in severe imbalances in the system performance. Therefore, it is proposed that due priority may be given in making adequate investments in transmission and distribution works with a view to reduce the imbalances. It may also be ensured that the outlay earmarked for transmission and distribution is not diverted to other projects.

Analysis of hydro power development depicts that hydro power development was given high priority during the first three five year plans. It registered substantial
increase during these plan. The decline in the contribution of hydro power to the overall capacity addition commenced in the Fourth Five Year Plan, reached a value of 28 per cent at the end of the Seventh plan. A optimal hydro thermal mix for improved economies of system operation indicates a ratio of 40:60 for the Indian system.

Optimisation studies on long-term power planning show that without proper hydel power back up, the overall cost of meeting the power demand is more costly. Therefore, it is suggested that necessary measures should be taken to improve the hydro-thermal mix during the course of planning.

The operational availability in hydro plans can be improved through planned maintenance as well as renovation and modernisation of a plant.

It has been observed in the study that 66226 MW of potential available for hydro power development still remains unharnessed despite inherent advantages of hydro electric power plants over thermal and nuclear plants. Bulk of the undeveloped potential lies in the northern region. Therefore, it is suggested that unharanessed
hydro projects should be developed in those areas which are away from coal resources like Northern Region, and has plenty of scope for hydro development.

Since the short term solutions to mitigate the immediate power shortage have been getting priority over long-term solutions, thermal power projects having substantially shorter gestation periods have been getting pushed up for early gains, leading to the deferring of benefits from hydro schemes and power development has moved along sub-optimal course. A decision is required to strike a balance between short term and long term solutions so that the power development could move towards optimal course. Accelerated hydro power development would be the corner stone of improvement in productivity of power sector in the long run. In this context, it is suggested that Government of India may advise the Power Finance Corporation limited to provide necessary funding for the development of attractive hydro projects, which are languishing since long.

The share of hydro power is also declining as environmental and forest clearances are given after a lapse of considerable time which has resulted in substantial time and cost over-runs. To reduce time and cost over-run due to delayed environment and forest
clearance procedures, procedural bottlenecks must be identified and clearance process must be streamlined. Often it is found that the Ministry of Environment and Forest seek information and details from the project authorities in a piecemeal manner leading to delay in the clearance of the projects. It is suggested that the Ministry of Environment and Forest should seek additional information and details in one go so that the delays could be avoided. Inter-state differences and disputes over sharing of water resources are delaying many important hydro-electric projects. Settlement of these differences would have to be followed by active co-operation between state in which the potential sites are located for rapid development of the hydro power potential in the country. Inter state co-operation would involve participation in completing investigation, project report preparation, project organisation and management and financing.

To reduce gestation period of hydel projects the Government of India may advise State Governments central/state organisations responsible for developing hydro electric projects to take up site development including site clearance, roads formation and provision of telecommunication links as soon as the schemes are techno-economically cleared by Central Electricity
Authority, to speed up the construction activities. The project implementing authorities may take up these works as advance action without awaiting final sanction by the government.

Accelerated hydro power development is very essential because it is the cheapest among various available sources of power and utilize natural resource. Hydro projects have a relatively longer life and low depreciation. They have the unique advantage of increasing the capacity of peaking manifold by having pumped storage schemes. Therefore, hydro power should be harnessed to the maximum possible limit.

It has been observed from the study that performance of thermal plants in the country is not satisfactory as plant load factor is not upto the mark. Plant load factor in many states continue to remain low and trail far behind the capacity. It has been very low in the states of Haryana, West Bengal, Bihar, Orissa, and Assam. All India plant load factor has been low as compared to plant load factor in National Thermal Power Corporation Units. All India average plant load factor in 1989-90 was 65.5 per cent as against 68 per cent of National Thermal Power Corporation plants. The plant load
factor of thermal power plants can be improved by reducing the periods for planned shut-down of the unit for thorough maintenance work through proper organisation and coordination. Further improvement in the performance of the thermal power stations may also take place by maintaining high efficiency of operation and high degree of availability of the units. For increasing efficiency of operation of units it may be necessary that the units operate at or near the designed maximum output. Adequate maintenance and operational standards may also be of great importance for obtaining best efficiency. World Bank Report on India's Power Sector Efficiency Review (1989) has also observed that 10 to 15 per cent capacity gain can be economically obtained by efficiency improvement.

To improve the performance of thermal plants the availability of the plants should be increased. It has been found out that pulverised boilers have been responsible for unavailability of the plants. Therefore, improvement in the design of boilers may increase availability factor. Modifications in basic design and materials of the equipments may also improve the availability of the plant. The availability factor would also increase if forced outages may be brought down to the minimum by following proper maintenance practices. The availability
of the required spares at right time may also reduce waiting time for spares during the period of outages.

It has also been noticed that some of the thermal units would complete their expected life by 1994-95, while many units of 60 MW have completed their life and majority of the 100 to 150 MW units have been in service for more than 15 years. So they require major overhauling. As the units go on ageing, their performance declines. Therefore, thermal power plants need major renovation and modernisation schemes. Renovation and modernisation of all the aged units may increase the plant load factor of thermal plants. It is also suggested that whenever the plants undergo renovation, efforts should be made to introduce modern sub-systems which were not available earlier at the time of installation of the units, to improve their performance.

We have observed in our study that the main problem of thermal power plants is the quality and supply of coal. In order to overcome the problem of poor coal quality, the process of coal beneficiation is suggested. But the coal beneficiation process results in production of considerable waste of combustible matter in the form of rejects. In order to solve this problem of quality of coal without jeopardising the coal conservation policy, simple beneficiation process are
being suggested. It has also been observed that inferior grades of coal are being supplied to the thermal power plants creating serious problems to boilers, which are basically designed to use different and superior grade of coal. The supply of coal to power stations should be in requisite quantity and also of good calorific value according to the boiler design so that the cost of power generation may not increase further.

Air pollution is one of the grey areas with coal based power generation. The main air pollutants generated are particulate matters, sulphur dioxide, oxides of carbon and nitrogen. Various measures may minimise their impact on the ecology. The improved design of electrostatic precipitators may result in controlling fly ash emission to very low level. Besides, various new technologies available may also help in controlling environmental pollution of thermal plants.

In view of the abundant availability of nuclear fuels in the country, it would be worthwhile to lay stress on the installation of nuclear power stations in future, specially in the areas which are far away from coal belts so as to cut down on transportation cost of coal and ease congestion on railways. However,
appropriate safety measures in regard to setting up of nuclear power stations may have to be strictly followed.

It has been observed in the study that supply of power is not regular in rural areas due to lack of close integration in many States between the planning of rural electrification and the rest of the distribution network. Therefore, it is suggested that the integration of generation, transmission & distribution planning should comprise the rural electrification system also, and power cut should be brought to minimum to enhance the agricultural productivity. Besides irregular supply of power, there are sharp fluctuations in voltage and power load factor due to poor planning, execution and maintenance of the distribution system. To reduce fluctuation and improve load factor in rural areas, State Electricity Boards should take necessary steps for proper planning, execution operation and development of rural electrification systems. The Boards should also check the illegal connections to avoid revenue losses. It has also been observed that rural electrification has been uneven among the states and Union territories. For the balanced development of the rural areas backward and undeveloped states and Union territories should also be electrified. Further the flow of benefits of rural
electrification should not be confined to large and rich farmers but small and poor farmers may also get fair share of rural electrification and for this easy loan facilities should be provided to them.

It has also been observed that State Electricity Boards are mainly responsible for generation, transmission and distribution of power in the country. They constitute more than 80 per cent of the country's power generation and transmission and almost entire distribution of power, yet their performance is very dismal. The State Electricity Boards are criticized for their inability to operate power generating and distribution systems efficiently. Almost all the State Electricity Boards are running at losses. The causes of inefficiencies in State Electricity Boards may be because the Boards have not yet adopted the modern management system. The same old bureaucratic style of functioning still prevails in the State Electricity boards. The maintenance of the generating plants, transmission and distribution is gloomy. Research and Development activities are in a low state in the State Electricity Boards. Therefore, it is suggested that modern management system should be introduced in State Electricity Boards. Maintenance should be improved through skilled personnel and importance should be given
to proper training facilities. In order to improve the performance of the power industry and increase in installed capacity, it has been suggested by the Rajadhyaksha committee that we have to choose the ways which minimise investment, maximise operational efficiency, major structural, organisational, procedural, financial, technical changes will need to be made with immediate effect in the power industry.

It also suggested that for the healthy growth of the power sector and to formulate agreed policies and programmes, there should be close and constant interaction and better coordination among different organisations of power industry.

It is high time that private sector participation in the power sector may be given due importance. The public sector alone will not be able to raise sufficient resources to invest on new power generation projects for meeting the rapidly growing demand for electric power in the coming years. Therefore, considerable emphasis may be given to private investments for power development, private sector investment could bridge the shortfall in the resources for additional power capacity.