CHAPTER -1

INTRODUCTION

1.1. Development and Infrastructure

Development is one of the major concerns of the developing countries including India. The economic structure that India inherited from the Britisher was limited to a small number of selected industries and industrial centers to serve the colonial interests at the time of freedom. The model and tempo of industrialization also demonstrated a distorted scenario. There was disproportionate expansion of raw materials and production, lack of entrepreneurship, inadequacy of banking and transport infrastructure. Almost all the important characteristics of an underdeveloped economy were present in the Indian economy. After independence, the Government of India (GOI) decided to give a big push to the relatively stagnant economy through planned development process. Besides reducing inter-regional disparities, attaining self-sufficiency was considered to be essential.

With the efforts of the GOI, significant economic development has indeed taken place during the last two decades of planning. But unfortunately, disparities among social groups and regions have widened. India, after China, is a fastest growing country in the world. It accounts one fifth of world population and one forth of world's poor (India Infrastructure Report, 2000). .

Infrastructure development is very important for development of an economy. Development of an economy is to be viewed as a process in which its different sectors move from the existing levels to the higher level of performance. Now a concept of economic development has become more comprehensive. Development is a multidimensional procedure involving transformation in economic structure, changes in attitudes and institutions, speeding up of economic growth, lessening of inequalities and reduction of absolute poverty (Todaro, 1977). In a line, development must symbolize the entire spectrum of changes by which all the socio economic system shifts from environment of miseries and sorrow and provides social justice with better standard of living to all.

The accessibility of infrastructure facilities is vital for the overall economic progress of a country. A high positive correlation is present between the availability of various infrastructure services (*viz.* telecommunication, power, road and availability of safe water) and per capita GDP (Rao, 1971). Therefore, basic infrastructure facilities *viz.* power, water, irrigation and road are quit essential for low income countries.

1.2. Meaning and Importance of Infrastructure

In any economy, most of the economic activities like industrialization, farming and developing the service sector require energy, telecommunication, water and transport as intermediate inputs. A developing country like India has an inadequate infrastructure for transformation of its agriculture and revolutionizing its process of industrialization. Efforts to develop agriculture and industry without adequate provision of infrastructural facilities may be a futile exercise.

Infrastructure is physical framework of facilities by which goods and services are made available to the people of the country. The association of infrastructure with the economy is highly complex. Concept of 'social overhead capital' often used synonymously with the concept of infrastructure. It was probably used first by H.W. Singer in 1951 that identified it with certain kinds of investment which are regarded necessary for economic development. It is an umbrella term for many activities.

Infrastructure may be defined with some precision (Shah, 1969). Infrastructure comprises all those facilities and activities, the basic rational of which is the sustenance which they provided to income generation and production. Social overhead capital, which we equate with infrastructure, is usually defined as those basic facilities which are essential for primary, secondary and tertiary economic activities. Many economists have elaborated the concept of infrastructure to denote it as a social overhead capital; which forms an essential basis for small

scale private investment in miscellaneous industries (Puri & Misra, 2016). In the stage of economic growth, the economy has to satisfy certain conditions before it is ready for takeoff. One of the preconditions for takeoff is the building up of social overhead capital elements involved in the usual definition of infrastructure are-

1) Basic requirement for various economic activities.
2) Provided in almost all the countries by the public sector. However, in some cases, provided by the private sector subject to some public control.
3) Provided free of charge or at a very low rate usually regulated by the public agencies.
4) Cannot be imported and have to be provided near the sites for industries.

The infrastructure consists of number of services viz transportation services, power (production, transmission and distribution), water supply, telecommunication, sewage disposal, urban mass transport system, medical, irrigation, educational and other primary services etc. Thus, a few services have a direct effect on the functioning of business enterprise while the others are most important for society's welfare.

Rao (1980) has also given a very comprehensive concept of infrastructure. He has adopted a broader concept of infrastructure, which is more helpful for the planner in developing countries. He has divided the concept of infrastructure into the following categories:

i) Transport
ii) Communication
iii) Energy
iv) Intermediate goods of output (mines and minerals)
v) Increasing the productivity of natural resources such as land, animal husbandry, forestry and fisheries.

vi) Science and technology

vii) Information system

viii) Financial system

ix) Human resources development

Infrastructure helps in development of economy by increasing productivity and by making availability of facilities which improves the quality of life. On one hand, these facilities play the role of intermediate inputs to production which increase profitability, production of output, employment and income. On the other hand, they increase the productivity of factors of production, including labor and capital.

Infrastructure is often illustrated as an unpaid factor of production, because availability of these facilities leads to higher return from other factors of production such as capital and labour (Ghose & De, 1998). Infrastructure can be classified as physical, social, and financial types. All these types of infrastructure play an important role in development. The most significant of these consist of transport, electricity, irrigation, telecommunication, water supply etc. In addition to their crucial role to increase production, they are advantageous for crowding-in of domestic and foreign private investment in the country. As the physical infrastructure accumulates in a region, it leads to economic augmentation through lowering business cost; and creates multiplier effects of investment, employment, income and output. Similarly, social infrastructure through empowerment of human resources in terms of health and education systems, housing and recreation amenities improves the quality of life. Financial infrastructure which includes postal, banking and non-banking financial institutions and taxpaying capacity of population represents the financial performance of the country. All these three types of facilities, taken jointly determine the relative income- creating potentiality of any country (De, 2004).

The most important sector in infrastructure is power sector. Power is an crucial necessity in all facets of our life; and is recognized as a fundamental human need. The socio- economic development of any country depends on infrastructure to boost up growth of the economy and global competitiveness. Power is the key deriver for India. Electricity is a key element of power sector, prime mover of growth and a very important for the nutrition of modern economy. The desired growth of Indian economy also depends greatly on the performance and progress of power sector or electricity in the country.

1.3. Power Sector in India: History and Overview

Energy is considered as the most important commercial good. After the industrial revolution and formation of machine industry, energy was considered at the first and most applied factor of production. Electricity is one of the most convenient forms of energy. It is catagorised as secondary source of energy as primary sources *viz.* gas, coal, wind or hydro energy, petroleum or solar energy can be employed to generate electricity. As it is better in adaptable nature, it's a highly demanded source of energy at consumer's ends. Its optimal use is very important as it is scarce, valuable resource and non-storable in nature. Due to its non-storable nature, it becomes important that there should be a direct and continuous connection between its suppliers and consumers.

The power sector has significant progress after independence in India. In 1947, at time of independence, it had power producing capacity of 1,362 MW. Coal and hydro based power units have been main sources of generating electricity. Private utility companies carried out the distribution of electricity. After 1947, the state and the center government started generating electricity in India. There was a big gap between supply and demand. Only urban areas were electrified. In rural areas was a lack of electricity. The national electricity policy 2005 gives the concept of universal services that all villages should be electrified by 2007-08. The *Rajiv Gandhi Grameen Vidyutikiran Yojna* (RGHVY) lunched in 2005, aims to electrifying all villages and providing access to electricity to all rural households over a period of four year.

Power is central not only to household activities but to economic development as well. In fact, it is the fuel of economic progress in all sectors not only agriculture and industrial but in all other allied areas. Economic progress depends very much upon how a country manages in power sector successfully. Agriculture, industry and other core areas of economy ultimately depends for their development and success on the availability of adequate power constantly. If power consumption by all sectors is seen to increase, then the index of economic development as a measure of its progress is also found to increase.

The power sector as always got attention or high priority for overall development of economy since India's independence. To boost up power sector, financial support has been provided time to time. This sector is on concurrent list of the constitution of India which means that center as well as state government have jurisdiction to frame rules to govern the power sector. Electricity Act 1910 was enacted during British period to regulate the electric power sector. After independence, Electric (Supply) act 1948 was enacted to redesign the power business in India. On the basis of this act, Central Electricity Authority (CEA) at central level and State Electricity Authority (CEA) at state level were constitutionalised. The CEA was main responsible body for coordinating and planning of overall power sector across the country. The SEBs were made responsible to conduct the production, transmission and distribution of power the state level.

1.4. Power Sector in India: Background of the Legislative Initiatives

On April 17, 1899, at Culcutta (now Kolkata), the first power generating station was commissioned. It was starting of power generation process in India. The electrification of Kolkata took place after 17 years of New York (in 1882) and 11 years after London (in 1888). In Kolkata, the initial per unit price of electricity was rupee one which was same as of London during that time (Calcutta Electricity Supply Corporation, 1912). The power sector in India, from time to time, has been governed by various statutes. A glimpse of the different phases of electricity supply industry in India is given in the Table 1.4.1

Table 1.4.1. Different Phases of Power Sector Restructuring in India

Phase. I : 1950 to 1960 (Period of State Patronage)	**Phase. II: 1970 to 1980 (Period of Subsidization)**
a) Enactment of Electricity (Supply) Act, 1948 b) Establishment of State Electricity Boards (SEBs) in an integrated system to generate, transmit and distribute power at the state level c) Predominantly state ownership of electricity utilities d) Professional management of SEBs and establishment of Bharat Heavy Electricals Limited (BHEL)	a) The SEBs began providing electricity at a flat rate for agriculture sector in 1980s b) Non - metering of agricultural consumption started and it helped the respective SEBs to conceal the theft of power and T & D losses by overestimating the agricultural consumption c) Deterioration of the pricing policy being followed by SEBs d) Establishment of central sector generation companies
Phase. III: 1990s (Period of Liberalization)	**Phase. IV: 2003 to till Date (Period of Far Reaching)**
a) Increasing the role of Central Government and International Financial Institutions in the sectoral policies b) Stage. I (early 90s): Focus on generation through private sector - IPP policy which proved to be counterproductive due to poorly negotiated contracts (High capital cost, unfair incentives, wrong fuel choice etc.) c) Stage. II (mid 90s): Focus on restructuring of SEBs and introduction of Electricity Regulatory Commissions (ERCs) such as Orissa model	a) The number and reach of policy changes introduced were unprecedented. b) Consolidation of increased role of Central Government on sectoral policies. c) Enactment of Electricity Act, 2003 d) Restructuring of SEBs, delicensing of generation, open access and competition in distribution, cost reflective tariffs, limiting cross subsidies etc., are the implications of the Electricity Act 2003

Source: Pani, B. Sarangaet. al. (2007) Power sector Reforms in Andhra Pradesh: Their Impact and Policy Gaps, Centre for Economic and Social Studies, Hyderabad (AP).

1.4.1. The Indian Electricity Act, 1910

The Indian Electricity Act, 1910 was the first formalized statute that formalized electricity supply industry in India. As the electricity generation activity stared in India, opinions stared to raise that some statue should be framed to govern this industry. This act was build to provide basic framework to govern this industry. This act laid down the provision for license for supply of electricity for growth in this industry. This act also specified the relationship between of licenser and end consumers. License holders were basically private firms responsible for operating electricity supply activities in urban area of the country viz. Kolkata (erstwhile Culcutta) and Mumbai (erstwhile Bombay).

1.4.2. The Electricity (Supply) Act, 1948

After independence, the power sector which was one of the important sectors in infrastructure was identified as priority sector to serve fast industrialization in India. Power sector remained in the hands of public sector like other heavy industries as it was anticipated that only public sector can fulfill the requirements of this sector like huge investment. At this point of time, Electricity Act 1910 became outdated; and a new act was the need of the time for development of power sector. The provisions of Electricity (Supply) Act, 1948, created SEBs for running the activities *viz.* generation, transmission and distribution at state level; and the CEA was made to coordinate the development and planning of this sector across India. Rural electrification in India was also a responsibility given to SEBs. This act governed this sector till new economic policy in 1990s, however, a few amendments were made in this act in between in 1970, 1975 and 1980. New economic policy of 1991 opened a way for private participation but Electricity Supply Act 1948 played an important role in providing shape to industry. Electricity Regulatory commission Act, 1998 was enforced for regulatory reforms in this sector at state and centre level.

1.4.3. The Electricity Regulatory Commission Act, 1998

The Electricity Regulatory Commission Act, 1998 was the first power reform act at central level. However, some of the states had already passed their own state level power reforms acts before the notification of this act. Orissa was the first state to do so and became role model for other states like Haryana (1997), Andhra Pradesh (1998), Rajasthan (1999), Delhi (2000) and Gujarat (2003). The GOI also realized the necessity of power sector reforms and passed an ordinance which was later known as Electricity Regulatory Commission Act 1998. Instead of popular pricing due to political reasons, the key objective of this act was to ensure a rational tariff for the sustainability of the sector.

1.4.4. The New Electricity Act, 2003

This electricity act was a path breaking step in power sector reforms. This act was related to transmission, distribution and generation. The key aim of this act was progress of electricity industry with supply of electricity to across the country. The prominent features of this act are follows:-

1) Unbundling of production, distribution and transmission sector.
2) Complete liberalization of the generating sector to allow private participation.
3) Exclusion of FDI limits on power generating firms.
4) Regularizing the supply chain for coal and thermal power.
5) Removal of license needed for generation and distribution in rural India.
6) Region–wise demarcation of the nation and other modification, if required, may be done by the GOI in order to optimum and integrated supply of electricity for facilitating voluntary interconnection and co-ordination of amenities for the interstate and inter-regional electricity transmission.

7) The state governments are required to spilit SEBs, however, they can carry on with SEBs as state transmission utilities and distribution licensees.

9) Establishment of state electricity regulatory commission was made compulsory.

10) Setting up of an appellate tribune to take notice of appeals against the verdict of and State Electricity regulatory Commission (SERCs) and Central Electricity Regulatory Commission (CERCs).

11) Provisions related to thefts of electricity made more stringent.

12) Stand-alone system for production and distribution was permitted for rural and remote vicinities.

13) Rural electrification and management of rural electricity distribution would be given thrust by local *panchayat*, cooperative societies, NGOs etc.

14) National electricity policy and tariff policy to be prepared by Central Government.

15) National electricity plan was to prepared by Central electricity authority.

1.4.5. National Electricity Policy 2005

The GOI notified National Electricity Policy in 2005.Target of the policy was to achieve universal right to use of power by 2012. The policy also mentioned that supply good quality of power at reasonable rates to meet fully the demand of power. For this, state governments were required to take steps to enhance the quality of services.

A crucial sign of the economic strength of a country is Per capita power consumption. Hence this policy aims to amplify the per capita consumption of electricity. This policy also highlights the role of private players in power sector.

1.4.6. Electricity Tariff Policy 2006

Electricity Tariff Policy 2006 gives the importance of tariff policy. This policy also deals with the issues of deterioration of ground water in different states of the country. This policy

also mentioned that the sustenance of the ground water is a crucial subject; and need to be regulated suitably. Free power supply, provided by some states viz. Punjab and Tamil Nadu, is also a significant issue raised by this policy.

Universal metering at consumer ends was also looked at to encourage accountability in the system by Electricity Tariff Policy 2006.

1.4.7. Power Sector Restructuring in India

Restructuring process of power sector was commenced in early 1990s in India. Due to poor technical and financial performance of SEBs, the need of restructuring was initiated. As they were unable to generate revenue for making new investment for the purpose of power generation. As a result, some steps were taken to allow participation of private sector for generation, transmission and distribution of power. Thus, some fast track projects were permitted for private sector for production of power in early 1990s. Dabhol Project Company (DPC) in Maharashtra was one of those private sector players who got permission to participate in generation of power. Since its commencement, DPC was questioned; and several petitions were filed in public interest in the Mumbai High Court as well as the Supreme Court of India. A serious issue came into the light when DPC asked to MSEB for the purchase of power at the rate of Rs. 7.80 per Unit. This high pricing became the issue of debate at local as well as global arenas. Finally, Government of Maharashtra had form a committee to evaluate the policy issues related to DPC project. Mr. Madhav Godbole chaired this committee; and some of the key conclusions of this committee were:-

i) A large scale and expensive power plant as DPC was not required at all at the current situation.

ii) The negotiations related to pricing were done in hustle and lacking rationality.

iii) Transparency was overlooked in discussions and agreement with DPC.

iv) The cost of DPC project was very far above the ground and falsely inflated.

v) DPC cleverly shifted risks of fluctuations in fuel prices and exchange rate on Maharashtra State Electricity Board.

vi) DPC project was not a kind of foreign investment as the required finance was generated primarily from Indian financial institutions.

In short, DPC was an absolute failure in the power generation by foreign players.

Second half of 1990s witnessed another phase of restructuring of power sector in India. Extreme structural changes were done in this sector. Orissa and Haryana started their restructuring procedure under the eyes of World Bank. World Bank provided long term financial assistance to these states. It recommended almost the similar model to all states looking for reforms. It incorporated splitting, corporatization and privatisation of SEBs. Some states of India privatised the power distribution activity after splitting SEBs.

1.5. Energy Scenario: World versus India

Energy or power consumption is the one of the most important indicators of economic progress of any country. Total global primary energy consumption from coal (28%), crude oil (33%), natural gas (24%), hydro electricity (7%), nuclear energy (4%) and renewable power (2%) is equal to 13276.3 million tons of oil equivalent (BP Statistical Review of World Energy, 2017).

India is the third largest primary energy consuming country after China and USA with the global share of 5.5%. Here the total primary energy consumption from coal (56.90%), crude oil (29.38%), natural gas (6.23%), hydro electricity (4.01%), nuclear energy (1.19%) and renewable power (2.28%) is equal to 723.9 million tonne of oil equivalent (BP Statistical Review of World Energy, 2017).

Power sector in India experienced a phenomenal growth rate in the last forty years to fulfill the fast increasing demand for electricity. Electricity is a vital part of our daily life. India ranks fifth in generation of electricity. India's current installed power generation capacity as

on 2017 is at 91730 MW. Out of this, the share of coal is maximum i.e. 58.7 per cent while for gas and oil are 7.9 per cent. Hydro shares about 14.9 per cent while share of nuclear and renewable is 2.35 per cent.

Rate of energy consumption has been rising very fast due to large population and economic progress. As in India most of power production depends on coal; and coal reserve in India is always short, there always exists a huge gap between demand for power and its supply.

1.6. Installed Generating Capacity in India

Energy means work performance ability or material capability to perform work: or it is the system capability to affect external environment. For adequate energy, sufficient generating capacity is must to be installed. In India, public sector utilities (SEBs or CEA) owned and operated the power generation capacity. Mega power plants like National Thermal Power Corporation (NTPC), National Hydro Power Corporation (NHPC) etc are still run by them. The ownership was detail of power generating capacity is shown in Table 1.6.1.

Table 1.6.1. Total Installed Generating Capacity in India (2017)

S. No.	Sector	M.W	Relative Share (%)
1.	State Sector	81,102	24.6
2.	Central Sector	103,033	31.3
3.	Private Sector	145,163	44.1
Total		329,298	100

Sources: CEA (Central Electricity Authority)

It is given in the above table that out of the total generating capacity 24.6 % is owned by the state power sector. The share of central power undertaking is 31.3 % whereas the share of private sector is 44.1 % of the total installed generating capacity.

1.7. Statement of the Problem and Objectives of the Study

Power or energy is one of the key constituent of infrastructure as it drives the engine of growth in a nation. It plays an essential role as it significantly affects the demand and supply forces of the economy. For the demand side, energy is one of the products a consumer makes a decision to purchase for his utility. For the supply side, energy is one of the main inputs of production in addition to labour and raw materials. In the globalized economy, countries with huge power supply gap may become uncompetitive due to high energy input cost. The power sector is possibly the single biggest catalyst for inclusive growth in urban and rural India. It is a prerequisite not only for economic growth but for social advancement also. Therefore, the magnitude of energy consumption can be taken as an indicator of development status of any economy. This implies that there should be a causal relationship running from energy consumption to national income or GDP as well as vice versa. This existence of this causal relationship depends on technical efficiency and financial performance of the sector. Technical efficiency is the effectiveness with which a collection of inputs is used to produce an output. A firm or industry is said to be technically efficient if a firm or industry is producing the maximum output from minimum inputs. It is also inevitable for an economy like India to have a technically efficient power sector so that cost of per unit consumption of energy can be reasonable. Although significance of power for the process of development is undoubtable but its fulfilment depends on several components including natural and financial. Several studies have discussed about the concerns of the fulfillment of required power in India. Glancing the data given in previous studies, it is found that there is gradual increase in the supply cost of electricity in India. In the era of pre and post liberalization, there is not much control over the rise of per unit supply cost. In 1974-75, it was 22.5 paise per unit which became to 41.9 paise per unit in1980-81, with annual growth rate 10.9 per cent. In the year 1990-91, the supply cost increased at the annual growth rate 10 per cent and became

108.6 paise per unit. After liberalisation era its annual growth rate increased faster than earlier, which was 11.8 percent and supply cost for electricity was 227.89 paise per unit in the year 1997-98. The supply cost is not the only issue, there is a variation of supply cost from one region of India to another region. In 1997-98, the unit cost varied from 1.60 paise per unit in Himachal Pradesh to 4.23 paise per unit in Assam (Kannan & Pillai, 2001).

All these issues are much related to inefficiencies that come out in inflated proportion in the cost of electricity supply. Generally, two factors are crucial for the variation in supply cost which are source of power and coverage of electrification. It is underlined in the several studies that those region have to bear lesser cost for their energy fulfilment who have strong power generation system than those who have weaker power generation system. Major dimension in the power sector are availability of finance, lack of efficiency to install and produce, supply the produced power to the required destination. These circumstances prompt to examine the problem at both dimensions for efficient allocation of resources. Thus, it is vibrant to study the technical efficiency and financial performance of the power sector in India.

As power sector itself is business sector, it has to be financially viable. Though GOI participate in various activities of power sector, still it's certainly not a welfare sector. Unless, financial performance of power or energy sector in India becomes satisfying, the dreams of inclusive growth will be a nightmare.

Therefore, the present study entitled as 'Infrastructure Development in India: A Study of Power Sector' aims at following objectives-

1) To examine the relationship between electricity consumption and economic growth in India.
2) To examine the technical efficiency of power sector in India.
3) To examine the financial performance of power sector in India.

1.8. Organization of the Study

The content of this study have been organized in to eight chapters. Chapter one, introduces the meaning and importance of the infrastructure, history and overview of power sector, historical background of the legislative initiatives, energy scenario world versus India, total installed generating capacity in India. Here, the relevance of the study is discussed in detail and specific objectives are framed for the study.

Chapter two consists literature review. In this chapter of the study, relevant existing literature is reviewed comprehensively to explore the various dimensions issues of the study.

Chapter three is devoted to profiling power sector in India whereas forth chapter outlines the study period and methodology used to analyze the data to draw the results.

Chapter fifth establishes causal relation between electricity consumption and economic growth. Chapter six deals with the technical efficiency of power sector in India by applying data envelopment analysis.

Chapter seven consists with financial performance of power sector in India. Chapter eight is the last chapter of the study but is the most important as it encompasses the whole study. In this chapter the study is finally concluded. The findings provided in this chapter of the study intend to help the policy makers.