Chapter 1

INTRODUCTION

1.1. The Issues Involved

Today we are living in a world where electricity is needed in every walk of life from household appliances to sophisticated industrial activities. Electricity being the basic resource for day-to-day living, entertainment, health care, agriculture and any other economic activity, the need for its sufficient and balanced supply has gained immense importance. However, the technical availability of any resource is not recognized unless it is economically viable. To make electricity sufficiently available to meet the enormously growing demands in the society, attention must be drawn to the aspect of its economic viability. The capital cost and revenue cost of generation and distribution of electricity form the pivotal role in the attainment of economic viability.

This research is primarily a study of the cost of electricity that involves examination of different factors having impact on the cost of electricity. However electricity being a non-storable commodity, its production must be matched to its demand for every moment of time. This requires attention to the study of demand of electricity. The study of demand of electricity gets added importance for another feature of the demand of electricity; that is the fluctuating pattern of demand over the span of time of a day, month or year. The present research includes the study of demand of electricity also.

1.2. Theme of the study

In this study attempt has been made to examine different factors, conditions, features, problems and developments falling in the areas of generation of electricity, having impact on its capital and revenue cost and on its time dimensional matching with fluctuating demand. The study considers two aspects of electricity: 1) Power demand & load and 2) cost of power generation.

Power demand refers to the demand potential of electricity at any moment and load means demand met through generation and supply of electricity at that moment. In the area of power demand, the study has attempted to analyze the fluctuating demand pattern over the different hours of the day, the sectoral demand pattern and the seasonal fluctuation. The installed capacity, its growth and composition and capacity utilisation are considered for the study of power load.

In examining the cost of power generation, attempt has been made to study the behaviour of cost with respect to the installed capacity, capacity utilization, factors related to materials and machines, hydro-thermal mix etc.

The inter-utility cost variation has also been considered for the study. Besides inter-utility cost variation, cost of power generation of plants varies on seasonal, inter temporal demand fluctuation, capacity utilisation and certain other plant specific factors like age, technology of plants etc. On the basis of this study, attempt has been made to assess the impact of the individual factors on the cost of power. The assessment is based on the analysis of behaviour of cost in order to achieve cost control in power generation and supply.

1.3. Statement of the problem

The problem centers round the impact of different features of power demand and power generation on the cost of electricity. The existing state of generation of electricity is characterized by high fluctuation in demand, significant gap between demand and supply, high difference in cost structure among different power utilities and underutilization of capacity. All these factors contribute adversely to attain cost efficiency. The study attempted to find the relation between these features of power generation and the costs of power from the observed results.

1.4. Research objectives

The key objectives of the research are:

I. To find the pattern and nature of demand for electricity with respect to different sectors as well as different hours of the day.

II. To assess the responses of the production and distribution system to the demand for electricity in terms of installed capacity and capacity utilisation.

III. To study the behaviour of cost of power with respect to:

A. Hydro - Thermal mix,

B. Utilization of capacity and fluctuation in demand,

C. Nature of plant.

1.5. Hypotheses

For studying the behaviour of cost of power as referred to in research objective III the following hypotheses are developed:

H_1: Unit cost of power is inversely related with the proportion of hydro installed capacity in the total of hydro and thermal installed capacity.

H_2: Unit cost of power is inversely related with extent of utilisation of installed capacity. This is derived from the hypothesis that the rate of fuel consumption is inversely related with Plant Load Factor of plants.

H_3: Average unit cost of power can be reduced by stabilizing seasonal fluctuations in demand through Demand Side Management.

H_4: With modernization as to nature of plant actual level of operation did achieve the benefit of overall cost reduction through reduction of both variable costs per unit as well as fixed cost per unit.

1.6. Research Methodology

Nature and scope of work

Although a lot of papers on the technical aspects of the problem are available, not many papers are there focusing on different factors having impact on cost aspect, what is why the present study begins with exploratory research. A major portion of this study is based on descriptive research which can be viewed as a study of "conditions or relationship that exist; practice that prevail; beliefs, point of views or attitudes that are held; process that are going on, effects that are being felt; or trends that are developing" (Sadhu and Singh, 1985).

The study involved use of data of power sector at national, regional and state level. For analysis of any trend, data has been considered for last two decades ending on 2005-06. Case studies have also been undertaken for the study based on situations related to recent past. The power generating plants in West Bengal representing over 80% of the total State Sector capacity are taken under coverage of the study.

Collection, nature and analysis of data:

Primary data has been collected from official records of different power plants and different load distribution points (substations) and through field survey and interviews of officials. Main sources of secondary data are different web sites, annual reports of different power sector organizations and books, articles and government reports.

Regarding demand of power, data have been collected and analysed for both periodic energy demand in Million Units (MU) and instant demand of electricity in terms of Mega Watt (MW). Both the types of data have been gathered at national, regional and state level. Data of hourly load has been collected from different sub stations representing different sectors. Data collected from the generating plants are related with hourly generation, hourly coal flow, monthly generation etc. Different cost related data are like price of coal, investment and depreciation, monthly fixed and variable cost. The study has generally considered facts and figures for two decades up to the year 2005-06 barring a few instances where data for the year 2006-07 has also been considered. For studying cost structure of different State Electricity Boards, data has been collected from web site of Planning Commission of India and there data is available up to the year 2002 which has been considered for the study. For studying sectoral demand pattern field servey was done in the year 2003-04 for collection of primary data from different sub-stations.

Both time series data and cross section data have been collected and processed to test the hypothesis. Different statistical and mathematical tools are used for processing of quantitative data. For data analysis, software like MS-EXCEL, SPSS are used. Data has been presented in Tables, charts and diagrams for clear understanding. Some simple cost accounting system and techniques are applied for analyzing the behavior of cost.

1.7. Scheme of Work

The thesis contained the statement of the problem, the objectives and hypothesis and cauterization of the document in the introductory chapter.

In Chapter 2 a brief review has been made of some earlier studies that dealt in some of the important issues of electricity where from the central problem of the present research has been developed.

In Chapter 3 a study of the general scenario of Indian electricity sector has been undertaken covering discussion on topics like constitutional status of Indian electricity sector, the legal framework, the institutional pattern, investments in power sector, general pattern of demand and production of electricity and its growth, study of different types of consumers etc. This chapter has contributed as building block for subsequent analysis of demand and cost of electricity.

In Chapter 4 analysis has been made to study nature and pattern of power demand and the extent of variation of the same as well. This chapter has made an in-depth study of the nature and extent of different types of demand variations which restricts stabilization in power system. To attain a possible balance between demand and supply of electricity, attempt has been made from demand side in this chapter. To achieve power stabilization from consumers end a case study based on sensitivity analysis of differential tariffs has been attempted under demand side management approach..

In Chapter 5 the gradual capacity addition and growth of installed capacity at national, regional and state level has been studied. After analyzing the scope of power balance from demand side in Chapter 4, the problem of demand supply imbalance of power has been addressed from supply side in this chapter. A study on demand supply gap, both in terms of energy demand and peak demand has been made here. An attempt has

also been made in this chapter to assess the extent and reasons of underutilization of installed capacity of thermal power generating stations.

In Chapter 6 study has been made to find the impact of demand variation (which has been studied in Chapter 4) and investment for capacity addition (which has been studied in Chapter 5) on cost of generation of power. This chapter contains the detail analysis of different elements of costs, variations in cost structure of different State Electricity Boards with the study of behaviour of cost with respect to certain influencing factors like generation mix, degree of capacity utilization and some other plant specific factors.

In Chapter 7 the thesis has been concluded summarizing the research findings from the observed results in tune with the objectives and hypotheses set with due mention of the limitations of the work and need and scope for further research in this field.