Electricity supply industry has an important place in the socio-economic transformation of an underdeveloped economy. However, the per capita consumption of electricity in India is one of the lowest (78 KWH in 1968 as against 6550 KWH in U.S.A. and 2377 KWH in Japan). Within the country there is wide variation in electricity consumption levels among the States. The per capita consumption in Gujarat is well above the national per capita. Investment in electricity is continuously rising in the State.

Electricity (generation, transmission and distribution) is a 'concurrent' subject under the Indian Constitution, the States carrying a lion's share. Electricity Boards are constituted in the States to plan, implement and administer electricity projects.

In Gujarat besides GEB - which came into existence in 1961 - there are private units which were operating much earlier than GEB. The share of private sector in electricity industry in Gujarat is greater than what it is at the all India level. Industrial and agricultural consumption of electricity is higher in Gujarat than the national average consumption. But there are certain areas like domestic and commercial power where Gujarat lags behind the national average.
In the sale of energy industry and agriculture dominate as consumers. From 1960-61 agriculture is registering a continuous rise, being next only to industry as a consumer. Private sector largely caters to domestic power, commercial and industrial power.

In 1968-69 GEB's power projects constituted 23.70 per cent of productive assets of the State of Gujarat and GEB borrowed 55.30 per cent of all public loans advanced by the State of Gujarat.

Electricity in Gujarat: Supply and Demand:
Role of the Gujarat Electricity Board, 1960-61 to 1971-72:

The main problem of GEB is to find means to cope with the expanding demand for electricity in the State. The GEB has to install a capacity of 4700 MW in about a decade's time with 1142 MW at present (1974). GEB's power system is based on thermal power and uses three types of fuel namely RFO, gas and coal. Coal is imported from other States. Despite developments in RFO and gas coal is going to be the main determinant of future development of thermal power in the State of Gujarat. A weak point about GEB is lack of adequate stand-by capacity.

Between 1960-61 and 1971-72 installed capacity in the State has increased 175 per cent; GEB's growth is ten times
over that of private sector. The transmission lines have increased by 577 per cent and distribution lines 653 per cent. Rural electrification as such has yet to make its headway while 26 per cent of villages are fed with electricity. Gujarat buys power from Maharashtra as a contractual obligation.

Demand for electricity in the State is in excess of its supply and also inelastic in nature. GEB's connected load, electricity sold and sales revenue have increased by about 579 per cent, 460 per cent and 599 per cent respectively during 1960-61 to 1971-72. The growth of sales to Irrigation and agriculture dewatering is highest; Industrial high voltage and Public water works are the next two in order.

In the 'daily load curve' of a typical day, the minimum demand of power is about 60 per cent of the maximum peak demand of that day for the State. Further, the off-season (July) daily peak demand is found 20 per cent to 25 per cent less than the season's (January) daily peak demand.

Beginning with Rs. 24 crores (and a little over Rs. 27 crores at the end of 1960-61) GEB's investment has increased more than nine times during the period. This capital investment is divided into commissioned and uncommissioned (i.e. work in progress) capital. Increased share of un-
commissioned capital reflects its adverse effect on the net surpluses as interest cost on uncommissioned capital is not capitalised.

Energy losses from 1964-65 have always been more than 20 per cent. As it is shown in the thesis a slight reduction in energy losses by one per cent would have resulted in additional earning of Rs.42 lakhs in 1970-71 and Rs.47 lakhs in 1971-72. It is obvious that they have adversely affected the finances of GEB.

GEB is essentially a capital intensive industry. The ratio of commissioned capital to sales revenue is 5.27 and to gross revenue is 4.79 during the period. The commissioned capital as percentage of value added may be interpreted in line with capital output ratio showing capital intensity of the operations. The entire capital of GEB is loan financed. The Government has lent to the extent of 92 per cent in the beginning which has come down to 69 per cent.

An important landmark in the study of working of State Electricity Boards, the Venkataraman Committee made a suggestion that the overall return on investments to be of 11 per cent or 9.5 per cent exclusive of Government duty after meeting the operation, maintenance and depreciation
charges. In fact the Electricity Boards have given an undertaking in this regard.

The Finance Commissions which are called upon to examine the prospects of States Financial Resources have pronounced time and again that the Electricity Boards must strive to achieve the said rate of return resulting into 3 per cent net surplus. However, the opinion of the Sixth Finance Commission is totally different from that of its predecessors. According to it 11 per cent is beyond the Electricity Boards' capacity in the context of their performance to date.

GEB's rate of return is found short of the 11 per cent target and there occurs accumulation of deficit on account of non-fulfilment of financial obligations.

Financial Analysis: Gujarat Electricity Board:
Cost and Revenue Study, 1960-61 to 1971-72:

Cost Study:

The cost study is divided into cost classification and cost structure analysis. The classification is a rearrangement of the cost components which would lend themselves easily for correctives at the social level for the final evaluation. Further it is used to calculate the direct value added.
The cost structure analysis is by no means unique and sacrosanct. We have formulated the cost structure which in our opinion suits the cost analysis of State Electricity Boards in general and GEB in particular. The object of such formulation has been to show the complex nature of costs, both severally and collectively. In fact our cost structure analysis shows the impact of operations at successive stages. We proceed from 'generation' to 'total units' and finally to 'total units sold'.

Several factors affect the 'costs' in the electricity supply industry. However, the factors which are found important in their influence on costs and cost structure are: load factor, bulk power purchased, energy losses and transmission, distribution and consumers' servicing cost.

In the context of GEB's power system Dhuvaran is a giant which contributed to overhauling of the cost complex since 1965-66.

The factors responsible for altering unit costs at the generation stage are also responsible for altering or raising the costs at the total units level. However, the load factor can influence the costs, though, there are compensating factors against the variations in load factor. In the system we have studied the cost of generation and
the cost of power purchased both play, together as well as individually, an important role. Given the generation cost a reduction in bulk power purchased costs can reduce the production cost (i.e. cost at 'total units' level). However, we see no trend in this respect.

Energy losses and transmission, distribution and consumers' servicing costs are important at the final 'total units sold' level. Energy losses have influenced the final costs not only by influencing the costs at the 'total units sold' level but, at the earlier level also, as for a given level of demand, so many additional units will have to be generated or produced. The transmission, distribution and consumers' servicing costs are positively related to the distance over which the supply operations are extended and the sparse consumption load.

An overall cost picture is provided by operating costs inclusive of depreciation. Operating cost per KWH sold consists of two components viz., total operating costs and units sold. Variations in it are therefore related to and the net results of variations in operating costs as well as in units sold. If relative yearly increase in units sold is greater than the relative yearly increase in operating cost, the operating cost per KWH sold in that year declines.
The depreciation provision as an element of cost has exerted an upward pressure particularly since 1966-67.

It is observed that unit costs are moving upward at every stage rendering GEB an increasing cost industry. It is further observed that the policy decisions taken outside GEB have adversely affected its cost structure more importantly.

Revenue Study:

The revenue aspects study needs the understanding of GEB's tariff policy as well as its power supply policy.

GEB's tariff policy is discriminating. The price discrimination is not only with reference to different categories of consumers but also with reference to different blocks of power consumption, lower rates are prescribed for higher blocks of power consumption.

GEB's power supply policy during a year is mainly related to distribution of available supply of power among different categories of consumers. It is observed that all throughout the period demand for power remained in excess of its supply.

While tariff policy is a major determinant of generation of surpluses it should be noted in this case that a
peculiar situation arises out of the working of the GEB. The shortage in supply determines the allocation of power and hence sales of power. If the total revenue is a function of quantity sold, the tariff policy recedes to the background.

The revenue structure study relating to last three years shows that about 50 per cent of GEB's sales contributed less than operating cost, about 17 per cent of the sales contributed just above the operating cost and about 33 per cent of the sales contributed more than the operating cost. The sales to Industrial high voltage consumers contributed less than the operating cost. Any deviation in the above mentioned pattern of sales will influence GEB's rate of return. Industrial high voltage and Distribution licensees taken together consumed about 67 per cent of GEB's total sales during 1971-72 but contributed about 51 per cent to GEB's sales revenue. The above affairs have resulted from GEB's tariff as well as power supply policies.


In discussing the financial aspects of the State Electricity Boards more especially their financial viability,
as well as profitability, their commitment to pay the interest on Government loans and their earning capacity are a major factor. It has been agreed upon that State Electricity Boards should earn minimum 3 per cent net surplus on their capital investment in the long run.

The evaluation attempted here is to determine whether the present working of GEB is commensurate with the long run minimum norm of 3 per cent net surplus on its capital investment. The evaluation is in financial terms mainly locating the break-even position and financial viability in terms of time and estimating the net surpluses accumulation at the end of useful life of capital investment.

The 12 years actual performance of GEB is projected for the remaining 34 years of economic life of total investment. The approach is not purely 'project approach'. It is the 'area' or 'total investment' approach.

The evaluation analysis is restricted to the GEB's thermal investments; already commissioned as well as likely to be commissioned during the period upto 1975-76. In view of expanding demand GEB has to make further investments. Thus its investment operations will remain continuously expanding in future (i.e. even after 1975-76). This entails a situation wherein the investments made and the
power supply capacity installed up to 1975-76 will have to be fully utilised during the economic life of such investments. This largely eliminates risk and uncertainty arising out of time element on demand side. Similarly, the yearly financial obligations viz., depreciation provision, general reserve provision and interest payments on loan capital are predetermined as they are adjusted to the legal requirements laid down in the Electricity (supply) Act, 1948, and the terms and the conditions specified by the State Government - the main creditor to GEB. These have largely reduced the risk and uncertainty on cost side. All these enable us to assume away the element of risk and uncertainty in the long run analysis and to base the evaluation on simple average rate of return calculated for the total period.

On the basis of first 12 years observations units sold are found related to installed capacity with the GEB and maximum demand in the State. Units sold, therefore, are regressed and we get the multiple regression equation:

\[ x_3 = -6.786 + 0.079x_1 + 4.147x_2 \]

Where,

- \( x_1 \) = Installed capacity with GEB
- \( x_2 \) = Maximum demand in the State
- \( x_3 \) = Units sold in Million KWH.
We have used this relationship to project units sold respective to each year since 1973-74. Again a limit is assumed in relation to variations in maximum demand to installed capacity at 95 per cent of the installed capacity. But this could be an extreme situation (1973-74). Thereafter, for all the remaining years they are stabilised at 85 per cent of the installed capacity.

Each year cash flow (revenues as well as costs) is calculated till the end of the period. The total period of 46 years (12 years actual + 34 years estimate) is divided into three periods on the basis of changes in installed capacity. The first period is marked by accumulation of deficits. The second period is notable for the break-even and resulting reduction in accumulation of deficit. The third period is characterised by the attainment of financial viability and accumulation of net surpluses of Rs.117.49 crores at the end of the period.

It is very pertinent to observe that throughout the total period the interest element of cost remained dominant in influencing the net results. The deficits during the first period, the break-even position during second period and the financial viability as well as profitability during the third period are all very importantly influenced by this single factor.
In the analysis we employed a slightly modified concept of capital viz., total commissioned capital (tangible and intangible) plus Working capital minus Depreciation reserve. The concept is based on 'capital base' as well as 'capital employed'. However, it is nearer to 'capital employed' and greater than 'capital base'.

GEB's performance (financial) during past 12 years has not resulted into enough earnings so as to meet the usual financial obligations over and above its operating expenses. Such a situation, it seems, has resulted from fast expanding capital investment operations of the GEB which are of long gestation period and its capital being mainly loan capital found loaded with interest charges.

However, the cash flow calculations relating to GEB's total investment in thermal power system upto the end of 1975-76, considering the entire economic life of such total investment, suggest that the investment is not only financially viable but also profitable.

Though there occurs an accumulation of net surpluses at the end of the economic life of the investment such accumulation is found very marginally short of the 3 per cent net surplus long run norm. This would suggest that the present working of GEB is approximately commensurate with
the attainment of the long run minimum financial norm.

The present analysis would provide a clue to devise a course of actions to attain the norm and thereby provide a start towards a more detailed profit planning analysis.

Economic Analysis: Gujarat Electricity Board:

Estimate of Social Rate of Return: 1960-61 to 1971-72:

In this country profitability of the public sector enterprises has lately been accepted and from 1956 the Plans expected contributions from the surpluses of the public sector units. However, the accounting rate or private rate of return does not adequately reflect their importance to economy as a whole. It is the social rate of return which does this task.

The social rate of return measures the viability as well as profitability of the investment from the point of view of society. It is calculated here with respect to GEB in relation to its first 12 years operations. Such study is useful to 'macro' level policy in framing and relationa-

lising the decisions in relation to GEB.

The social rate of return is the corrected private rate of return. The corrections relate to costs as well as revenues to show their importance in the economy. The cost
correctives are in terms of the respective opportunity costs of the various cost components. Similarly correctives with respect to revenues are in relation to consumers' valuation of the product sold to them. Here measurement of consumers' valuation (and consumers' surplus) poses a problem. Contribution to Government exchequer in terms of taxes and duties resulting from the concern's operations are to be considered as benefits.

On the cost side we have abstained from providing correctives to the items like material purchased, bulk power purchased, foreign exchange component of capital and wages and salaries. Each one of them merits some explanation. Materials are purchased at their market prices. Bulk power purchased is from third party. Foreign exchange component of capital is not only small but it is 'tied' to the project. Therefore it does not command any other value. Most of the labour is skilled labour and unskilled labour is negligible. As such wages and salaries can be taken as competitive in character. The depreciation provision in our analysis is calculated on the basis of conventional economic life of the assets. The fuel cost (RFO) is still subject to negotiations and the probability is it would not depart from the market price.
On benefit side, GEB's tariff policy, which is discriminating, is expected to take care of consumers' surpluses. But with inelastic demand for electric power it can seize only a small part of consumers' surpluses. We have tried to show and estimate consumers' surplus as the difference between consumers' total valuation and the price paid by them for the electricity consumed (exclusive of electricity duty). Different methods have provided different magnitudes of the estimate of consumers' surplus. They are all biased in a downward direction. We have preferred the estimate of consumers' surplus arrived at by the first method under situation (II) as it is more diversified and further biased in downward direction.

GEB's private rate of return for the period 1960-61 to 1971-72 is worked out at 5.05 per cent which is inadequate to meet the interest payments obligations. However, the social rate of return relating to the period is worked out at 11.87 per cent. It is further observed that the social rate of return so worked out is more than enough to meet the norm laid down in terms of 11 per cent rate of return and is fairly comparable with a market rate of interest (12 per cent). This establishes the feasibility (or viability) of the GEB's investment from the viewpoint of society.
The investment policy in public sector enterprises should be related to the social rate of return. The gap between the private rate of return and the social rate of return can be bridged but such issues are left to policy makers.

However, if a concern is not able to earn enough to satisfy its financial obligations (i.e. the private rate of return is less than the interest rate of its borrowings) in order to attain the financial viability in the long run, it has to devise certain positive steps. The calculation of social rate of return and its constituents are helpful to the concern to devise such steps relating to revenue as well as cost policy.

Economic Analysis: Gujarat Electricity Board:
Impact Study, 1970-71:
Estimate of Employment and Income Impacts:

Being infra-structure in nature and having high forward linkage GEB's investment operations have considerable indirect importance in the State economy. It is, therefore, essential to consider both direct and indirect effects of GEB's investment operations for proper evaluation.

The impact study which consists of both direct and indirect effects is carried out in relation to the most
significant sectors of the economy from the point of view of economic growth, viz., industry and agriculture and with reference to two significant components of growth, viz., employment and income. The measurement of indirect effects poses a problem.

In the absence of detailed input-output table for the State economy a method is devised to estimate the indirect effects of electricity in general and GEB's operations in particular. In industry the employment and income impacts of electricity are estimated on the basis of the study of relationship between electricity and employment empirically. In agriculture the income and employment impacts are estimated on the basis of use of electricity in lift irrigation and are based on the principal irrigated crops.

The employment impacts are employment association and employment contribution. Similarly the income impacts are income association and income contribution. They are related to each other. In industry, the income impacts are derived from the employment impacts. Whereas in agriculture, the employment impacts are derived from the income impacts. The employment impacts in agriculture are reduction in the number of the underemployed.
The impacts are considered as a flow over a period of time and are co-terminus with the economic life of the investment. However, the quantum of flow may vary from year to year depending upon other factors. In estimating the impacts, therefore, for the year 1970-71, we have taken this year as a 'sample year' and worked out the impacts.

It is observed from the empirical analysis of the relationship between electricity (fuel/power input) and employment (labour input) in industry that electricity as a variable explains substantial part of variations in the employment in industry. Electricity - its availability and use - explains the employment creation capacity to a greater extent in the case of Household industry and in 'rural' area than in Factory establishments and in 'urban' area of the State. Thus, the analysis shows that electricity has more potential of raising employment in industry in 'rural' than in 'urban' and 'city' area of the State. From this we conclude that greater the pace of rural electrification the greater will be the rise in rural employment in industry. Household establishments provide 67.64 per cent of employment in 'rural' area. This shows the importance of Household industry in the rural economy and its dominance in terms of employment. As shown in the thesis only 6.21
per cent of Household units are using electricity as fuel/power input in the 'rural' area which are responsible for 7.69 per cent of total employment in Household industry in the 'rural' area. This substantiates the case of rural electrification in view of its employment potential and shows the importance of electricity in that.

The average consumption of electricity per person employed in electricity using industrial establishments can be used to decide about the feasibility of employment targets in industry, at the State level as well as at the District level, in the State Plan in view of the availability of electricity supply to avoid bottlenecks in their realisation.

The employment association of electricity in industry was 5,48,342 which was 58.16 per cent of the total employment 9,42,736 in industry. The employment association of GEB was 4,02,319 persons which was 42.68 per cent of the total employment in industry. The employment association of GEB is in proportion to its sales, direct as well as indirect, in total electricity sold to industry. The proportion was 73.37 per cent during 1970-71.

The employment contribution of electricity was 2,90,118 in situation (i) and 4,26,075 in situation (ii). GEB's
employment contribution was 2,12,860 in situation (i) and 3,12,611 in situation (ii). Situation (i) shows the minimum limit and situation (ii) the maximum limit. In terms of percentage share in total employment in industry the employment contribution of electricity was within the two limits 31 per cent and 45 per cent and of GEB 23 per cent and 33 per cent.

The income association of electricity in industry was Rs.318.31 crores and of GEB Rs.233.54 crores.

The income contribution of electricity in industry was Rs.168.41 crores in situation (i) and Rs.247.33 crores in situation (ii). The income contribution of GEB was Rs.123.56 crores in situation (i) and Rs.187.47 crores in situation (ii).

The impact study of electricity on agriculture is based here on the consideration of its use in lift irrigation and, through it, its contribution in raising agriculture produce in the State. Further the total requirement of agriculture is almost wholly supplied by GEB. The impacts of electricity on agriculture are, therefore, the impacts of GEB.

Gujarat lags far behind the national average in the field of irrigation development. Out of gross cropped area
the gross irrigated area was about 13 per cent during 1970-71. Further out of total net area irrigated the area irrigated by wells was about 80 per cent. This shows directly the importance of lift irrigation in total irrigation in the State. And as lift irrigation through the electrified pumpsets is most economical, the importance of electricity is great indeed.

On the basis of the empirically tested observations the performance equation between the three alternatives used in lift irrigation is evolved. With equal size of prime-movers (investment cost) the performance equation is:

1 Electrified well = 1.33 Dieselised wells
= 2.67 Wells using animal power.

Generally the importance of irrigation is more with rabi crops than with kharif crops. The impact study is, therefore, made in terms of the use of electricity in lift irrigation to irrigate the rabi crops.

The income association of GEB (and also of electricity) was Rs. 29.54 crores. The income contribution was Rs. 4.94 crores in situation (i) - the minimum and Rs. 19.69 crores in situation (iii) - the maximum.
We have not provided special treatment to GEB's investment in rural electrification programmes as our main concern is to evaluate GEB's total investment which is inclusive of the former. However, it would be possible to associate the impact study relating to agriculture with that of rural electrification programmes as the later has been turned into 'agricultural (wells) electrification programme' since the year 1966-67. It is shown that the investment in agriculture electrification programmes is socially viable and earning social rate of return lying between 12 per cent and 49 per cent.

The employment impact of GEB in agriculture is in terms of reduction in underemployment. The employment association was more than 3,70,057 persons. The employment contribution was more than 61,901 persons in situation (i) - the minimum and more than 2,46,705 persons in situation (iii) - the maximum.

GEB's direct income (value added) contribution was Rs.13.98 crores. On adding GEB's indirect income contribution (in industry as well as in agriculture) the minimum income contribution was Rs.142.38 crores and the maximum Rs.215.04 crores. In relation to the State income of Rs.2129 crores (1970-71) GEB's minimum income contribution
was 6.69 per cent and the maximum 10.10 per cent. This shows the importance of GEB's operations in the State economy in terms of its total income contribution. It is important to note here that within GEB's total income contribution the relative share of its indirect income contribution was found between 90 per cent and 94 per cent. This substantiates that the GEB's investment operations have low direct value added but considerable indirect importance.

Income and employment impacts are related to each other. What is true of GEB's income impacts is, therefore, true of its employment impacts too. The GEB's total employment contribution is significant in State employment and within its total employment contribution the share of the indirect employment contribution is very much dominating.

The impact analysis has considered the primary benefits of GEB's operations and measures indirect contributions in terms of income (value added) and employment in industry and agriculture sector of the economy. The valuation of benefits to secondary activities is not attempted here mainly because GEB's operations are so extensive that the problem of isolating them is formidable. The intangible benefits, though not quantifiable, are mentioned for their value to policy makers. They are more pronounced to the
Thus it is clear from the impact analysis that GEB's investments lead to a stream of benefits, both direct as well as indirect, which, taken together, are clearly very significant from the point of view of the State economy. It is important to note that, though the impact analysis is an evaluation of GEB's operations relating to the year 1970-71, the magnitude of GEB's benefits is not likely to decline in future as (whatever) benefit streams shown by the analysis are very much likely to flow uninterrupted in future too. When demand for electricity has remained in excess of its supply and the stupendous growth potential in the State indicates the supply bottlenecks to continue for some years to come the benefits measurement of 1970-71 is likely to continue increasing in years to come. The impact analysis is useful to policy makers in their 'macro' level or State level decision making in relation to investment in electricity supply industry in the State.

Section II

Conclusions

For a planned economy the projects constitute crucial elements in the implementation of the plan. Whether these
projects have been able to fulfill their objectives or not is assessed through benefit-cost analysis. As it has been rightly pointed out by Marglin benefit-cost analysis is a tool for implementation of a plan strategy. The main thrust of the thesis developed here is that project evaluation in the context of an underdeveloped economy should go beyond the mere framework of benefits over costs. Indeed every project should be growth oriented. The indicators of such growth orientation are generation of surpluses at the micro level and expansion of employment and creation of additional income at the macro level. One may make a special mention of the needs of growth in an economy like India viz., growth with distributive justice. The generation of surpluses has two important implications: (i) Such surpluses would enable further investment. (ii) Since in a capital shortage economy investment decisions have a high opportunity cost; projects with high surpluses get higher priority. In the shorter period operating results of the existing projects influence the investment decisions in other competing areas.

The analysis of the GEB's investment has shown that the GEB as a project is capable of generating surpluses in the long run. Based on the performance of first 12 years the financial evaluation shows that the private rate of
return is around 5.0 per cent as against the required overall rate of 11 per cent or net 3 per cent. This financial evaluation is subject to two important constraints. The first one relates to the costs and the second one relates to revenues.

GEB incurs costs which are partly decided by the forces of supply and demand over which the GEB has decision-making authority. These costs are called internal costs. There is an impressive list of costs which are determined by the policy making bodies of the Government over which the GEB itself has no control. These are bulk power purchase, depreciation, use of fuel like RFO or gas, price of coal, changes in interest rates and the treatment of loans, discontinuing certain units and connection of remote places. It should be noted that excepting the discontinuing of diesel operated units all other decisions have adversely affected GEB's costs.

Similarly on the revenue side the constraints are even more decisive. While the tariff policy of the public sector undertaking is a major determinant of the generation of surpluses, in the case of GEB the conditions are different. The shortage of power supply throughout the first 12 year period has been responsible for the decision on rationing
of power and hence the sale of power. As the total revenue is a function of quantity sold, tariff policy, per se, has secondary influence on the revenues. Again, the energy sales composition shows that 'the high-profit urban sector power supply operations' are dominated by the private sector companies and Distribution licensees, whereas the sole burden of power supply operations to 'low-profit rural sector areas' (Agriculture and Public lighting) has been entrusted to GEB. This is an in built constraint as the share of agriculture sector is increasing. Further GEB supplies power to Distribution licensees at cost. GEB's sales to this category of consumers are around 17 per cent over which GEB is not making profit.

Any tariff policy must take note of the returns from different categories of consumers with reference to the average operating costs. The Industrial high voltage category of consumers does not contribute to the GEB commensurate with its consumption. Considering the average of last three years, this category of consumers contributed less than the average operating costs, although it enjoyed high priority in distribution and, under the strain of rationing of power, it was the net beneficiary in terms of getting the largest share. This needs to be considered in future revision of the tariff policy.
The projection of cash flows is based on the first 12 years performance. It is shown that there are three distinct periods of cumulative deficits, of break-even position and of financial viability and then accumulation of net surpluses. The cumulative investment on the projects which have been subjected to evaluation in the thesis amount to Rs. 350 crores by the end of March, 1976, over which the surpluses would be Rs. 117.5 crores at the end of the economic life period. It may be pointed out that the interest element of costs has played a crucial role in the determination of surpluses or deficit. In view of the nature of the capital structure of GEB this was to be expected. However, taking the total investment and the economic life of this investment, the rate of return is nearly 3 per cent (net). From this it would be easy to devise a course of actions to attain the norm and work out the detailed profit planning analysis.

The social rate of return, it is shown, is adequate and fairly comparable with the market rate of interest. The social rate of return works out to 11.87 per cent which is comparable with 12 per cent market rate of interest. This establishes the viability of GEB's investment from the viewpoint of society. Social rate of return is the corrected measure of the private rate of return. There are few cost
correctives. On the revenue side the consumers’ surpluses, taxes and duties are added up to bring them to the level of social benefits. The social rate of return is calculated on the basis of first 12 years performance. The consumers’ surplus is calculated in three ways. This was necessitated because of the peculiarity of demand and supply, the existence of price discrimination, the need to assume extreme values of elasticity of demand and the availability of data. Another important element may be added here viz., categorisation of consumers. The results have shown not only the existence of the consumers’ surplus but its high values. In the ultimate analysis this would help in the rationalisation of tariffs in a more meaningful way.

In the next stage the benefits which accrue to the economy are added up to the stream of benefits which are already assessed directly. The emphasis here is on economic growth rather than mere enumeration and valuation of benefits. To recall what has been stated earlier the prime need of a developing economy like India is growth with distributive justice. Additional income generation and extension of employment potential meet the above requirements. It is clearly demonstrated in the thesis that GEB’s functioning has resulted in both augmenting the employment potential and generating the additional income. The impact
of electricity has been assessed in terms of employment association and employment contribution and similarly income association and income contribution. As has been observed in the thesis the forward linkage of the electricity industry is exceptionally pronounced. Even more than this is the fact that the use of electricity explains as a variable substantial part of variations in employment. Its availability and use explain the employment creation capacity in the rural areas and household industry. From this it has been shown that average consumption of electricity per person employed can be used as an important index for planning future programmes of employment creation. An important finding is in relation to the rural economy of Gujarat. The reckoning of employment potential is by creating conditions for the fuller employment of men in agriculture.

It is shown that out of a total employment of a little less than a million in industry electricity contributes between 31 per cent and 45 per cent and GEB's contribution is between 23 per cent and 33 per cent. Based on these data the income contribution of GEB is estimated at between Rs. 123 crores and Rs. 187 crores for the preference year 1970-71. This is with reference to industry in economy.
In the early stages of the thesis itself it is noted that there is a clear shift of power supply in favour of agriculture. Indeed the role of agriculture both in the general life of the country and the growth process can scarcely be exaggerated. In this context, therefore, the shift is quite desirable. On the basis of the irrigation through pumpsets using electric power an estimate is made of the extent to which well irrigation and therefore electricity raises the level of income in agriculture. It is shown that overall generation of income by using electricity in agriculture is a little less than Rs.30 crores for the reference year and direct contribution to income by using electricity is between Rs.5 crores and Rs.20 crores in that year. On the basis of these data the additional employment in agriculture is calculated in terms of providing gainful employment to the underemployed. The estimate shows for the reference period that the employment could be not less than 62000 at the minimum and not less than 2.46 lakhs at the maximum.

Thus it is clear that GEB's investments lead to a stream of benefits which are over and above costs in the long run. This must be noted against the pronouncements of the Finance Commissions. It is, therefore, clear from the Sixth long term point of view the Finance Commission's assessments
were short-sighted. The long term benefits justify investments in the GEB and the benefits are clearly growth-oriented.

Earlier it is stated in this thesis that while dealing with the financial problems of the State Electricity Boards in India, the Fifth Finance Commission endorsed the views of the Venkataraman Committee namely that an expected 11 per cent rate of return including electricity duty be accepted as a norm to be attained by the Electricity Boards. On this the Sixth Finance Commission made a significant departure in so far as it considered 11 per cent to be on the high side, and that in the given context, the Electricity Boards would not be able to attain to that level. It felt that 6 per cent - instead of 11 per cent - rate of return could be realistic and also suggested that interest rate on loans to the Boards be reduced from 6 per cent to 5 per cent for thermal power systems as their operating costs were higher than those of hydro power systems. The Commission also noted that there was no uniformity in the levy of duty on electricity in the different States. It varied from a total absence of such duty to actual levy in some States. Moreover in many States the levy of duty and the raising of the tariff are considered as alternative policy measures. But purely from the point of the Electricity Boards' finances this makes a basic change. The revenue from a duty is a
direct contribution to the Government exchequer while raising tariffs would augment the Boards' resources. The levey of duty would limit the scope for revision of tariffs and to that extent reduce the Boards' operating surplus out of which interest is payable. This has to be considered in calculating the interest rate burden. In other words, the duty must be allowed (subtracted) in the calculation of the interest rate.

However it should be noted that this is in the general context of the whole country. This is based purely on the issues arising out of financial analysis. In the thesis, only GEB is studied and the analysis is an in-depth study of the performance and projections extending over several decades. It is concluded there (in the thesis) that, the long term picture of the GEB is different from the Sixth Finance Commissions' assessment of the Electricity Boards in India and, that in the long run, attaining 3 per cent net surplus in GEB is not out of its reach.

The Pattern or a 'model':

The pattern or a 'model' which evolves from the present study is explained below:

The general framework used here is that of social benefit-cost analysis, viz.,
\[ B - C > 0 \]

Where,
\[ B = \text{Social benefit} \]
\[ C = \text{Social cost} \]

hence the project - total investment - makes positive contribution. However, to assess the role of GEB in the economic development we have departed from the benefit-cost framework and studied the impact of GEB in specific growth components viz., employment and income.

The costs are studied in terms of the cost-classification and the cost structure analysis. In cost classification total cost inclusive of depreciation provision (TCDP) is classified in terms of following components:

(i) Material cost \( (M) \)
(ii) Fuel cost \( (F) \)
(iii) Bulk power purchased cost \( (BC) \)
(iv) Depreciation provision \( (DP) \)
(v) Selling and other fixed cost \( (SO) \)
(vi) Wages and salaries \( (W) \)

Thus,
\[ TCDP = M + F + BC + DP + SO + W \]

The cost classification is useful in calculating the value added and to apply cost correctives for deriving social rate
of return calculation.

In cost structure analysis costs are computed in three successive stages:

(i) Generation,

(ii) Total units, and

(iii) Total units sold.

Costs at 'generation' i.e. generation costs (GC) refer to the cluster of costs of power generation with thermal, diesel and gas systems and maintenance and management expenses.

Costs at 'total units' i.e. production costs (PC) are a combination of costs of units generated (GC) and of unit purchased in bulk (BC)

Costs at 'total units sold' i.e. operating costs inclusive of depreciation provision (OCDP) comprise all costs at 'total units' and transmission, distribution and consumers' servicing costs (TDCS).

Thus,

\[ \text{OCDP} = \text{PC} + \text{TDCS} \]

\[ \therefore \text{OCDP} = \text{GC} + \text{BC} + \text{TDCS} \quad (\therefore \text{PC} = \text{GC} + \text{BC}) \]

and operating cost net of depreciation provision (OC)

\[ = \text{OCDP} - \text{DP} \]
Revenue i.e. gross revenue (GR) consists of revenue from the sale of electricity (RE) and revenue from other miscellaneous sources inclusive of Government subventions (RO).

Thus,

$$\text{GR} = \text{RE} + \text{RO}$$

Whether or not the present working of GEB is consistent with the long-run financial norm of 3 per cent net surplus is examined in the long-run financial analysis. The first 12 years performance is projected for the remaining period of 36 years of economic life of GEB's total investment. With the help of multiple regression equation

$$x_3 = a + bx_1 + cx_2$$

Where,

- $x_1$ = Installed capacity with the GEB
- $x_2$ = Maximum demand
- $x_3$ = Units sold in million KWH
- a, b and c are unknown constants.

the units sold are projected. The gross revenue (GR), the operating cost (OC) and the financial obligations are also projected (for details, See: Chapter VI). The net surpluses
(NS) for the total period are:

\[ \Sigma NS = \Sigma (GR - OC - DP - GRP - GIP + S) \]

Where,
- GRP = General reserve provision
- GIP = Gross interest payment provision on loan capital net of repayment
- \( S \) = Salvage value

and \( \Sigma \) denotes the total.

The net surpluses are percentage of Capital \( K^* \) are:

\[ \frac{\Sigma NS}{\Sigma K^*} \times 100 \]

Where,
- \( K^* \) = Our concept of 'capital'.

'Capital' \((K^*)\) in the analysis is defined as:

\[ K^* = K + KW - DR \]

Where,
- \( K \) = Total commissioned capital (tangible and intangible)
- \( KW \) = Working capital
- \( DR \) = Depreciation reserve.

If net surpluses as percentage of 'capital' \((K^*)\) for the total period are equal or greater than the long run financial norm of 3 per cent the present working is justifiable and
if they are less, the present working needs corrections.

This analysis would provide a start towards a more detailed profit planning analysis - a very important tool to management in rationalising the decision-making.

The social rate of return analysis is used to examine the viability and profitability of GEB's investment from the point of view of society. The social rate of return is the corrected private or accounting rate of return.

The social rate of return = \[
\frac{(\Sigma G - \Sigma T C D P + IS) + \{ (\Sigma AGR - \Sigma AT CDP) + IT \}}{\Sigma K^* + \Sigma AK^*} \times 100
\]

Where,

\[ \Delta \] denotes the change resulting from the introduction of corrective to reflect social value.

Here,

\[ AGR \] is related to the estimate of consumers' surplus.

\[ \Delta T C D P \] and \[ \Delta K^* \] are zero (for explanation, See: Chapter VII)

\[ T \] are taxes inclusive of import duty paid by GEB to Government exchequer and are benefits to society.

The consumers' surplus is the difference between consumers' total valuation and consumers' price valuation i.e. price paid by consumers for the electricity consumed
(exclusive of electricity duty). The measurement is based on 'quantity into price' approach rather than the 'price into quantity approach'. The maximum price which consumers would be willing to pay is estimated yearwise as well as consumers' categorywise and thereby consumers' total valuation and consumers' surplus are estimated. The maximum price is the corrected actual price ($P^*$), the corrective is formulated in terms of the relationship between the potential demand for power consumption ($D$) and the realised power consumption ($d$) per consumer during a year (for further details, See: Chapter VII).

The social rate of return analysis with its constituents is helpful to the State level policy decisions in making the concern or project effective in the attainment of the targets in a more meaningful way.

The impact analysis shows the present as well as potential role of GEB in the economic growth of State economy in terms of employment and income impacts through electricity supply in industry and agriculture sectors of the economy.

[The impacts of electricity in industry are estimated through the use of electricity in industrial establishments as fuel/power input.] They are estimated as follows:
Employment Association = Total employment in all industrial establishments using electricity as fuel/power input.

Employment Contribution in Industry (ECIn) = The difference between EAIn and potential employment in the situation of non-availability of electricity as fuel/power input.

Obviously EAIn > ECIn

From this the income impacts viz., income association in industry (IAIn) and income contribution in industry (ICIn) are derived.

IAIn = Value added in all units using electricity as fuel/power input

= EAIn x Value added per employee in organised sector of industry.

Similarly ICIn = ECIn x Value added per employee in organised sector of industry.

The impacts in agriculture are felt through the use of electricity in lift irrigation for non-monsoon rabi crops. Main irrigated crops viz., wheat (food crop) and cotton (non-food crop) are considered in estimation. The proportion of lift irrigation used for these crops is the basis of computing the monetary value of the impacts. The performance equation evolved from considering differences in irrigation costs between the three alternatives used (with equal invest-
ment) in lift irrigation viz.,

1 Electrified well = 1.33 Dieselised wells
= 2.67 Wells using animal power

is used in estimating the 'contribution' impacts.

The impacts in agriculture are estimated as follows:

Income association in agriculture (IAAg) = Value of output (current prices) in irrigated area through electrified wells (as defined above).

Income contribution in agriculture (ICAg) = The difference between IAAg and value of the potential output (current prices) in the situation of non-availability of electricity.

Obviously IAAg > ICAg

From this the employment impacts viz., employment association in agriculture (EEAg) and employment contribution in agriculture (ECAg) are derived. [The employment impacts in agriculture are in terms of reduction in the number of underemployment by raising income per worker in agriculture to the State level.

The extent of underemployment (G) = The average annual earnings of a worker at the State level
- the average annual earnings of a worker in agriculture.]
Hence the employment impacts are:

\[ EA_{Ag} > IA_{Ag} - G \]

and

\[ IC_{Ag} > IC_{Ag} - G. \]

The inequality sign \( (>) \) indicates the existence of other factors (sectoral skill differences) contributing to the difference between average annual earnings of a worker at the State level and in agriculture.

The 'contribution' impact in above measures GEB's benefits to the economy. These benefits relate to one year and are likely to fluctuate from year to year. In any case their relative magnitude shows the significance of GEB in the economic growth.

The impact study is useful to the State level policy making relating to investment in electricity supply industry in the State in general and in GEB in particular.