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GROWTH TRENDS OF DEMAND AND SUPPLY SIDE VARIABLES IN KERALA ELECTRICITY SYSTEM: - AN ANALYSIS

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Abstract

Energy is an independent parameter in the overall economic development activity of any country. It has become synonymous with progress in all fields of activities. Being a clean and versatile form of energy, electric power is one of the most important infrastructure sectors of national economy. Providing adequate and affordable electric power is essential for economic development, human welfare and higher standard of living. Uninterrupted supply of adequate and reliable power at an affordable price would be the best ingredient to generate quicker growth through better production in power based units. But unlike the other commodities electricity cannot be stored for future use. Its generation and consumption have to be simultaneous and instantaneous. Installing power generation, transmission and distribution capacity is a complex, time consuming and expensive process.

Introduction

Electric power is a critical component as well as a determinant of a nation's development. It is the most widely used form of domestic and commercial energy. Among the primary sources of electricity, hydropower ranks high in the list of priorities in energy exploitation. It is one of the first non - animal energy resources harnessed by man. Today, nearly all hydro power is converted in to electricity. It is easily obtainable as it comes in mechanical form, which does not need conversion. In a hydro power system, electricity is produced through water, which is collected in a reservoir and a steady a stream is regulated through a specially built dam. This water is brought by pipes to a lower level where it flows through turbines. The rotation in the turbine provides mechanical energy, which is turned into electrical energy in the generators.

Growth of electricity system in Kerala can be examined in terms of the changes in power system variables. Electricity system variables like installed capacity, generation, maximum demand, total number of consumers, connected load and other variables are mutually interactive and inter-dependant. Therefore, the study of electricity system in the state means the study of the trends in the

growth of all these variables, which constitute the supply side and demand side of the state electricity system. An attempt is thus made to study the trends in the rate of growth of these variables - supply side and demand side - without which it is near impossible to analyse the key issues, which the electricity system has been witnessing.

Objectives of the study

To study the major supply side variables affecting the Kerala electricity system.

To study the major demand side variables affecting the electricity system of Kerala.

To make a comparison in the growth rates of supply and demand side variables.

Electricity System Variables - Supply side

The important system variables on the supply side include the installed capacity, Generation, Maximum Demand, Number of Transformers etc.

1. Installed capacity

The installed capacity of the Kerala Electricity system, which was 38 MW in 1950,

increased to 2746 Mw as on 31-3-2010, the annual average compound growth rate being 7.39 per cent (Table - 1) During the first four five- year plan periods, perceptible increases were recorded in the installed capacity. Though installed capacity is the basic determinant of electricity generation; its rate of growth is not in proportion to the changes in other variables, as it appears to be based mainly on governmental decisions, which are influenced by non- economic factors.

2. Generation

Electricity generation depends on several variables like installed capacity, internal

Maximum demand, the load factor, availability of sufficient quantities of water evacuation of power from the generating end etc. However, of all the factors affecting generation, installed capacity is the most crucial factors feeder. It is true that as the internal maximum demand increases, the electricity system may try to enhance the volume of generation beyond the desired level of generation capacity. However, for supplying adequate and quanlitative electricity on a sustained basis, installed capacity has to increase proportionately with electricity requirement. Details of growth in generation in the state is given in Table - 1

Table - 1

Plan wise Growth in installed capacity and Generation

Period	Installed capacity Mw	Changein Indices	Generation MU	Changein indices
1950	38	100	151	100
End of First plan 1956	86	226	350	232
End of Second plan 1961	132.5	349	582	385
End of third plan 1966	193	508	842	558
End of Forth plan 1974	622	1637	2510	1662
End of Fifth plan 1979	1012	2663	5190	3437
End of Annual plan 1980	1012	2663	5119	3390
End of Sixth plan 1985	1012	2663	4885	3235
End of Seventh plan 1990	1477	3887	5075	3361
End of Annual plans 1992	1477	3887	5326	3527
End of Eighth plan 1997	1508.5	3970	5502.86	3644
End of Ninth plan 2002	2601.62	6846	7142.18	4730
End of Tenth plan 2007	2657.22	6993	7745.78	5130
As on 31-3-2010	2746	7226	7240.38	4795
Annual average Compound growth rate (%)	7.39		6.66	

Source: 1) Kerala State Electricity Board, “Power System Statistics”, Thiruvanathapuram (Various Years)

2) KSEB, “Annual Administration Report” Thiruvanathapuram (Various Years)

Total electricity generated by the Kerala power system was 151 Mu in 1950. The rates of increase in generation up to the fifth five - year plan were considerably higher than the succeeding five - year plans. In the year 1978 - 79, there was a sudden increase in electricity generation, due to the increase in system demand and generating capacity made available by the commissioning of the Idukki hydel project in the fifth plan period. During the sixth, seventh and eighth five year plans, there was little or nominal increase in electricity generation. During the fourth year of the eighth five- year plan (1995 - 96), electricity generation registered an increase due to the commissioning of Kallada power project in 1994. The generation increased from 151 MU to 7240 MU between 1950 and 2010 at an annual average compound growth rate of 6.66 percent.

3. Maximum Demand

Energy literature distinguishes between two types of maximum demand, namely maximum demand (internal) and Maximum demand (system). The maximum demand internal refers to the maximum demand taking into consideration the peak load demand of the consumers. The maximum demand system refers to the maximum demand that the electricity system in the state can meet during the peak hours (6.30 pm to 10.00 pm). Demand details are given in Table - 2. Power engineering principles explains that the system (electricity system within the state) shall be able to meet the internal maximum demand. In the context of Kerala, the system has been unable to meet the internal maximum demand from mid - 1980's and therefore, load management techniques like load shedding and power cut have been implemented to overcome persistent power shortages. The gap between system demand and internal maximum demand is made up through power imports.

Table: 2

Plan wise Growth in Demand and Number of Transformers

Period	Maximum Demand MW (system)	Distribution Lines (Kms)		No. of Transformers
		High tension	Low Tension	
1950	25 (100)	1067 (100)	992 (100)	324 (100)
End of First plan 1956	63	2802	3783	845

	(252)	(263)	(381)	(261)
End of Second plan 1961	116 (464)	5549 (520)	8899 (897)	2998 (925)
End of third plan 1966	174 (696)	6570 (616)	14189 (1430)	3930 (1213)
End of Annual plan 1969	353 (1412)	7241 (679)	16952 (1709)	4907 (1515)
End of Fourth plan 1974	500 (2000)	9645 (904)	25968 (2618)	8285 (2557)
End of Fifth plan 1979	852 (3408)	12645 (1185)	42507 (4285)	10330 (3188)
End of Annual plan 1980	854 (3416)	13348 (1251)	47606 (4799)	10821 (3340)
End of Sixth plan 1985	939 (3756)	16317 (1529)	71259 (7183)	12597 (3888)
End of Seventh plan 1990	1171 (4684)	19127 (1793)	95938 (9671)	16394 (5060)
End of Annual plans 1992	1265 (5060)	25151 (2357)	108420 (10929)	18843 (5816)
End of Eighth plan 1997	1235 (4940)	26444 (2478)	132864 (13393)	25940 (8006)
End of Nineth plan 2002	2333 (9332)	30971 (2903)	191930 (19348)	32585 (10057)
End of Tenth plan 2007	2742 (10968)	36419 (3413)	226128 (22795)	39848 (12299)
As on 31-3-2010	2998 (11992)	44683 (4188)	249687 (25170)	52300 (16142)
Annual average	8.30	6.42	9.65	8.84

Compound growth rate (%)				

Source: 1) KSEB, “Power System statistics,” Thiruvanathapuram (Various issues)

2) KSEB, “Annual Administration Report” Thiruvanathapuram (Various issues)

Note : Figures in brackets show the change in Indices.

Internal maximum demand in the state is based on the connected load and time factor. Given the time factor, as connected load increases, the internal maximum demand also increases. To meet the increase in internal maximum demand, the installed capacity of the system should have been increased at least 30 percent above the maximum internal demand, so that the system can meet the entire demand.

4. Transformers

Transmission and distribution lines are connected to transformers of varying capacities.The transformer capacities are different in sub - stations and in High Tension (HT) and low tension (LT) distribution centers. If the transformer capacity of substation is below the expected rate, there will be higher levels of electricity loss and low voltage at the consumer end. Similarly if the transformer capacity is insufficient in the distribution centers, there will be higher levels of transformer loss and electricity losses. Therefore a reliable power system should install sufficient quantities of transformers to maintain load balance. Electric engineering principles explain that there is a standard normal range of distance between substations, so also with transformers. This range is to be maintained to reduce electricity loss and to provide desired level of voltage at the tail end of distribution lines.

The number of transformers in Kerala increased from 324 in 1950 to 52300 in 2010 at an annual average compound growth rate of 8.84 percent (Table 2). Similarly the rate of growth in High Tension distribution lines is at 6.42 percent and that of Low Tension distribution lines is at 9.65 percent. However it is necessary to verify whether this much number of distribution transformers is sufficient to meet state’s electricity distribution system. A general view in this regard is that even such a high number of distribution transformers are quite insufficient to dispatch better quality electricity due to the fact that there exist abysmally low levels of voltage in the state.

Electricity System Variables - Demand side

The number of consumers and connected load are the major demand side variables that affect the growth of the electricity sector.

1. Electricity consumers

Electricity consumers consists of Domestic, Commercial, Industrial - LT, Industrial HT&EHT, public lighting, Agricultural, Public water works, Licensees and Railway Traction. The number of consumers in the state remained at 0.28 lakhs in 1950, which increased to 97.43 lakhs as on 31-3-2010 at an annual average compound growth rate of 10.25 percent (Table -3).The rate of increase in the number of consumers was relatively higher from the sixth five - year plan onwords. The trend analysis of total power consumers in the state power sector shows that from fourth five year plan on words there has been considerable increase in the number of consumers. It further means that the demand for electricity started increasing at a faster rate since 1969.

2. Connected Load

Demand for electricity is expressed in terms of the connected loads, that is, the Electricity capacity (kw) requirement of consumers. When the electricity capacity requirements of all consumers are added together, we get the total connected load of the electricity system.

Table - 3

Plan- wise Growth in Consumers and connected Load

Period	Number of Consumers (Lakhs)	Changein indices	Total Connected Load (MW)	Changein indices
1950	0.28	100	70	100
End of First plan 1956	0.79	282	142	203
End of Second plan 1961	1.75	625	311	444
End of third plan 1966	3.25	1161	510	729
End of Annual plan 1969	4.40	1571	805	1150
End of Fourth plan 1974	7.77	2775	1231	1759
End of Fifth plan 1979	11.72	4185	1738	2483
End of Sixth plan 1985	22.17	7918	2803	4004
End of Seventh plan 1990	31.90	11393	4166	5951
End of Annual plans 1992	36.98	13207	5526	7894
End of Eighth plan 1997	49.23	17582	6089	8699
End of Ninth plan 2002	66.62	23792	8917	12739
End of Tenth plan 2007	87.14	31121	11466	16380
As on 31-3-2010	97.43	34796	15867	22667
Annual Average Compound Growth Rate (%)	10.25		9.46	

Source: 1) KSEB, “Power System statistics,” Thiruvananthapuram (Various issues)

2) KSEB, “Annual Administration Report” Thiruvananthapuram (Various issues)

Connected load in the state has been steadily increasing and in the fourth, sixth and eighth five - year plan, the rate of increase is relatively faster as this is evidenced from the changes in its rate of changes of the indices (Table 3). It is also observed that the rate of changes of indices of connected load is relatively slower than that of total consumers. That is due to the fact that there is no one to one correspondence between consumers and connected load. Electricity demand by a consuming unit is not only the function of connected load but also the duration of electricity consumption by these units. There may be higher levels of connected load, but all this entire loads necessarily do not demand corresponding levels of electricity. Instead, even without an additional increase in connected load, there will be higher levels of electricity consumption if the duration of electricity consumption increases. The total connected load of the Kerala electricity system was 70 MW in 1950, which rose to 15867 MW as on 31-3-2010 at an annual average compound growth rate of 9.46 percent.

The above analysis of the growth of demand and supply side variables in Kerala Electricity system reveals the annual average compound growth rate in the supply side variables and demand side variables between 1950 and 2010. The growth rate in installed capacity was at the rate of 7.39 percent where as the generation has increased at the rate of 6.66 percent. Maximum demand (system) has increased at the rate of 8.30 percent, High tension lines increased at 6.42 percent, Low tension lines at 9.65 percent and number of transformers at 8.84 percent. The demand side variables such as number of consumers increased at 10.25 percent and total connected load at 9.46 percent. The average growth rate in supply side variables like installed capacity, Generation, Maximum demand, Distribution lines and number of transformers was at 7.88 percent. The average growth rate in the demand side variables like number of consumers and connected load was at 9.86 percent. That shows that the annual average compound growth rate in the demand side variables is more than the annual average compound growth rate in the supply side variables.

Conclusion

The foregoing analysis of the growth of demand and supply side variables in Kerala Electricity system has thrown up several issues of serious concern. The major issues are that the key supply side variables such as installed capacity, generation, Maximum demand, distribution lines and number of transformers grew much slower than the demand side variables like number of consumers and connected load. This led to widening gap between electricity supply and demand, in turn, leading to very fast increase in electricity imports. The per capita electricity consumption increased steadily, but the units of consumption per actual consumer has been declining, a phenomenon reflecting shortage of adequate and reliable electricity supply. The need for new thinking, fresh management approaches for restoring operational efficiency and financial viability in electricity sector is more urgent now than ever before.

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