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Green Buildings, Energy Conservation and Sustainability- A Study of Jaipur City

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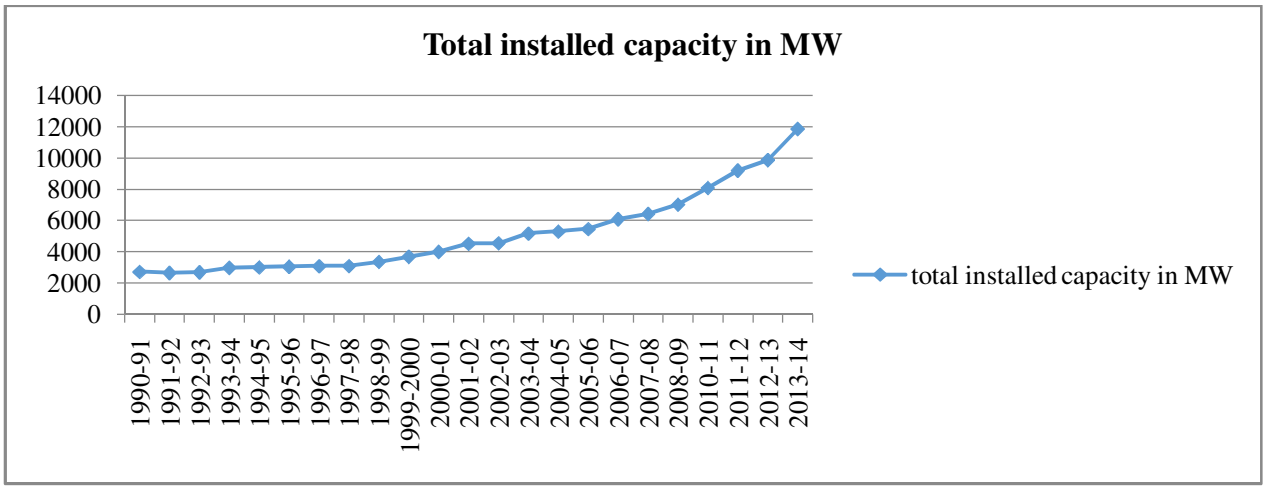
ABSTRACT: India has witnessed rapid growth in the past few decades. It is true that all these developments have been made possible by the use of energy, as energy and economic development are positively related to one another. Of all the forms of energy, electrical energy significantly affects the all-around development of the nation. Growth of Indian economy since the period of independence has increased the per capita consumption of power to a great extent. The increase in the per capita consumption of power from mere 50 KWh in 1950-51 to more than 1000 KWh in 2014-15 (Economic Survey) is a positive indicator of growth. However, this has led to serious problems such as growing power crisis (demand exceeding supply), rising debt on the Indian power sector since it lacks the adequate funds to increase the installed capacity, and finally adverse effect on our environment as more than 70 per cent of our energy requirements are met out from coal and thermal generation. The present article presents the current scenario of Rajasthan Power sector and also offers some strategies to overcome the power deficit through green buildings.

Key Words: Economic development, power crisis, power deficit, increasing debt.

I. INTRODUCTION

No doubt the economic development of the state largely depends on its infrastructure and in the pace of rapid economic development, supply of adequate power is considered to be a most important component of infrastructure. Rajasthan, the largest state of the nation is not only rich in natural resources but also endowed with tradition, heritage, culture and beauty. During last two decades the state has shown a very healthy path of development and it is one of the fastest growing states in the country during 2005-2012(Rajasthan State Profile). Rajasthan ranks 12th in terms of investment, infrastructure, agriculture and education in the country. Infrastructural developments are inevitable for any nation to attain rapid economic development and among all the components of infrastructure electricity in the modern era are considered as one of the critical inputs for economic development and the per capita consumption of power is considered as an effective indicator of growth and development. Since the entire development process of the economy is totally dependent on the power, the power sector development was conceived through by the government. Rajasthan as a state was formed in the year 1949 with the total installed capacity of 13.27 MW but the supply of electricity was restricted only to few cities. Realizing the importance of power, RSEB (Rajasthan State Electricity Board) was formed on 1st of July 1957 and in order to strengthen the power sector around 28-30% of its plan outlay was spend towards the growth of power sector. The state power sector has witnessed rapid growth of around 9 % per year and the sale of power has increased at an annual average rate of 11% (Rajasthan Power Sector Vision 2020).

Power Scenario of Rajasthan: Since the formation of the state in 1949 government of Rajasthan and power sector together have taken serious efforts to increase the installed capacity of power in order to bring a balance between the growing demand and supply of power and also drive the economy on the path of development. The growth of installed capacity of the state is shown in the Fig. 1. The above figure clearly indicate that the installed capacity of the state has increased manifold i.e. from 13.57 MW in 1950-51 to 11850 MW in 2013 - 14 which is more than 800 per cent increase. This tremendous increase in the installed capacity of state has no doubt imposed excessive financial stress on both the government as well as power sector leading to financial deficit.



Source: Annual reports of Vidhyut Bhawan, Jaipur.

Fig. 1. Growth of Installed capacity.

But in spite of increasing the installed capacity manifold the power sector of the state has not been successful in bridging the gap between the growing demand and supply of power or narrow down the gap. The demand and supply position of the state is clearly shown in figure 2.

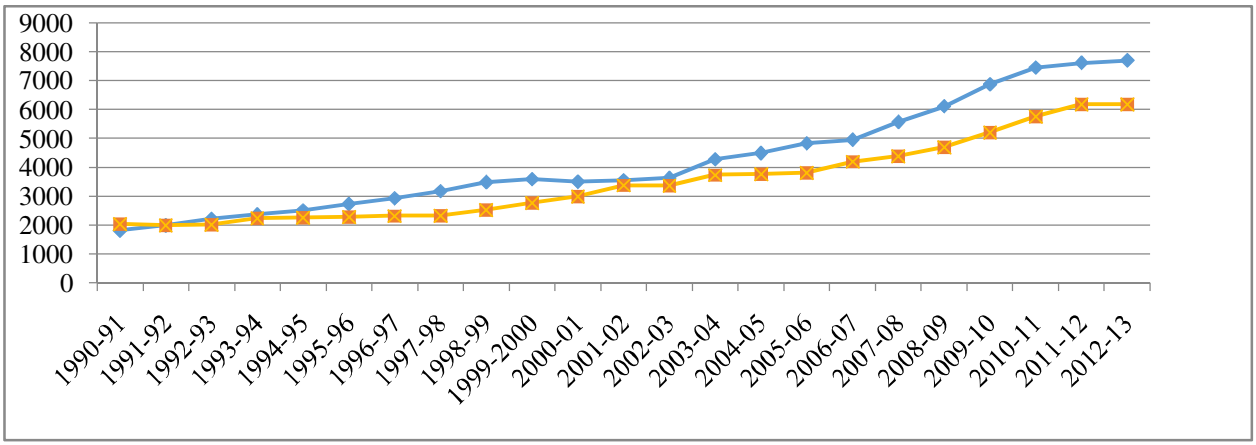


Fig. 2. Growing deficit of power of Rajasthan since 1990.

The above figure clearly shows that the energy deficit during the year 1991-92 was only 0 .02 MW but now in 2012-13 it has increased to around 1438.50 MW (Vidhyut Bhawan, Jaipur). In spite of increasing the energy supply manifold Rajasthan power sector has not been successful in overcoming the power deficit. In order to bring a balance between the Demand and Supply of Power Government has also been allocating more funds from the budget outlay so as to increase the installed capacity. In the year 2015-16, in order to overcome the problem of power crisis a major portion *i.e* 42% of Rajasthan budget has to be spent on power sector from total budget outlay (17 th Electric Power Survey). The allocation of budget outlay to the power sector during the planning period is shown in the Table 1.

It is seen that in order to bridge the gap between the demand and supply of power Government has continuously increased the investment on the State Power Sector. During the First Five Year Plan nearly 15% was allocated for Power sector of the State i.e. 9.58 Cr. But out of the allocated fund only 1.24 Cr was actually spending on Power Sector which was very much below the targeted outlay.

Table 1: Total plan outlay for Rajasthan.

Five Year Plan	Total Plan Outlay (Cr)	Total Outlay for Power Sector (Cr)	Actual Plan Expenditure on Power Sector (Cr)
I	64.5	9.58	1.24
II	105.27	19.99	15.15
III	236	35	39.36
Annual Plans	132.72	47.29	46.82
IV	306.21	90.37	93.98
V	847.16	242.30	248.97
Annual Plan	275	90	100
VI	2025	650.61	566.14
VII	3000	927.48	921.77
2 Annual Plans	1262	555.92	622.24
VIII	11500	3255.49	3253.90
IX	27650	6528.00	5258.06
X	31831.75	8460.43	10461.46
XI	71731.98	25606	---
XII	196993	73734.47	----

Source: Directorate of Economics and Statistics, Rajasthan.

Even in the consequent Plans importance was given to strengthen the power sector and overcome the problem of power deficit. During the Fifth Plan 29%, Sixth Plan 28%, Seventh Plan 30%, Eighth plan 28%, Ninth plan 24% and Tenth plan 27% of total outlay was allocated for the development of State Power Sector. During the Eleventh plan the allocation made on Power was 36% of total plan outlay (DES Rajasthan). The total allocated fund for power sector in the XII plan is the highest of the entire plan which is 37.43% of total plan outlay (Report of Vidhyut Bhawan 2013). But In spite of huge investments made by the State on power sector still the Energy Scenario of the State is not satisfactory. If the condition of state power sector continues in the same manner, then it would be very difficult to overcome the problem of power deficit in future. It is estimated that the demand for power would grow rapidly in the future as shown in the figure 3.

Fig. 3 reflects that the forecast for growth in power consumption by 2020 in the domestic sector is the highest. This emphasizes the significance of research in DSM of residential electricity consumption in the State.

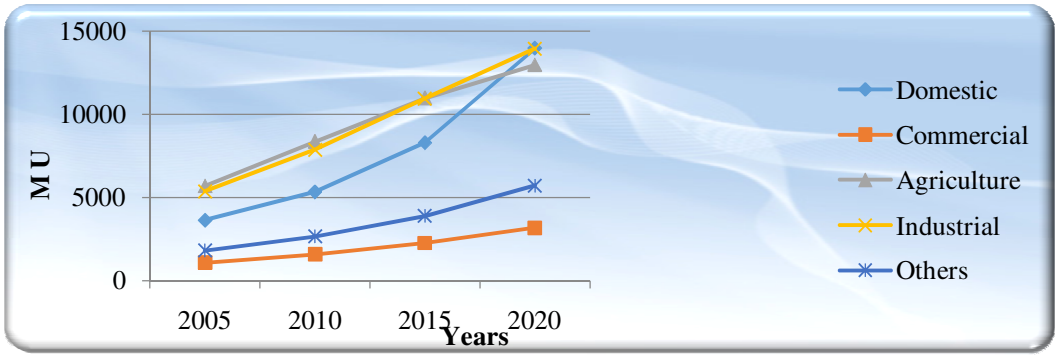


Fig. 3. Category Wise Load Forecast for Rajasthan (Million Units).

The figure 3 clearly brings out the fact that the consumption of power is likely to increase exorbitantly and if adequate efforts are not taken at the right time it would lead to the fall in the economic growth rate of the economy as the economic growth is determined by adequate supply of power. It is also seen from the following figure that growth in the consumption of power is the highest in residential (domestic sector) i.e there is huge potential to conserve energy in residential sector if effective strategies are taken to curb excessive demand of power in Rajasthan.

II. STRATEGIES TO OVERCOME POWER DEFICIT

There are multiple options open to us to overcome the power crisis and out of all the available options, DSM would go a long way in curbing the problem of power deficit.

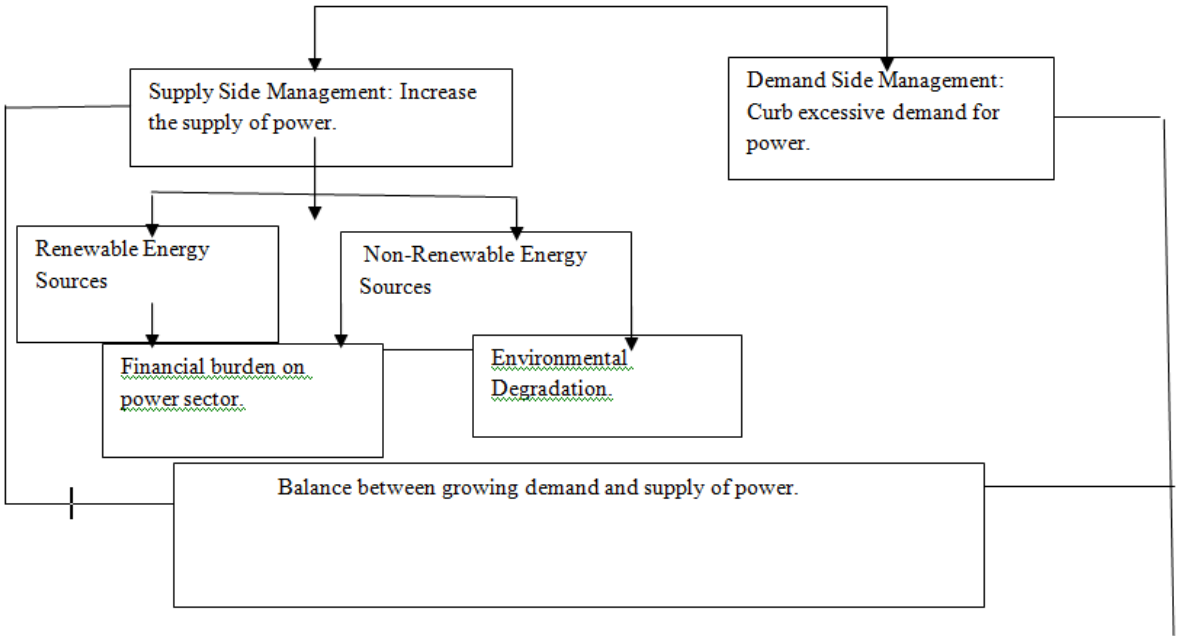


Fig. 4. Strategies to overcome Power Deficit.

Fig. 4 depicts the fact that supply side management using renewable sources will be effective strategy as it does not have negative impact on our environment but would require huge financial investments which our economy lacks. But Demand Side Management strategy is one of the best options that could be adopted in short as well as long run to overcome power deficit.

A. Green Buildings and Energy Conservation

Of recent times the DSM strategies have incorporated the concept of energy efficient or green buildings as the structure and nature of the dwelling influences the level of electricity consumption of the residents and hence the characteristics of dwelling such as the number of rooms, doors, windows, ventilators, color, detachment and insulation of walls are considered as important determinants of residential electricity consumption. Besides, age and ownership of the house has an impact on household electricity consumption. Therefore, in the present research these variables have been incorporated. A sample of 353 Households has been taken covering all the seven circles of Jaipur city in order to analyses the nature of residential buildings as t is proved in many national and international studies that the age, nature, built in area etc. influences the residential electricity consumption to a great extent.

Table 2: Age of Dwelling of Sample Households.

Category / Household	AGEDWEL_1 (New built after 2000)	AGEDWEL_2 (Mid Age built between 1975-2000)	AGEDWEL_3 (Old built between 1965-1974)	AGEDWEL_4 (Very old built before 1965)	Total
No of Houses	89	157	10	97	353
In percent	25.2	44.5	2.8	27.5	100

Source: Primary Survey

Table 2 reflects that new residential buildings comprise of merely 25.2 percent i.e .one fourth of the surveyed houses in Jaipur city, where as the percentage of very old houses (27.5 percent) is relatively higher. Thus, it can be said that the existence of older buildings constitutes an important cause of increased residential electricity consumption in Jaipur city. It is suggested that State government policies should encourage construction of green buildings and renovation of the existing ones with adequate energy efficient technologies in order to curb the excessive demand and bring a balance between the growing demand and supply of power.

IV. CONCLUSION

The above empirical study of Jaipur city clearly brings out the fact that the consumption of power is likely to increase exorbitantly, and if adequate efforts are not made at the right time it will hamper the economic growth and development rate in the State. The forecast for growth in power consumption by 2020 in the domestic sector of Rajasthan is the highest (17th Electric Power Survey). Thus, to conserve this scarce resource, the option of DSM has an important role to play in the near future and is also a more effective strategy in the short run. This emphasizes the significance of research in DSM of residential electricity consumption in the State. In the present study an attempt has been made to analyze the age of residential building as one of the determinants of residential electricity consumption in Jaipur city. If adequate financial assistance is provided to the residents at a very low rate of interest in order to either renovate their existing building or construct new ones, this would go a long way in curbing the residential electricity demand.

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