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Strategies of Demand Side Management and Implementation for Peak Load Reduction

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ABSTRACT: This paper includes the analysis of the particular state and finding the solution to reduce the peak load reduction. During few months of the year the energy demand increased in a very rapid state, which leads to the power purchase at a very high cost. This high cost of power purchase will make the distribution company in loss state. Various steps has been taken from the ministry of power to reduce the energy demand from the consumer side and still some measures are in progress. Our work is based on the load research profile of a Union Territory to capture few years peak load profile and steps to be taken for the peak load reduction. A study of the impacts due to the measure taken or planned for the future is done in this work. Solar roof top schemes are going nation wise and after considering a particular amount of solar roof top installation and reducing the demand by several megawatts will definitely impact the peak load and will be beneficial for the respective distribution company.

KEYWORDS: DSM Demand side management, CFA Central finance assistant, MNRE Ministry of New and Renewable Energy, Solar Roof Top, DISCOM Distribution Company, BEE Bureau of Energy Efficiency.

I. INTRODUCTION

India is witnessing tremendous growth in electricity demand. Over time, capacity augmentation has not been able to keep pace with the increase in demand and has associated environmental concerns. Given the high capital intensity of infrastructure required and the extensive resources that are expended in the supply of fuels for production of power, energy efficiency measures and Demand Side Management (DSM) initiatives are extremely attractive in economic terms, particularly with the generally poor record of financial performance of the power sector as a whole. The power sector has ample opportunity to improve its avoided-generation capacity if consumers use energy efficient appliances/equipment and follow energy saving practices. The urgency for appropriate interventions to improve the performance of different power utilities in India is fully realized at the central and state levels. Energy Conservation Act, 2001, Electricity Act, 2003, and National Electricity Policy accord priority to Demand Side Management. Bureau of Energy Efficiency (BEE) has commenced a program for capacity building of Distribution Companies (DISCOMs) during 2012-17, further extended up to 2020 by targeted reaming DISCOMs. It is closely linked with BEE's other programs, such as Agricultural Demand Side Management, Municipal Demand Side Management, SMEs (Small and Medium Enterprises), Industries, etc. This program will help integrate these activities with activities managed by the DISCOMs for Demand Side Management. This initiative will also help in the capacity building of DISCOMs and developing various mechanisms to promote DSM in their respective states. The program's objective is the capacity building of DISCOMs for carrying out the load management program, developing the DSM action plan, and implementing DSM activities in their respective areas. 62 DISCOMs. [1]

II. DEMAND SIDE MANAGEMENT

Demand Side Management is any activity undertaken with an objective to lower the overall cost of electricity to the consumers of the Distribution Licensee as well as the Distribution Licensee, by economical and efficient use of resources, which shall include the measures/principles to:

- Control reduce and influence electricity demand.

- Encourage consumers to amend their electricity consumption pattern both with respect to timing and level of electricity demand for efficient use of energy.
- Complement supply side strategies to help the utilities to avoid or reduce or postpone
- Costly capacity (generation, transmission & distribution network) additions
- Costly power purchases
- Reduce the environmental damage by reducing the emission of greenhouse gases.
- Supplement national level efforts for implementation of various DSM programmes set out by the Bureau.
- Make strategic efforts to induce lasting structural or behavioural changes in the market that shall result in increased adoption of energy-efficient technologies, services, and practices.
- Protect the interest of the consumers and shall result in overall reduction in tariff for all the consumers.

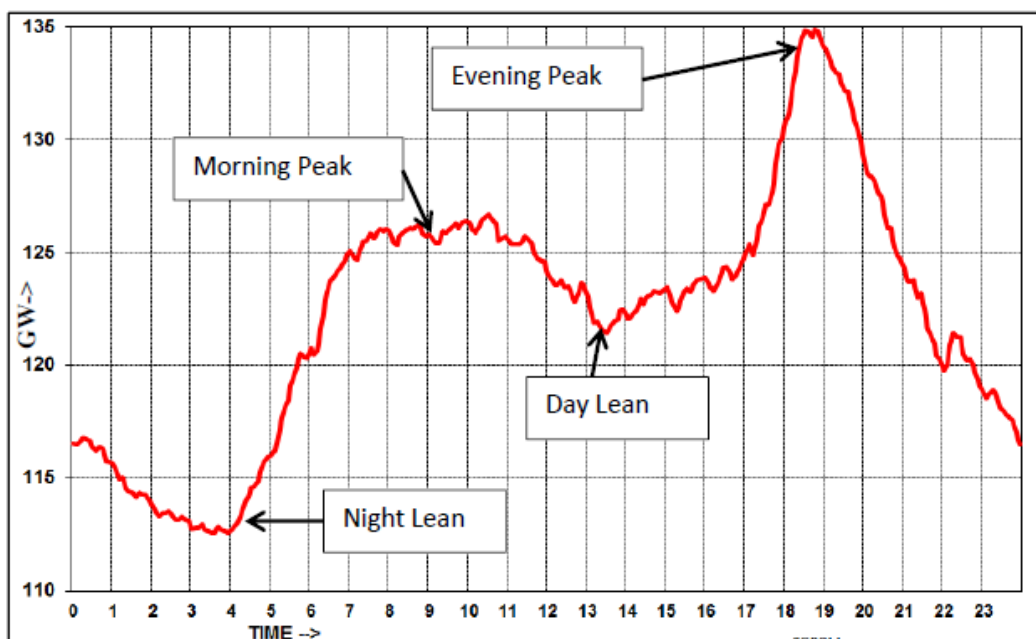


Fig. 1 Typical All India load curve

The load curve showing the demand variation with respect to time. Here this curve is plotted for 24 hours as a daily load curve. This curve reflects the activity of the population with respect to power consumption over a given period of time.

The four coordinates Night lean, morning peak, day lean, evening peak, however the shape and magnitude may be divided state to state and depends upon customer type, like domestic, industrial, agricultural and commercial. These curves may also vary as per the atmospheric temperature and season. This load curve can be managed or changed as per the strategies of demand side management. This scenario is of the whole country but for the analysis we have taken the capital of India for the implementation prototype of the DSM measure of Solar roof top scheme if this scheme will be successful in implementing up to 20 MW or above what kind of impact will be there in the energy demand and peak demand reduction.

III. POWER DISTRIBUTION

Delhi being the national capital and central hub for the business and other administrative services centre has a very high demand of power. The residential tariff for Delhi is the lowest among all other metro cities in the country. Better transport system, good communication better connectivity attracts other industrial services and activities thereby increasing the demand of power. The priority of the power sector is to maintain uninterrupted power supply and to take care of uninterrupted power supply. There are about 42 lakhs domestic consumer who are getting electricity subsidy.

The number of electricity consumers has been increased by 81.74% during the last decade 2010-2020. (Ref- Economic survey of India 2020-2021)

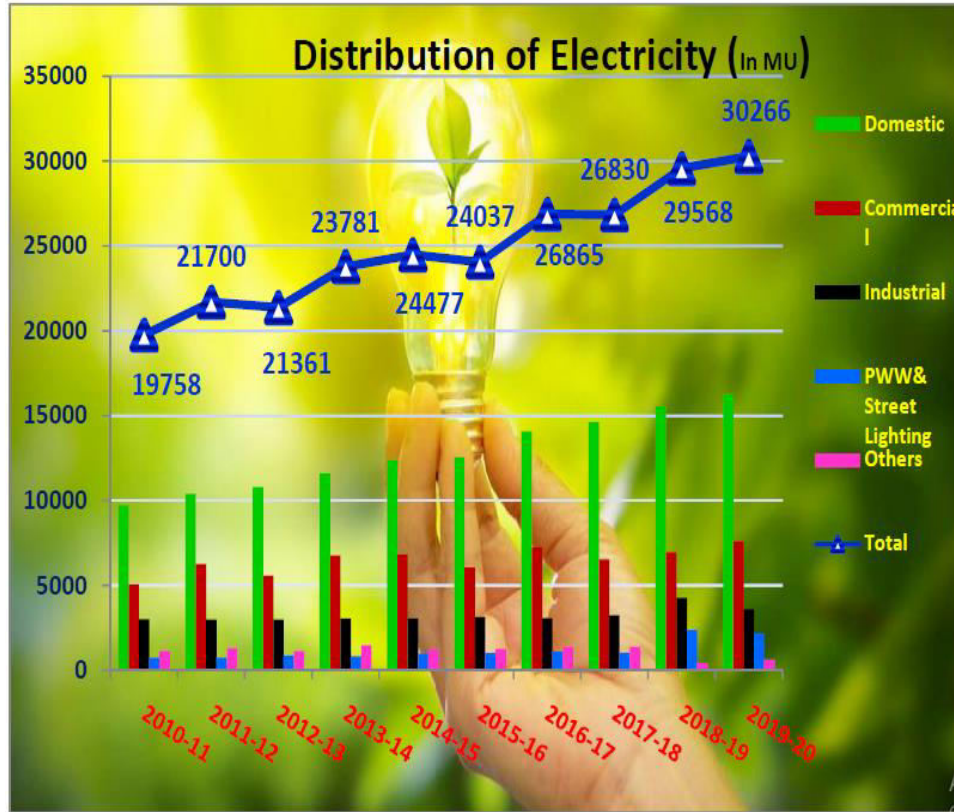


Fig. 2 Sector wise electricity distribution in Delhi

The distribution of electricity to various consumers category increased from 19758 Million Units in 2009-10 to the 30266 Million Units in 2019-20. Category wise distribution of electricity is shown in the above figure and as per the chart shown it can be easily recognised that the domestic sector has a great share of energy consumption and due to this reason some DSM measure has to be taken necessarily to reduce the demand.

IV. POWER PURCHASE

The total power purchase in Delhi has grown by 21.37% during the last ten years (2010-2020). The power purchase in Delhi has increased from 32744 Million Units in 2009-10 to 35419 Million Units in 2019-20. 14.72 % of total power purchase from own generation, Delhi government based power plants and 85.28% purchased from central government and other sources .The information regarding power purchase is shown in the below chart and as per the increase in the consumers in all category especially in residential sector, the amount of power purchase also increasing accordingly. So its necessary to take some kind of steps to reduce the power purchase and to make the distribution companies beneficial.



Fig. 3 Power Purchase in Delhi (IN MUs) (Ref- Delhi Statistical Handbook and power department)

In today's era the major concern is about the increase in demand of electricity to fulfill the requirements in the various sectors like Agriculture, Industrial, Commercial as well as Residential Buildings. In 2018-19 buildings in residential sectors consumed about 24% of India's Electrical Energy, primarily for HVAC, lighting and ceiling fan. India's developmental challenge becomes further convoluted with priority towards 24 X 7 electricity access to its 1.3 billion citizens. Other domestic initiatives like 'Make in India', and the 'National Housing Mission' (NHM) are also expected to further increase the demand for energy in industrial and buildings sectors.

The key factors behind this growth were rapid economic growth, rising per capita income, growing population, and increased urbanization rate resulting in higher appliance ownership. With urbanization this trend is expected to continue at least for the next decade. The electricity access having been provided to millions of new users in the past 4 years, appliance ownership, and thus the related energy demand is expected to rise further with household electricity consumption increasing 6 - 8 times by 2047 as per NITI Aayog's estimates.

V.METHODOLOGY

In this work one site has been selected for the calculation and analysis, the DSM measure as a solar roof top has been selected to reduce the consumer side demand. The major sector of consumer in Delhi are residential. So Solar Roof top may be one of the best solution to reduce the peak power demand. We have taken a solar roof top calculator and calculated the number of generating units from four KW solar system installed and as per the panel the calculation for 100 KWp capacity generating units has been calculated. Similarly if the roof top installation comes in force rapidly and cover up to 10 MW or 20MW power capacity installation then as per the calculation we can see the peak load effects from this solar PV generation as this amount of generation will be used in the same domestic where it has been generated,



Fig. 4 Site Selection for the solar roof top analysis

SYSTEM INFO

Modify the inputs below to run the simulation.

DC System Size (kW):	<input type="text" value="4"/>	i
Module Type:	<input type="text" value="Standard"/>	i
Array Type:	<input type="text" value="Fixed (open rack)"/>	i
System Losses (%):	<input type="text" value="14.08"/>	i Loss Calculator
Tilt (deg):	<input type="text" value="20"/>	i
Azimuth (deg):	<input type="text" value="180"/>	i

Fig. 5 System Information and specification of 4 KW

RESULTS

[Print Results](#)

5,740 kWh/Year*

Month	Solar Radiation (kWh / m ² / day)	AC Energy (kWh)
January	4.38	414
February	5.38	449
March	6.35	557
April	6.76	566
May	6.45	544
June	5.70	474
July	4.88	427
August	5.30	476
September	5.68	493
October	5.52	501
November	4.76	426
December	4.32	412
Annual	5.46	5,739

Fig. 6 Units generation yearly by 4 KW system installation at the selected site.

VI. RESULT AND DISCUSSION

Calculation for 100Kwp Solar Rooftop Savings			
S.NO	Particular	Units	Amount
1	Total kWp potential	kWh	100
2	Solar PV Panel Efficiency	%	16
3	Annual Energy Generation	kWh	143500
4	Cost (per kWp)	Rs	50000
5	Total capital cost for proposed Solar PV plant	Rs	5000000
6	CFA amount for 100 Kwp	Rs	1212840
7	Total capital cost for proposed Solar PV plant after adjusted with CFA	Rs	3787160
8	Electricity cost per kWh	Rs	7
9	Total cost saving	Rs	1004500

Calculation for 10MWp Solar Rooftop Savings			
S.NO	Particular	Units	Amount
1	Total kWp potential	kWh	10000
2	Solar PV Panel Efficiency	%	16
3	Annual Energy Generation	kWh	15700700
4	Cost (per kWp)	Rs	50000
5	Total capital cost for proposed Solar PV plant	Rs	500000000
6	CFA amount for 10000 Kwp	Rs	121284000
7	Total capital cost for proposed Solar PV plant after adjusted with CFA	Rs	378716000
8	Electricity cost per kWh	Rs	7
9	Total cost saving	Rs	109904900

In this research a site has been selected as a prototype and firstly a load research already done regarding how much energy demand increasing from the last 10 years and how it is increasing every year. The only option to give an interrupted power supply is to purchase the power at any cost. As we know at the peak time the power purchase is very much expensive and have to supply to the consumer at any cost. The only solution remain is to reduce the energy demand by the user end. There are so many measures are under progress at various sectors like time of day tariff at the industrial sector, energy efficient motor replacement in the agricultural sector or solarisation of agricultural feeders and the most important in the domestic sector is to scale up the solar roof top scheme for residential consumers. Firstly ion the selected site the 4 Kw solar PV can generate some amount of units in a year and taking that as reference we can go for the calculation for several megawatts installation. In this work we have assumed as a10 MW capacity solar PV installed successfully then it will have a great impact on the energy demand as that much megawatts generated from the solar PV plant is the energy that will be reduced from the demand with respect to grid. In the last year 2020-21 the

power purchased is 35419 million units so as per 10 MW capacity installed 1570 MW power generation from the solar plant. So this much amount can be reduced from the purchased amount of power.

VII.CONCLUSION AND FUTURE WORKS

The major focus of all the demand side measures is to reduce the peak demand because in the states where the power generation is not surplus as per the demand. So the company has to purchase power and sell it to the consumers considering all factors like T & D losses and all other factors including services and profit for the company. At the peak time even the power purchase is very costly so we have to make the demand reduction at the time of peak and it can be done by the shifting of load at the time of peak. In future other demand side measures in other sectors like agricultural, commercial, and industrial and all the sectors demand side measures will make a considerable amount of peak load reduction and avoid the needs of new generating plants because the energy saved will be given to the new consumers.

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