

Implimentation of Solar PV Supply and Demand Management for One, Two, & Three Bed Room Flats

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Abstract— Energy generation is one of key factors for the economic development of a country. World Bank reported that 2.4 Billion people rely on traditional energy sources, while 1.6 billion people do not have access to electricity. With an estimated world average growth rate of 2.8%, the electricity demand is expected to be doubled in 2020. During this period, the electricity demand in developing countries is projected to increase by 4.6% annually. In India, increasing demands for energy has already exceeded the generation capacity of existing plants from conventional energy sources so a viable alternative is an essentiality with an environmental friendly, quiet, having no harmful gas emission. A solar PV system with the appreciable solar radiation in India, moreover having on an average approximately 300 bright sunny days annually, can be viable solution for the electricity. The installation of solar power plant is of heavy investment, but this paper emphasizes and explores the reduction of cost by the use of demand management for the resident apartments. A comprehensive study is conducted of the utilities and the demands from randomly taken houses. “The energy saved is the energy produced” the demand is managed by using the energy efficient devices/appliances instead of old conventionally used. Cost analysis of the replacement is also taken into account with the energy efficient appliances or the ‘star’ appliances application [1]. A domestic supply model associated with cost and design was carried over for residential flats, one bed room, two bed room and three bed room apartments and comprehensive analysis of different apartments with and without replacing the energy efficient appliances associated with solar PV system capital cost is accessed. In NCR Delhi, the average energy demand, using conventional appliances for one, two and three bed room flats is estimated to be Rs.1396W, 1896W and 2601W respectively and if the energy efficient appliances are used than, 666W, 804W and 1030W respectively, reducing the cost of solar PV system as well. The new demand saves approximately 48.9%, 60.5% and 63.1% energy consumption and PV installation cost drops down to a considerable limit for one, two and three bed room flats, which provides the benefit of the integrated demand management design and execution.

Index Terms— Solar PV system, demand management, cost model, energy efficient appliance.

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I. INTRODUCTION

The relatively high acquisition cost of the solar PV system constrains the use of the emerging technology, but the moderate and optimal power management of electricity demand provides an alternative. The cost will inherently be directly proportional to the demand or the consumption rating. Nowadays as the market survey reflects the range variation is from Rs.175/Wp to Rs 200/Wp. The cost can be restricted by the use of efficient devices and Star appliances, there by reducing the cost of solar PV module. The design of the solar PV model depends upon the following;

- Load profile to be electrified by solar PV system,
- Available Solar radiation at the particular location,
- The design of the solar module.
- Use of energy efficient appliances.

The load profile will direct the use of appliance, their wattage, numbers and number of hours of their use, which will lead to the demand required for the particular location in NCR Delhi (India) region. The available solar radiation will help in accessing the solar PV area needed for the generation as kW/m²/day, than identification of energy efficient appliances to be used and finally will lead the design of the optimal area needed for the solar PV array to meet the electricity demand [2].The conceptual approach to this research can be illustrated by the following flow diagrams as shown in Figure-1.

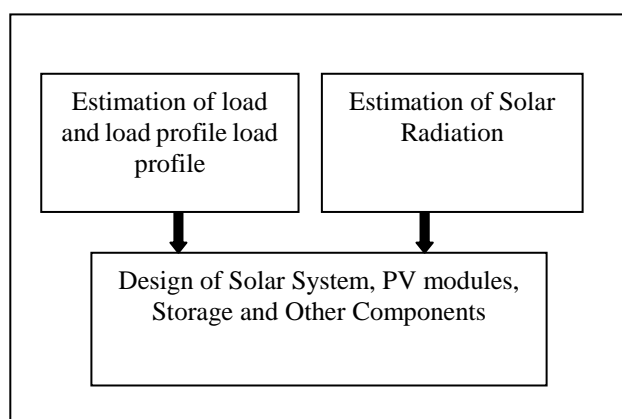


Figure-1. Conceptual flow diagram of solar PV system.

The chronological flow diagram showing the demand management theory and its execution for the efficient energy demand and expenditure is reflected herewith the flow chart;

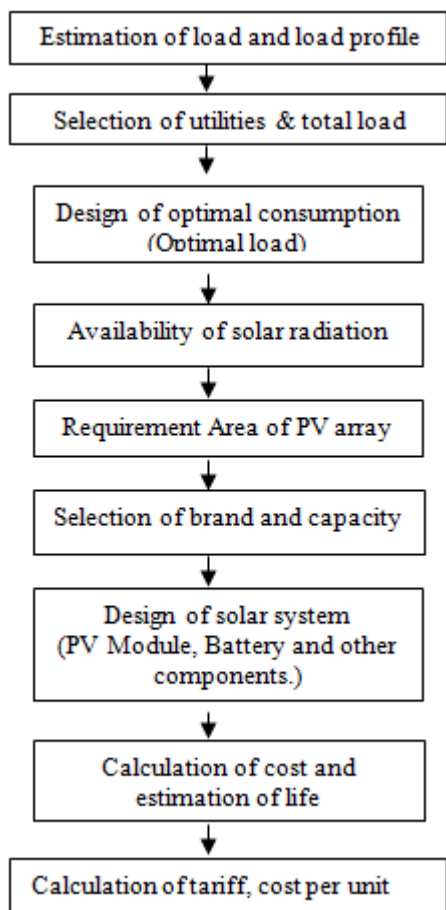


Figure-2: Solar PV system flow diagram for designing.

The solar energy since the ancient era has been utilized in India for doing agricultural tasks, crop heating i.e. to heat for warmth through direct or solar collectors, but moving ahead now converting it into electricity directly with the help of solar panels, ranging from some microwatts to megawatts, depending upon the type, size, numbers and their interconnections for optimum power.

The sun shine is not uniform and intensified homogenously throughout the days, months, and years, so an intermittent solar radiation results a variable voltage resulting variable power, while a constant voltage is desired by the consumers, therefore it can not be directly and efficiently used, so it emphasizes the necessity of a storage device to be essential for maintaining the voltage to a constant value.

This paper provides a technical and economical feasibility of the assessment of the load input and the expenditure which can be appreciably economical just by using the energy efficient devices/apparatus. It could be possible by determining the domestic conventional basic need of appliances, alternative energy efficient appliances and carrying the solar design with appropriate solar radiation data.

II. METHODOLOGY

The PV systems are designed and their sizes are selected according to the demand of the load, system configuration, and quality of each components, initial cost, its performance, availability and life of the components. A low quality component may be cheaper initially but their life; performance and efficiency will be poor, where as relatively

expensive but higher quality components are likely to exhibit better efficiency and longer life. The energy flow diagram is as under and can be illustrated with the help of a model as shown in Figure-3

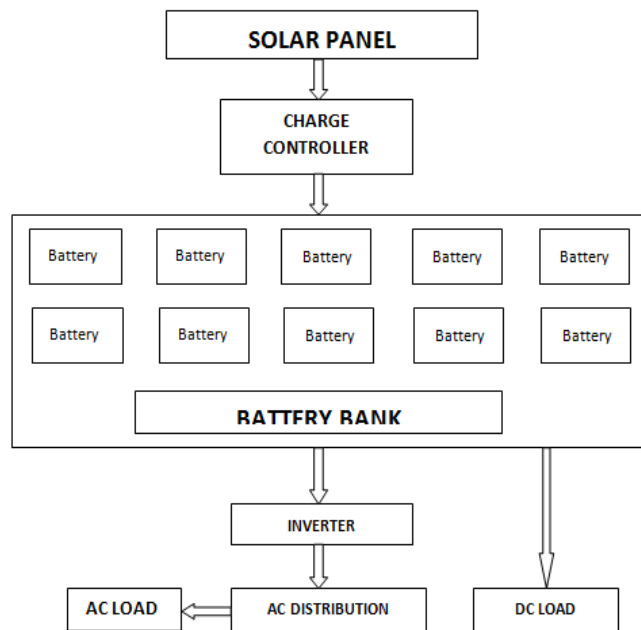


Figure-3 Model diagram of PV sub-system for one room set.

Thus both the conventional and energy efficient appliances have different load demand requirements for the solar PV system designs. The carried away study shows the consumption and savings as shown in Table No.2.

When the supply system is designed for conventional appliances there is no need for the replacement of the appliances but it is not advisable, economical feasibility will be if the appliances are replaced with energy efficient appliances. It reduces the cost of the system considerably.

III. CONCLUSIONS.

Recent developments and innovations have reduced the cost of solar PV system; simultaneously the energy efficient appliances have made the system more economical and meaningful. The reduction of cost price, less area of the PV array requirement to meet the load demand due to efficient solar panels and energy efficient appliances (LED etc.) has made feasibility very economical for a Solar PV system. Moreover the integrated input-output system design approach has further reduced the cost to an appreciable limit which made the system further light, safe, economical and environmental friendly. Obviously, considering the energy efficient system the savings for one room, two rooms and three rooms set up are 54.1%, 64.2% and 67.2% respectively. The subsequent reduction in PV array cost and subsidy provided by the Govt, is an additional charm to encourage consumers for the use of solar PV system for the residential buildings too.

Table 1: Load profile of different apartments in NCR Delhi region.

Utility	Appliances in use	Energy Efficient Appliances	Ave. Daily Run time Hrs.	Apartment type								
				One Bed Room			Two Bed Rooms			Three Bed Rooms		
				No.	In Watts		No.	In Watts		No.	In Watts	
					Pa	Pe		Pa	Pe		Pa	Pe
Lighting	Lamp-100W	LED-15W	6	0	0	0	2	200	30	4	400	60
	Lamp-40W	LED-11W	3	1	40	11	4	160	44	4	160	44
	Lamp-15W	LED-5W	6	2	30	10	1	15	5	2	30	10
	Tube-40W	LED-18W	5	2	80	36	2	80	36	3	120	54
Fan	Ceiling 100W	CF-65W	4	2	200	130	3	300	195	4	400	260
	Exh-45	Exh-35	1	0	0	0	1	45	35	1	45	35
Computer	Labtop-85W	54W	2	1	0	0	1	85	54	1	85	54
	PC-250W	64W	2	1	250	64	1	250		2	500	128
Blender	150ML-300W	150W	0.5	1	300	150	1	300	150	1	300	150
Refrigerator	165L-125W	87W	8	1	125	87	0	0	0	0	0	0
	250L-175W	100W	8	0	0	0	1	175	87	1	175	87
TV	100W	64W	4	1	100	64	1	100	64	2	200	128
Dom. Pump	186W	100W	1	1	186	100	1	186	100	1	186	100
Total saving in energy consumption Wh.					1311	612		1896	740		2601	1030

Table 2: Comparison of energy saving

Utility	Appliances in use	Energy Efficient Appliances	Ave. Daily Run time Hrs.	Net saving in Watts		
				1 One room	2 Two rooms	3 Three rooms
Lighting	Lamp-100W	LED-15W	6	0	2040	8160
	Lamp-40W	LED-11W	6	174	2784	2784
	Lamp-15W	LED-5W	6	240	60	0
	Tube-40W	LED-18W	8	704	704	1584
Fan	Ceiling 100W	CF-45W	4	880	1980	3520
	Exh-45	Exh-35	1	0	10	10
Computer	Labtop-85W	54W	2	0	62	0
	PC-250W	64W	2	372	372	1488
Blender	150ML,300W	150W	0.5	75	75	50
Refrigerator	165L-125W	87W	8	304	0	0
	250L-175W	100W	8	0	704	704
TV	100W	64W	4	144	144	576
Domestic Pump	186W	100W	1	86	86	86
Net savings				2979	9021	18962

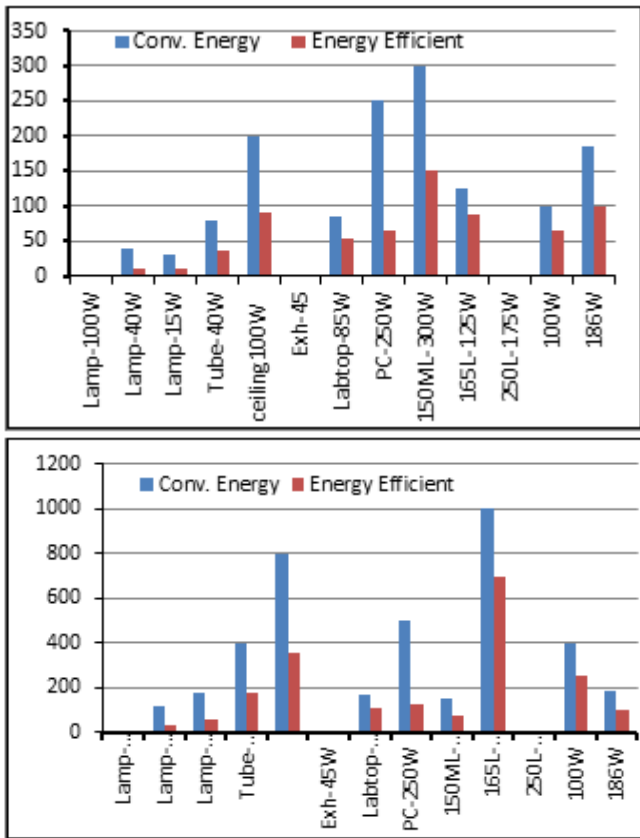


Figure 4: Comparison of Power and Energy Consumption of Conventional and Energy Efficient appliances in 1 Bed Room Set

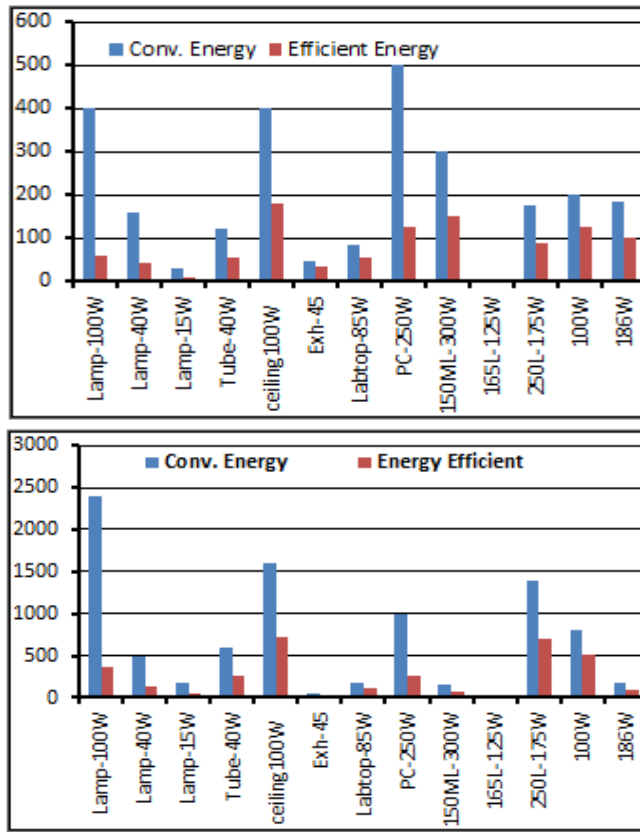


Figure 6: Comparison of Power and Energy Consumption of Conventional and Energy Efficient appliances in 3 Bed Rooms Set

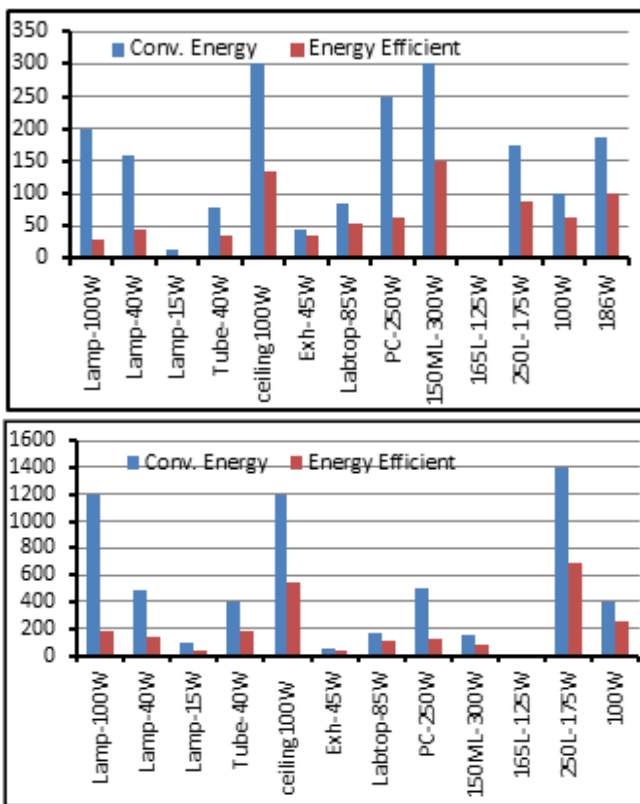


Figure 5: Comparison of Power and Energy Consumption of Conventional and Energy Efficient appliances in 2 Bed Rooms Set

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