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# 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;

a) Load profile to be electrified by solar PV system,
b) Available Solar radiation at the particular location,
c) The design of the solar module.
d) 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.

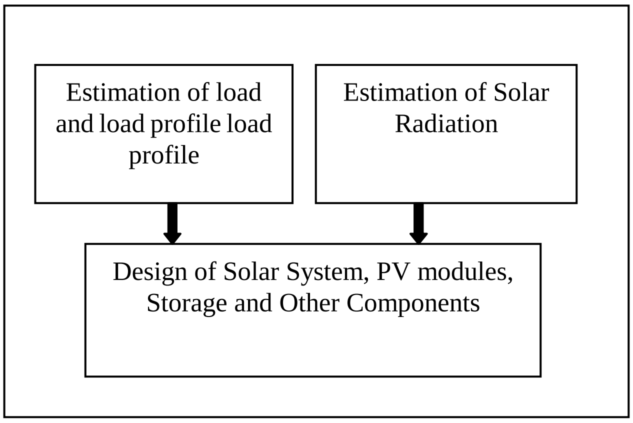


**Figure-1. Conceptual flow diagram of solar PV system.**

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;

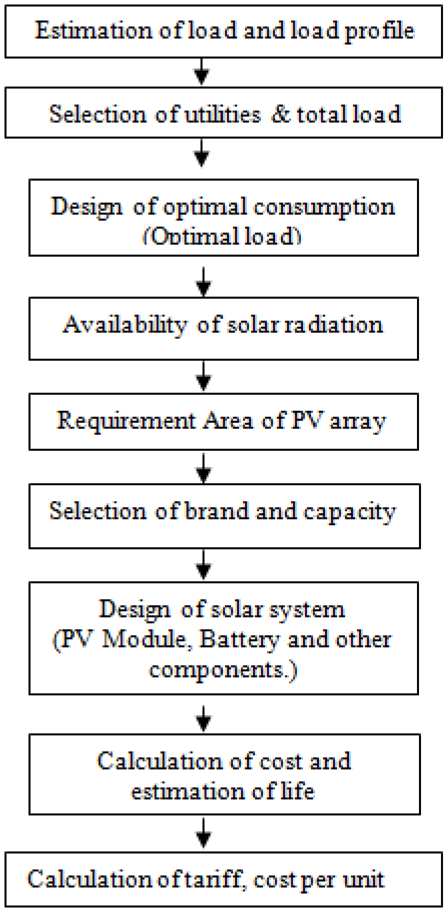


**Figure-2: Solar PV system flow diagram for designing.**

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 emphases 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

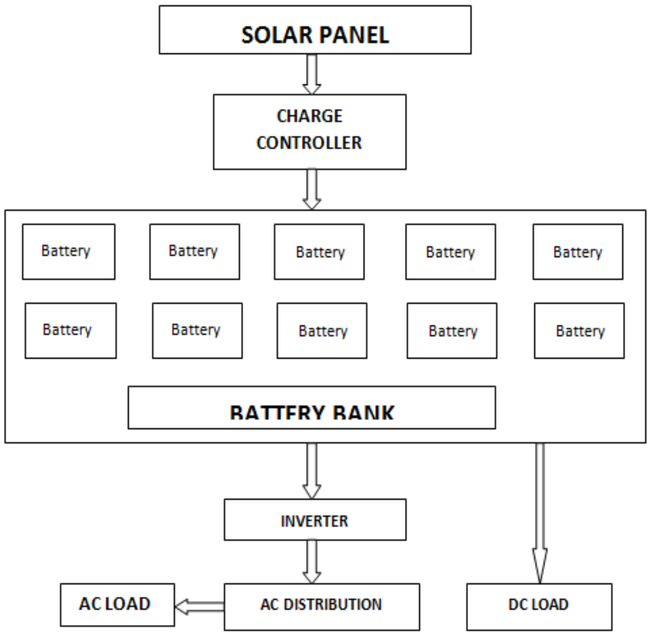


**Figure-3 Model diagram of PV sub-system for one room set.**

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-15 W | 6 | 0 | 0 | 0 | 2 | 200 | 30 | 4 | 400 | 60 |
| | Lamp-40W | LED-11 W | 3 | 1 | 40 | 11 | 4 | 160 | 44 | 4 | 160 | 44 |
| | Lamp-15W | LED-5 W | 6 | 2 | 30 | 10 | 1 | 15 | 5 | 2 | 30 | 10 |
| | Tube-40W | LED-18 W | 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 | Ceiling100W | 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** |

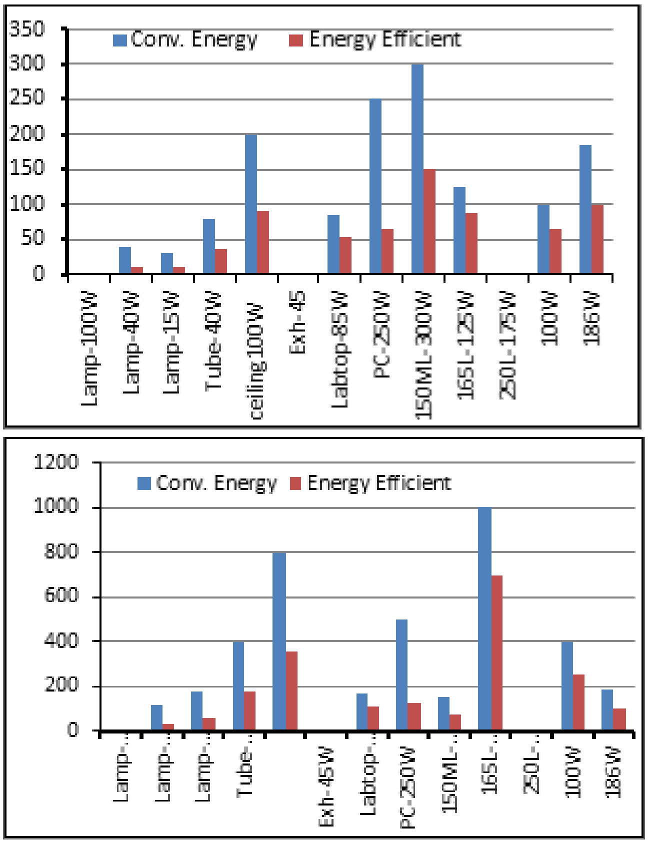


**Figure 4: Comparison of Power and Energy Consumption of Conventional and Energy Efficient appliances in 1 Bed Room Set**

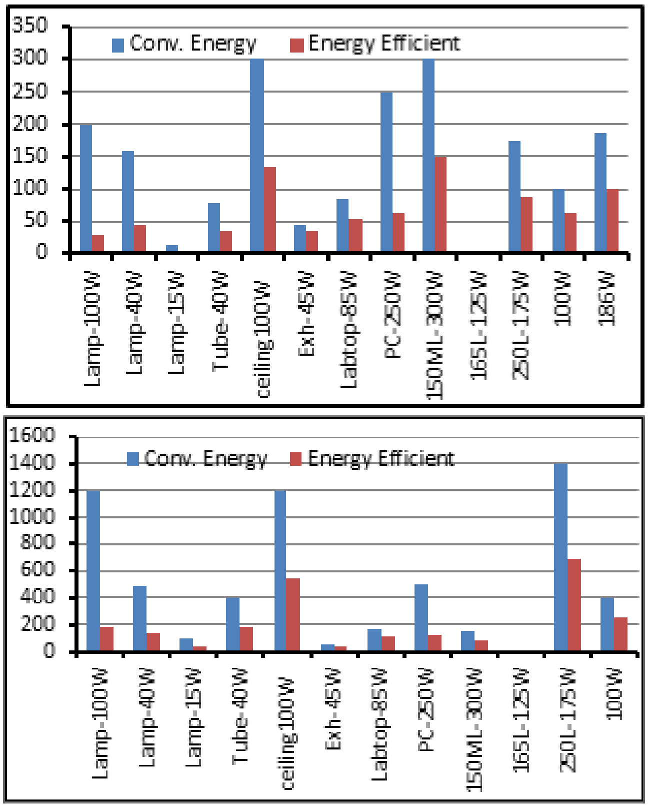


**Figure 5: Comparison of Power and Energy Consumption of Conventional and Energy Efficient appliances in 2 Bed Rooms Set**

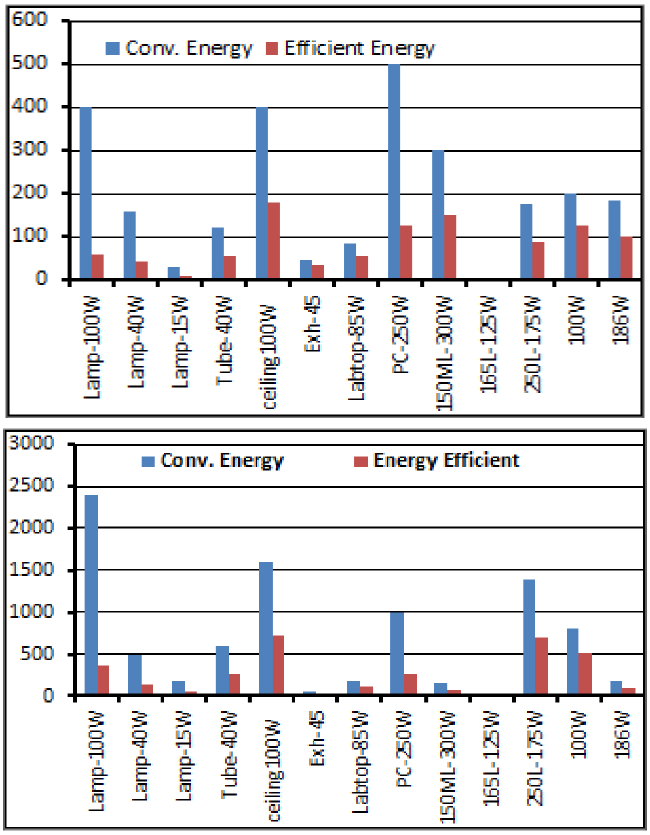


**Figure 6: Comparison of Power and Energy Consumption of Conventional and Energy Efficient appliances in 3 Bed Rooms Set**

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