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Energy Conservation: a Case Study on Energy Conservation in Residential apartment complex

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ABSTRACT : *Indian energy production is mainly dependent on fossil fuels which are depleting at a rapid rate. End user efficiency or Demand side management (DSM) is important under current energy scenario. This paper deals with the saving in energy in a residential apartment complex. The paper looks into the current consumption pattern and suggests the options for energy conservation. The paper considers that energy efficient equipments will be used in place of the existing less efficient equipments. The saving of energy is calculated.. Although use of energy efficient methods increase the initial cost they are of benefit in long run as they have long life and they save energy.*

Keywords: *Energy conservation, End User efficiency , Energy efficient equipments, Load factor, luminous efficiency.*

I. INTRODUCTION

India is world's 2nd largest nation by population. The consumption of all forms of energy is very high in the country. Due to urbanization, growth in population, growth in IT sector the energy consumption in India has increased sharply [1]. Availability of energy is a measure of the development of a society. Hence for sustainable growth of a nation the energy need has to be met. India, inspite of all the measures, faces problem in meeting the demand of all groups of people. It is seen that there exist a considerable gap demand and supply of power. New generation can be one of the solutions to meet the demand gap. But with fossil fuels depleting and renewable cost per MW being very high it is not economical to invest in new generation. Further the environmental impact of new generation is a big challenge. Under such circumstance the focus shifts from generation to conservation of energy at the consumer end [2]. DSM measures reduce the amount of energy consumed and thereby reduce the loading on the generating station. This in turn reduces the unit cost of energy can be reduced. [3] [4]. This paper focus on demand side management (DSM) measure at an apartment complex.

II. ENERGY SCENARIO IN INDIA:

The installed capacity in India is 305555MW of which 69.56% is from thermal source, 14.06% from hydro source, 14.47% from renewable and 1.89% from nuclear energy. Domestic sector consumes around 25% of the total energy while industry consumes 36%. Domestic consumption is the second major energy consuming sector. Central power corporation accounts for 24.97% of the total power generated, state power corporation accounts for 33.635 of the total power generated while private sectors contribute 41.66% of the total power generation.

III. ENERGY CONSERVATION AT THE END USER

The gap between generation and demand of energy is inevitable as on today. Due to environmental, financial and fuel depletion new generation is not an viable option. The solution lies in DSM by increasing end user efficinecy [5]. It is estimated that about 15000MW of energy can be saved through DSM [5]. In domestic sector the most common options for energy efficiency are lighting, fans, AC, etc. There is a large potential to save energy by using energy efficient lights and fans. It is a DSM measure which helps to reduces load requirement on the station. Conservation of energy leads to reduction in energy requirement. In addition improvement in the load factor can result in improving the utilization and reduce the need for peak load stations.

IV. LIGHTING SOURCES AND THEIR EFFICIENCY

The various electrical lighting sources line Fluorescent light, gas discharge lights, LED based lights, CFLs have different luminous efficacy.. The use of high efficiency light sources requires lower rating and in turn reduce the energy consumption. The high energy efficiency lamps (LED} lamps have higher life. Luminous efficacy of different light sources is listed in table I.

Table I: luminous efficacy of different light sources

Source	Incandescent lamp	Fluorescent lamps	CFL	LED	High intensity discharge lamps
Luminous efficacy lumen/watt	10-30	60-70	50-80	80-100	120-150

LED lamps are more energy efficient as the driving circuit requires less power. It is more safe than CFL and has high life.. Hence inspite of its high cost LED lamps are preferred. Due to its high life the payback will be within few months. This makes LED lamps the most energy efficient alternative..

V. A CASE STUDY OF ENERGY CONSERVATION AT A RESIDENTIAL COMPLEX:

A apartment complex "Chirag Residency" situated at Byatarayanapura, Bangalore was selected for the study. The apartment has 32 houses of which 24 are 2 BHK house and 8 are 3 BHK house. The energy bills for 1 year were collected and average of the consumption was calculated. The number of tube lights, fans, type of TV and average usage was identified in a discussion with the residents. The summary of the information gathered are listed in Table II.

Table II: Details gathered at Chirag residency.

Sl. No.	**Flat No.**	**Average monthly consumption in kwh**	**No. of TL**	**Wattage in watts**	**Hours of usage**	**No. of Fans**	**Average Wattage**	**Hours of usage**	**TV**
1	101	195	6	36	5	4	40	6	LED
2	102	206	8	36	5	6	40	6	LED
3	103	189	6	36	5	4	40	6	CRT
4	104	176	6	36	7	4	40	6	LED
5	105	191	6	36	5	4	40	6	LED
6	106	206	6	36	5	6	40	6	LED
7	107	215	6	36	5	4	40	4	LED
8	108	149	5	36	5	4	40	6	LED
9	201	183	6	36	5	4	40	6	CRT
10	202	204	7	36	5	6	40	4	LED
11	203	176	6	36	5	4	40	6	CRT
12	204	162	5	36	7	4	40	6	LED
13	205	182	6	36	5	4	40	6	LED
14	206	223	7	36	5	6	40	6	LED

15	207	187	1	36	5	4	40	6	LED
16	208	157	5	36	5	4	40	6	CRT
17	301	191	6	36	5	4	40	6	LED
18	302	214	8	36	5	6	40	6	LED
19	303	182	6	36	5	4	40	6	LED
20	304	159	5	36	7	4	40	6	CRT
21	305	174	6	36	5	4	40	6	LED
22	306	181	8	36	5	6	40	6	CRT
23	307	154	6	36	5	4	40	6	LED
24	308	149	6	36	5	4	40	6	CRT
25	401	175	6	36	5	4	40	6	LED
26	402	197	8	36	5	6	40	6	LED
27	403	183	6	36	5	4	40	6	LED
28	404	161	5	36	7	4	40	6	LED
29	405	184	6	36	5	4	40	6	CRT
30	406	193	7	36	5	6	40	6	LED
31	407	175	6	36	5	4	40	6	CRT
32	408	159	6	36	5	4	40	6	LED
Total			**193**			**144**			**9 CRT**

In addition the complex has 20nos. of 40W Tube light used for common lighting and 4 nos. of 250W Mercury vapor lamps used for yard lighting.

VI. ENERGY SAVING OPTIONS AND ANALYSIS:

Based on the data collected the analysis was done to identify the various energy saving options as listed in table III. The maximum saving potential has been considered for the calculation which assumes that all energy inefficient components/equipments are replaced by energy efficient equipments.

TABLE III: Energy saving options at Chirag residency:

Sl. No.	Energy saving option	Power saved in KW	Usage duration in Hrs	Energy saved per day in KWH	Energy saved per month in KWH
1	Replace Tube lights in the houses by 18W LED	=193*(36-18)/1000 = 3.474	5.25	18.24	547.2

2	Replace Fans with 30W EE fans	=144*(60-30)/1000 = 4.32	5.875	25.38	761.4
3	Replace CRT based TV's with LED based TV	= 9* (40-15)/1000= 0.225	6	1.35	40.5
4	Use 18W LED for common area lighting	=20* (40-18)/1000 = 0.44	4	1.76	52.8
5	use 85W LED lamp for yard lighting	=4*(250-85)/1000 = 0.66	4	2.64	79.2
	Total saving				**1481.1**

Assuming a cost of energy at Rs.5 per unit the savings per month are tabulated below in table IV.

Table IV: Average saving per house

Sl. No.	Energy saving in KWH	Cost saved in Rs.	Average energy saved per house in KWH	Average cost saved per house in Rs.
1	1481.1	7405.5	46.28	231.42

VII. CONCLUSION

It was observed that the implementation of energy efficient methods at the end user application has a high potential to reduce the monthly energy consumption by around 25-30%. The author feels that the end use energy conservation along with measures to improve the utilization in order to improve the load factor can be a solution to the present energy crisis. DSM will also be a future need to save environment from over usage of energy and save the world from global warming.

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