IJCRT.ORG ISSN : 2320-2882

INTERNATIONAL JOURNAL OF CREATIVE RESEARCH THOUGHTS (IJCRT)

An International Open Access, Peer-reviewed, Refereed Journal

SMART ENERGY SAVINGS POTENTIAL IN HOME APPLIANCES

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Abstract: Electricity plays a vital role in everyone's life. It is the most essential part in human day to day activities. As the dependency on electrical energy is increased, one must ensure that it being properly utilised without harming the environment. Nowadays this is not happening as our Air, Water, Land are getting polluted by our deeds. A much concentration on renewable resources like Solar, Wind, and Hydro, Geothermal etc. is must as they can be replenished when compared to Non renewable resources like Coal, Oil, And Natural gas etc. As part of it, there is solar Alliance that to generate 175GW of solar energy by 2022 in India. How many GWs be the generation, it must be ensured that the energy generated is utilised in an efficient way or not. As far as our concern, there is huge a concentration on industries when energy conservation comes into picture. But energy can also be conserved in Domestic loads by using energy efficient equipment. This paper deals with the savings that can be achieved by using the energy efficient equipment available in the market without compromising with the output that one used to get before with the existing electrical equipment.

Index Terms **- Energy Audit, Energy Savings, Energy Efficient Equipment**

I. INTRODUCTION

ENERGY AUDIT. "According to the definition in the ISO 50002 standard, an energy audit is a systematic analysis of energy use and energy consumption within a defined energy scope, in order to identify, quantify and report on the opportunities for improved energy performance" [1]. In simple it is a survey which gives us how much energy is being consumed and also suggests us the energy efficient methods by which one can reduce the energy consumption without any disturbance in the output that used to deliver before.

Fig 1: Save Energy Save Environment Save Bills

As said concentration on energy saving is also need to be done when compared to generation of energy. In industries there are many measures taken like retrofit of existing equipment with latest state of technology prevailing [2], Testing of relays[3], Breakers Servicing , Harmonic Study etc to know the healthiness of the equipment and to also study their performance so that preventive measures can be taken accordingly. While coming to residential area there won't be much concentration on them.

In line with it, as a case study will consider a residential house as a project and will do a survey on it and check how much energy can be saved and how much electricity bill can be saved as shown in fig 1.

II. NEED FOR SAVING ELECTRICAL ENERGY

a) More than 60% of generation in India [4]is from Thermal power Plants i.e. Coal based, which are generating lots of carbon dioxide(CO_2) and other green house gases leading to global warming .For generating 1 unit electrical energy it consumes 0.6kgs of coal and it releases about 1kg of CO_2 [5].
b) Non renewable resources cannot be reused or renewed.
c) The energy can be produced faster but for formation of coal, oil, natural gas it takes thousands of years.
d) Over usage of non renewable resources may lead to scarcity for future generations.
e) One can save money by saving their energy usage by reducing their electricity bill.
f) Energy saved is energy generated - one unit of energy saved is equivalent to 2 units of energy produced [6].

III. EXISTING ELECTRICAL APPLIANCES IN A HOUSE AND THEIR DETAILS

Considering a two BHK house like shown in fig. 2, the details of the electrical equipment present in the house along with their energy consumption are mentioned below

Fig 2: Layout of a Two BHK House

Table 1: Existing Electrical Appliances Rating at home

S. No	Description of the Appliance	Qty	Wattage (KW)	Working Hours in a day	Energy Consumption (KWH) per day	Working Days in a Year	Annual Energy Consumption (KWh)
1	Fluorescent Tube	2	0.02	3	0.12	365	43.8
2	LED Tube	1	0.02	5	0.1	365	36.5
3	LED Bulb	5	0.007	1.5	0.05	365	19.16
4	Fluorescent Tube Light	3	0.04	5	0.6	365	219
5	Electric Water Heater	1	0.032	0.25	0.008	210	1.68
6	Mixer Grinder	1	0.75	0.5	0.375	175	65.625
7	Fan	1	0.065	8	2.08	365	759.2
8	3 Star Frost Free Refrigerator	4	-	-	-	-	276
						Total	1420.97

Table 2: Existing Air Conditioner Rating

S. No	Description of the Appliance	Qty	Wattage (KW)	Cooling Capacity (KW)	Energy Efficient Ratio (EER)	Working Hours in a Year	Annual Energy Consumption (KWh)
1	2 Star Split Air Conditioner 1.5 ton	1	1.97	5.125	2.6	1600*	3152

* BEE has suggested AC operating hours shall be 1600 cooling hours per annum [7]

After gathering the required data regarding the electrical equipment energy consumption will calculate the total annual energy consumption and the annual electricity bill accordingly.

Total Annual Energy Consumption of existing Equipment = 1420.97+3152= 4572.97 KWh ……A

Case Study: With Energy Efficient Electrical Appliances

The calculation of existing equipment is shown above. Herewith Energy Efficient Equipment is used in place of existing equipment that would give the same output as existing equipment used to deliver. That would be a LED Tube in place of Fluorescent Tube. Likewise a 5 Star Split Air Conditioner of 1.5 ton in place of a 2 Star Split Air Conditioner of 1.5 ton is considered.

Table 3: Energy Efficient Electrical Appliances at home

S. No	Description of the Appliance	Qty	Wattage (KW)	Working Hours in a day	Energy Consumption (KWH) per day	Working Days in a Year	Annual Energy Consumption (KWh)
1	LED Tube	2	0.01	3	0.06	365	21.9
2	LED Tube	1	0.02	5	0.1	365	36.5
3	LED Bulb	5	0.007	1.5	0.05	365	19.16
4	LED Tube	3	0.018	5	0.27	365	95.55
5	Electric Water Heater	1	0.032	0.25	0.008	210	1.68
6	Mixer Grinder	1	0.75	0.5	0.375	175	65.625
7	Fan	1	0.065	8	1.12	365	408.8
8	3 Star Frost Free Refrigerator	4	-	-	-	-	276
						Total	928.22

Table 4: Energy Efficient Air Conditioner Rating

S.No	Description of the Appliance	Qty	Wattage (KW)	Cooling Capacity (KW)	Energy Efficient Ratio (EER)	Working Hours in a Year	Annual Energy Consumption (KWh)
1	5 Star Split Air Conditioner 1.5 ton	1	1.15	5.2	4.51	1600*	1844.79

* BEE has suggested AC operating hours shall be 1600 cooling hours per annum [7]

In this case, the calculations will be mentioned below.
Total Annual Energy Consumption with energy efficient equipment = 928.22+1844.79
= 2773.01 KWh ……B

Total Annual Energy Saved= Total Annual Energy Consumption of existing Equipment - Total Annual Energy Consumption with energy efficient equipment
= A-B
= 4572.97 KWh - 2773.01 KWh = 1799.96 KWh …… C

Lets calculate the payback of the amount invested in the buying the energy efficient equipment.
The prices of the energy efficient equipment is mentioned below

Table 5: Energy Efficient Equipment Prices

S. No	Description of the Appliance	Qty	Unit Price (INR)	Amount (INR)
1	LED Tube	2	130	260
2	LED Tube	1	Existing Equipment is energy efficient	
3	LED Bulb	5	Existing Equipment is energy efficient	
4	LED Tube	3	325	975
5	Frost Free Refrigerator	1	Existing Equipment is energy efficient	
6	Electric Water Heater	1	Existing Equipment is energy efficient	
7	Mixer Grinder	1	Existing Equipment is energy efficient	
8	Fan	4	2500*	10000
9	5 Star Split Air Conditioner 1.5 ton	1	29000*	29000
			Total	40,235.00

* Under Buyback Scheme the existing Fan and Air Conditioner can be returned to the manufacturer and can buy the latest energy efficient equipment and the prices are as mentioned below.

Original Price of New Fan= INR 3,000.00
Buyback Price of old fan= INR 500.00

Original Price of New Air Conditioner= INR 39,000.00
Buyback Price old AC= INR 10,000.00

From Eq. C, Total Annual Energy Saved= 1799.96 KWh
Annual Electricity Bill Savings= Price per Unit (KWh) x No. Units Consumed
= INR 8.00 x 1799.96= INR 14,399.68

$$\text{Payback (Years)} = \frac{\text{Total Investment on Energy Efficient Equipment}}{\text{Annual Energy Savings}} = \frac{40235.00}{14399.68} = 2.79$$

It can be concluded that the investment which has been invested in buying the energy efficient equipment can be regained in period of around 2.79 years.

IV. DO'S &DON'TS TO SAVE ENERGY

DO's

- Turning off the lights when not in use.
- Use of electronic chokes in place of conventional copper chokes.
- De-dusting lighting fixtures to maintain illumination.
- Allow natural sunlight to enter into houses through windows, doors rather than using lights in the daytime
- Use of electronic fan regulators in place of conventional regulators for ceiling fans.
- Plant more trees surrounding your house as it reduces the energy consumption of AC.
- Annual Maintenance of Air Conditioner is mandatory.
- Filters in the air conditioner must be cleaned on regular basis as dust gets accumulated in it.
- Keep windows, doors of air conditioned room closed as often as possible.
- A regular cleaning of refrigerator is required as it reduces the energy consumption
- Operate the appliances safely [8] in addition to energy conservation.
- Test the safety gadgets like relays and fuses at regular intervals [3].

DONTs

- Do not overload the mixer grinder as it takes long time to crush.
- Do not grind hard and dry items in the mixer grinder.
- Do not overload the refrigerator.
- Do not open the refrigerator frequently.
- Do not leave the refrigerator door open for long time.
- Avoid putting hot or warm food directly into the refrigerator.

V. CONCLUSION

As per the power generation in India 62.31% of the power is generated from Thermal Power Plants and rest is generated from Hydro, Nuclear, Wind Power, Small Hydro Power Plants, Bio Plants and through Solar Power [4]. As our demand is increasing, there is need to concentrate more on renewable sources and to use the energy generated in an efficient manner. In line with it, it is observed from a residential house of two BHK that around 1799.96 KWh can be saved by using energy efficient equipment which helps in reduction of almost 1273 kilograms of Carbon Dioxide [5] from emitting into the atmosphere which has its own side effects. An energy efficient house is the first step taken in saving our environment. Saving energy along with safety from low level from a residential building [8] to a large scale industry should also be taken care of.

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