ENERGY SAVING PROSPECTIVE FOR RESIDENTIAL HOME THROUGH ENERGY AUDIT

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ABSTRACT

In the present scenario utilization of electrical energy & need for its conservation is an imperative concern. This dissertation signify the conservation proposals through energy audit in residential houses as it plays a major role in usage of electric power .This energy audit facilitate the consumption & wastage of power by means of household appliance thereby implementing the given recommendations. In so doing the result shows around 33.2% energy can be saved by advocating & adopting the given bid.

KEYWORDS: Energy Audit, Energy Conservation, Efficiency.

The advancement of the country and the existence of standard of living are exclusively reliant on Energy. The mounting energy demand and supply gap is one of the reasons for hike in price of fossil fuels. The increasing use of fossil fuels has caused air pollution leading to global warming. These sources of energy are not refillable and consequently the spotlight is shifting towards energy conservation and use of renewable energy. Electricity consumption constitutes major part of energy usage. The total electricity consumption in the year 2014-2015 has increased 8.48% [1]. Energy audit is one of efficient method to conserve energy.

Energy audit helps to recognize the energy flows and to measure energy usage according to distinct functions. Energy audit may be defined as an analysis or survey which serves the idea of detect where a household or an industry uses energy and finds energy conservation opportunities [2]. Basically it attempts to determine the magnitude of use of energy presently attributed to each of the major components of energy use. In order to save energy Introducing the concept of rational use of energy aims at reducing energy use and also corresponds to the optimum use of all limited economic resources [3] According to estimates, adopting existing well-established energy-conserving technologies and products would result in savings of approximately 11–18% [4]. Accordingly the probable resolution to match the generation and demand is by increasing power generation and energy conservation measures. As an emerging country it is not possible to set up the full load capacity instantly, looking over this situation the primary work is on track for energy conservation through electrical energy audit [5]. Perking up the efficiency of energy usage in prevailing households through energy audit is essential as fuel prices, inadequacies and intermittent scarcities of fuels are increasing [6]. Usually the audit is broadly classified into three categories

Category 1:walk-through audit

Category 2: mini audit

Category 3: maxi audit

OBJECTIVE

Energy audit is measured as one of the inclusive methods in scrutinizing the energy consumption and expenditure in buildings. Audit is widened to literate energy economics for the general public. Consumer can be capable to use this intended feasible method to accomplish their house energy audit. The suitable energy saving proposals will be offered by this method. The main aim of this project is to perform energy audit to a household. A Sample house data has been taken for the analysis of proposed energy audit. In this present study, the methodology used for preliminary energy audit was adopted. Suitable recommendations were given for the efficient use of electrical energy.

ENERGY AUDIT METHODOLOGY

Muhammad usman Khalid et al. [7] in December 2012 had conducted lighting audit in siemens Pakistan department transformer business unit (TBU). Energy usage of lamps and other lightings are studied through is audit. 10.41% of energy usage can be saved by their proposed lamp relocations and lighting maintenance.

Rasanajan mendis[8] in 2006 had conducted a detailed energy audit in a medium scale apparel industry in srilanka and studied about the energy consumption of the equipment. His study had provided an overview of energy conservation techniques and

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also energy efficiency of a textile industry which results in immediate cash flow.

Jian zhang et al. [9] has made an in-depth study to reduce the energy consumption in china. They also have studied about the problems of energy audit & energy management. Some solutions were proposed to strengthen the energy management & reduction of unnecessary wasting of energy.

Energy Audit Process

Energy audit has several phases depending on the requirements of the customer. The first phase after selecting the site to be audited would be evaluating the operational conditions and outlines of energy use of the Existing equipment .patterns of energy use can be obtained by compiling the utility bills over several years. In the second phase efficiency, performance & reliability of the equipment is analyzed. The wastage of energy due to the aged equipment ad unnecessary usage is evaluated. After the analysis the third phase is proposing the appropriate recommendations for energy conservation, analyzing the initial cost for implementation of each conservation measure & finally evaluating the pay-back period for each recommendation after implementation. The last phase would be carrying out extensive measures when the prevailing facilities have completed their life span or need for any replacement of prior parts due to outmodedness.

Data Collection

A 2BHK residential house in palakol, west Godavari district, Andhra Pradesh was taken for auditing. The energy bills are around 35000-40000 per year. This is a big amount for household where we have analyzed energy wastage which shows the wasting of money and mainly the limited resources. So primarily we have to reduce the wastage which is being done in this particular residential house so that our research will further be useful for auditing of some more residential houses and help in conserving the energy &limited resources.so our aim is to make the residential house energy efficient.

Data Analysis

The average energy consumption of the2BKH house is about **700KWh per month** with major loads like Air conditioners, Fridge, Geyser and Lightning etc. The following tables represent various equipment with power ratings and energy consumption. Table 1 represents the usage & energy consumption of equipment in bedroom 1 consisting of fluorescent lamps, fan, air conditioner, CFL, exhaust fan, geyser .it has a total consumption of 155.97 kWh per month. Here the point to be observe is that in table (1) the energy consumption by Air conditioner is taken as 1 hours instead of 3 hour. A good conditioned compressor of an A.C or Refrigerator would run 8 hours per day (24 hours). Hence for 3 hours it would be 1 hours. Table 2 represents the usage & energy consumption of equipment in bedroom 2 which consists of fluorescent lamps, fan, air conditioner, CFL; exhaust fan .the total consumption is about 333.257 kWh per month. Like mentioned at table 1, here the air conditioner has considered for 5.33 hours out of 16 hour.

Table 1: Conventional Load Calculation

S .No	Equipment Name	No. of equipment	Power rating (w)	Power rating (Kw)	Usage per day (Hours)	Energy Consumption per day(X)	Energy Consumption per month(X*30)
1	Fluorescent lamps	2	36 15	0.036 0.015	1 1	0.036 0.036	1.08 0.45
2	Fan	1	65	0.065	1	0.065	1.95
3	Air Conditioner	1	2000	2	3	2	60
4	Exhaust Fan	1	55	1	1	0.055	1.65
5	CFL	1	4*7=28	0.028	1	0.028	0.84
6	Geyser	1	3000	3	1	3	90
Total Energy Consumption (Kwh)							155.97

Table 2: Conventional Load Calculation

S .No	Equipment Name	No. of equipment	Power rating (w)	Power rating (Kw)	Usage per day (Hours)	Energy Consumption per day(X)	Energy Consumption per month(X*30)
1	Fluorescent lamps	2	36 15	0.036 0.015	3 0.5	0.0108 0.0075	3.24 0.45
2	Fan	1	65	0.065	3	0.065	1.95
3	Air Conditioner	1	2000	2	16	5.33*2=10.66	319.8
4	Exhaust Fan	1	55	1	0.5	0.0275	0.825
5	CFL	4	4*7=28	0.028	4	0.112	3.36
Total Energy Consumption (Kwh)							333.327

Table 3: Conventional Load Calculation

S .No	Equipment Name	No. of equipment	Power rating (w)	Power rating (Kw)	Usage per day (Hours)	Energy Consumption per day(X)	Energy Consumption per month(X*30)
1	Fluorescent lamps	2	36*2=72	0.072	4	0.288	8.64
2	Fan	2	60*2=120	0.012	3	0.36	10.8
3	Audio System	1	300	0.3	2	0.6	18
4	LED TV	1	82	0.082	6	0.492	14.76
5	CFL	4	4*7=28	0.028	4	0.056	1.68
Total Energy Consumption (Kwh)							68.88

Table 3 represents the usage & energy consumption of equipment in hall which constitute fluorescent lamps, fan, audio system, LED TV, CFL, and Desktop Computer with total consumption of 68.8 kWh per month. Table 4 represents the usage & energy consumption of equipment in dining hall consisting of fluorescent lamp, fan, washing machine, refrigerator, CFL, Microwave oven with total energy consumption of 102.96 kWh per month. Like mentioned at tables 1&2 here the Fridge has considered for 8 hours out of 24 hours. Table 5 represents the usage & energy consumption of equipment in kitchen consisting of grinder, mixer, CFL, exhaust fan, with total consumption of 11.85 kWh per month. Table 6 represents the usage & energy consumption of equipment in veranda fluorescent lamp, incandescent lamp, CFL, motor with total consumption of 37.86 kWh per month. Table 7 represents the energy consumption of various loads in various areas.

Table 4: Conventional Load Calculation

S .No	Equipment Name	No. of equipment	Power rating (w)	Power rating (Kw)	Usage per day (Hours)	Energy Consumption per day(X)	Energy Consumption per month(X*30)
1	Fluorescent Lamp	1	36	0.036	4	0.144	4.32
2	Fan	1	65	0.065	4	0.26	7.8
3	Washing Machine	1	2000	2	1	2	60
4	Refrigerator	1	125	0.125	8/24	1	30
5	CFL	4	4*7=28	0.028	1	0.028	0.84
6	Microwave Oven	1	-	-	-	-	-
Total Energy Consumption (Kwh)							102.96

Table 5: Conventional Load Calculation

S .No	Equipment Name	No. of equipment	Power rating (w)	Power rating (Kw)	Usage per day (Hours)	Energy Consumption per day(X)	Energy Consumption per month(X*30)
1	Fluorescent Lamp	1	36	0.036	5	0.18	5.4
2	Grinder	1	500	0.5	1/Week	0.5/Week	2
3	Mixer	1	700	0.7	1/Week	0.7/Week	2.8
4	Exhaust Fan	1	55	0.055	1	0.055	1.65
5	CFL	1	-	-	-	-	-
Total Energy Consumption (Kwh)							11.5

Table 6: Conventional Load Calculation

S .No	Equipment Name	No. of equipment	Power rating (w)	Power rating (Kw)	Usage per day (Hours)	Energy Consumption per day(X)	Energy Consumption per month(X*30)
1	Fluorescent Lamp	2	2*36=72	0.072	2	0.144	4.32
2	CFL	6	6*7=42	0.042	9	0.378	11.34
3	Incandescent Lamp	1	60	0.06	1	0.06	0.18
4	Motor	1	370	0.37	2	0.74	22.2
Total Energy Consumption (Kwh)							37.86

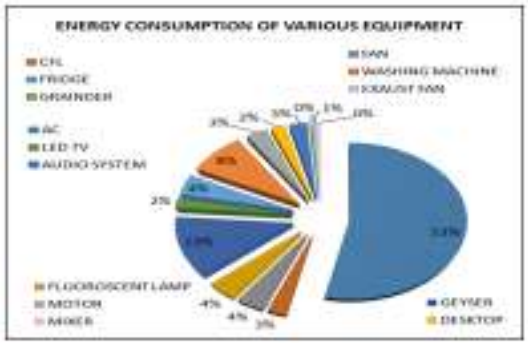

Figure 1: Energy consumption of various loads

It is observed that most of the energy is consuming by the Air conditioner about 53% followed by Geyser 13%, Washing, Machine 8%, and Lightning load 7% etc. The pie chart and Column chart (load in various areas) are shown in Fig. 1 and Fig. 2 respectively.

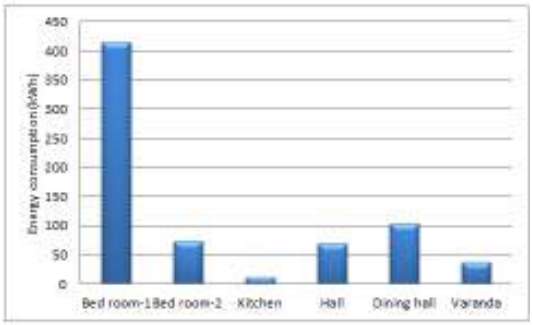

Figure 2: Energy consumption in various areas in buiding

Table 7: Conventional Load Calculation

Equipment	Bed room 1	Bed room 2	Kitchen	Hall	Dining Hall	Veranda	Total By Each Equipment
Fans	1.95	5.85	-	10.8	7.8	-	26.400
Fluorescent Lamps	1.53	3.45	5.4	8.64	4.32	4.32	27.655
CFL	0.84	3.36	-	1.68	0.84	11.34	18.060
Exhaust Fan	1.65	0.825	1.65	-	-	-	4.125
AC	319.8	60	-	-	-	-	379.800
LED TV	-	-	-	14.76	-	-	14.760
Fridge	-	-	-	-	30	-	30.000
Washing Machine	-	-	-	-	60	-	60.000
Grinder	-	-	2	-	-	-	2.000
Mixer	-	-	2.8	-	-	-	2.800
Motor	-	-	-	-	-	22.2	22.200
Desktop	-	-	-	15	-	-	15.000
Audio System	-	-	-	18	-	-	18.000
Geyser	90	-	-	-	-	-	90.000
Total	**415.77**	**73.475**	**11.85**	**68.88**	**102.96**	**37.86**	**710.600**

ENERGY SAVING PROPOSALS WITHOUT INVESTMENT

- While auditing it is observed that the refrigerator is with frost. So that it is advised defrost fridge the regularly. Because frost causes more difficulty to freezer to work efficiently.
- While auditing it is observed that the doors and windows are kept close even in day time. So, open them in day time to allow sufficient sun light into the home. It prevents from more usage of lightning.
- The walls of the house are painted with dark colours. For next time use light and highly reflecting colours on walls for better reflection of internal lightning.
- It is noticed that the switches of equipment are made ON when they are not in use so have a look on switches and plugs if they are not in use put them off.
- Make your kids play outdoor games rather than computer games and mobile games. It helps in saving energy and being healthy.

ENERGY SAVING PROPOSALS WITH INVESTMENT

1) Replacing old Air conditioner from the whole data it is found that more energy is being consumed due to old Air conditioner in Bed room 2. Working for 16 hours a day it is drawing an energy of 319.8 KWh per month with power rating of 2000KW. If it is replaced with new 5 star rated one we can have the following benefits.

The average cost per unit	6/-
Monthly saving	96*6 = Rs.576/-
Annual saving	576*12 = Rs.6912/-
A new AC	35000/-
Selling cost of old one	4000/-
Final cost of new one	31000/-

The payback period will be calculated below

Power rating of new Air conditioner	1400W = 1.4KW
Compressor run time per day	5.33 hours
Energy consumption per day	1.4*5.33 = 7.462KWh
Energy consumption per month	7.462*30=223.863KWh
Monthly saving of	319.8-223.863=96KWh

Therefore the payback period is 4.48 years.

2) Replacing Fluorescent lamps with LEDs If we replace the 36W fluorescent lamps in closed rooms like Bed rooms and kitchen with 7W LEDs which is more suitable for closed rooms as it has less beam angle & even exhibit more luminous intensity than fluorescent lamp apart from being eco-friendly. The following outcomes could be observed in table8.

Table 8

Area	Rating of LED in KW	Usage per day	Units per month	Consumption of fluorescent lamp	Saving per month
Bed room 1	0.007	1	0.21	1.08	0.87
Bed room 1	0.007	1	0.21	0.45	0.24
Kitchen	0.007	5	1.05	5.4	4.35
Bed room 2	0.007	3	0.63	3.24	2.61
Bed room 2	0.007	0.5	0.105	0.225	0.12
Total saving					8.19

Therefore, Energy saving per month	8.19 KWh
Saving per year	8.19*12 = 98.28 KWh
Saving in terms of money	98.28*6 = Rs.589.68/-
Cost of each LED	350/- .
For 5 LEDs	350*5 = Rs.1750/-

Therefore the payback period is 2.9 years.

3) Use of Immersion water heater instead of Geyser

We have seen that the Geyser is taking 13% from the whole consumption. It is used for 1 hour a day and it consumes 3KWh a day. i.e.; per month its usage is 90 KWh. Cost per 90 KWh is 90*6 = Rs.540/-. If we use immersion water heater instead of geyser it will consume 1 KWh for 1 hour usage. (For the same work) That is per month its usage is 30 KWh. We can save up to 60 KWh. Cost per 30 KWh is 30*6 = Rs.180/-. Therefore we can save up to Rs.360/- per month and an annual saving of Rs.4320/-. Cost of a new Immersion water heater is Rs.1500/- Payback period is 4.16 months.

4) Use of energy monitoring and targeting system

Employing a monitoring system to check the rate of energy flow periodically. Since the type of tariff system is blocked rate tariff it is essential to know energy flow periodically. Once we identify the energy flow then there would be a possibility of energy saving. Energy flow transparency is the basis for creating benchmark i.e. specific energy consumption. Continuous comparison of target values against actual values paves the way for reduction in energy consumption [10].

CONCLUSION

The energy audit is very effectual to probe & detect the energy expenditure of any construction and facilitate to propose elucidations and retrofitting.

Alterations can be amended by means of the payback method. In this work a building was chosen and evaluated from energy consumption point of view. Modifications to diminish energy expenditure were also proposed.

In synopsis the followings are the main conclusions:

1. Replacement of old Air conditioner with a new star rated would cost around 31000/- and it will pay back in period of 4.48 years, by implementing this we can save up to 96KW per month i.e. 13.5% of total consumption.
2. As mentioned in recommendation 2, it is efficient to replace fluorescent lamp with LED will save up to 1.2% and its payback period of investment is 2.9 years.
3. If they use Immersion water heater instead of Geyser we can prevent power wastage of 60KWh. The cost of a new immersion water heater is 1500 rupees and the payback period 4.16 months. It will save 8.5% of total power.
4. Through the monitoring and targeting system we can save up to 10% of power wastage.

Hence, the theoretical study and calculations says that if entire recommendations are implemented there would be a scope of saving around 234.5 KWh per month i.e. 33.2% of total energy consumption.

ACKNOWLEDGEMENT

We would like to acknowledge and thank Dr.L.Ramesh, Member Board of Research - Energy Efficiency Research Group-Green9 for providing all the necessary help to carry out this work.

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