



Energy Management and Audit of a Domestic Consumer

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Abstract: The following report has been prepared with a view point to facilitate our understanding of the energy usage pattern of our own houses in which electricity service is provided by CESC PVT.LTD and WBSEDCL. Energy audit and management is an essential step to reduce energy consumptions for sustainable and energy efficient living and standards. It is a method of an organization to measure the usage of energy that how and where what amount energy is being used. It also provides recommendations including techniques that should be applied to save the energy and reduce wastage of money. The Energy audit and management of our own houses is just the preliminary step towards our aim to achieve a better energy efficiency and focus on greener energy sources and practices to reduce the carbon energy footprint of each and every person. In this paper we try to provide a detailed overview of energy usage pattern of our own houses and also give some important and easily achievable recommendations on how we can reduce our electricity bills and lessen the damage our everyday life has on the environment. This energy audit enabled us to build a specific home energy model which has been used in order to analyse the impact of various energy saving actions on the primary energy consumptions of the site. Here we also emphasize on the usage of non-conventional sources of energy instead of using the non-renewable energy resources because the amount of fossil fuel in our earth's crust is limited and would be exhausted in the nearby upcoming future years. In order to avoid a catastrophe, we have to set up arrangements that come into action well before the fossil fuel are exhausted and such arrangements should be able to fulfil our rising energy demands without any trouble. Though the initial capital investment needed would be high to install such arrangements, but after being in use for a few years, the savings will overcome the costs. It will also reduce the various types of environmental pollutions providing clean and safe living conditions.

Key Words: Energy Audit, Energy Savings, Usage of Renewable Energy, Sustainable Development.

I. INTRODUCTION

Energy is one of the key inputs for the economic growth of any country. Electrical utilities are becoming more and more stressed since existing transmission and distribution system are facing their operation constraints with growing load. Now a day our life cannot be imagined without electricity. Energy saving means to decrease the amount of energy used while achieving a similar outcomes of end use, because we know we are having limited amount of conventional energy resources in the earth for the electric power generation. Energy demands and costs are increased with the time. Increasing the usage of non-energy-saving products and services directly disturbs the greenhouse-gas emissions and climate change.

It directly and indirectly affects our human health. An energy audit consists of a detailed examination and study about of a how facility, equipment's and area uses energy, what the facility pays for that energy, and a finally, a recommended program for changes in energy consuming. Energy management includes efficient planning and operation of energy production and energy consumption units. The Objectives of energy management are resource conservation, climate protection and cost saving and energy saving while the users have permanent access to the energy they need. It is connected closely to environmental management, production management, logistics and other established business functions. Energy management is the proactive, organized and systematic coordination of procurement, conversion, distribution and use of energy to meet the requirements taking into account environmental and economic objectives.

This Project is the vision to make our houses more energy efficient. To make our houses energy efficient will not only help us to reduce the energy expenses but also helps us to fulfil our moral responsibility of not wasting these precious resources, which are scarcely available to rest of the people of the country. This project would act as a prototype project; the lessons which we have learnt from here can be put to practice in the future. An energy audit is an inspection, survey and analysis of energy flow for energy conservation in college building, industries and commercial, process to reduce the amount of energy input into the system without negatively affecting the output. Energy audit is a testing and analysis of how the institute, industry or another organization use energy. According to national energy conservation laws and regulations for energy, consumption investigation and energy audit management. Energy auditing is a survey of the energy consumption processing related with of institute or organization.



II. METHODOLOGY

Mainly three steps are being followed by us during the energy audit of our homes which are described below:

Data Collection: In preliminary data collection phase, exhaustive data collection was performed using different tools such as observations and measurements.

Data Analysis: Analysis of detailed collected data was done using graphs, tabulation and other statistical methods.

Recommendation: On the basis of results of data analysis and observations, some steps for reducing power consumption without affecting our comfort and satisfaction were recommended along with their cost analysis.

The procedure for doing the energy audit which was done in our residential homes is presented below:

- At first the all-load details with a maximum demand of the Electrical Equipments of each home (room- wise) is collected and noted down.
- Then the time usage of load and the power consumption of the particular loads are calculated.
- Then in MS Excel a database of this and sum up the values is prepared.
- The last one-year electricity bill is collected and the units consumed per months and monthly charges are also noted in other sheets.
- Then the energy consumption by each appliance and room wise energy consumption and also overall energy consumption per day and per month is also calculated using the formula.
- To analysis in a detailed manner various graphs for different parameters are made using the above databases for each house individually.
- The unnecessary usage of power wastage is identified and calculated.
- Power Utilization Chart with respect to the layout is also prepared
- The daily utilization of Power by each the equipments are calculated and then those are converted to pie chart.
- Interaction about the energy usage with suitable survey is also done.
- The energy saving and conservations opportunity is also identified and noted.
- Some suitable recommendation with existing and implementable suggestions is also given.
- Cost benefit analysis with breakeven chart is also plotted.
- Awareness on energy savings and usage of non-conventional energy for the sustainable development is also given to the Person there.
- Finally the Suitable Energy Audit Report with breakeven analysis is submitted to our mentor.

III. RESULTS AND DISCUSSIONS

3.1 Number of Working Equipment:

LED Tube light Set (22W):3, LED Lamps (9W&5W):4; Fans :3, LED Television (57W) :1, Automatic Washing Machine (408W):1, Kitchen Chimney (350W):1, Water Purifier (20W):1, Refrigerator(35W):1, Mixer Grinder (600W):1, Geyser (2kW):1, Exhaust Fan (40W):2, Mobile Chargers (18W,15W):1+1, Laptop Charger (45W):1, Digital Clock (4W):1

3.2 Number of Non-Working Equipments

N/A

3.3 Daily Energy Consumption Pattern:

LED Tube light Sets:0.33 kWh, LED Lamps :0.0178 kWh, Fans: 2.1 kWh, LED Television:0.285 kWh, Automatic Washing Machine :0.408 kWh, Kitchen Chimney :0.7 kWh, Water Purifier :0.01 kWh, Refrigerator:0.84 kWh, Mixer Grinder :0.12 kWh, Geyser :1 kWh, Exhaust Fan :0.06 kWh, Mobile Chargers :0.066 kWh, Laptop Charger :0.135 kWh, Digital Clock :0.056 kWh. Total machines and instruments: 3.67kWh

Total daily energy consumption: 6.12 kWh

Total monthly energy consumption: 174.66 kWh

3.4 Room Wise Energy Consumption Pattern

Total energy consumption is calculated by each appliance for a particular room and plotted in a graph. The graph is represented below in figure1. Figure 2 to figure 9 are showing the load pattern of different part of a domestic house.

Energy Consumption in Bedroom 1: 1.713 kWh, Energy Consumption in Bedroom 2: 0.9995 kWh, Energy Consumption in Balcony: 0.4098 kWh, Energy Consumption in Kitchen cum dining room: 1.922 kWh, Energy Consumption in Bathroom 1: 1.049 kWh, and Energy Consumption in Bathroom 2: 0.52 kWh.

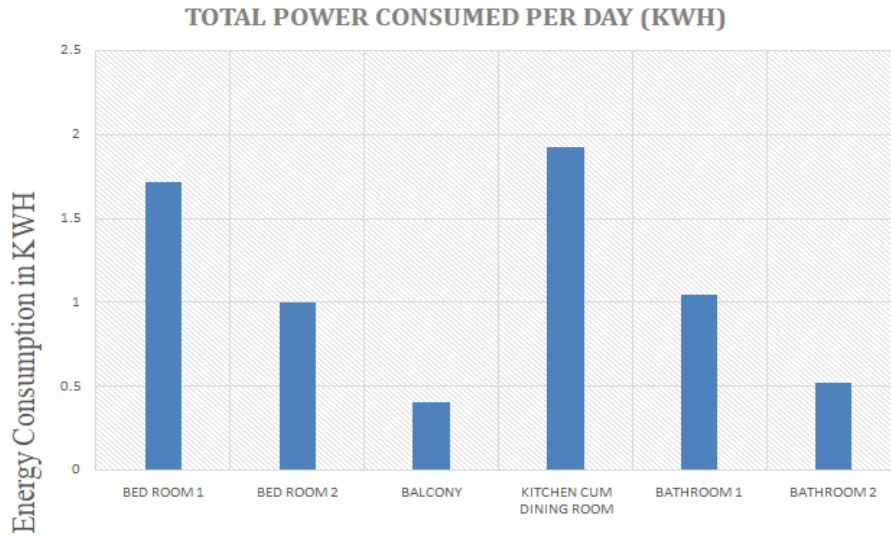


Fig. 1 Room wise energy consumption pattern

Room wise Load Distribution Pattern are showing in the below figures:

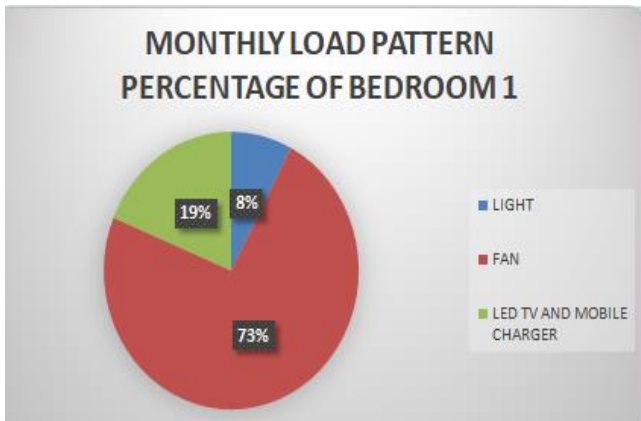


Fig. 3 Monthly load distribution of bedroom 1

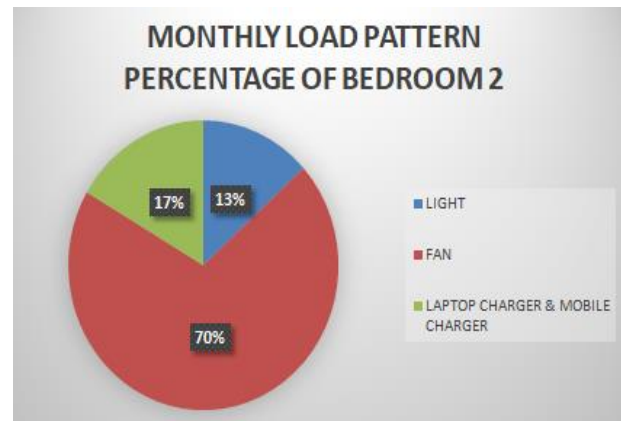


Fig. 2 Monthly load distribution of bedroom 2

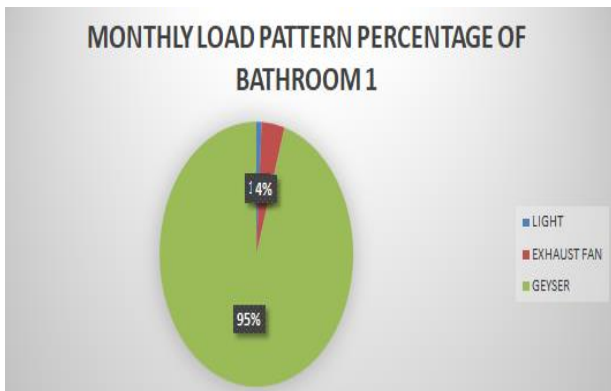


Fig. 4 Monthly load distribution of bathroom 1

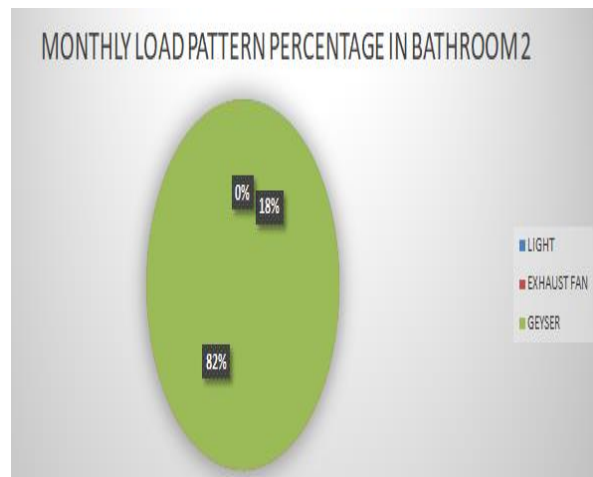


Fig. 5 Monthly load distribution of bathroom 2



Load Wise Energy Consumption Pattern:

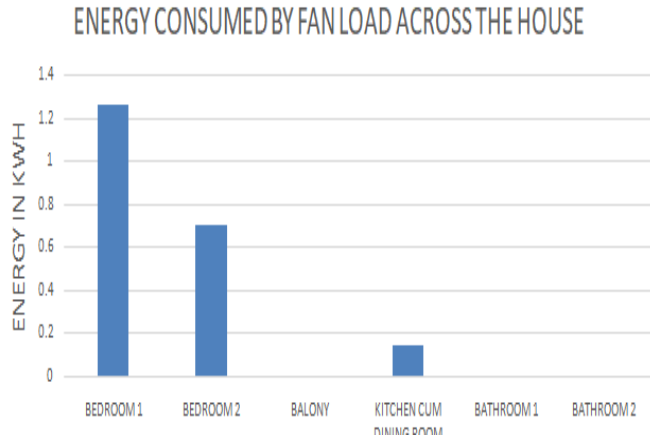


Fig. 6 Energy consumption pattern by light load across the house

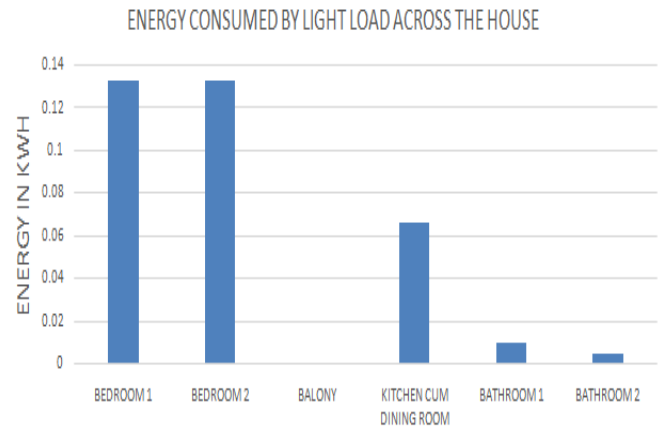


Fig. 7 Energy consumption pattern by fan load

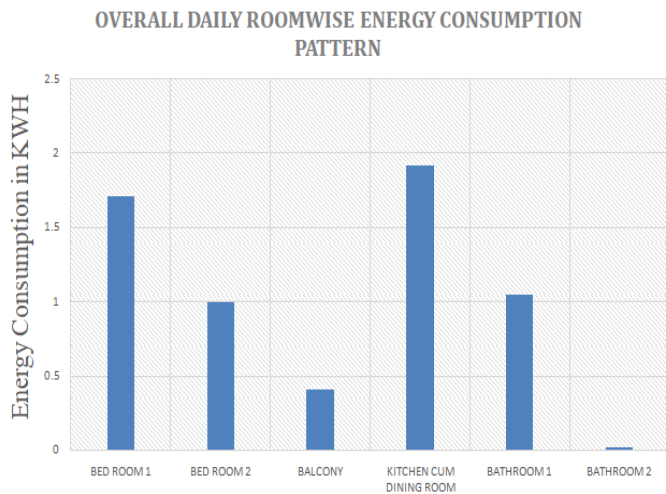


Fig. 8 Energy consumption pattern by machine and instruments

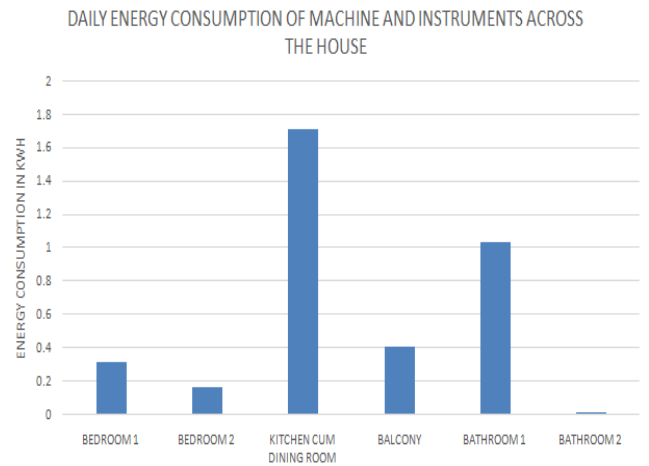


Fig. 9 Overall load wise energy consumption

One Year Billing Data:

It is seen that the peak usage is from August to October. As per audit, average monthly electricity consumption is around 174 kWh which is nearly the real energy consumption of August 2021, that is 119 kWh and hence within acceptable limits which is shown in the figure no 10.

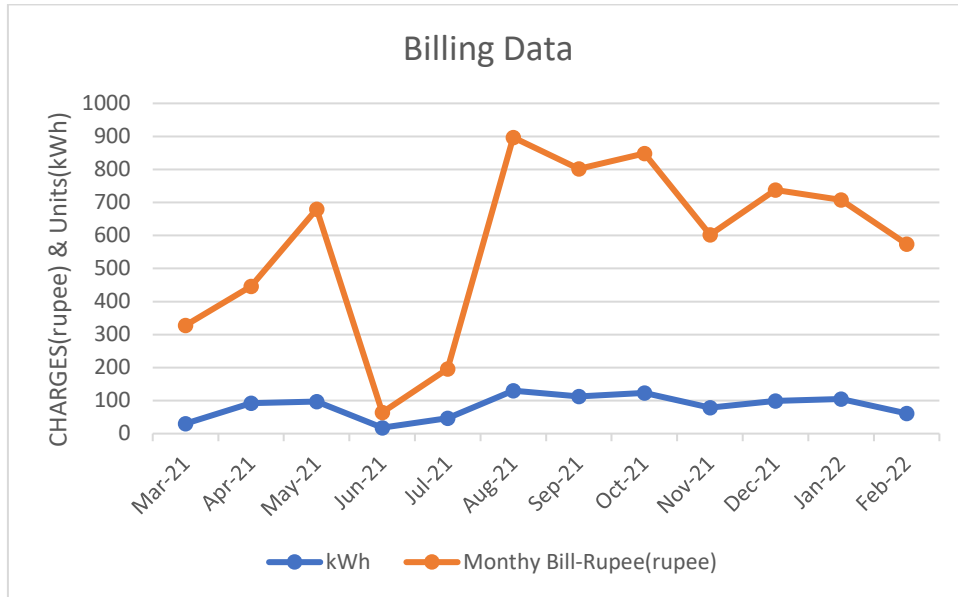


Fig. 10 One-year billing data of consumer

IV. RECOMMENDATION

- a. All the existing 22 W LED tube lights must replace with the new T5 LED tube lights.
- b. The all 14/9W LED PA lamps must replace with the 7W LED PAP lamps.
- c. PIR sensor must be installed inside of each room to restrict the unnecessary energy consumption of the lights.
- d. The existing conventional 70W fans must be replaced with the new BLDC 35W Fans.
- e. The One-star rating led television must be replaced with the minimum 4 star led television.
- f. The existing Washing Machine should be replaced with the inverter washing machine.
- g. Solar energy is a better option. The consumer must install solar panels on the rooftop to get the solar energy.

V. FINAL BENEFIT ANALYSIS

TABLE1: Final benefit analysis table after the recommendation

Appliances	Number	Annual savings (KWH)	Annual savings (Rs.)	Capital Investment (Rs.)	Payback period (years)	Carbon Footprint (Kgs of CO ₂)
Tube lights& Led Lights	3+2	17.5	123	3160	37	15.29
Fans	3	123	861	9000	10	108
Other appliances	1 TV	78	546	16000	29	68
Solar energy	-	2379.6	16657	290000	17	2070

VI. CONCLUSION

Entire house has been covered and each of the energy consuming equipment has been accounted for in the tabular columns. The energy consumption of the house is 150-200 kWh per month, approximately considering usage dependency upon climate. If the recommendations given in this report are followed, it is sure that the overall energy consumption and also the carbon footprint are sure to decrease substantially.



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