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Electrical Energy Audit in Residential House

Awanish kumar^{a*}, Shashi Ranjan^a, M.Bharath Kumar Singh^a, Priyanka Kumari^a,
L.Ramesh^b

^aMember MGR-Vision 10 MW, ^bDirector MGR-Vision 10 MW and Professor, EEE Department
Dr .M.G.R Educational and Research Institute, Chennai, India

Abstract

Electrical energy plays a vital role in our day to day life. Anything cannot be imagined without electricity. As there is a limited amount of resources that can be help us to generate electricity, so this is our keen duty to save these resources or save electricity for our further use and this is only possible by doing an energy audit to a different sector. Our vision is saving electrical energy by conducting an Intelligent Electrical Energy audit under an initiative forum “MGR vision 10MW”. The first initiative is started and presented in the paper about auditing a residential house, and presented the suitable recommendation with the help of ETAP software package.

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1. Introduction

In India the energy conservation is very much essential as the demand in the society is increasing day by day, looking over the scenario, electrical energy audit is done. It is a process of checking how energy is used and identifying the areas where wastage can be minimized if not totally eradicated. [1-2] Energy audit consists of several tasks which can be carried out depending on the type of the audit and the function of the audited facility. It starts with a review of the historical data on energy consumption, which can be compiled from the electricity bills. The energy audit work was carried out by various researchers for the consumption of energy is presented here.

*Corresponding author. Tel.: +91-9043667993;

E-mail address: awanish249@gmail.com

Mukesh k saini [3] state the industrial development in the country and provide the recommendation for industry energy audit. Malkiat Singh [4] present his idea about industrial energy management. He suggest to look forward to more renewable resources present around us and with the managed approach of renewable energy source with the audit a more cost effective and efficient energy technology can be achieved. Mehul Kumar [5] deals with energy and its value in developing the economy. This paper will help the consumer to know the procedure for residential house energy audit through ETAP software. The double bed room house is considered for the audit and the recommendation is presented with the help of software. This work is carried out under the MGR Vision 10MW pilot project-1. This is the project to save 10MW in the period of 10 years.

2. Procedure

The first phase of energy audit starts with site inspection work. In this paper the first initiative we have done auditing in a home and giving them an appropriate results with single line diagram in ETAP simulation software and recommendation regarding their usage of electricity with suggestions to reduce the tariff of the electricity bill. The procedure adopted for our work is presented below.

- Collect all the Load details with a maximum demand of the Electrical Equipment,
- Calculate the Usage of Load
- Plot the single line diagram according to the ETAP simulation software.
- Plot Real time load curve by taking the energy meter kwhr for 20 days.
- Calculate the connected load with respective to single diagram.
- Plot a graph in between years and Tariff
- Identify and calculate the unnecessary usage of power wastage in the layout with graphs
- Draw the Power Utilization Chart with respect to the Layout
- Calculate the daily utilization of Power by all the equipment's and convert to pie chart.
- Data Collection of all the major equipment's and find out the performance
- Interaction about the energy usage with suitable survey
- Identify the Energy Saving and Conservations Opportunity
- Report on suitable recommendation with existing and implementable suggestions
- Plot Cost Benefit Analysis with Breakeven Chart
- Check the earth resistance and report on the status of earthing in that concern
- Provide Awareness' on Electrical Safety to the Person there.
- Submission of Suitable Energy Audit Report with Breakeven Analysis

3. Electrical Energy Audit Survey

The team members of our group conducted energy audit at 25 houses, 2 industries and 2 commercial buildings. This paper deals with the ETAP simulation and recommendations conducted at one of the houses are shown according to the layout given below.

3.1. ETAP Single Line Diagram

According to the electrical energy audit survey conducted at a home, the single line diagram is drawn in ETAP simulation software. In this diagram, the utility service was connected first with a bus bar, from bus bar the 11KV step down transformer is connected on the secondary side. Then the loads in the houses are connected with their capacity.

3.2 Data Acquisition Analysis

According to the layout of the house, the daily utilization chart is given in Fig.1. In this graph, we can analyze the consumption of the energy in 24 hours by the lighting and the major equipment's like fridge, fans, etc. The daily utilization graph makes easy to understand the utilization of energy in a particular day. The wattage of all the appliance are also represented in Fig. 1. The age of each equipment data are collected to know the equipment age and their performance through the graph . It is observed that the fridge was purchased in the year 2009, fan was purchased in the year 2010, whereas A.C is the oldest one in the house because it was purchased by owner in the year 2003. T.V and washing machine was purchased in the same year, which was 2010. The tariff details are collected to check the unit consumption of the particular house in which the data have been collected for the past two years. In general, it was found that at the time of the summer the consumption was very high and also at the time of winter the consumption is low, this is due to the maximum use of the air conditioner during summer. But in this house the scenario was entirely different. As can be clearly analyzed that in the month of august and September 2013, the unit consumption was 2000 units. We did this survey on the house owner's request regarding this apparent change in the unit consumption, but he was not able to recognize the proper region. The average unit consumption of this house is 470.5 units per month.

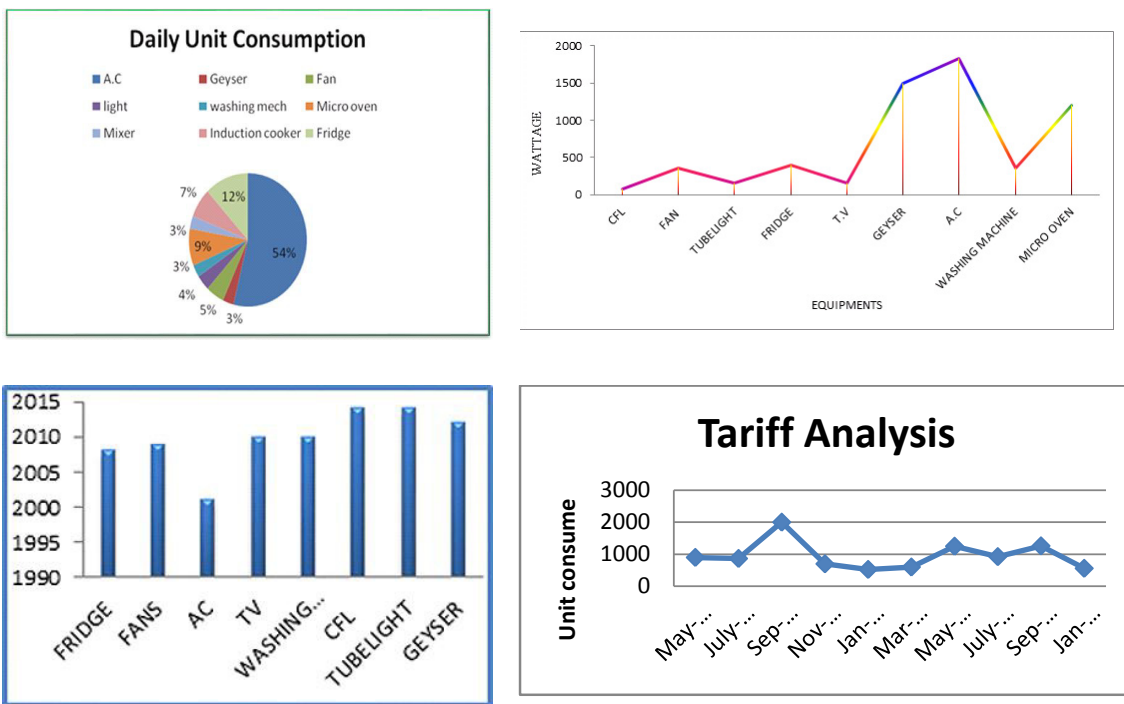


Fig. 1. Daily Power Utilization, Equipment Wattage, Age Analysis and Tariff analysis of the house

3.3 ETAP Analysis

The layout of the building is drawn in the ETAP simulation software through which the load analysis is done. According to the load flow analysis, the bus current and voltage drawn is shown in Fig. 2.

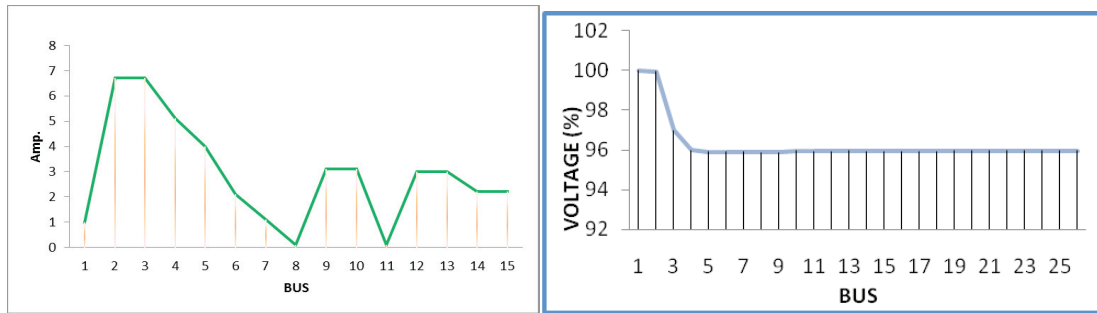


Fig. 2. ETAP Voltage and Current Analysis

It is seen that the voltage of each equipment's maintained from bus no 3 to bus no 25. This graph shows the result of analysis before the recommendation was implemented. The same analysis was done after implementation of the recommendation through ETAP software in the single line diagram. It resulted the 50 % decrease in the load current through the daily load analysis.

4. Recommendation

4.1 Recommendation without Investment

According to the layout of the home, we have recommended some of the best saving tips by which they can save electrical energy and tariff without any investment by proper utilization and also reduce the tariff in their bills. These are some important tips to save energy at home.

- Unplug and switch off the entire electrical device of appliance that is not in used to reduce no-load losses.
- Clean the light fixtures regularly as a heavy coat of dust can block 50% of light output.
- Clean the fans regularly as heavy coat of dust in fan blades reduces motor efficiency and output.
- Set your refrigerator temperature with respect to the climatic condition
- Defrost the refrigerator regularly and don't leave your fridge open, 30% of cool air get escape as well as in microwave hot air is escaped.
- Run the washing machine with full load.
- Clean the Air conditioner duct and filter regularly to reduce the power consumption and increase cooling.
- Use the heavy load appliances in the non-peak load condition

4.2 Recommendation With investment

In this layout according to the site review, it can be seen that tube light is used a lot. It is suggested for replacement of tube light with LED light. The LED has two years of warranty and it also saves the consumption of units compare to the CFL and tube light. Fig. 3 represents the comparison picture representation for the usage of tube light and LED for next five years. It shows that LED is very much effective and also very useful in the consumption of electrical energy. There is only one refrigerator in the home which is of 1000 W rating which is resulted below 50% load test efficiency result. It is recommended for the implementation of star rated refrigerator. The existing refrigerator consumed 1642.5 units which covers annual expense of Rs 4927.50. If old refrigerator is replaced by 3 star rated refrigerator, its annual Power consumption will be 636 units per year which covers annual expense of Rs 1878 with the saving of 1016.5 units per year, which in turn save Rs 3050 per year. Similarly 5 rated refrigerator will save Rs 3727.5 per year. The Air conditioner which is used of old model and delivered non performing result after the load test analysis. It is suggested for star rated one to replace old one. The existing one consumed 20075 units which covers annual expense of Rs 60225. If old refrigerator is replaced by 5 star 1.5 ton split rated Air conditioner, its annual power consumption will be 13466.1 units which cover annual expense of Rs 40398.30 per year which gives saving of 6608.1 unit per year which in turn save Rs 19826.70 per year.

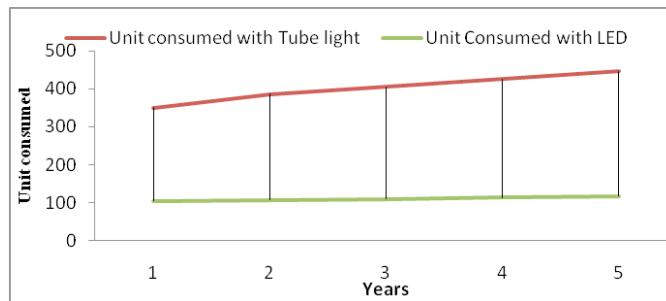


Fig. 3. Unit Comparison Graph for tube light and LED

4.3 Recommendation with Distributed Generation (D.G)

The study reveals that 1kW capacity of solar power is recommended for implementation to run the basic electrical equipment. The investment cost for solar after subsidy is Rs 65,000. With reference to the heat radiation in Chennai resulted for 4 to 5 kW power generation per day for 1kw panel. The estimated savings in unit consumption and tariff as per the Fig. 4 is 25% of the present tariff with the payback period of 5 years.

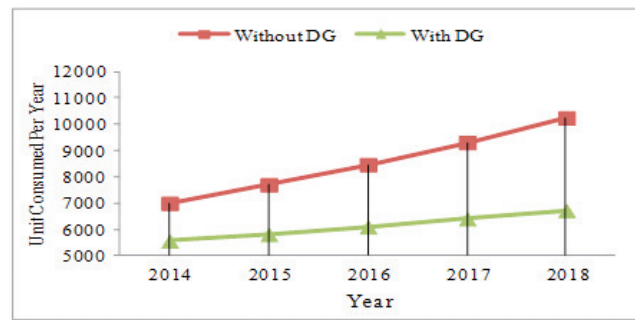


Fig. 4. Unit Comparison Graph With DG And Without DG

5. Conclusions

Considering the present scenario the wastage of energy is mostly done by the domestic users. In residential area users should think about the installation of new machines and equipment with low cost, effective and efficient techniques to achieve high efficiency of energy user. The present audit work executed in a 2-BHK residential house in Chennai. The effective recommendation is presented along with different graphs. The house owner agreed to implement the idea presented in this paper. The authors also recommended the use of different methods of renewable energy sources, tree plantation around the building and changes in the installation procedure for an effective, efficient, cleaner and greener environment.

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