International Journal of Engineering Research in Electrical and Electronic Engineering (IJEREEE) Vol 1, Issue 5, July 2015

Energy Auditing of Campus: A Case Study

[1] Kurian Joseph, [2]Linda Wilfred, [3]Ribin Raj, [4]Sruthisree O Menon
Amal Jyothi College of Engineering Kanjirappally, Koovappally (P.O),
Kottyam 686518, Kerala India.

Abstract: **This paper is an overview of a energy conservation measures that can be recommended for a college campus. Energy audit is to identify and minimize the wastage of energy and to optimize its use. It is an inspection, survey and analysis of energy flow for energy conservation in an institute, to optimize the use of energy input in the system. Energy auditing has been conducted at college to estimate the daily, monthly and annual energy consumption. This paper presents such energy saving methods in a methodological approach, experienced during a detailed energy audit of a college campus in Kerala. The energy consumption and savings assessed in term of equipments used and functional areas occupied. The main aim of this paper is to offer a documentary evidence for this high potential of energy saving in campus.**

Keywords: **ECO,DG SETS,KSEB,LED,LPG.**

I. INTRODUCTION

The energy process is an organized approach to identify energy waste in a facility, determining how this waste can be eliminated at a reasonable cost with a suitable time frame. Energy audit is widely used and many have different meaning depending on energy service companies. Energy auditing of a building can range from a short a walkthrough of the facility to a detailed analysis. It is not only serves to identify energy use among the various services and to identify opportunities for energy conservation but it is also a crucial first step in establishing an energy management program. The audit will produce the data on which such a program is based. The study should reveal to the owner, manager, or management team of the building the options available for reducing energy waste, the costs involved, and the benefits achievable from implementing those energy-conserving opportunities (ECOs). The energy audit discusses in this paper is known as "Detailed Energy Audit". This type of audit is the most comprehensive and time-consuming type of energy audit. This includes the use of instruments to measure the energy use of whole building and energy systems within the building. Detailed energy audits

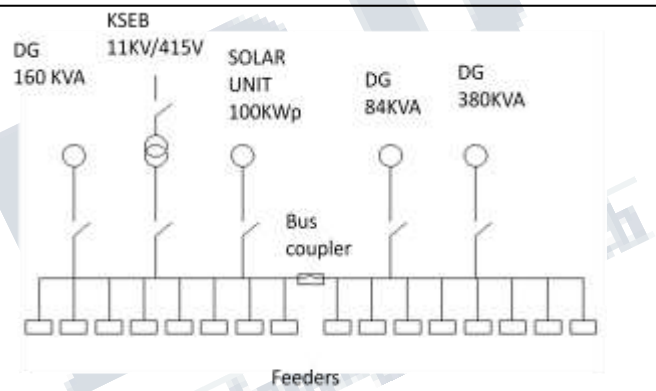

Fig 1. single line diagram of AJCE campus

also use the sophisticated computer simulation programs to evaluate and recommend the energy retrofits for the facility. The audit discusses in this paper is carried out in aim of analyzing and identifying possible energy saving measures, which can be implemented in a factory. This effort will help the factory to reduce their monthly electrical energy consumption thus reducing the cost of production. The total energy survey is conducted by means of onsite inspections, measurements, questions and discussions with the maintenance staff. Energy consumption data have been logged over a period of time at the main supply and in identified main equipments in the factory. This energy analysis contains valuable information such as energy consumption patterns of the factory and the identification of high energy intense equipments, possible energy saving measures and cost benefit analysis of energy saving measures.

II. AUDITING PROCEDURE

Energy audit consists with several tasks which can be carried out depending on the type of the audit and the size and the function of the audited facility. Therefore an energy audit is not a linear process and is rather iterative. The audit describes in this paper was carried out with in four days time frame based on the following functional activities.

a. Building and utility data analysis.
b. Walk through survey
c. Base line for building energy use.
d. Evaluation of energy saving measures.

III. CAMPUS ENERGY PICTURE

This section is mainly concentrated on the energy consumption patterns of the campus. Apart from statistics a breakdown of the energy usage is presented under all major functional areas. These statistics are vital for understanding the present energy scenario of the campus.

A. Campus Energy Sources

The electricity source for the campus is supplied through a 415 V three phase KSEB supply along with three DG sets and a 100 Kw solar power plant . it is shown in the fig1.

B. Campus Energy Consumption

The campus energy consumption is identified in terms of the equipments and functional area wise. The results are obtained, after having the data analysis during the campus visit. Data loggers, power analyzers, lux meters. Etc are used to measure the energy consumption of the campus. When the electrical energy is discriminated by area- wise, the major portion of the electrical energy is used for academic area, which is 45% including workshops. Hostel and canteen 35%, Office Rooms & Stores an 11% , others 7% and Pump house 2% of the total energy respectively.

IV. ENERGY CONSUMPTION AND COST ANALYSIS

In order to understand the present energy scenario we are taking the energy consumption per month along with the electricity bills of the campus

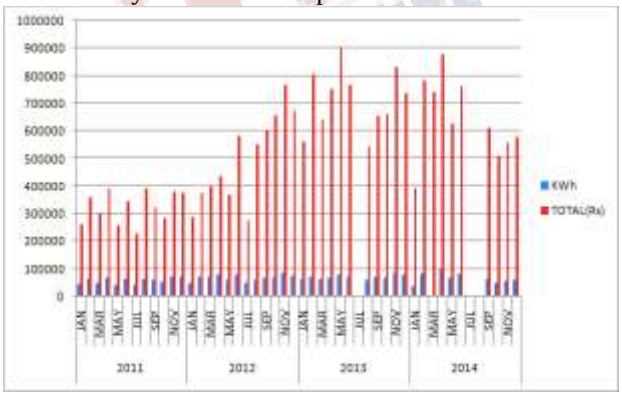

Fig.2 analysis of monthly energy consumption and electricity bill

From the analysis of the consumption and bills there are more energy consumption in the summer season and the exam time in the college. From the above conclusion we can came to the point that there can be reduction in cost by making improvements in different areas such as lightening systems , pumping system, kitchen and canteen etc.. The college has a good power factor of 0 .97.

V. IDENTIFYING THE AREAS TO BE IMPROVED

From the study of campus energy consumption system there are lots of wastages of energy in the areas such as lightening system used in the college, pumping system to supply the water to the college hostel and college, equipments and its usage patterns in the kitchen and canteen

VI. ENERGY SAVING ON LIGHTING SYSTEMS

Lighting energy consumption of the whole campus is limited to the 30% of the total electrical energy consumption. During the campus audit several places are identified as the places where the savings are easily guaranteed. A count on lighting is needed to be done, after identifying the proper locations. As a rule of thumb, the followings are the common methods of energy saving on the lighting systems.

* Replacing the existing lamps with LED lights.
* Halogens (spot lights) are replaced with infrared coating halogens.
* Incandescent lamps are replaced with compact fluorescent lamps (CFL).
* Halogens (flood type) are replaced with metal halides.
* Replacement of the magnetic ballast from electronic.

A. Installation of LED lamps

The campus uses the CFL (compact fluorescent lamps) at class rooms , veranda, cafeteria and nearby areas for lighting. The compact fluorescent lamps 14W are proposed to replace with 10W rating LED lamps. The following savings are guaranteed after the implementation of the proposal.

Existing Lamp wattage=14
LED wattage=10
Load reduction due to replacement= 4
Total Operating hours per year=3600
Annual Energy saving per lamp= 14 KWh
Total number of lamps=1500
Light bulb projected life span= 50,000 hours
KWh of electricity used over 50,000 hours= 500
Cost of electricity(@.10 per KWh)= Rs. 3100
Blub needed for 50k hours of use = 1
Equivalent 50k hours blub expense =Rs. 210490
Total cost for 50k hours= Rs. 5316.5
Total cost for 1500 blubs= Rs. 7974750

Equivalent total cost for 1500 blubs= Rs.8346750
for fluorescent lamps
Saving to campus by switching from = Rs.372000
fluorescent lamps

VII.ENERGY SAVING ON PUMPING SYSTEM

Replacement of the present motor-pump with a new monoblock pump set, having a system efficiency of 60 %, will lead to a saving of 5 MWh/year which translates to a saving of Rs 0.32 lakhs per annum.

VIII. ENERGY SAVING ON CANTEEN AND KITCHEN

About 360 LPG cylinders (14 kg capacity each) are used for water heating in the canteen per Annum. It is proposed to replace this LPG and electrical heater with solar water heating system, of capacity 4,500 LPD. This will lead to a savings of 2.97 lakhs per year [1.23 lakhs from LPG Heating and 1.74 Lakhs from electrical heating]. The investment on the solar water heating system will be around Rs. 8.0 lakhs and the payback period is 2.7 years.

IX. CONCLUSION

The results reveal that the campus has a considerable savings on energy in the areas of lighting, pumping system and in the areas of kitchen and canteen by the methods suggested by us . this will lead to a saving of 5.35 lakhs per annum. The motivation of students and employees of the campus for energy saving and educating them about the need of energy conservation will play a great part in the auditing procedure. Several energy conservation methods that are cost effective are not often implemented due to the lack of internal funding. But its is the responsibility of the energy auditor to urge the management to elaborate the advantages that can be achieved through successful implementation.

REFERENCES

[1] Haberl J.S., and Claridge D.E., An Expert System for Building Energy Consumption Analysis: Prototype Results, ASHRAE Transactions, 1979

[2] Greely K., Harris J., and Hatcher A., Measured Saving and Cost- Effectiveness of Conservation Retrofits in Commercial Buildings, Lawrence Berkely National Laboratory Report-27586, Berkeley, CA, 1990

[3] Fels, J., Special Issue Devoted to Measuring Energy Savings: The Socrekeeping Approach, Energy and Buildings.

[4] Thumann, A., and Mehta, P., Handbook of Energy Engineering. The Fairmont Press Inc., Librun, GA 1997

[5] Tuluca A., and Steven Winter Associates, Energy Efficient Design and Constructionfor Commercial Buildings, Mc-Graw Hills, 1997

[6] Moncef Krarti, Energy Audit of Building system- An Engineering Approach.., CRC Press LLC 2000