

IoT Based Energy Auditing System in Boys Hostel

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Abstract---In this paper, the importance of energy auditing and process of energy auditing are presented in detail. A sincere attempt has been made to conduct the energy audit at M.Kumarasamy College of Engineering, Karur, to estimate the Energy consumed in a day, week and month. Identification of area of energy wastage and estimation of energy saving potential in boys hostel and mess has been made by walk through energy audit. Also, detailed analysis of data collected is done by suggesting cost-effective measures to improve the energy efficiency of use. Estimation of implementation costs and payback periods for each recommended action has been made. The result & vital information generated through these activities are documented. The Energy Auditing for a day is the index of the consumption which normalize the situation of Energy crises by providing the conservation schemes.

I. INTRODUCTION

In energy audit is an inspection, survey and analysis of energy flows, for energy conservation in a building, processor system to reduce the amount of energy input to the system without negatively affecting the output(s). In commercial and industrial real estate, an energy audit is the first step in identifying opportunities to reduce energy. The main goal of our project is survey of energy consumption and to minimize the energy wastage and to identify the energy saving location in boys hostel and mess at M. Kumarasamy College of Engineering, Karur. Design and architect professionals as well as plant engineers have to recognize the importance of reducing overall energy consumption, whether it is a building, plant or process that is under their jurisdiction for design construction or operation. Energy use reduction or energy conservation has four main steps. The planning of energy conservation requires setting goals to meet within the time frame available, prioritizing the use of resources, and determining a schedule for implementation. Conducting a survey of existing facilities, process, equipment, operation, and maintenance is very important may be needed. The subject "Energy Auditing" is highly technical and it involves many engineering branches like Electrical, Mechanical, Chemical, etc. For an energy auditor, it is necessary that he should have complete knowledge of the system for which he is going to perform energy auditing. For example, in a process plant energy auditing. For example, in a process plant energy auditor will come across pumps, motors, fans and blowers and many other types of equipments. Besides this, a little background of finance is also needed.

II. NEED OF AUDIT

In energy audit is a survey and analysis of flow of energy. Auditing helps in reduction of energy bills improving the efficiency of energy consumption in the in hostel. This audit

reduces the carbon footprint and helps to decrease unnecessary waste and pollution. This is very important to have a check on the energy saving and the devices consuming large amount of energy which can be replaced by the more efficient technologies.

III. BENEFITS OF ENERGY AUDITING

In any industry, the three top operating expenses are often found to be energy (both electrical and thermal), labor and materials. If one were relate to the manageability of the cost or potential cost savings in each of the above components, energy would invariably emerge as a top ranker, and thus energy management function constitutes strategic area for cost reduction. Energy Audit will help to understand more about the ways energy and fuel used in any industry, and help in identifying where waste can occur and where scope for improvement exists. The Energy Audit would give a positive orientation to the energy cost reduction, preventive maintenance and quality control programs which are vital for production and utility activities. Such an audit program will help to keep focus on a variation which occur in the energy costs, availability and reliability of supply of energy, decide on appropriate energy mix, identify energy conservation technologies, retrofit for energy conservation equipment etc. In general, Energy Audit is the translation of conservation ideas into realities, by lending technically feasible solutions with economic and other organizational considerations within a specified time frame.

IV. METHODOLOGY FOR ENERGY AUDIT

Structured methodology is helpful in carrying out the energy audit in a more efficient way. Methodology varies from one organization to another; however, the objectives of energy auditing should be fulfilled whatever methodology adopted should be known to the external auditor before hand, so that the energy auditor remains aware about the activities, He is supposed to do during the auditing phase. This can be discussed during bid discussion. Some of the steps for finalizing the methodology for preparation of single line diagram of electrical system.

The methodology adopted for this audit was a three step process comprising of:

[1]Data Collection: In preliminary data collection phase, exhaustive data collection was made using different methods such as observation, interviewing key persons, and measurements.

Following steps were taken for data collection:

- Visited each department, centre, laboratories, library, canteen, auditorium and other entities of the institution.
- Information about the general electrical appliances was collected by observation and interviewing.
- Obtained Site drawing of available building lay-out and Electricity distribution.
- Collection of Electricity bill from the in-charge personnel.
- The power consumption of appliances was measured using power analyzer in some cases (such as fans) while in other cases, rated power was used (CFL for example).
- Information collected on redundant / non-operational energy systems
- The details of usage of the appliances were collected by interviewing key persons e.g. Electrician, caretaker (in case of departments) etc.
- Approximations and generalizations were done at places with lack of information.

[2] Data Analysis: Detailed analysis of data collected was done. Energy consumption per month in kWh is calculated based on each department and block-wise.

The analysis of data is done in following way:

- Power Flow diagram
- Evaluation of collected data department wise analysis, block wise analysis and location wise analysis.

Reasons for the Variance between connected load and actual consumption was evaluated.

- The database prepared was further studied and the results have been graphically represented.

This helped to identify the areas with maximum energy saving potential.

[3] Recommendation: On the basis of results of data analysis and observations, some steps for reducing power consumption were taken. The recommended measures will not affect the present working conditions and at the same time substantial energy savings will arise.

Following were the steps involved in this process:

- The capital cost involved in replacing an appliance and/or process was estimated.
- The energy saving by the move was calculated in terms of price of energy per year.
- These two costs were compared to calculate the capital cost recovery time which is defined as the total time by which the saving in energy bill balances the capital cost involved.
- If capital cost recovery time is less than the product life, the move can be supported.

Some other recommendations were also made which are based on lighting intensity, computer usage, fans and motion sensors.

VI. GOALS OF ENERGY AUDITING

Generally goals of energy audit vary for different kinds of energy. The overall goals of energy auditing can be simplified as following:

- Study of variation and improvement in power factor and load factors.
- Clearly identifying the various types and costs of energy use.
- Reduction in utility bills.
- Also to understand how energy is possibly wasted.
- Identify and analyze more cost-effective ways of consuming energy.

The real power which is consumed by loads is mainly depend on power factor. Similarly improper employment of loads results in the wastage of energy hence a suggestive proposals are made to overcome the wastage.

VI . POWER MONITORING KIT WITH SD CARD STORAGE AND WI-FI MODULE

In this project, we used one power monitoring device. This device is used to calculate and store the energy consumption of one building in an hour, a day, a week, and a month. Through this device we can easily measure the energy utilization of one building or one room. So we can easily find the peak load timings and low load timings. By using that we made a chart of energy usage in a day and one week. In this project we calculate the boy's hostel energy consumption. So, we fix the power monitoring and storing kit at the inlet power line of boy's hostel. Before that we take the electrical equipments used in each room.

Equipments used in north block:

NEW BOYS HOSTEL-NORTH BLOCK					
LOCATION	EQUIPMENT	AMPS	WATT	HOUR	TOTAL WH
GROUND FLOOR-20 ROOMS	FAN 20	8	1400	16	22400
	FLUORESCENT LAMP 40	8	1600	8	12800
	CFL 20	4	220	1	220
	IRON BOX 2	60	1500	3	4500
	MOBILE CHARGER 60	30	900	2	1800
	LAPTOP 8	22.5	720	3	2160
FIRST FLOOR-20 ROOMS	FAN 20	8	1400	16	22400
	FLUORESCENT LAMP 40	8	1600	8	12800
	CFL 20	4	220	1	220
	IRON BOX 3	60	2250	3	6750
	MOBILE CHARGER 60	30	900	2	1800
	LAPTOP 6	15	540	3	1620
SECOND FLOOR-20 ROOMS	FAN 20	8	1400	16	22400
	FLUORESCENT LAMP 40	8	1600	8	12800
	CFL 20	4	220	1	220
	IRON BOX 3	36	2250	3	6750
	MOBILE CHARGER 60	30	900	2	1800
	LAPTOP 5	30	450	3	1350
THIRD FLOOR-20 ROOMS	FAN 20	8	1400	16	22400
	FLUORESCENT LAMP 40	8	1600	8	12800
	CFL 20	4	220	1	220
	IRON BOX 3	72	2250	3	6750
	MOBILE CHARGER 60	30	900	2	1800
	LAPTOP 5	15	450	3	1350
TOTAL wh					180110
UNITS PER DAY					180.11
UNITS PER MONTH					5400
TOTAL COST					34290

Table. 1. ENERGY DATA BASE

In new boys hostel (north block) there are three floors. Each floor has 20 rooms. Each room have one fan (70 W), two tube (fluorescent lamp) lights (40 W), one CFL (compact fluorescent lamp) lamps (11 W). Each floor 2 to 5 iron boxes and 60 mobile and 5 to 6 laptops are used.

As per our project, first one week we fix the power monitoring and string device in inlet of the one room of boys hostel. Next we fix at the one floor. Next we fix one block. So, we can easily take the peak hours and energy saving locations. Through that we easily save the energy.

VII.CALCULATION OF ONE ROOM

We calculate approximately working hour. Because the accurate usage was measuring is impossible one.

(i). POWER USAGE IN ONE HOUR:

It is example of power usage in one working hour. But, in a day the mobile and laptop chargers are not used full time. These equipments and iron box are used some hours. So, we calculate approximate usage of power in one day.

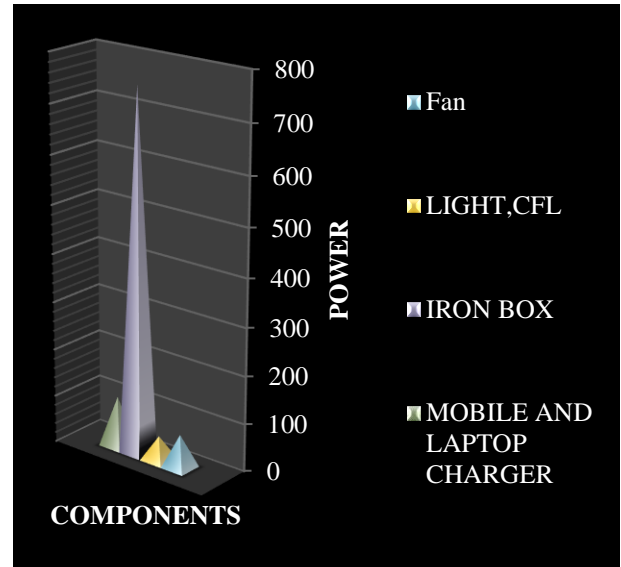


Fig. 1 componenet usage

(ii). POWER UTILIZATION IN ONE DAY (approx):

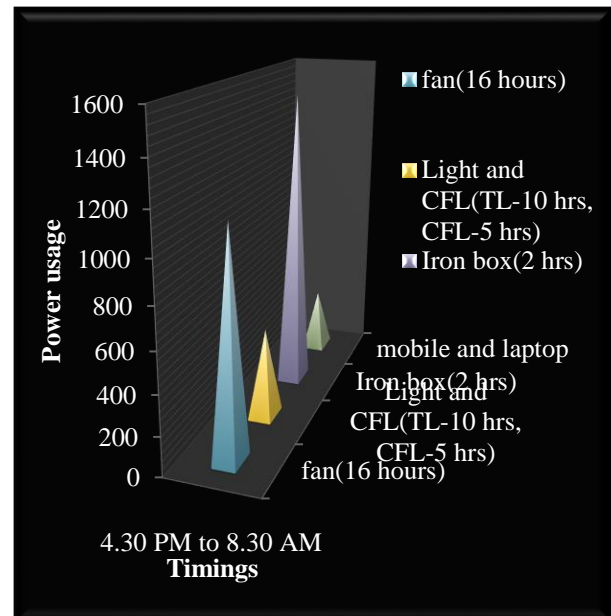


Fig. 2 power usage in one day

Fan =70 Watts*16 hrs =1120 w-h
 Tube Light =40 Watts*10 hrs =400 w-h
 CFL =11 Watts*5 hrs =55 w-h
 Iron Box =750 watts*2 hrs =1500 w-h
 Mobile Charger=15 Watts*3hrs =135 w-h
 Laptop Charger=90 Watts*2 hrs =180 w-h
 Total =3390 w-h
 Total Unit=3.39 units
 One unit utilization cost is=6.35 Rs
 Cost of one day for single room=3.39*6.35 =21.52 Rs.

(iii). POWER USAGE IN A WEEK :

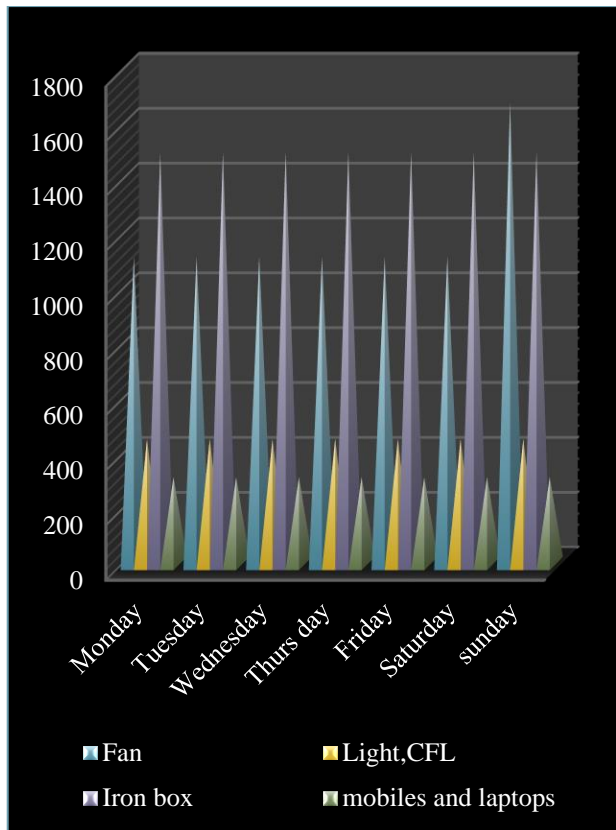


Fig. 3 power usage in a week

EB-BIL COMPARISON OF TWO MONTHS:

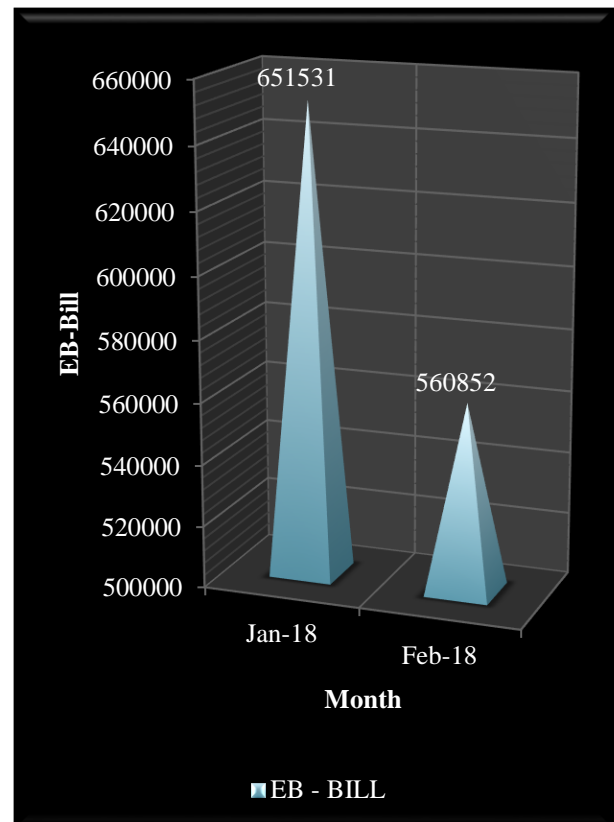


Fig. 4 comparison of two months

CALCULATIONS:

Energy usage in Monday=3.39 units
 Energy usage in Tuesday=3.39 units
 Energy usage in Wednesday =3.39 units
 Energy usage in Thursday =3.39 units
 Energy usage in Friday =3.39 units
 Energy usage in Saturday =3.39 units
 Energy usage in Sunday =3.95 units
 Total energy in a week=24.29units
 Total cost in a week =154.24Rs.
 One having 20 floors=154.24*20
 Ground floor cost =3084.83Rs
 North block Cost = 12339.32Rs
 Floor lights =6*40 Watts
 =240 Watts
 =0.24unit*6.35Rs*7d
 =10.668 W-H
 Total Cost =12339.32+10.668
 =12349.988 Rs.

VII.PROPOSING SYSTEM:

In existing system fans and lights are taking over power. Instead of using 70 Watts fan we change ES-40 Watts fan. Instead of using 40 Watts tube light we change 18 Watts LED tube light. Through that we achieve the energy saving.

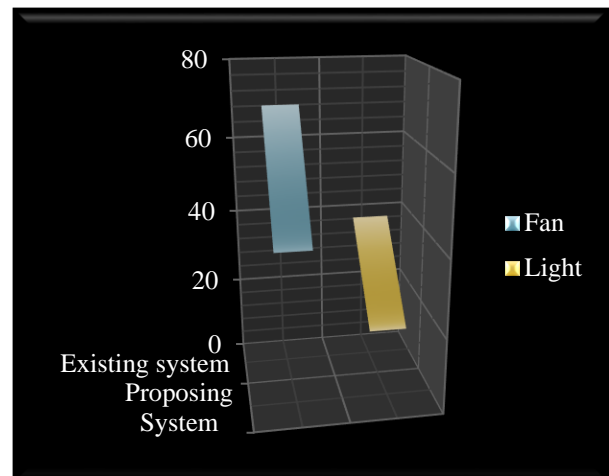


Fig. 5 comparison of equipment

Calculation for proposing system:

Fan =40 Watts*16 hrs =640 w-h
 Tube Light =18 Watts*10 hrs =180 w-h
 CFL =11 Watts*5 hrs =55 w-h
 Iron Box =750 watts*2 hrs =1500 w-h
 Mobile Charger=15 Watts*3hrs =135 w-h
 Laptop Charger=90 Watts*2 hrs =180 w-h
 Total =2690 w-h
 Total Unit=2.69 units
 One unit utilization cost is=6.35 Rs
 Cost of one day for single room=2.69*6.35
 =17.08 Rs.

WE SAVE 4.44Rs IN EACH DAY.
 WE SAVE 32.64Rs IN EACH WEEK.
 WE SAVE 130.56Rs IN EACH MONTH.

IX.COST COMPARISION:

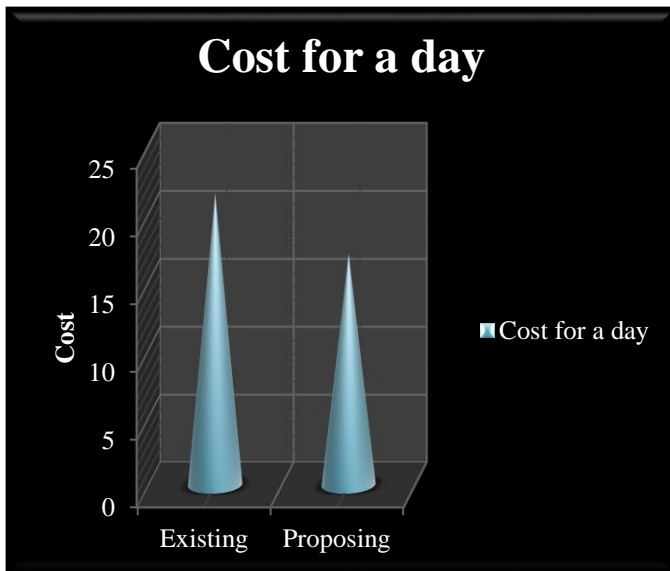


Fig. 6. Cost for a day

CALCULATION FOR LIGHT SYSTEM:

40 Watts tube light energy in a day =40*10
 =320W-H
 18Watts tube light energy in a day =18*10
 =144W-H
 Saved energy =400-180
 =220 W-H
 Working hour in a day (approx) =8HRS
 IF WE APPLY THIS TYPE OF LED TUBE LIGHT MEANS,
 220watt-hour*323(10hrs) =71060 W-H
 One unit =1000 W-H
 One unit cost =6.35Rs
 LED Tube light cost = 448 Rs
 =70.55*6.35
 =448 RS

323 DAYS ENOUGH TO TAKE THE PAYBACK AMOUNT
 AFTER 323 DAYS WE SAVE 1.397Rs EACH DAY THROUGH CHANGING LIGHT SYSTEM.

By changing a Fan system we achieve high cost saving.

X.CONCLUSION

A famous quote “Energy saved is Energy generated”. This shows that apart from increasing the generation capacity at higher cost, one must go for the energy audit to save the electricity at much lower cost. Energy audit is a successful tool in identifying energy problems. By means of energy auditing the high power consuming equipments are identified and the sources of power loss can be detected. It identifies the poor quality equipment or the old equipment which causes energy losses. These problems can be limited by energy auditing and by means of this the energy bill can be reduced. By performing the cost-base analysis the energy consumption is analyzed effectively. Lighting loads in the institutions are considered as case studies and its reports before and after conducting energy audit are presented.

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