International Journal of Electrical Electronics & Computer Science Engineering
Volume 4, Issue 1 (February, 2017) | E-ISSN : 2348-2273 | P-ISSN : 2454-1222
Available Online at www.ijeecse.com

A Novel Case Study on Energy Management

U P Kumar Chaturvedula[1], D Tata Rao[2]
Associate Professor, EEE Department, Aditya College of Engineering, Surampalem, Andhra Pradesh, India
[1]contactchaturvedula@gmail.com, [2]donepudi10@gmail.com

Abstract*: *The management of M/s Sarojini Academy, Surampalem, understood the importance of energy audit by making a sincere attempt to conserve energy consumed in a day, week and month. In this regard, we intend to conduct the energy audit to estimate the energy consumed in a day, week and month. The prime energy consumption and wastage are identified in the areas of Canteen, all Departments and Central Facilities of 5 colleges .Energy audit is done by both ways i.e., walk-through energy Audit and Detailed analysis. The corresponding data is collected and cost-effective measures are recommended for improving the energy efficiency. The costs are estimated and implemented and payback periods for each recommended action have been made. The results & vital information generated through these activities are documented. The Energy Auditing for a month is the index of the consumption which normalizes the situation of Energy crisis by providing the conservation schemes.

Keywords*: *Energy audit, Energy Consumption, Energy management, Estimation, Energy conservation, Energy efficiency.

I. INTRODUCTION

An energy audit is a study of a plant or facility to determine how and where energy is used and to identify methods for energy savings. There is now a universal recognition of the fact that new technologies and much greater use of some that already exist provide the most hopeful prospects for the future. The opportunities lie in the use of existing renewable energy technologies, greater efforts at energy efficiency and the dissemination of these technologies and options.

Energy auditing is done in M/S Sarojini Educational Society to determine the energy efficiency of the Educational Society with respect to energy performance and willingness to improve it. This energy audit is focused at various end usage of energy consumption activities and identifying, enumerating and evaluating the possible energy savings opportunities:

A. Energy auditing survey of Educational Society:
There are five institutions are running under the Educational Society: Two Engineering colleges and three Polytechnic colleges.

B. The total electrical loads were demarcated for each college based on the end use as lighting, fans, air conditioning, Computer/printers, Xerox machines, laboratory equipment and Laptop/cell charging etc.

The literature reviews for this project is done by studying various papers related to the Energy Audit available in the IEEE archives were studied. Most of the papers related to such studies made in different industries like, mechanical and heavy engineering. Energy auditing has been conducted at the Technical Institute Campus. In this paper the Energy Auditing has been dealt as the index of the consumption which normalizes the situation of Energy crisis by providing the conservation schemes. This has been done to minimize the unwanted power shutdown either incidentally or by load shedding. Here author has defined Energy auditing is one of the tools through which balancing of demand and supply is determined. The recommendations reduce around 15-20% of the energy and 25-30% of cost reduction.

II. PROBLEM FORMULATION

The total Electricity bill for the year 2015 is ₹ 979613.9 and power consumption for this year is 54471 kWh. Subsequently, the institution is planning to start skill development center for civil engineering and the mechanical engineering in 2016-17. These labs with heavy machines are being installed in the year 2017. The total energy taken from EPDCL will be insufficient for further usage including mechanical and civil departments. In order to manage the power requirements, there is an absolute necessity to save the energy consumption. In order to achieve the required savings in power the different steps need to be taken. The details of all the components and factors involved need to examine.

The main objective is to investigate the energy consumption of full campus by energy auditing. In the paper equipment wise analysis has been performed in order to identify the electrical equipment within the same application area, which consume more power as compared to others. During equipment wise analysis of the overall campus, the equipment with power consumption less than 1% of total power consumption of the campus were ignored so as to make the analysis results simple and easy to observe. This energy audit has a significance due to the fact that the electricity bill of M/s Sarojini Educational Society had crossed Rs.97.9 lakh during 2015 financial year. It was aimed at obtaining a detailed data about the various end use energy consumption activities and identifying, enumerating and evaluating the possible energy savings opportunities. The target is to achieve savings in the electrical energy consumption to the extent of 20% to 60%. The audit was also aimed at to learn or to get a feel of the practical problems and difficulties in carrying out energy audits.

III. ADOPTED METHODOLOGY

The adopted methodological process for this audit comprises of three steps:

*Data Collection***:** In preliminary phase data is collected, exhaustively using different methods such as observation, interviewing key persons, and measurements.

Following steps were taken for data collection:

- Visited each department, laboratories, library, canteen, seminar halls and other entities of each institution.
- Information about the general electrical appliances was collected by observation and interviewing.
- The Electricity distribution and site drawing is obtained.
- The Electricity bill for monthly consumption of electricity is collected 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 considered at places with lack of information.

Detailed Analysis: The data collected was analysed for energy consumption per month in kWh and is calculated based on each department and block-wise. The analysis of data is done in following way:

- Evaluation of collected data department wise analysis, block wise analysis and location wise analysis.
- Reasons for the difference in 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. This paper presents a case study of M/S Sarojini Educational Society.

IV. EXISTING UITLITIES OF M/S SAROJINI

The energy consumed by the utilities of each institute are calculated from the following data:

a) Avg. Consumption Per Day:

Tube light: Class room- 4hrs, Admin – 9 hrs & Staff room- 7hrs

Fan: Class room/Lab - 6 hrs, Admin – 9 hrs & Staff room- 7hrs

AC: 5 hrs in summer

CPU: Lab – 5 hrs, Admin – 8 hrs & Staff room- 7hrs

Monitor: Lab – 5 hrs, Admin – 8 hrs & Staff room- 7hrs

Xerox (Commercial):2hrs- exams period, Stand by: 6hrs

Printer: 2hrs - 40W, stand by 6hrs: 5w

LCD TV (50"): 7hrs

WIFI router: 24hrs

Refrigerators: 24hrs

Laptop charging (avg.): 4hrs

Cordless Phone: 24 hrs

Coffee/Tea maker: working-2hrs, stand by – 5hrs

Cell phone charging (Avg.): 3 hrs

UPS: 24 hrs

Street lights: 10 hrs

Centrifugal (Overhead pump) motor: 3hrs

Building lighting: 8hrs

Garden Trimmer: 5hrs.

B) Average Wattage Assumed as Follows:

Tube: 40W

Fan: 80W

AC: 1785W

CPU: 60W, Stand by: 12w

Monitor: 40W, Stand by: 5W

Xerox (Commercial): 400W, Stand by: 50w

Printer: 40W, stand by: 5w

LCD TV (50"):150W

WIFI router: 6w

Refrigerators: 180w

Laptop: 15w

Card less Phone: 3w

Coffee/Tea maker: 450w

Cell phone: 3w

UPS: 22w

V. ENERGY CONSUMED BY COMMON LOAD

The commonly available load in the educational society are tabulated in the table given below:

International Journal of Electrical Electronics & Computer Science Engineering
Volume 4, Issue 1 (February, 2017) | E-ISSN : 2348-2273 | P-ISSN : 2454-1222
Available Online at www.ijeecse.com

Table 5.1. Energy Consumed by Common Load

Load Description	Energy Consumed in Watt Hrs	Consumed in kWh
Street lights:72	12x72x10	8.640
CF Motor: 12	746x12x3	26.856
Building lighting: 70	70x20x8	11.200
Garden Trimmer: 6	375x6x4	9.0
AC:15	(6x1270x9)+ (9x1785x6)	68.580 & 4.260 (Avg/Day)
Refrigerator:8	8x180x24	34.560
Miscellaneous	25000 wh	25

Total 48902.73 Kwh load consumed is continuous for throughout month on average.

The major consumable load , average energy consumption by each institute are depicted and tabulated below :

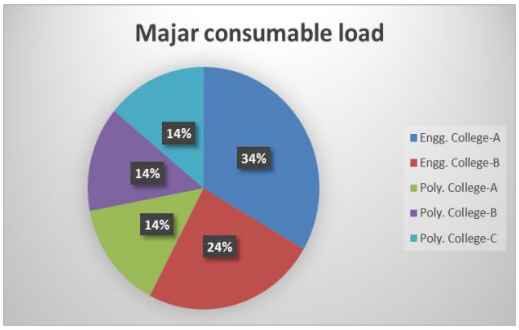

Fig 5.1: Major Consumable Load

The average Energy consumption per month of each institute is calculated and the energy bill of each institute can be estimated .A table is formulated to understand the energy consumption of each institute in Sarojini Education Society.

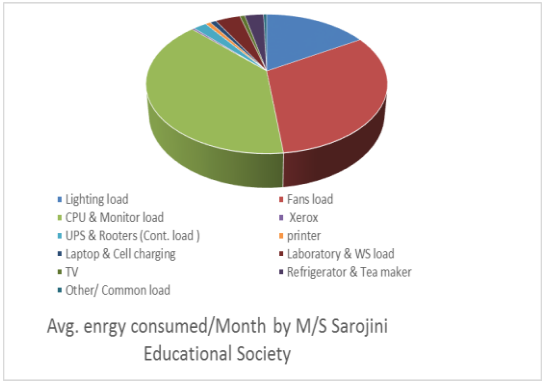

Fig 5.2: Average Energy Consumed per Month

Table 5.2: Average Energy Consumption in kWh/ Month

End user	Average Energy Consumed in a Day	Avg. Energy Consumed in a Month (on Avg. 23.9166 Days/Month)
Engg. College-A	661.129	15811.95784
Engg. College-B	517.264	12371.19618
Poly. College-A	304.007	7270.813816
Poly. College-B	278.857	6669.311326
Poly. College-C	283.462	6779.447269
Total	204.4719	

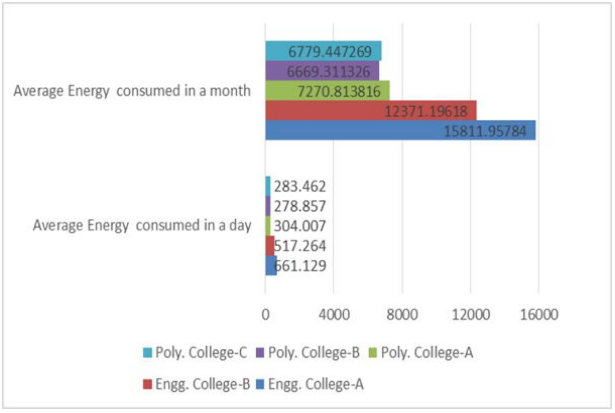

Fig5.3: Average Energy Consumed by Each Institute in Kwh Month/Day

VI. RECOMMENDATIONS

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.

- The present 0.5 H.P and 1 H.P motors can be replaced with energy efficient fractional H.P motors

The recommendations are formulated in the given table 6.1.

Table 6.1. Recommended Measures

Recommended Measure	Energy Saving/ Year in kWh	Savings in Rs. /Year	Capital Investment in Rs.	Pay-Back Period (Years)
Replacing conventional choke of all FTL's by Electronic choke.	1209.6	10886.4	26,250	3.8
Use of motion sensors in corridors and toilets	1168	10512	1500	0.22
Avoiding Using Xerox Machine In The Sleepy Mode when not in use	57.6	328.32	Nill	Nil
Replacing all FTL's by LED lights of equal similarities	2563.2	23068.8	53400	3.67
Replacing all Laser Printers by Ink-jet Printers	2695.68	24261.12	88,912	5.78
Replacing CRT monitors of PC's with LCD monitors	2741.76	22245.84	72,000	4.6
	10435.84	90974.16	2,42,062	

Implementation of all the above measures can bring about a total saving of around ₹ 90974.16 per year that is 26.6 % of the present electricity bill. The total investment is ₹ 242,062 for various appliances. The pay-back period for each appliance varies.

VII. CONCLUSION

Energy audit is an effective tool in identifying a comprehensive energy management program. An audit will give the organization a plan with which it can effectively manage the energy systems at minimum energy cost.

In this paper, a detailed study has been made to reduce the electrical energy consumption in the complete campus of M/s Sarojini Educational Society. It highlights the amount of energy savings that can be obtained in every educational Institution, thereby considerable reduction in energy crisis.

The Following facts have emerged after the detailed energy auditing of M/s Sarojini Educational Society.

1. Energy saving per year is 10435.84 kWh
2. Total Cost reduction per year is INR 90974.16.
3. Pay-back Period of various appliances.

The Proposed paper gives strong warning to the Society not only in terms of the energy bills, but also the energy crisis in the near future. By implementing the suggestions there will be a reduction of around 40.33 % of the energy and 32.4 % of costs. The total investment required for implementing the recommendations would be to the extent of ₹ 2, 42,062 .The Payback period for various appliances have also been calculated. Energy Auditing is a continuous process and organizations should carryout auditing periodically.

VIII. REFERENCES

[1] Bureau of Energy Efficiency, India

[2] Barney L Capehar and Mark B. Spillter "Energy Auditing".

[3] Dr. K. Umesha "Energy Audit Report on a Technical Institute", (IOSR-JEEE) ISSN: 2278-1676 Volume 4, Issue 1 (Jan. - Feb. 2013), PP 23-37.

[4] Energy conversion guide for industry & Commerce, hand book & supplement.

[5] Hersey, Paul and Kenneth "Management of organizational behavior" 1970.

[6] International Journal of Government Auditing.

[7]Instruction for energy auditor, Vol I & II U.S. Dept. of Energy, Sept 1978.

[8] W. C. Turner, Energy Management Handbook, Wiley, New York, 1982

[9] William H. Mashburan, P.E., CEM "Effective Energy Management".