ENERGY COST SAVING POTENTIAL IN EDUCATIONAL BUILDINGS - A CASE STUDY OF MIET CAMPUS

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Abstract: **This paper is the result of the energy audit conducted in Meerut Institute of Engineering And Technology (MIET) as a part of the final year project report. This energy audit will help in finding all the possible areas where energy is wasting and have a high consumption rate than usual. The result of this report shows that how and where the extra energy can be saved in MIET campus .This paper will help the institution in saving a lot of money in the form of electricity bills and help in saving the environment by saving energy and also identify all the possible aspects and points in the institution which will come in consideration so that the waste energy flow can be minimized and also the energy efficient equipments will help the process in making more energy efficient way then before. The proposed methodology will be very beneficial for the institution and by implementing it , the will provide a long term profit to the institution as it may have some high initial cost but will save a lot of energy for years and help the institution in saving cost and this initial investment will recover very in a year.**

Keywords: **Energy audit process, Measurement of energy, college buildings, cost saving, energy saving.**

1. INTRODUCTION

Energy Audit process is a survey that is conducted to save energy it has two parts in implementation the first is a normal visit to the campus and finding out the problems of excess losses in the campus and the second step is the detailed study of the campus with facts and complete analyses. This consist of applying the different methods and using various devices to find out the patterns of energy losses in the buildings.

Energy audit is a process in which a survey, a general walk, a proper study and inspection is done to find out the different ways in which the energy flow can be find out in the building and then to find out the different measures and way to make the loss minimum

As the act of 2001 describes that the verification, analyses and using the energy is define as the energy audit principal and it will help in improvement and finding the different ways to reduce the excess energy demand and provide a cost benefit to the applicant implementing it. It will make a technical report having all the aspects mentioned and will provide a complete solution as a proposed methodology.

It will provide a systematic study and proper proposed steps in order to have a full energy efficient life. There are various concrete methods which help in the fast improvement in energy efficient in industrial buildings as well as in home. The first step is to find out the points in which the energy is wasting.

The objectives are as follows-

1. To reduce the cost of energy / waste without affecting the quality and production.

2. To minimise the various effects of environment.

To reduce the energy consumption is the primary and the main aim of energy audit. This will help in saving the money and also reduction of the units will take place. This helps in various management of energy at various points in the complete organisation.

2. ENERGY DATA COLLECTION

The data collection is the most time consuming step of energy audit as the applicant has to go to all the sections of building and perform a detailed survey in which the person has to make a complete report and note down every single instrument with its rating and its consumption.

The requirement or various instrument is needed to collect the data, the instrument should be very precise so that the accuracy of the calculations can be maintained.

A person having a complete knowledge of energy audit that is energy audit manager can perform these tasks because these tasks require a complete knowledge to be performed under guidance.

Phase I – Pre Audit Phase

Phase II - Audit Phase

Phase III - Post Audit Phase

PLAN OF ACTION	PURPOSE/RESULT
Phase 1 Pre Audit Phase • Plan & organise • Walk through audit • Informal interview with energy manager, production/ plant manager • Conductor of brief meeting/awareness programme with all divisional heads & persons concerned (2-3 hrs)	• Resource planning establish/organize a energy audit team • Organize instrument & time frame • Familiarization of process/plant activities • First hand observation &assessment of current level operation & practices • Building up cooperation • Issue questionnaire for each department • Orientation, awareness creation

Phase 2 Audit phase
 	
• Primary data gathering, process flow diagram & energy utility diagram
 	
• Conduct survey & monitoring
 	
• Conduct of detailed trials/experiments for selected energy guzzlers
 	
• Analysis of energy use
 	
• Identification & development of energy
	• Historic data analysis, baseline data collection
	• Prepare process flow charts
	• All service utilities system diagram (Example single line power distribution diagram, water, compressed air & steam distribution).
	• Measurement: motor survey, insulation, & lighting survey with portable instruments for collection of more & accurate data.
	Trials/Experiments:
	  - 24 hrs power monitoring (MD, PF, KWh etc.)
	  - Load variations trends in pumps, fan.
	• Energy & material balance & energy loss/waste analysis
	• Identification & consolidation ENCON measures
	  - Conceive, develop, & refine ideas

conservation (ENCON) opportunities • Cost benefit analysis • Reporting & presentation to the top management	• Assess technical feasibility, economic viability & prioritization of ENCON option for implementation • Select the most promising projects • Documentation, report presentation to the top management

Phase 3 Post Audit Phase
 	
• Implementation & fallow –up
	• Assist & implement ENCON recommendation measure & monitor the performance
	   - Action plan, schedule for implementation
	   - Follow- up & periodic review

3. SURVEY REPORT

3.1 J.R.D. Tata Block (Department of Mechanical Engineering)

3.2 Khorana Block (B.Sc. Department)

3.3 Azim Premji Block

    3. 3.1 Dept. of Computer Science &Engineering

    3.3.2 Dept. of Information Technology

    3.3.3 Dept. of Electronics & Communication

3.4 Visvesvaraya Block (Dept. of Civil Engineering)

3.5 Raman Block (Dept. of First Year Students)

3.6 Schroff Block (Dept. of Master of Computer Applications)

3.7 Chandra SenAggarwal Block

    3.7.1 Dept. of Electrical Engineering

    3.7.2 Dept. of Biotechnology

    3.7.3 Dept. of Chemical Engineering

    3.7.4 Dept. of Master of Business Applications

4. PROPOSED METHODOLOGY

It is proposed that:

• Tube lights can be replaced by LED's. Amount of money saved per day when replacing whole Tube lights on the Campus by LED's = amount generated by Tubes(per day) – amount generated by LED's(per day)

= (Total number of Tube lights * Power consumed in one hour * Price of one unit * Number of hours used) / 1000 – (Total number of LED's * Power consumed in one hour * Price of one unit * Number of hours used) / 1000

= (1103 * 36 * 4.34 * 8) / 1000 – (1103 * 20 * 4.34 * 8) / 1000

= Rs 1378.66 – Rs 765.92

= Rs 612.74 (per day)

• Water cooler operating switch can be replaced by solar operating switch. Amount of money save per day when replacement of water cooler switching system with solar power switching system= amount generated by water cooler operating switch(per day) – amount generated by water cooler solar operating switch(per day)

= (Total number of Water Coolers * Power consumed in one hour * Price of one unit * Number of hours used) / 1000 – (Total number of Efficient Water Coolers * Power consumed in one hour * Price of one unit * Number of hours used) / 1000

= (27 * 200 * 4.34 * 8) / 1000 – (27 * 120 * 4.34 * 8) / 1000

= Rs 187.5 – Rs 112.5

= Rs 75 (per day)

- Desktop LCD Monitors can be replaced by Laptops. Amount of money save per day replacing the LCD screens with the laptops having led screens

= amount generated by monitor having LCD display (per day) – amount generated by Laptop (per day)

= (Total number of LCD Monitors * Power consumed in one hour * Price of one unit * Number of hours used) / 1000 – (Total number of Laptops * Power consumed in one hour * Price of one unit * Number of hours used) / 1000

= (1474 * 90 * 4.34 * 8) / 1000 – (1474 * 50 * 4.34 * 8) / 1000

= Rs 4605.95 – Rs 2558.86

= Rs 2047.09 (per day)

- System's setting should be changed to avoid them run in Sleepy Mode. Amount of money save per day when systems are Avoid to run in Sleepy Mode

= (Total number of Systems used * Power saved in one hour * Price of one unit * Number of hours used) / 1000

= (1474 * 5 * 4.34 * 8) / 1000

= Rs 255.88 (per day)

- Photocopy/Xerox must machines should not be allowed to run in Sleep Mode. Amount of money save per day when Photocopy/Xerox machine are Avoid to run in Sleepy Mode

= (Total number of Machines used * Power saved in one hour * Price of one unit * Number of hours used) / 1000

= (1 * 407 * 4.34 * 8) / 1000

= Rs 14.13 (per day)

5. CALCULATIONS

- Amount of money save per day when Replacement of old tube of college campus by LED= amount generated by Tubes(per day) – amount generated by LED's(per day)

= (Total number of Tube lights * Power consumed in one hour * Price of one unit * Number of hours used) / 1000 – (Total number of LED's * Power consumed in one hour * Price of one unit * Number of hours used) / 1000

= (1103 * 36 * 4.34 * 8) / 1000 – (1103 * 20 * 4.34 * 8) / 1000

= Rs 1378.66 – Rs 765.92

= Rs 612.74 (per day)

Amount of money save in a month = Rs 612.74 * 30

= Rs 18382.2

Amount of money save in a year = Rs 18382.2 * 12

= Rs2, 20,586.4

- Amount of money save per day when Replacement of water cooler switching system with the solar system of switching= amount generated by water cooler operating switch(per day) – amount generated by water cooler solar operating switch(per day)

= (Total number of Water Coolers * Power consumed in one hour * Price of one unit * Number of hours used) / 1000 – (Total number of Efficient Water Coolers * Power consumed in one hour * Price of one unit * Number of hours used) / 1000

= (27 * 200 * 4.34 * 8) / 1000 – (27 * 120 * 4.34 * 8) / 1000

= Rs 187.5 – Rs 112.5

= Rs 75 (per day)

Amount of money save in a month = Rs 75 * 30

= Rs 2,250

Amount of money save in a year = Rs 2250 * 12

= Rs 27,000

• Amount of money save per day when Replacement of old screen of desktop with the laptop= amount generated by LCD display Monitor(per day) – amount generated by Laptop(per day)

= (Total number of LCD Monitors * Power consumed in one hour * Price of one unit * Number of hours used) / 1000 – (Total number of Laptops * Power consumed in one hour * Price of one unit * Number of hours used) / 1000

= (1474 * 90 * 4.34 * 8) / 1000 – (1474 * 50 * 4.34 * 8) / 1000

= Rs 4605.95 – Rs 2558.86

= Rs 2047.09 (per day)

Amount of money save in a month = Rs 2047.09 * 30

= Rs 61,412.7

Amount of money save in a year = Rs 61,412.7 * 12

= Rs 7, 36, 952.4

• Amount of money save per day when systems are Avoid to run in Sleepy Mode

= (Total number of Systems used * Power saved in one hour * Price of one unit * Number of hours used) / 1000

= (1474 * 5 * 4.34 * 8) / 1000

= Rs 255.88 (per day)

Amount of money save in a month = Rs 255.88 * 30

= Rs 7, 676.4

Amount of money save in a year = Rs 7, 676.4 * 12

= Rs 92, 116.8

• Amount of money save per day when Photocopy/Xerox machine are avoid to run in Sleepy Mode

= (Total number of Machines used * Power saved in one hour * Price of one unit * Number of hours used) / 1000

= (1 * 407 * 4.34 * 8) / 1000

= Rs 14.13 (per day)

Amount of money save in a month = Rs 14.13 * 30

= Rs 423.9

Amount of money save in a year = Rs 423.9 * 12

= Rs 5, 086.8

Therefore, we save a total amount **Rs 10,81,742.4**in a year if we replaced the equipment's according to the proposed methodology.

6. SUMMARY AND CONCLUSION

6.1 Summary

We have carried out the project for Detailed Energy Audit during the session 2019 - 2020. We found this project to be very challenging and also very interesting. These steps suggested by us in the recommendations will contribute to a great extent for Energy Efficiency. We have carried out very elaborate measurements for various Operating-Parameters, related to Energy efficiency, covering each area. We have studied all the common areas under the control of the Management.

6.2 Conclusion

The project will help in saving a lot of money of MIET College in the form of electricity bill and also help in saving a lot of energy and also help the environment from degradation. The project has looked in all the forms and factors that could have caused energy wastage and help in saving Rs10,81,742.4. There is always scope of saving energy as it also help in saving the environment and it also save a large amount of money in the form of bill. It will help the institution in become energy efficient if every aspect by implementing the suggestions we have provided in our survey and report, the 5stars rating of the equipment's make them energy efficient and better for use and make less area of complain.

REFERENCES

[1] J. Zhang, Y. Zhang, S. Chen, and S. Gong, "How to reduce energy consumption by energy audits and energy management: The case of province Jilin in China," in *2011 Proceedings of PICMET '11: Technology Management in the Energy Smart World (PICMET)*,2011, pp. 1-5.

[2] J. Gomes, D. Coelho, and M. Valdez, "Energy audit in a school building technology, professional and Artistic School of Pombal," in *Proceedings of the 2011 3rdInternational Youth Conference on Energetics (IYCE)*,2011, pp. 1-6.

[3] M. Stamenić, G. Jankes, N. Tanasić, M. Trninić, and T. Simonović, "Energy audit as a tool for improving overal energy efficiency in Serbian industrial sector," in *20122nd International Symposium On Environment Friendly Energies And Applications*, 2012, pp. 118-122.

[4] H. Singh, M. Seera, and M. A. M. Idin, "Electrical energy audit in a Malaysian university - a case study," in *2012 IEEE International Conference on Power and Energy (PECon)*, 2012, pp. 616-619

[5] B. L. Capehart, W. C. Turner, and W. J. Kennedy, "Guide to Energy Management," Seventh ed. 700 Indian Trail, USA: The Fairmont Press, Inc., 2012, p. 651.

[6] *Success Stories in Building Energy Efficiency*. Available:http://ccap.org/assets/Success-Stories-in-Building-Energy-Efficiency_CCAP.pdf

[7] [Last Access: 30 May2017]

[8] *Energy and Buildings-Renewable Energies and EnergyEfficiency*. Available:https://ec.europa.eu/jrc/sites/jrcsh/files/energy_and_build ings_en.pdf [Last Access: 30 May 2017]

[9] Y. Allab, M. Pellegrino, X. Guo, E. Nefzaoui, and A. Kindinis, "Energy and comfort assessment in educational building: Case study in a French university campus," *Energy and Buildings,* vol. 143, pp. 202-219, 5/15/ 2017.

[10] J. e.Wafula, "Evaluating energy efficiency in building control regulations in local authorities in south africa," MSc Master's, Faculty of Engineering and The Built Environment,, University of the Witwatersrand, Johannesburg, South Africa, 2012.

[11] B. P. Numbi and S. J. Malinga, "Optimal energy cost and economic analysis of a residential grid-interactive solar PV system- case of eThekwini municipality in South Africa," *Applied Energy,* vol. 186, Part 1, pp. 28-45, 1/15/ 2017.