International Journal of Science, Environment and Technology, Vol. 5, No 1, 2016, 204 – 212

ISSN 2278-3687 (O)
2277-663X (P)

ENERGY AUDIT FOR CHENGALPATTU MEDICAL COLLEGE HOSPITAL BUILDINGS

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Abstract: The ever-increasing energy prices, acute energy shortage, forever widening and supply gap, efficiency and conservation measure have gained importance in the recent years. Hospital buildings are using huge energy and the energy saving possibilities is expected to be substantial. This project involved an energy auditing with view to enhance the existing energy efficiency level in the Chengalpattu Medical College Hospital (CMCH), Chengalpattu. Energy Auditing is a systematic study of existing energy consumption pattern and to suggest suitable measures for improving energy efficiency. During the energy audit, a complete survey of power consumption in the Chengalpattu Medical College Hospital (CMCH) was carried out. Audit was conducted for Lighting, Fans, Air Conditioners, Computers, Medical Laboratory Equipments, DG Sets, Motors and their power consumption pattern was determined. Energy conservation measures were suggested for minimizing the power consumption in the CMCH Campus. By implementing the measures, there exists not only scope to save power and money but also conserves our Environment. Implementation of the measures suggested would mitigate about 1,11,565 kg of Carbon dioxide emissions, annually in the region. There is a wide scope to conserve energy and environment by conducting energy audit. When this kind of energy audit is conducted all over India, we can imagine the amount of money that can be saved and decreased environmental damage. Thus energy conserved is energy produced.

I. INTRODUCTION

1.1 GENERAL

Hospital buildings are large energy consumers in many countries. In order to evaluate energy saving possibilities in such facilities an energy audit was conducted in a typical Hospital campus. The audit objective was to provide background for similar applications in all Hospital facilities.

The ever-increasing energy costs and environmental concerns make paramount the rational use of energy and the energy conservation acts. Attention must be paid both in the industry and the building sectors. The last has attracted considerable interest in large scale, country wide, and in small scale, for example residential, commercial and hospital buildings.

*Received Jan 16, 2016 * Published Feb 2, 2016 * www.ijset.net*

Governmental and generally state-owned buildings, especially the old ones are good for conducting energy audits and proposing energy conservation opportunities. Government officials accept easily the idea of audit and collaborate with auditors. Hospital buildings are using huge energy and the energy saving possibilities is expected to be substantial. Many of them are old and present similarities in the building construction and in the other facilities and services because they follow common building codes and practices. Based on the above considerations, an energy audit was carried out in a typical Hospital campus. The audit implementation mode and recommendations may serve as a guide for audits in Hospital campuses country-wise and/or to form a basis for estimations of energy saving investment possibilities in the Hospital sector.

1.2 NEED FOR ENERGY AUDIT

In any building, the three top operating expenses are often found to be energy (both electrical and thermal), labour and materials. If one were to 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 a strategic area for cost reduction. Energy Audit will help to understand more about the ways energy and fuel are used in any building, and help in identifying the areas 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 programme will help to keep focus on variations 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.

The primary objective of Energy Audit is to determine ways to reduce energy consumption per unit of product output or to lower operating costs. Energy Audit provides a “Bench-mark” (Reference point) for managing energy in the building and also provides the basis for planning a more effective use of energy throughout the Campus.

1.3 NEED FOR THE PRESENT STUDY

Chengalpattu Medical College Hospital was commissioned from 1965 before that it was a District Head Quarters Hospital. In 1965 Tamilnadu Government upgraded as a teaching institution with 250 beds clinical training.

This 44-year old institution has included Medicine, Surgery, O&G, Pediatrics, Orthopedics, Ophthalmology, ENT, Psychiatry and Chest Clinic with the super specialty functioning are

Neurology, Cardiology, Nephrology, Pediatric Surgery, Plastic Surgery, Urology, Neuro Surgery, etc., The number of beds which was 250 then has been increased to 600 now with nearly 28 numbers of individual buildings about an area of 1,80,000 SFT.

The use of energy use in hospital buildings has increased in recent years due to the growing demand. Without energy the hospital buildings could not be operated or inhabited.

The eleventh five-year plan aims to conserve 10,000 MW of power, through various energy efficient technologies. The hospitals in India spend Rs 1,000 crore every year to meet their energy demands. This is expected to double in the next three years.

Improvements have been made in insulation, plant, lighting and controls and these are significant features that help towards achieving an energy efficient hospital building.

1.4 OBJECTIVE OF ENERGY AUDIT IN THIS HOSPITAL BUILDING:

The Objectives of the study are to:

- Develop a suitable tool for energy audit for the Chengalpattu Medical College Hospital (CMCH)
- Review the energy related activities in CMCH
- Measurement and quantification of energy consumption by all utility areas at CMCH
- Identify areas of energy wastage at CMCH
- Establishing of energy balance
- Identification of energy improvements opportunities
- Development of energy managements proposals
- Preparation of standard operating practices for efficient use of energy at CMCH
- Create energy conservation awareness among the end users

1.5 SCOPE OF WORK

- Planning
- Basic data collection
- Measurements and equipment tests
- Data analysis
- No cost/low cost recommendations
- Capital investments
- Action plan formulation

Energy is used in various forms in these hotels, the main being electricity, the others being LPG, other gases, diesel, petrol for the commutation of the employees and for the customers for their travel that is included in the package. Thus all these sources of energy

must be quantified and their carbon footprint equivalent is calculated which will provide a baseline information for reducing the footprint thus the energy efficiency measures can be applied and paving way for environmental sustainability.

II. METHODOLOGY

2.1 NINE STEPS METHODOLOGY FOR DETAILED ENERGY AUDIT:

STEP NO	PLAN OF ACTION	PURPOSE / RESULTS
Step 1	• Plan and organize • Walk through Audit •Informal Interview with Electrical Engineer (PWD) Maintenance	•Resource planning, Establish a Energy audit proposal •Organize Instruments & time frame •Macro Data collection (suitable to this Hospital) •Familiarization of process activities •First hand observation & Assessment of current level operation and practices
Step 2	•Conduct of brief meeting / awareness program with all Head of the departments and persons concerned.	•Building up cooperation •Issue questionnaire for each department •Orientation, awareness creation
Step 3	•Primary data gathering, Process Flow Diagram, & Energy Utility Diagram	•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.) • Design, operating data and schedule of operation • Annual Energy Bill and energy consumption pattern (Refer manual, log sheet, name plate, interview)
Step 4	•Conduct survey and monitoring	• Measurements: Insulation and Lighting survey with portable instruments for collection of more and accurate data.
Step 5	•Analysis of energy use	•Energy and Material balance & energy loss/waste analysis
Step 6	•Identification and development of Energy Conservation (EC) opportunities	•Identification and Consolidation of EC measures •Conceive, develop, and refine ideas •Review the previous ideas suggested by unit personal •Review the previous ideas suggested by energy audit if any •Use brainstorming and value analysis techniques •Contact vendors for new/efficient technology

Step 7	• Cost benefit analysis	• Assess technical feasibility, economic viability and prioritization of EC options for implementation • Priorities' by low, medium, long term measures
Step 8	• Reporting & Presentation	•Documentation, Report Presentation.
Step 9	•Implementation and Follow-up	•Assist and Implement EC recommendation measures and Monitor the performance •Action plan, Schedule for implementation •Follow-up and periodic review

2.2 SYSTEMS FOR STUDY

2.2.1 Lighting Systems

• Measurement of light

• Efficiency / light color

• Lamp lumen depreciation

• Lamp types and characteristics

• Controls

• Energy management opportunities

2.2.2 Air Conditioning Systems

• HVAC basics / load estimating / efficiencies

• Components

• Chillers — electric, gas-driven, absorbers

• Piping arrangements

• Energy savings opportunities

2.2.3 Motors and Drives

• Types of motors and its

• Operating characteristics / efficiencies

• Variable frequency drives

• Energy management opportunities

• Circulating pumps

• Water heaters

• Energy management opportunities

• Energy accounting

2.2.4 Actions adopted in this audit:

- Visual inspection and data collection
- Observations on the general condition of the facility and equipment and quantification
- Identification / verification of energy consumption and other parameters by
- Measurements
- Detailed calculations, analyses and assumptions
- Validation
- Potential energy saving opportunities
- Implementation

2.2.5 Field work

- The mechanical and electrical systems are examined in order to verify that their implementation, operation and use correspond to that designed.
- The most essential factors affecting energy use, the present operating situation and the most important savings potential are investigated.
- The staff and occupants at the site are guided on matters related to energy use.
- The most obvious operational energy saving measures is carried out immediately
- Data collection forms are a helpful reminder while checking and writing results.

2.2.6 Detailed reporting

- Includes a comprehensive description of the Hospital Building
- The number of lights, fans, computers and air conditioners, their type and their hours of usage were noted down. The power consuming equipment in the laboratory were identified and listed.
- Details of the equipment like name of the equipment, hours of usage per day were collected and recorded.
- Data regarding the type of lights, fans, computers, and air conditioners, their numbers and hours of usage per day and their location were collected and listed out.
- Introduces all profitable energy saving measures in detail, including some comments on implementation, saving calculations, cost estimates
- Ranks the saving measures according to e.g. simple payback time

2.2.7 Analysis of data

- The data collected were analyzed to identify major energy consumers in energy consumption by all utilities at CMCH was measured and quantified. From the data, the monthly power consumption (kWh) by CMCH was determined.

2.3 ENERGY CONSERVATION MEASURES

Based on the data collected, low / no cost options were suggested for energy conservation at CMCH. The feasibility of commonly employed techniques of energy conservation. Energy consumption and costing were analyzed and energy saving potentials was estimated.

2.4 ENERGY SAVING CALCULATION

The present status of the energy consumption and the status after the implementation of the proposal were compared to determine the energy savings. Their difference gives energy savings in kWh. For one kWh of energy saved, it is saved to reduce 1.04 kg of carbon di-oxide emissions.

2.5 PAY BACK PERIOD CALCULATION

Pay back period is defined as the length of time it will take an investment to 'hat was put in. It is the period required to recover the original or initial cost of the capital project out of the cash inflow generated from the capital project. It is also called as the pay-off or cash recovery period. It is the ratio of the investment required and the savings achieved.

$$\text{Pay back period (in years)} = \frac{\text{Investment (Rs.)}}{\text{Savings (Rs.)}}$$

III RESULTS AND DISCUSSION

3.1 GENERAL

The purpose of conducting energy audit at Chengalpattu Medical College Hospital (CMCH) was to develop a database to determine the patterns and levels of current energy use and opportunities for cost-effectively reducing energy use within the context of performing the functions intended within CMCH.

3.2 ENERGY CONSUMPTION PATTERN OF CMCH

During the audit, the energy consumption pattern for lighting, fans, computers and air conditioners at various locations of Chengalpattu Medical College Hospital (CMCH) was studied for 30 days and standard deviation was computed for the operating hours.

Following table shows: Total energy consumed by Lighting, Fans, Computers, Air conditioners Equipments in the Medical Laboratory, DG Sets and power consumed by Motors per day at CMCH.

S. No	Instruments	Power Consumption / day (kWh)
1	Lighting	802.70
2	Fans	643.56
3	Computers	123.20
4	Air Conditioners	1602.00
5	Medical Laboratory	491.47
6	DG Sets	187.50
7	Motors	51.60
	Total	**3902.03**

3.3 DISCUSSION

Energy Conservation Measures (ECM) with investment and without investment have been suggested for possible energy savings. An energy saving potential of about Rs. 9,02,070 per year can be achieved by implementing the proposals.

The implementation would require a onetime investment of about Rs. 2,96,580 to reap the benefits. By implementing all the measures suggested, it is possible to mitigate about 1,11,565 kg of carbon dioxide emissions, annually in the region. The anticipated reduction in annual energy consumption at CMCH after implementing the Energy Conservation Measures is about 1,07,274 kWh per year.

List of Energy Conservation Measures suggested for CMCH

S. No	Energy Conservation Measures	Investment (Rs)	Annual Savings (Rs.)	Pay back period (Months)	Reduction in CO 2 emissions (kg)
l.	Replacement of the existing 40W Fluorescent Tube Lights with Energy Efficient 36W Fluorescent Tube Lights	Nill	155925	Nil	21600
2.	Installation of Inverters in Air Conditioners	218400	595350	33	82560
3.	Installation of high frequency Electronic Ballasts in place of Conventional Copper Chokes	51180	68750	108	7100
4.	Use of fans in Air Conditioned rooms	Nil	15120	Nil	1.25
5.	Switching off the computers during idle use	Nil	2125	Nil	295
6.	Installation of electronic regulators for ceiling fans	27000	64800	5	9
	Total	**2,96,580**	**9,02,070**	**146**	**1,11,565**

3.4 CONCLUSION

Each energy conservation measure should be given a top priority to achieve energy savings and each proposal should be assigned to specific operating or maintenance personnel for implementing and monitoring. All implemented proposals are to be monitored on a proposal by proposal basis for quantifying the actual achievement of savings obtained on a monthly basis. There exists wide scope to conserve energy and environment by conducting energy audit. By implementing the proposals suggested, the following economic and environmental benefits could be achieved:

- Reduction of power cost at Chengalpattu Medical College Hospital (CMCH) is Rs. 9,02,070/-
- Prevention of atmospheric emissions of carbon di oxide to the tune of about 1,11,565 kg per year.

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