

# Energy Audit and Energy Saving Measures for Conservation of Energy in Technical Institute

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## ABSTRACT

With increasing energy need, energy gap between Demand and Supply of energy gets widened. There is an acute need to take measures to fill this gap by energy saving and use of alternative energy sources. There is a loss and unjustified use of large amount of energy at the energy using site if proper monitoring and energy conservation measures are not implemented. Energy saving requires optimum use of energy, minimizing losses & avoiding excess use without compromising the quality of output and personnel's comfort. In this paper focus is on study of energy audit and energy saving measures for technical institute. There is a large potential for energy saving in technical institutes which can be analyzed by detailed energy Audit and can be achieved by implementing energy saving measures. In this paper energy audit methodology and energy conservation measures are presented which helps in energy conservation.

**Keywords:** Energy Conservation Opportunities, Feasible measures for energy saving, Types of load in institute.

## 1. INTRODUCTION

A successful energy management plan should initiate with energy accounting or energy audit in order to record and track the progress of energy efficiency program. Energy audit of a facility is done to find out energy losses and cost effective energy saving measures to reduce them. Thus we can say that Energy audit is a tool for conservation of energy. Energy audits are a powerful tool to save energy, reduce energy costs, and for higher performance. Energy audits can be done as a stand-alone effort but may be conducted as part of a larger analysis across a group of facilities. Energy audit is a collection and proper arrangement of data related to energy usage and analysis of this data to find out energy losses and wastage in process or apparatus by comparing the consumption with standard consumption data and suggests cost effective measures to reduce or eliminate losses. Besides designated costumers energy audit can also help building owners and industries to reduce their billing cost. For every unit of energy consumption environment suffers a loss in the form of pollution and reducing natural resources that is saving energy not only save money but also saves environment and energy sources. Energy audit provides data related to energy consumption, energy usage pattern, energy

demand trend of a building to find out energy conservation opportunities and measures to save energy. It is a essential part of cost cutting and energy saving process where large amount of energy is involved.

**1.1 Contents of an Energy Audit :** An energy audit seeks to document things that are sometimes ignored in the plant, such as the energy being used on site per year, which process use more energy, and the areas with opportunities for energy savings. In so doing, it assesses the effectiveness of management structure for controlling energy use and implementing changes. The energy audit report establishes the needs for plant metering and monitoring, enabling the plant manager to institutionalize the practice and hence, save money.

The energy audit action plan lists the steps and sets the preliminary budget for the energy management program.

### 1. Analysis of Energy Use

Identifying where energy is used is useful because it identifies which areas the audit should focus on and raises awareness of energy use and cost. The results of the analysis can be used in the review of management structures and

procedures for controlling energy use. Analysis of energy use can be done by installing sub meters in different plant locations to pinpoint actual energy usage per area. This is a good source data for allocating energy use. The energy manager can also list all equipment used and the corresponding operating hours. With this information, he can create spreadsheet information and generate charts useful for analysis.

**1.2 Types of Energy Audit:** Type of energy audit depends on facility or organization whose energy audit is to be done and depth to which audit is needed. It also depends on how much and to what extent energy loss, cost saving and energy saving opportunities is to be find out. In energy audit even those things are documented that are sometimes ignored such as the energy being used per year, which processes use more energy, and areas with opportunities of major savings. It also assesses the effectiveness of building design structure for controlling energy use and recommends changes in design if required. Energy audits typically take a whole building approach by examining the building envelope, building systems, operations and maintenance procedures, and building schedules. [2] Whole building audits provide the most accurate picture of energy savings opportunities. [2]

Alternately, energy audits can be targeted to specific systems (i.e., lighting or heating, ventilation and air conditioning). Targeted audits may miss significant bigger picture energy savings opportunities, but may be a good route if you have specific energy efficiency retrofit projects in mind and limited funds to invest. [2]

**1.3 Levels of Energy Audits:** The American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) define three levels of audits. Each audit level builds on the previous level. [2]

As audit complexity increases, so does thoroughness of the site assessment, the amount of data collected and the detail provided in the final audit report.

This effort can translate into higher energy savings.

Level I: Site Assessment or Preliminary Audits identify no-cost and low-cost energy saving opportunities, and a general view of potential capital improvements.[2] Activities include

an assessment of energy bills and a brief site inspection of building.

Level II: Energy Survey and Engineering Analysis Audits identify no-cost and low-cost opportunities, and also provide EEM recommendations in line with your financial plans and potential capital-intensive energy savings opportunities. Level II audits include an in-depth analysis of energy costs, energy usage and building characteristics and a more refined survey of how energy is used in building.[2]

Level III: Detailed Analysis of Capital-Intensive Modification Audits (sometimes referred to as an “investment grade” audit) provide solid recommendations and financial analysis for major capital investments. In addition to Level I and Level II activities, Level III audits include monitoring, data collection and engineering analysis.[2]

**1.4 Need of Energy Audit:** Energy Audit needs to be done to identify energy saving opportunities in a facility or areas with excess use of Energy or having loss of Energy in comparison with set up standards level. Energy audit is a useful tool for energy management. With the help of energy management energy can be used effectively and efficiently. Energy audit is a process or methodology to find out Power Consumption according to different areas and in various slots of time, Total Connected load, Maximum Demand, Power Factor, Load Factor and most importantly it proposes economic measures to save energy with detailed comparison of cost of energy saving and investment required in terms of payback period.

## 2. ENERGY AUDIT METHODOLOGY IN A TECHNICAL INSTITUTE (UIT-RGPV)

The audit consists of three distinct steps:

- *Preliminary data collection and evaluation*
- *Site visit or walkthrough*
- *Data collection*
- *Analysis and reporting.*

An estimate of the time for each step can be made. Allocating time for each step leads to a more comprehensive and useful audit.

In an energy audit following steps by step procedure is followed:-

The First step of energy audit is to determine which audit is appropriate for a facility, given the complexity of its systems and buildings. Then, information may be collected on the structural, electrical and mechanical components that affect building energy use and the operational characteristics of the facility. Much of this information can be collected prior to the site visit. Evaluating energy use and systems before going on-site helps identify potential savings and makes best use of time spent on-site. [6]

Therefore as a first step for energy audit in technical institute, Analysis of historical usage or billing history is done to determine energy trends and consumption of facility. Audit site is visited by walk through of building to find major energy intensive areas with scope of energy saving such as chillers, large air handling units (AHUs), or over-cooled spaces and lighting loads.

### 2.1 Second step -Audit Phase

In this phase data related to current energy usage is collected and analyzed. Important Points are considered while collecting site Load Data

- (1) Operating hours - This can be gathered from plant personnel. It is important to ensure the accuracy of this data because much of the potential for energy savings lies on correct estimation of the equipment's operating hours.
- (2) Duty cycle - Machines such as large electric motors have varying loads and hence, different power requirements.
- (3) Actual power consumed - For electric power users, this is based on either 3-phase current/voltage readings or power analyzer measurements (e.g., direct kW which incorporates power factor).

Reference to record of equipment ratings, technical catalogue, O&M manuals that are readily available in brochures or online is helpful to quickly determine whether equipment/systems are operating efficiently or not. Calculations and analysis of collected data is done to quantify

the saving achievable from implementation of the identified ECOs (Energy Conservation Opportunities) which is the most cost-effective & Identification of areas in establishment where energy is unnecessarily. In energy audit instruments such as Multi-Meters, Tong Tester, Power Analyzer and Lux Meter are used.

In Third step of Energy Audit energy consumption calculations, detailed and technical analysis of collected data, comparison of results with respective standards, finding of energy saving measures and financial analysis of proposed energy efficiency measures is done. The financial analysis allow us to truly understand the financial benefits of installing energy efficient measures. End use of energy is categorized for detailed and proper analysis. The report is made which outline the objectives and scope of audit, description of characteristics and operational conditions of equipment/systems audited, findings in the audit, energy conservation measures, corresponding savings and implementing costs.

**2.2 Energy saving measures:** ECMs given below are prove to be cost-effective and energy saving can be achieved by implementing them [5].

### 2.3 Building Envelope

- Install Storm Windows
- Install Replacement Windows
- Install Window Sun Shades
- Install Storm Doors
- Install/Increase Attic Insulation
- Install Roof Insulation
- Install Wall Insulation
- Control Air Leakage

### 2.4 Lighting

- Replace Incandescent Lighting with Compact Fluorescent Lamps in Dwelling Units.
- Replace Incandescent Lighting with Fluorescent Lighting in Common areas.

- Replace Standard Fluorescent Lamps with Energy-Saving Lamps and Install Electronic Ballasts in Common areas.
- Install Lighting Controls in Common Areas.
- Convert Exterior Lighting Fixtures.
- Install Photo-Controls for Exterior Lighting.
- Switch off lights when absent from your work area.
- Maximize the use of natural light and turn on lights only when there is inadequate lighting.

## 2.5 Air conditioning system

- Prefer split Air-conditioning system or inverter AC.
- Do not over cool- maintain ideal temperature 22°C to 24°C.
- Installation of energy saver for each AC
- Insulate wall & ceiling.
- Routine maintenance for air filters& cooling pins to make proper operation at regular interval.
- Use air curtains in front of door to avoid false air entry.
- Keep doors and windows closed in air-conditioned space, particularly doors leading to stairwells and external areas.
- Avoid Usage of Air-conditioners in the evening hours & favorable climate conditions.
- Use pedestal fan instead of air-conditioners during non laboratory hours.

## 2.6 Computer and Monitors

- Switch off monitors when absent for more than 30 minutes.
- Switch off computers and monitors at the end of the day.
- Do not use screen savers as this does not save energy. Set screensaver to blank screen.
- Adjust your power management settings to put your screen to sleep if it is not in use for more than five minutes.
- Online UPS – Battery Status Indication. It can be switched-off during non-use period. To minimize no-load power consumption.

- Advice on PC energy saving features like advanced LED monitor.
- Switch-off the Offline UPS. When the power failure is less. Improves life of SMF Batteries. Over charging will leads to bulging of batteries and leads to battery failure.

## 2.7 Xerox machines, Printers

- Where possible use email, circulation lists and electronic archiving in preference to printing.
- Switch off printers and fax machine if they are not being used.
- Ensure power management functions are operational.
- Use double-sided copying and printing whenever possible.

## 2.8 Laboratories

- Turn off laboratory equipment that can sensibly be turned off when not in use, especially anything with a heating or cooling function e.g. microscopes.
- Keep fume hood sashes at their lowest as much as possible. Fume hoods not only operate more effectively but this significantly reduces the air conditioning load and associated energy usage.

## 2.9 Miscellaneous ECMs

- Replace Older Refrigerators with High-Efficiency Units
- Install Energy- and Water-Efficient Washers and Dryers
- Convert Water Supply Pumps into solar pump
- Install Check metering or Individual Metering
- Install Water-Saving Toilets
- Replacement of conventional regulators with electronic since electronic regulators are more energy efficient.

## 3. CONCLUSION

In present scenario the energy conservation plays an important role. It is because consumption of energy is increasing day by day and the generation is not matching with it. The energy conservation helps in reducing the energy consumption and provides the savings. By adopting proper measures as suggested in the report, i.e. de-lamping, replacements etc., energy awareness to make the people aware the importance of energy the required result can be achieved.

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