International Journal of Research in Engineering, Science and Management
Volume 5, Issue 5, May 2022
https://www.ijresm.com | ISSN (Online): 2581-5792

Energy Audit at PES Campus

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***Abstract*: Energy demand is increasing on a daily basis, making it necessary to cut consumption and conserve energy. Energy auditing is the best alternative for energy conservation. An energy audit is a method of determining when, where, why, and how energy is consumed in a factory or structure. The gathering of this data aids in identifying situations where energy efficiency and production costs must be improved. Students began to think of energy as a reasonable expense and aim to preserve it in day-to-day activities after participating in an energy audit at PES Campus. The goal of this work is to conduct a lighting and electric load management assessment on the PES Campus. The major goal of this research is to assess how much energy is being used.**

***Keywords*: Energy audit, PES campus.**

1. Introduction

Every society's economic decision must be founded on the facts available at the time of the decision. A bank's decision to make a loan to a firm, for example, is based on previous financial ties with that company, the company's financial status as represented in its financial statements, and other criteria.

The information used in the decision process must be reliable if the decisions are to be consistent with the decision makers' intentions. Unreliable data can lead to inefficient resource allocation, which is bad for society and bad for decision-makers.

Assume that the barfly makes the loan on the basis of false financial representations, and that the borrower Company is ultimately unable to repay the debt. As a result, both the principal and the interest have been lost by the bank. Furthermore, another company that could have made good use of the capital was denied access to it.

As society becomes more complicated, there is a greater chance that decision-makers will be given inaccurate information. This is due to a number of factors: information asymmetry, large amounts of data, and the occurrence of complicated exchange interactions.

To overcome the challenge of untrustworthy data, the decision-maker must devise a method of convincing himself that the data is sufficiently trustworthy for these decisions.

Having some type of verification (audit) performed by independent persons is a frequent technique to gather such dependable information. On the assumption that the audited data is reasonably full, accurate, and unbiased, it is subsequently employed in the decision-making process.

We are optimistic that the results of this exercise will pique everyone's curiosity and will serve as the first step toward making PES the most energy-efficient campus in India.

2. Objectives

The energy audit would provide a favourable direction for energy cost reduction, preventive maintenance, and quarterly Central Programs, all of which are critical for production and utility operations.

Such an audit programme will assist in maintaining emphasis on differences in energy costs, availability and dependability of energy supply, determining an approximate energy mix, identifying energy conservation solutions, and retrofitting for energy conservation equipment, among other things.

In general, an Energy Audit is the process of transforming conservative thoughts into reality by providing technically possible solutions that take into account economic and other organisational factors within a set time limit.

The main goal of an energy audit is to find strategies to minimise energy usage per unit of output or cut operating costs. The results of an energy audit serve as a "benchmark" for managing energy in the company, as well as a foundation for planning more efficient energy consumption across the board.

3. Problem Statement

The problems noticed during the audit are as follows,

- Plants and Shrubs are spawned in the HT Yard.
- Earthing pit need to be reconditioned along with painting and marking.
- UG Cables should be maintained in the trench instead of placing outside.
- Usage of LED Bulbs instead of Fluorescent Lamps.
- Usage of DP Switch beside the door in every rooms.

4. Block Diagram

A. Preliminary Energy Audit

The Preliminary Energy Audit concentrates on the primary energy suppliers and demands, which typically account for about 70% of overall energy consumption. It's essentially a data collection and analysis endeavour in its early stages.

It is based solely on publicly available information and includes only a few diagnostic tools. The PEA is completed in a short period of time, often 1-3 days, during which the energy

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auditor draws on his experience as well as all pertinent written, oral, and visual data to make a fast evaluation of the plant's energy condition.

The PEA focuses on locating obvious energy waste sources. A PEA often produces a set of recommendations and low-cost action items that the department head can implement right away.

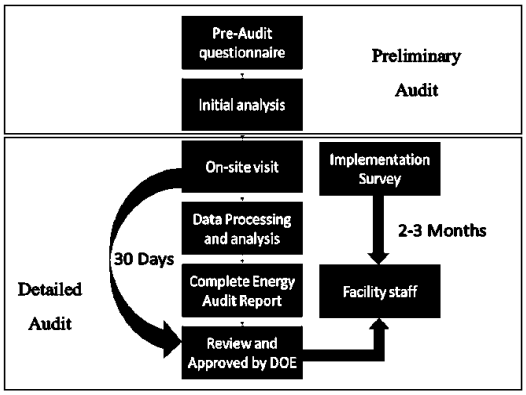

Fig. 1. Block diagram of energy audit process

B. Detailed Audit

The detailed audit goes beyond quantitative cost and savings predictions. It contains engineering recommendations as well as a well-defined project with appropriate priorities. During the detailed audit, approximately 95% of all energy is accounted for.

After the preliminary energy audit, the detailed energy audit is carried out. Energy efficiency is computed using sophisticated instrumentation such as a flow metre, flue gas analyzer, and scanner.

5. Methodology

A. Phase I – Pre-Audit

For efficient working, a defined technique for conducting an energy audit is required. An initial site assessment is usually recommended, as the planning of the procedures required for an audit is crucial.

1) Initial site visit and preparation required for detailed auditing

An initial site visit may take one day and allows the Energy Auditor/Engineer to meet the individuals involved, become familiar with the site, and assess the procedures required to conduct the energy audit.

During the initial site visit, the Energy Auditor/Engineer should do the following:

- Discuss the goals of the energy audit with the site's top management.
- Talk about the economic criteria that go along with the audit's recommendations.
- Collaborate with the required employees to analyse the major energy usage data.
- Obtain site designs (building layout, steam distribution, compressed air distribution, electricity distribution, etc.) if they are accessible.
- Take a tour of the site with a member of the engineering/production team.

2) The main aims of this visit are

- To complete the Energy Audit team.
- To determine which areas/plant items are the most energy-intensive and should be surveyed during the audit.
- Identify any existing instrumentation or the need for further metering.
- Determine whether any metres, such as kWh, steam, oil, or gas metres, will need to be installed prior to the audit.
- To determine the instrumentation needed to conduct the audit.
- To plan according to a time frame.
- Gathering macro data on plant energy resources and main energy consumers.
- Raising awareness through meetings and programmes

B. Phase II - Detailed Energy Audit

A comprehensive audit might take anything from a few weeks to several months to perform, depending on the scope and complexity of the site. Energy and material balances for specific plant departments or pieces of process equipment are established and investigated in detail.

To guarantee that nothing is overlooked, plant operations are checked over extended periods of time whenever possible, including at night, on weekends, and during normal working hours.

The audit report will include a breakdown of energy inputs and outputs by major department or major processing function, as well as an assessment of each step of the manufacturing process' efficiency. The methods for increasing efficiency will be identified, and at the very least, a preliminary estimate of the cost of the improvements will be provided to indicate the estimated payback on any capital expenditure required. The audit report should conclude with specific suggestions for extensive engineering studies and feasibility analyses, which must be carried out to justify the implementation of conservation measures that demand investments.

1) The information to be collected during the detailed audit includes

- Consumption of energy by kind of energy, department, major process equipment, and end-use.
- Information on the material balance (raw materials, intermediate and final products, recycled materials, use of scrap or waste products, production of by-products for re-use in other industries, etc.).
- Process and material flow diagrams.
- Data on energy costs and tariffs.
- Site service creation and dissemination (eg. compressed air, steam).
- Potential for fuel substitution, process adjustments, and the utilisation of co-generation systems.
- Sources of energy supply (e.g. electricity from the grid or self-generation) (combined heat and power generation).

- Procedures for energy management and energy awareness training programmes inside the organisation.
- Baseline data and reports are helpful in determining consumption patterns, production costs, and productivity levels in terms of product per raw material input. The audit team should collect the following baseline data:
  i. Technology, processes used and equipment details
  ii. Capacity utilisation
  iii. Amount & type of input materials used
  iv. Water consumption
  v. Fuel Consumption
  vi. Electrical energy consumption
  vii. Steam consumption
  viii. Other inputs such as compressed air, cooling water etc.
  ix. Quantity & type of wastes generated
  x. Percentage rejection/reprocessing
  xi. Efficiencies/yield

An overview of unit activities, key process steps, material and energy use regions, and waste generation sources should be gathered and displayed in a flowchart like the one below. This flow chart will be aided by existing drawings, data, and a walkthrough of the shop floor. At each process stage, the team should simultaneously identify the numerous inputs and output streams.

2) Identification of energy conservation opportunities

- *Fuel substitution:* Identifying the appropriate fuel for efficient energy conversion.
- *Energy generation:*
  Identifying efficiency opportunities in energy conversion equipment/utility such as captive power generation, steam generation in boilers, thermic fluid heating, optimal loading of DG sets, minimum excess air combustion with boilers/thermic fluid heating, optimising existing efficiencies, efficient energy conversion equipment, biomass gasifiers, Cogeneration, high efficiency DG sets, etc.
- *Energy distribution:*
  Identifying Efficiency opportunities network such as transformers, cables, switchgears and power factor improvement in electrical systems and chilled water, cooling water, hot water, compressed air, etc.
- *Energy usage by processes:* This is where the major opportunity for improvement and many of them are hidden. Process analysis is useful tool for process integration measures.

3) Technical and economic feasibility

The following topics should be addressed in the technical feasibility report:

- The influence of energy efficiency measures on safety, quality, production, or process.
- The availability of technology, space, qualified people, reliability, and service, among other things
- The need for maintenance and the availability of spare parts.
- Economic viability is frequently used as a criterion for management acceptability. A variety of methodologies can be used to conduct an economic study. Payback method, Internal Rate of Return method, Net Present Value method, and so on are examples. Payback is usually sufficient for low-investment, short-duration measures with attractive economic viability, the simplest of the approaches.

C. Classification of Energy Conservation Measures

Based on energy audit and analyses of the plant, a number of potential energy saving projects may be identified. These may be classified into three categories

- Low cost – high return;
- Medium cost – medium return;
- High cost – high return

Normally the low cost – high return projects receive priority. Other projects have to be analyzed, engineered and budgeted for implementation in a phased manner. Projects relating to energy cascading and process changes almost always involve high costs coupled with high returns, and may require careful scrutiny before funds can be committed. These projects are generally complex and may require long lead times before they can be implemented.

6. Advantages

An energy audit will provide you with a list of action items to minimize your energy usage, energy expenditures, and carbon footprint, along with predicted costs and benefits. It's simple to prioritize and know exactly what you need to do to minimize your energy expenses and greenhouse gas emissions, how much you'll have to spend, and how much you can anticipate to save with this straightforward guide. When performed by a qualified energy auditor:

- An auditor should be able to find more savings opportunities for you than you could on your own.
- An auditor will be able to calculate savings with a reasonable degree of precision (as determined by the audit scope).
- An auditor can determine the potential desired and unintended outcomes of a given upgrade and perform calculations to quantify them. For example, in a cold region, the auditor would calculate both the electricity savings from switching to high-efficiency LED office lighting and the increased energy usage of the heating system to heat the buildings (as more efficient lights produce less heat, heat which usually helps keep the office warm). Longer-lasting LEDs would also save money in terms of maintenance.
- An auditor can provide you with up-to-date information on specific technologies and assist you in avoiding investments in well-marketed technologies that have questionable energy-saving potential.

7. Recommendations

- Solar water heaters will be installed in the hostels and residential quarters.
- Electronic Rheostatic Regulators Replace Rheostatic Regulators Electronic regulators are more energy efficient, according to tests conducted at PES Campus, but resistive regulators are more durable, according to experience. Even yet, it's still stated as a possibility.
- Establishment of a biogas plant on the PES campus.
- Instead of using conventional power, Solar Power Panels, which are renewable in nature, will be installed on the campus, generating a large amount of renewable energy.
- Install energy-efficient LED lights instead of traditional lighting. Energy audits should be done on a regular basis on campus, and the results should be made public to raise awareness. We believe that this is just the top of the iceberg, and that the Campus still has a lot of work to do in terms of energy efficiency.

8. Conclusion

The wave of the future is energy efficiency. The world is heading in the direction of energy sustainability at a breakneck speed. Simultaneously, humanity is attempting to re-establish its relationship with nature. A campus that is energy efficient is a personal step toward renewable energy, environmental protection, and long-term living. Having a campus like this can help campus owners save money and is a good investment. Furthermore, energy efficiency equates to healthier, more pleasant, and environmentally friendly living.

Have a professional complete a campus energy audit to determine exactly what you need to do to increase your school's efficiency. You can perform your own audit, but it will not be as accurate. Generating your own energy is a smart starting step toward energy sustainability. Solar panels are the most cost-effective and practical option to generate electricity and heat on your property. Furthermore, appropriate insulation and draught-proofing are critical for reducing the amount of energy wasted in your home.

Reduced electricity, water, and fuel usage are all part of making your campus more energy efficient. You can upgrade to a more efficient water heater and install water-saving fixtures. Changing your laundry and showering habits can help you save water as well. Although lighting may not appear to be costly, it is undoubtedly a role in your energy loss. Energy loss is reduced by switching to LEDs and CFLs. In addition, to reduce your power expense, you should make more use of sunlight and natural daylight.

9. Future Scope

The goal of this project is to conduct a lighting and electric load management audit at PES Campus. The major goal of this project is to assess the usage of energy on campus for energy purposes and to identify potential for energy savings through the use of energy efficient equipment or procedures in order to make PES Campus more energy efficient through an energy audit.

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