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Energy Survey and Audit of Buildings for Energy Conservation

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ABSTRACT

Today the energy utilization of each nation is expanded pointedly. In all area energy is especially significant for country economy. The energy request is expanding exceptionally quickly with the improvement of society. The costs and request of energy is expanding with time so to control the cost and request a more compelling and feasible energy framework becomes important. The point of this paper is to make an energy overview of the structure, assessing various wellsprings of energy supply and misfortunes in the structure. An energy review is a cycle for energy examination, building study and investigation of energy stream for energy protection in a structure or industry, or to decrease the measure of energy into the structure without influencing the yield of the structure. Energy review is a course of testing and examination energy utilizes the ventures and different associations. Public energy preservation laws details that the guidelines for energy utilization, examination and energy review the board. In energy review the overview of all electrical gadgets which use energy in a structure after a timeframe. Energy review incorporates the stock of energy, utilization of energy and energy misfortunes for every typical structure.

KEYWORDS: *Survey, Audit, Buildings, Conservation, Energy, Climate, Maintenance, Materials, Electricity*

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INTRODUCTION

Energy management begins with an energy audit Effective management of energy-consuming systems can lead to significant cost and energy savings as well as increased comfort, lower maintenance costs, and extended equipment life. A successful energy management program begins with a thorough energy audit. The energy audit evaluates the efficiency of all building and process systems that use energy. The energy auditor starts at the utility meters, locating all energy sources coming into a facility. The auditor then identifies energy streams for each fuel, quantifies those energy streams into discrete functions, evaluates the efficiency of each of those functions, and identifies energy and cost savings opportunities. Audit activities, in general order, include:

- Identify all energy systems
- Evaluate the condition of the systems
- Analyze the impact of improvements to those systems
- Write up an energy audit report

The report documents the use and occupancy of the building and the condition of the building and building systems equipment. The report also recommends ways to improve efficiency through improvements in operation and maintenance items (O&M), and through installation of energy conservation measures (ECM).

Degrees of Thoroughness Audit levels, in order of increasing complexity are:

Level 1- The walk-through audit:

The walk-through audit is a tour of the facility to visually inspect each system. The walk-through includes an evaluation of energy consumption data to analyze energy use quantities and patterns, as well as to provide comparisons with industry averages, or benchmarks, for similar facilities. This is the least costly audit, but a level 1 audit can yield a preliminary estimate of savings potential and a list of low-cost savings opportunities through improvements

in operational and maintenance practices. The level 1 audit information may be used for a more detailed audit later if the preliminary savings potential appears to warrant further auditing activity.

Level 2- Standard audit:

The standard audit quantifies energy use and losses through a more detailed review and analysis of equipment, systems, operational characteristics, and on-site measurements and testing. Standard energy engineering calculations are used to analyze efficiencies and calculate energy and cost savings based on improvements and changes to each system. The standard audit will also include an economic analysis of recommended ECMs.

Level 3- Computer simulation:

The level 3 audit is the most expensive level of energy audit and is most often warranted for complex facilities or systems. The audit includes more detailed energy use by function and a more comprehensive evaluation of energy use patterns. Computer simulation software is used to predict building system performance and accounts for changes in weather and other conditions. The goal is to build a base for comparison that is consistent with the actual energy use of the facility. The auditor will then make changes to improve the efficiency of various systems and measure the effects compared to the baseline. This method also accounts for interactions between systems to help prevent overestimation of savings.

ENERGY CONSERVATION

A. Measures

In Energy Conservation, some important point should be implemented which are discussed as below.

- Energy conservation should be given the pride of place in official policy.
- Distribution companies should use energy conservation program for industries in co-operation with various industrial associations and other related agencies.
- Electricity should be realistically priced. Peak load and time off day pricing must be made mandatory for large industrial users.
- Staggering of holidays must be made permanent for industrial consumers.
- Maintenance of existing power stations should receive more importance than reckless expansion of capacity.
- Suitable tax incentives should be provided for installing new energy efficient equipment's.
- Co-generation of heat and power should be encouraged in industries.
- Norms of consumption should be drawn up for all important industries.

B. Benefits of Energy Conservation:

- Individual consumer or industry can save energy cost.
- Grid can increase Capacity without increasing capital investment.
- Natural resources can be saving for the betterment of next generation.
- Due to Reduction in the emission of greenhouse gases helps protecting the environment for controlling the global warming.
- Nation can develop faster and Gives Energy security

Table 1 The various sectors energy conservation potentiaeconomy

Sector	Potential (%)
Economy	Up to 22
Agricultural Sector	Up to 33
Industrial Sector	Up to 26
Transport Sector	Up to 19
Domestic	Up to 18

Steps in Energy Auditing

The energy audit may range from a simple walk - through survey at one extreme to one that may span several phases: -

1. The first steps is to identifies that areas where energy is wasted and reduced energy without affecting the outputs of various functions.
2. The second steps is to implement energy efficient appliances in place of normal appliances which reduce energy use by proper operations and maintenance. For this reason, it is necessary to reduce the number of operating machines and operating hours according to the demands of the load, and fully optimize equipment operations.

Energy audit depends on following factors: -

- Building equipment operation.
- Lighting systems.
- Power systems.
- Building envelope.
- Air-conditioning and ventilation equipment systems.
- Miscellaneous services.

The first two steps can be can be implemented without changing buildings and existing appliances.

3. The third steps would require investment for remodeling, rebuilding, or introducing further control upgrades to the building.
4. The fourth steps is to carry out large-scale energy reducing measures when existing facilities have past their useful life, or require extensive repairs or replacement because of obsolescence. In this case higher energy savings may be achieved. For

these last two stages, the audit may be more extensive in order to identify more ECOs for evaluation, but at an increased need for heavier capital expenditure to realize these opportunities.

Preliminary Survey: - In this Preliminary survey, the auditor may need to know the building envelope and its energy consumption.

The data of a building can be obtained from: -

- Building Architectural blueprints.
- Building Air-conditioning blueprints.
- Building Electrical lighting and power drawings.
- Electrical bills and operation logs for the year preceding the audit.
- Air-conditioning manuals and system data.
- ECOs for evaluation, but at an increased need for heavier capital expenditure to realize these opportunities.

Report

At this stage, ECOs could be found in measures such as:

- Reduce system operating hours,
- Adjust space temperature and humidity,
- Reduce building envelope gain,
- Adjust space ventilation rates and building exfiltration,
- Review system air and water distribution,
- Adjust chiller water temperatures, and
- Review chiller operations.

The benefit from adopting each ECO should be compared against cost of implementation. Caution should be exercised in the cost-benefit analysis given the wider range of certainty of the projections made. However, a survey at this level may be sufficient for small buildings.

MODEL ANALYSIS

Building energy consumption in simplest terms is just the product of rate of consumption of a system and the period of operation. In lighting systems, its energy consumption could be determined manually with precision as it does not interact with other consumption variables. Energy consumption of cooling systems, however, is many times more complicated as it is affected by the internal heat gain within a building as well as weather variables, which varies in a complex manner over time. Building model analysis using computers offers several improvements over manual calculations.

These include:

- Precise schedule of building parameters,
- Precise determination of weather impact,
- Specification of part load performance of plant and equipment, and
- Consideration of parameter interactions such as lighting load on air-conditioning consumption.

Building Profile

Obtaining mechanical, architectural, and electrical drawings and specifications for the original building as well as for any additions or remodeling work that may have been done is the first step to creating a building profile. Any past energy audits or studies should be reviewed.

The auditor can use this information to develop a building profile narrative that includes age, occupancy, description, and existing conditions of architectural, mechanical, and electrical systems. The profile should note the major energy-consuming equipment or systems and identify systems and components that are inherently inefficient.

Having several copies of a simple floor plan of the building will be useful for notes during the site visit. A separate copy should be made for noting information on locations of HVAC equipment and controls, heating zones, light levels, and other energy-related systems. If architectural drawings are not available, emergency fire exit plans are usually posted on each floor; these plans are a good alternative for a basic floor plan.

A site sketch of the building or complex should also be made. The sketch should show the relative location and outline of each building; name and building number of each building; year of construction of each building and additions; dimensions of each building and additions; location, fuel type and identification numbers of utility meters; central plants; and orientation of the complex.

While completing the pre-site review, the auditor should note areas of particular interest and write down any questions about the lighting systems and controls, HVAC zone controls, or setback operation. Other questions may regard equipment maintenance practices. At this point the auditor should discuss preliminary observations with the building manager or operator by phone. The building manager or operator should be asked about their interest in particular conservation projects or planned changes to the building or its systems. The audit should be scheduled when key systems are in operation and when the building operator can take part.

Table 2 Energy Consumption

Equipment	Quantity	Actual load	Actual Consumption (watts)
Fan	325	70	22750
2X18 tube light	363	36	13068
2x36 tube light	70	72	5040
1x40 tube light	275	40	11000
Wall Fan	19	70	1330
2x40 light	103	80	8240
Flood light	12	400	4800
outdoor light	18	70	1260
Computers	97	70	6790

Follow-up: The building manager should review the audit report with the auditor to become familiar with ECMs and methods of funding the ECMs. The building manager must also understand how to provide training for building operators and occupants to improve the operating efficiency of the building. Energy audits provide the information that energy managers need to identify energy consumption patterns and components of a facility and document existing conditions, Energy conservation opportunities can be identified and prioritized. By taking an open-minded and methodical approach to the audit process, it is possible to identify and avoid unnecessary expenditures in most facilities while improving building operation and comfort. Occupants will welcome the improvements and management will appreciate the reduced energy costs.

The following outlines the basic components of a well-organized audit report:

1. **Executive Summary:** The executive summary should be a simple, straightforward, and to the point explanation of the current situation and recommended improvements, outlining the advantages of those improvements. The executive summary should include a brief introduction to the facility and describe the purpose of the audit and overall conclusions. An executive may read no further than this one- or two-page introduction, so a list of recommended actions is essential.
2. **Building Information:** This section provides a general background of the facility, the mechanical systems, and operational profile. A description of the building envelope, age and construction history, operating schedules, number of employees, occupancy patterns, and a discussion of the operation and maintenance program should be included. The building information section should also contain a floor plan, selected photos of the facility and mechanical systems, a description of energy types used in the plant, and a description of the primary mechanical systems and controls.
3. **Utility Summary:** The utility summary provides energy accounting information for the last two years as well as selected charts and graphs. The charts and graphs should be easy to understand and demonstrate the overall consumption patterns of the facility. Actual monthly consumption by fuel type may be of more interest to the engineering and maintenance staff while annual costs or dollar-savings information may be more appropriate for administrative personnel. Pie charts of energy use and cost by fuel type can offer compelling documentation of overall energy uses and expenses. The utility summary also includes reports of overall facility benchmarks, energy use indices, and comparisons with industry averages. A copy of the utility rate schedules and any discussion or evaluation of rate alternatives for which the facility may qualify can be part of this section.

CONCLUSIONS-

The target of energy review is to distinguish the end utilization of energy in building and its ECOs; and as a practicality concentrate on prompting execution of an energy the board program. The review methods can be extended depending on the situation in the different periods of the energy program, with the use of each succeeding stage yielding more data on energy use, and more freedoms for raising energy proficiency. Normal assets on earth are restricted and devouring forcefully. It tends to be saved by utilizing energy effectiveness and it is extremely important to forestall exhaustion of regular assets. The Electrical review of school structures shows that the heap of electrical hardware's is huge and ought to be made some important stride for diminishing energy protection. Today energy protection assumes a vital part for energy moderating in light of the fact that energy utilization is expanding step by step yet the normal assets are not expanding and furthermore age isn't match with utilization People should mindful with regards to energy preservation and decrease energy utilization by embracing current advances.

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