

Industrial facility has designated construction essay



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Once a commercial or industrial facility has designated its energy manager and given that person the support and authority necessary to develop an adequate energy management program, the first step the energy manager should take is to conduct an energy audit. Also called an energy survey, energy analysis, or energy evaluation, the energy audit examines the ways energy is currently used in that facility and identifies some alternatives for reducing energy costs. The goals of the audit are: to clearly identify the types and costs of energy use, to understand how that energy is being used—and possibly wasted, to identify and analyze alternatives such as improved operational techniques and/or new equipment that could substantially reduce energy costs*, and to perform an economic analysis on those alternatives and determine which ones are cost-effective for the business or industry involved. This chapter addresses the three phases of an energy audit: preparing for the audit visit; performing the facility survey and implementing the audit recommendations. In the first phase, data from the energy bills are analyzed in detail to determine what energy is being used and how the use varies with time. Preliminary information on the facility is compiled, the necessary auditing tools are gathered, and an audit team is assembled. Phase two starts after a safety briefing when the team performs a walkthrough inspection, looking carefully at each of the physical systems within the facility and recording the information for later use. After the plant survey, the audit team must develop an energy balance to account for the energy use in the facility. Once all energy uses have been identified and quantified, the team can begin analyzing alternatives. The final step of phase two is the audit report which recommends changes in equipment, processes or operations to produce energy cost savings. Phase three—the

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implementation phase—begins when the energy manager and the facility management agree on specific energy savings goals and initiate some or all of the actions recommended to achieve those goals. Setting up a monitoring system will allow management to assess the degree to which the chosen goals have been accomplished and to show which measures have been successful and which have failed. The results of the monitoring should feed back to the beginning of the audit cycle and thus potentially initiate more analysis, implementation, and monitoring.

PHASE ONE—PREPARING FOR AN ENERGY AUDIT

The energy audit process starts with an examination of the historical and descriptive energy data for the facility. Specific data that should be gathered in this preliminary phase include the energy bills for the past twelve months, descriptive information about the facility such as a plant layout, and a list of each piece of equipment that significantly affects the energy consumption. Before the audit begins, the auditor must know what special measurement tools will be needed. A briefing on safety procedures is also a wise precaution.

Gathering Preliminary Data on the Facility

Before performing the facility audit, the auditors should gather information on the historical energy use at the facility and on the factors likely to affect the energy use in the facility. Past energy bills, geographic location, weather data, facility layout and construction, operating hours, and equipment lists are all part of the data needed.

Tools for the Audit

To obtain the best information for a successful energy cost control program, the auditor must make some measurements during the audit visit. The amount of equipment needed depends on the type of energy consuming equipment used at the facility, and on the range of potential EMOs that might be considered. For example, if waste heat recovery is being considered, then the auditor must take substantial temperature measurement data from potential heat sources. Tools commonly needed for energy audits include the following: Tape Measures Light meters Thermometer Wattmeter Combustion Analyzer Ultrasonic Leak Detector Airflow Measurement Devices Smoke Generator Safety Equipment

Safety Consideration

Safety is a critical part of any energy audit. The auditor and the audit team should have a basic knowledge of safety equipment and procedures. Before starting the facility tour, the auditor or audit team should be thoroughly briefed on any specialized safety equipment and procedures for the facility. They should never place themselves in a position where they could injure themselves or other people at the facility. Adequate safety equipment should be worn at all appropriate times. Auditors should be extremely careful making any measurements on electrical systems, or on high temperature devices such as boilers, heaters, cookers, etc. Electrical gloves or insulated gloves should be worn as appropriate. If a trained electrician is available at the facility, they should be asked to make any electrical measurements. The auditor should be cautious when examining any operating piece of equipment, especially those with open drive shafts, belts, gears, or any form

of rotating machinery. The equipment operator or supervisor should be notified that the auditor is going to look at that piece of equipment and might need to get information from some part of the device. If necessary, the auditor may need to return when the machine or device is idle in order to get the data safely. The auditor should never approach a piece of equipment and inspect it without notifying the operator or supervisor first.

Safety Checklist

Electrical: Avoid working on live circuits, if possible. Securely lock circuits and switches in the off position before working on a piece of equipment. Always keep one hand in your pocket while making measurements on live circuits to help prevent accidental electrical shocks. **Respiratory:** When necessary, wear a full face respirator mask with adequate filtration particle size. Use activated carbon cartridges in the mask when working around low concentrations of noxious gases. Change the cartridges on a regular basis. Use a self-contained breathing apparatus for work in toxic environments. **Hearing:** Use foam insert plugs while working around loud machinery to reduce sound levels by nearly 30 decibels.

PHASE TWO—THE FACILITY INSPECTION

Once all of the basic data have been collected and analyzed, the audit team should tour the entire facility to examine the operational patterns and equipment usage, and should collect detailed data on the facility itself as well as on all energy using equipment. This facility inspection should systematically examine the nine major systems within a facility, using portable instrumentation and common sense guided by an anticipation of what can go wrong. These systems are: the building envelope; the boiler and <https://assignbuster.com/industrial-facility-has-designated-construction-essay/>

steam distribution system; the heating, ventilating, and air conditioning system; the electrical supply system; the lighting system, including all lights, windows, and adjacent surfaces; the hot water distribution system; the compressed air distribution system; the motors; and the manufacturing system. Together, these systems account for all the energy used in any facility; examining all of them is a necessary step toward understanding and managing energy utilization within the facility. We briefly describe these systems later in this chapter; we also cover most of them in detail in separate chapters. The facility inspection can often provide valuable information on ways to reduce energy use at no cost or at a low cost. Actually, several inspections should be made at different times and on different days to discover if lights or other equipment are left on unnecessarily, or to target process waste streams that should be eliminated or minimized.* These inspections can also help identify maintenance tasks that could reduce energy use. Broken windows should be fixed, holes and cracks should be filled, lights should be cleaned, and HVAC filters should be cleaned or replaced. The facility inspection is an important part of the overall audit process. Data gathered on this tour, together with an extensive analysis of these data will result in an audit report that includes a complete description of the time-varying energy consumption patterns of the facility, a list of each piece of equipment that affects the energy consumption together with an assessment of its condition, a chronology of normal operating and maintenance practices, and a list of recommended energy management ideas for possible implementation.

Introductory Meeting

The audit leader should start the audit by meeting with the facility manager and the maintenance supervisor. He should briefly explain the purpose of the audit and indicate the kind of information the team needs to obtain during the facility tour. If possible, a facility employee who is in a position to authorize expenditures or make operating policy decisions should be at this initial meeting.

Audit Interviews

Getting the correct information on facility equipment and operation is important if the audit is going to be most successful in identifying ways to save money on energy bills. The company philosophy towards investments, the impetus behind requesting the audit, and the expectations from the audit can be determined by interviewing the general manager, chief operating officer, or other executives. The facility manager or plant manager should have access to much of the operational data on the facility, and a file of data on facility equipment. The finance officer can provide any necessary financial records, such as utility bills for electric, gas, oil, other fuels, water and wastewater, expenditures for maintenance and repair, etc. The auditor must also interview the floor supervisors and equipment operators to understand the building and process problems. Line or area supervisors usually have the best information on the times their equipment is used. The maintenance supervisor is often the primary person to talk to about types of lighting and lamps, sizes of motors, sizes of air conditioners and space heaters, and electrical loads of specialized process equipment. Finally, the maintenance staff must be interviewed to find the equipment and

performance problems. The auditor should write down these people's names, job functions and telephone numbers, since additional information is often needed after the initial audit visit.

Initial Walk-through Tour

An initial facility/plant tour should be conducted by the facility/ plant manager, and should allow the auditor or audit team to see the major operational and equipment features of the facility. The main purpose of the initial tour is to obtain general information, and to obtain a general understanding of the facility's operation. More specific information should be obtained from the maintenance and operational people during a second and more detailed data collection tour.

Gathering Detailed Data

Following the initial facility or plant tour, the auditor or audit team should acquire the detailed data on facility equipment and operation that will lead to identifying the significant Energy Management Opportunities (EMOs) that may be appropriate for this facility. These data are gathered by examining the nine major energy-using systems in the facility. As each of these systems are examined, the following questions should be asked: What function(s) does this system serve? How does this system serve its function(s)? What is the energy consumption of this system? What are the indications that this system is probably working? If this system is not working, how can it be restored to good working condition? How can the energy cost of this system be reduced? How should this system be maintained? Who has direct responsibility for maintaining and improving the operation and energy

efficiency of this systemAs each system is inspected, these data should be
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recorded on individualized data sheets that have been prepared in advance. Manual entry data forms for handling these energy data are available from several sources, including the energy management handbook from the National Electrical Manufacturers Association [4]. Some energy analysis procedures in current use are computer-based, and data are entered directly into the computer.

Preliminary Identification of Energy Management Opportunities

As the audit is being conducted, the auditor should take notes on potential EMOs that are evident. As a general rule, the greatest effort should be devoted to analyzing and implementing the EMOs which show the greatest savings, and the least effort to those with the smallest savings potential. Therefore, the largest energy and cost activities should be examined carefully to see where savings could be achieved. Identifying EMOs requires a good knowledge of the available energy efficiency technologies that can accomplish the same job with less energy and less cost. For example, over-lighting indicates a potential lamp removal or lamp change EMO, and inefficient lamps indicate a potential lamp technology change. Motors with high use times are potential EMOs for high efficiency replacements. Notes on waste heat sources should indicate what other heating sources they might replace, and how far away they are from the end use point. Identifying any potential EMOs during the walk-through will make it easier later on to analyze the data and to determine the final EMO recommendations.

The Energy Audit Report

The next step in the energy audit process is to prepare a report which details the final results of the energy analyses and provides energy cost saving recommendations. The length and detail of this report will vary depending on the type of facility audited. A residential audit may result in a computer printout from the utility. An industrial audit is more likely to have a detailed explanation of the EMOs and benefit cost analyses. The following discussion covers the more detailed audit reports. The report should begin with an executive summary that provides the owners/managers of the audited facility with a brief synopsis of the total savings available and the highlights of each EMO. The report should then describe the facility that has been audited, and provide information on the operation of the facility that relates to its energy costs. The energy bills should be presented, with tables and plots showing the costs and consumption. Following the energy cost analysis, the recommended EMOs should be presented, along with the calculations for the costs and benefits, and the cost-effectiveness criterion. Regardless of the audience for the audit report, it should be written in a clear, concise and easy-to-understand format and style. An executive summary should be tailored to non-technical personnel, and technical jargon should be minimized. The reader who understands the report is more likely to implement the recommended EMOs. An outline for a complete energy audit report is shown in Figure 2-6 below. See reference [5] for a suggested approach to writing energy audit reports.

Add Energy Audit Report in This section

The Energy Action Plan

An important part of the energy audit report is the recommended action plan for the facility. Some companies will have an energy audit conducted by their electric utility or by an independent consulting firm, and will then make changes to reduce their energy bills. They may not spend any further effort in the energy cost control area until several years in the future when another energy audit is conducted. In contrast to this is the company which establishes a permanent energy cost control program, and assigns one person—or a team of people—to continually monitor and improve the energy efficiency and energy productivity of the company. Similar to a Total Quality Management program where a company seeks to continually improve the quality of its products, services and operation, an energy cost control program seeks continual improvement in the amount of product produced for a given expenditure for energy. The energy action plan lists the EMOs which should be implemented first, and suggests an overall implementation schedule. Often, one or more of the recommended EMOs provides an immediate or very short payback period, so savings from that EMO—or those EMOs—can be used to generate capital to pay for implementing the other EMOs. In addition, the action plan also suggests that a company designate one person as the energy monitor or energy manager for the facility if it has not already done so. This person can look at the monthly energy bills and see whether any unusual costs are occurring, and can verify that the energy savings from EMOs is really being seen. Finally, this person can continue to look for other ways the company can save on energy costs, and can be seen

as evidence that the company is interested in a future program of energy cost control.

IMPLEMENTING THE AUDIT RECOMMENDATIONS

After the energy consumption data have been collected and analyzed, the energy-related systems have been carefully examined, the ideas for improvement have been collected, and management commitment has been obtained, the next steps are to obtain company support for the program, to choose goals, and to initiate action.

The Energy Action Team

Now that the preliminary audits have uncovered some energy management measures that can save significant amounts of money or can substantially improve production, funding for the changes and employee support are two additional critical ingredients for success. These can best be obtained with the help of a committee, preferably called something like the energy action team. The functions of this committee are given in Table 2-1. No program will work within a company without employee support, particularly such a program as energy management which seems to promise employee discomfort at no visible increase in production. Therefore, one function of the energy action committee is to give representation to every important political group within the company. For this purpose, the committee must include people from unions, management, and every major group that could hinder the implementation of an energy management plan. The committee must also include at least one person with financial knowledge of the company, a person in charge of the daily operation of the facility, and line personnel in each area of the facility that will be affected by energy

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management. In a hospital, for example, the committee would have to include a registered nurse, a physician, someone from hospital administration, and at least one person directly involved in the operation of the building. In a university, the committee should include a budget officer, at least one department chairperson, a faculty member, a senior secretary, someone from buildings and grounds, and one or more students. In addition to providing representation, a broadly based committee provides a forum for the evaluation of suggestions. The committee should decide on evaluation criteria as soon as possible after it is organized. These criteria should include first cost, estimated payback period or (for projects with a payback period longer than 2 years) the constant dollar return on investment (see Chapter 4), the effects on production, the effects on acceptance of the entire program, and any mitigating effect on problems of energy curtailment. The committee has the additional duty to be a source of ideas. These ideas can be stimulated by the detailed energy audit which clearly shows problems and areas for improvement. The energy manager should be aware, however, that most maintenance personnel become quickly defensive and that their cooperation, and hopefully their support, may be important. The specific tasks of this committee are to set goals, implement changes, and monitor results.

Goals

At least three different kinds of goals can be identified. First, performance goals, such as a reduction of 10 percent in Btu/unit product, can be chosen. Such goals should be modest at first so that they can be accomplished—in general, 10-30 percent reduction in energy usage for companies with little

energy management experience and 8-15 percent for companies with more. These goals can be accompanied by goals for the reduction of projected energy costs by a similar amount. The more experienced the company is in energy management, the fewer easy saving possibilities exist; thus lower goals are more realistic in that case. A second type of goal that can be established is an accounting goal. The ultimate objective in an energy accounting system is to be able to allocate the cost of energy to a product in the same way that other direct costs are allocated, and this objective guides the establishment of preliminary energy accounting goals. A preliminary goal would therefore be to determine the amount of electricity and the contribution to the electrical peak from each of the major departments within the company. This will probably require some additional metering, but the authors have found that such metering pays for itself in energy saving (induced by a better knowledge of the energy consumption patterns) in six months or less.

Implementing Recommendations

In addition to providing and evaluating ideas, setting goals, and establishing employee support, the energy action committee has the duty of implementing the most promising ideas that have emerged from the energy evaluation process. Members of the committee have the responsibility to see that people are assigned to each project, that timetables are established, that money is provided, and that progress reporting procedures are set up and followed. It is then the committee responsibility to follow up on the progress of each project; this monitoring process is described in detail in the next section.

Monitoring

Energy management is not complete without monitoring and its associated feedback, and neither is the energy audit process. In an energy audit, monitoring discloses what measures contributed toward the company goals, what measures were counterproductive, and whether the goals themselves were too low or too high. Monitoring consists of collecting and interpreting data. The data to collect are defined by the objectives chosen by the energy action committee. At the very least, the electrical and gas bills and those of other relevant energy sources must be examined and their data graphed each month. Monthly graphs should include: the total energy used of each type (kWh of electricity, therms [105 Btu] of gas, etc.); the peaks, if they determine part of the cost of electricity or gas; and any other factors that contribute to the bills. At the same time, other output-related measures, such as Btu/ton, should also be calculated, recorded, and graphed. The monitoring data should provide direct feedback to those most able to implement the changes. Often this requires that recording instruments be installed in a number of departments in addition to the meters required by the utility company. The additional expense is justified by increased employee awareness of the timing and amounts of energy consumed, and usually this awareness leads to a reduction in energy costs. Metering at each department also enables management to determine where the energy is consumed and, possibly, what is causing the energy consumption. Such metering also helps each department manager to understand and control the consumption of his or her own department. Monitoring should result in more action. Find what is good, and copy it elsewhere. Find what is bad, and avoid it elsewhere. If the goals are too high, lower them. If the goals are too

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low, raise them. Wherever the difference between the planned objectives and the achievements is great, initiate an analysis to determine the reasons and then develop new objectives, initiate new action, and monitor the new results. In this way, the analysis, action, and monitoring process repeat itself.

ENERGY MONITORING, TARGETING AND REPORTING

Energy Monitoring, Targeting and Reporting (MT&R) is a powerful management technique for analyzing the historical energy performance of industrial, commercial, and institutional facilities setting energy reduction targets controlling current energy performance Projecting future energy budgets. It is a technique that has proven its effectiveness in achieving energy cost savings in the range five to fifteen percent as a direct consequence of effective performance monitoring, and in creating the management information needed to identify and implement energy efficiency measures. Further, it provides a framework for savings verification when measures are implemented. The working definitions that commonly apply are the following:

Energy Monitoring:

It is the regular collection and analysis of information on energy use. Its purpose is to establish a basis of management control, to determine when and why energy consumption is deviating from an established pattern, and to provide a basis for taking management action where necessary. Targeting is the identification of levels of energy consumption towards which it is desirable, as a management objective, to work. • Reporting closes the loop, by putting the management information generated in a form that enables

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ongoing control of energy use, the achievement of reduction targets, and the verification of savings. MT&R is built around one key statistical technique: CUSUM (Cumulative Sum of Differences) analysis of the variance between energy consumption predicted by an energy performance model (EPM), and the actual measured consumption. Ancillary functions that are derived from the CUSUM analysis are a target-setting methodology, and the application of energy control charts for real-time management of performance. The key steps in an effective MT&R process are: measurement of energy consumption over time measurement of the independent variables that influence energy consumption (weather, production, occupancy) over corresponding time intervals development of a relationship (the energy performance model) between energy and the independent variables historical analysis of energy performance using CUSUM, and application of the CUSUM trend into the future definition of reduction targets frequent comparison of actual consumption to targets reporting of consumption and target variances Taking action to address variances and ensure targets are met. The achievement of energy cost savings is the primary objective of MT&R, but there are other benefits as well, including: improved budgeting and forecasting improved product/service costing tracking and verification of energy efficiency retrofits opportunities for improved operation and maintenance practices.

MT&R and Continuous Improvement

Monitoring and target setting have elements in common and they share much of the same information. As a general rule, however, monitoring comes before target setting because without monitoring you cannot know precisely

where you are starting from or decide if a target has been achieved. The reporting phase not only supports management control, but also provides for accountability in the relationship between performance and targets. MT&R is consistent with other continuous improvement techniques applied in organizations, and should be viewed as an ongoing, cyclical process, as Figure 1-16 suggests.