Three Levels of Energy Audits (Pre-Contract Considerations)

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The term "energy audit" is commonly used to designate a wide variety of energy related functions. There is much confusion throughout the energy industry when the term is referenced. Definitions range from a very simple and inexpensive process, to one of high complexity and expense.

The primary intent of this article is to provide a structured definition for various types of energy audits while explaining their similarities, differences and applications of each type. By establishing a framework of three audit 'types' including their associated scopes, deliverables, and approximate cost ranges, professionals should be able to more confidently prepare audit proposal requests (RFP), audit services contracts, proposal responses, and contract negotiations.

BACKGROUND:

The general process of performing an 'energy study' on a facility for the purpose of identifying energy usage and perhaps finding ways to better utilize the energy for maximum efficiency has been practiced since the beginnings of the industrial age. The more recent, formal term of "energy audit" has gained popularity since the 1970's energy crises. The modern concept of the "energy audit" has evolved almost continuously for the past 25 years as energy costs, government regulations, new technologies, environmental concerns, and emerging business services have all concentrated on the cost effective strategy of energy conservation.

Audits can be performed on all facility types (residential, commercial, and industrial), and may include the entire facility or be limited to

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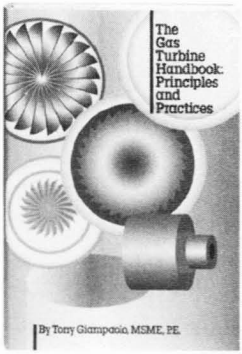

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a targeted area of the structure, specific equipment, or isolated processes/systems. All utility services (electric, gas/oil, water, sewerage/waste disposal, steam, etc.) may be included in the scope of an audit, which may also include environmental impact parameters (particularly in the consideration of refrigerants, boiler emissions, and chemical process applications).

Energy audits can provide the basic groundwork for major equipment and structural retrofits, in development of energy service contracts, in certification of compliance to governmental laws and regulatory codes, for corporate energy planning, as a basis for R&D projects and grants, and as documentation for funding approval, and financing, of projects.

The ultimate purpose of an energy audit's results will dictate the scope and detail required which will in turn specify the type of audit required. It is important for energy professionals and facility managers to be aware of the various types of energy audits so as to best specify the audit, which meets a project's objectives without undue complexity, time delay, and expense.

BASIC DEFINITION:

In the most basic definition: "an energy audit serves the purpose of identifying energy usage within a structure, plant, process, or equipment system and then identifies opportunities for conservation."

All types of energy audits will include the following three parts:

1. *Data Acquisition:* Identify where and how a structure, process, or equipment uses energy along with the costs and utility issues affecting the energy consumption.

2. *Data Analysis:* Perform analysis to identify energy conservation measures (ECMs) which when implemented, will make the energy usage more efficient, less expensive, and/or more environmentally friendly.

3. *Recommendations:* Present a final report detailing what was found, areas for improvement, and recommended actions usually accompanied with some type of economic justification.

TYPES OR 'CLASSES' OF ENERGY AUDITS:

The complexity and documentation required along with the budget available will usually dictate the type of audit performed. Because audits are somewhat customized for each site's particular needs, they will tend to vary somewhat in scope and content. While no exact, hard-fast rules exists which dictate the type and cost of an audit, most audits will generally fall within one of the following three categories:

A. Walk-Through Audit
(Simple Audit, Preliminary Audit, Screening Audit)

This is the simplest, quickest, and least costly type of audit. Its purpose is to be a "big picture" survey of the structure, process, or equipment and then to identify areas for *potential* energy savings. Only basic information is obtained regarding energy usage and utility issues, and a visual inspection is performed during the 'walkthrough' of the facility to determine if there are any operational saving opportunities. Minimal interviewing of site operational personnel may be performed during the walk through. (Detailed measurements, metering or testing is normally not performed in this class audit.)

Typically, this type of audit will uncover major problem areas and those opportunities for simple and/or quick paybacks. A quick comparison of the facility's Energy Use Index, EUI, (Btu/sq. ft.) against industry standard published indexes can provide a quick estimate of the possible savings potential. The final report format is simple and depending on the nature of the results, the **Walk-Through Audit** will determine the need for more detailed specific analysis. When results indicate appreciable savings opportunities, a more advanced type of audit can be justified.

[For comparative discussion purposes only: The cost of the **Walk-Through Audit** *can range from a free service (typically provided by electric and gas utilities, energy service companies, state and federal agencies, and even some equipment vendors) up to a contracted fixed fee of $0.01 to 0.03/sq. ft. Typically a minimum fee of $500 to $2,000 (well under a thousand dollars for most single family homes) or so will be required to cover minimal time and report preparation costs.]*

B. Site Energy Audit (Mini-Audit,
General Audit, Complete Site Audit)

The **Site Energy Audit** basically enhances the **Walk-Through Au-**

dit process (see 'A' above) by the inclusion of detailed data collection including: utility rates and contracts, energy usage profile, specific measurement, metering and/or testing of energy utilization equipment and even structural components as required for documentation. Interviews will be conducted with various site operational and business personnel to better understand the facility's operational parameters and business needs.

A **Site Energy Audit** requires that a more detailed analysis of the data is performed with usage patterns and EUIs evaluated against established norms and guidelines. In many cases a rough model of energy usage will be developed (this may use software models and for additional cost, may be a dynamic model reflecting various operating conditions during the year, throughout the day, etc.) to assist in predicting energy conservation and potential savings opportunities. Finally, a financial analysis will be performed on each identified energy conservation measure (ECM) deemed financially viable to determine the justification of the required investment based on the customer's investment criteria.

This type of energy audit will usually identify and quantify all ECMs which can meet reasonable investment justification. The report will provide sufficient detail and documentation for most firms to act on the recommendations without additional study. This type audit is normally sufficient for most applications where completeness and cost effectiveness is desired without excessive detail or unnecessary depth.

The **Site Energy Audit** almost always involves the services of professional engineers and/or certified energy professionals. There is usually a fee for the **Site Energy Audit,** although it will be directly proportional to the size of the facility and/or the quantity and complexity of equipment, as well as the scope of the technical and financial analysis required. It should be noted that many energy service companies (ESCOs) will provide this class audit "free" as part of their contracted 'package,' but will normally have a guaranteed fee should the final service contract not be signed. A simple contract or letter agreement can initiate this class audit.

[For comparative discussion purposes only: Minimum fees to cover time and report preparation for these audits will range from $2, 000 to well over $5, 000. Typical fixed fees for these audits will generally range from $0. 05 to $0. 10/sq.

ft. for simple equipment configurations or large area sites; and $0.10 to $0.15/ sq. ft. and up for more complex equipment configurations or smaller area sites. When applied to industrial process equipment, this class audit can become quite expensive, with mid-sized integrated plant audits running well over $100,000. When specialty and innovative technologies (such as cogeneration equipment, hybrid HVAC systems involving various fuel sources, extensive heat recovery applications, etc.) are required or requested as a component of this type audit, audit fees will be higher, reflective of the research and additional analysis required.]

C. Comprehensive Audit (Maxi Audit, Detailed Audit, Technical Analysis Audit)

This class of audit will be the most complete, complex, time consuming, and expensive of all audits. However, much of the detail and complexity may not be required or justified for many applications.

The **Comprehensive Audit** will further enhance the data collection, modeling, financial analysis, and reporting of the **Site Energy Audit** (as detailed in 'B' above). This class audit will require that *all* phases of energy purchase and utilization are identified, measured, documented, and evaluated for inclusion in the final report. Technically, this audit should result in an energy model which can account for most all energy use and cost at a site. This requires that every structural and equipment system be modeled and evaluated for possible energy conservation opportunities. Extensive interviews will be conducted with site operational and business personnel to fully appreciate the facility's operational parameters and business needs. This is an extremely data intensive project.

The analysis phase involves dynamic modeling (typically utilizing a software model) of all the energy usage at the site as well as for every ECM identified. The subsequent 'ranking' of these ECM opportunities through financial analysis will be presented with specific recommendations. Typical financial analysis in this class audit will involve full life cycle investment analysis with consideration for taxes, depreciation, and O&M impacts. Various financing and leasing options are usually included along with specific vendor quotes for major cost items.

The final report for this audit is all-inclusive, typically lengthy, and in a formal format. In summary, "no rock should be left unturned" in this class audit. This type audit may require that the auditor provide certain guarantees for his recommendations as well as ongoing support

services for the implementation and monitoring of the installed ECMs (although for this discussion, these additional services would be "adders" to the **Comprehensive Audit**, and would increase the cost of the ultimate contract).

Obviously, this class audit requires the services of professional engineers and/or energy professionals. Typically, a professional energy consultant or engineering firm will perform this class audit. All phases of this audit process are detailed and costly to prepare. Some of the reasons to perform this type audit include: to obtain special financing, for government grant applications, for R&D project funding and documentation, for regulatory compliance issues, or detailed documentation to meet a site's corporate energy/business qualifications.

The **Comprehensive Audit** usually be performed through a more formal consultant services contract and may even be bid out on a type process. Costs tend to be high as representative of the all-inclusive nature of the audit. Fees will typically be directly proportional to the size of the facility and/or the quantity and complexity of equipment, the scope of the technical and financial analysis specified in the contract, and the liability level/guarantee of the recommendations. Typically, industrial sites will not perform this class audit on a gross site basis due to the excessive data collection and costs required.

[For comparative discussion purposes only: Minimum fees to cover time and report preparation for these audits will usually run well over $10,000. Typical fixed fees for these audits will generally range from $0.10 to $0.20/sq. ft. for simple equipment configurations large area sites; and $0.20 to $0.30/sq. ft. and up for more complex equipment configurations or smaller area sites. When specialty and innovative technologies (such as cogeneration equipment, hybrid HVAC system involving various fuel sources, extensive heat recovery applications, etc.) are required or requested as a component of this type audit, audit fees will be higher reflective of the research and additional analysis required. As already mentioned, legal guarantee liabilities and/or ongoing services and support for ECM installations will also tend to increase the total contract fee.]

As a final consideration it is suggested that a site's energy manager and perspective audit consultant initially sit down and discuss the various services which can best meet a facility's needs. Using the above descriptions may prove useful in this discussion in terms of deciding

exactly what type services will be required and, just as important, what services are not required. A typical result of this discussion may be a "hybrid" audit contract that initially uses a **Walk-Through Audit** to set the stage from which negotiations can proceed on a very specific set of considerations for a **Site Energy Audit.** This will limit the scope of the audit, reduce the data and time inputs, and ultimately produce a more usable report at a lower cost. Perhaps only a few, high cost saving ECMs can be financed initially. After their implementation, the savings generated can fund additional audit services, which will support additional ECM installations with their respective additional energy cost savings, and so on.

The primary goal here is to facilitate energy conservation, waste reduction, and operational cost savings. The appropriate energy audit will serve as the catalyst to initiate this objective.

Hopefully, this article has taken some of the mystery and guesswork out of the energy audit dilemma. By better understanding the nature, scope and cost structure of the various audit types, energy professionals should be better prepared to develop and negotiate audit service contracts.

ABOUT THE AUTHOR

Louis J. Braquet, P.E., is an independent energy consultant whose work entails knowledge of the energy industry's customer/utility/regulatory environments. His background includes project experience with industrial and commercial power generation, electric technology application, and business development opportunities. He has been involved in over 60 large power systems projects, some exceeding 200 MW and $150 million construction value.

Mr. Braquet has received EPRI's "Innovators" award for Electric Drive Applications (1994); ASHRAE's Gary P. Gamble Award for Outstanding Service (1992); ASHRAE's Region VII Energy and Technical Affairs Achievement Award (1990).

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