

Energy Auditing



What is an Energy Audit?

The term “energy audit” can apply to a variety of different energy use surveys and/or assessments of varying scope and complexity. An audit may be broad in scope, covering an entire facility, or very specific, focusing on certain systems or equipment within a building. The level of detail can range from a simple overview of energy use, highlighting areas where energy use may be improved, to detailed modeling and analysis of equipment operation with precise estimates of energy savings and costs. An energy audit may focus on all forms of energy use within a facility, such as electricity, natural gas and renewable energy sources, or on a single form of energy, typically electricity. As the level of detail increases and the impact of energy saving measures are thoroughly examined, such things as water use and environmental impacts may be considered.

Who can benefit from an Energy Audit?

Commercial and industrial energy users of all sizes can benefit from an energy audit. Since the audit types encompass a wide range of scopes and levels of detail, an audit can be conducted on facilities ranging from medium commercial building operations to large industrial plants featuring many building types spread out over the site. The type of audit required depends on the size of the facility and the types of equipment involved, as well as the goal of management in requesting an audit.

Why perform an Energy Audit?

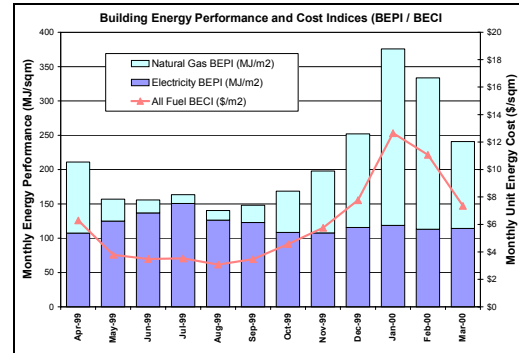
Depending on the level and scope of the audit, the final result can range from an overview of the energy use at a facility, with an energy intensity value that can be compared to the industry average, to a detailed breakdown of energy use and costs by piece of equipment, together with recommendations on how to achieve significant energy savings and/or process improvements. Simple audits, which combine billing analysis and energy “**benchmarks**”, can identify the need for more detailed investigation in a particular area. If it is already recognized that a facility can benefit from a more detailed audit, a “**walkthrough**” audit will narrow down the opportunities based on the type of equipment and operating schedule. A “**detailed**” or “**investment grade**” audit will provide an in-depth analysis of the operation, including an energy use model that can be used to provide working estimates of the potential energy savings. “**Engineering**” audits include a detailed analysis of specific systems within a facility and produce results ranging from general recommendations to detailed engineering plans, depending on the detail required.



Benchmark Audit

Benchmarking is the first step in the review of a facility's energy use patterns and in assessing the need for further investigation. A benchmark audit seeks to determine the average energy intensity of the building, such as kWh per floor area, in relation to similar space functions.

The analysis focuses on utility billing data, which is matched with monthly weather data, and provides an indication of seasonal and occupancy variations in energy consumption. The load factor can give a good indication of the energy utilization and the potential to reduce monthly demand peaks. The need for power factor correction may be another area identified through a preliminary benchmark audit.



Data Required

- Utility billing data
- Monthly weather data
- Building operating schedule
- Industry standard reference units
- Building square footage

Deliverables

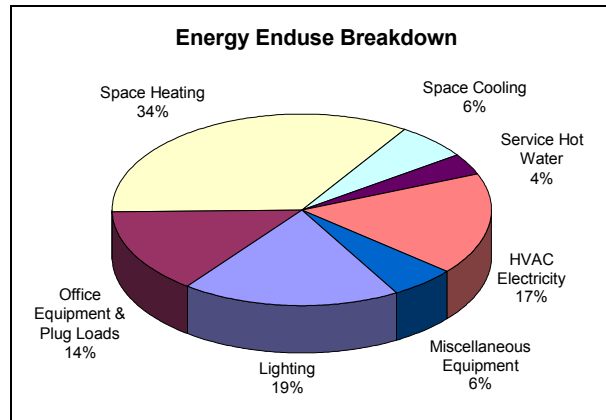
- Billing analysis
- Load factor and power factor analysis
- Energy utilization index (kWh/m²)
- Energy cost index (\$/m²)
- Benchmark with industry averages



Walkthrough Audit

The walkthrough adds a site visit and an additional level of detail to the benchmark audit. In addition to the billing analysis and benchmarking tasks, end-use and technology break down the energy use. A one day site visit is used to collect data and to verify operating practices.

This level of audit is used to develop a preliminary list of potential energy savings initiatives. Systems that may require further investigation are identified and general estimates based on typical projects may be developed. This level of audit does not incorporate a great deal of technical detail in terms of equipment operations and interactions with other systems.



Additional Data Required

- Description of equipment and schedule
- Walkthrough

Additional Deliverables

- Preliminary end-use breakdown
- General estimates of energy savings



Investment Grade Audit

This detailed audit incorporates the components of the benchmark audit and the walkthrough audit, with an additional level of detailed

analysis. A detailed audit makes use of an equipment list to compile a load inventory and an energy use model for the facility. The energy use model is matched to the utility billing summary to ensure its accuracy and the accuracy of the energy savings estimates.

The walkthrough component is more extensive, and equipment operation is examined in greater detail. A lighting survey provides information on the number of lights and opportunities for cost reduction. A detailed equipment list with energy use and operating cost per conditioned floor space is prepared.

Energy Enduse Summary						
Enduse	Qty	Rated Load (kW)	Load Factor	Operating Hours (hrs)	Energy Use (kWh)	BEPI (kWh/m ²)
Lighting	2,000	75	0.95	6000	427,500	73
Plug Loads (OE)	600	300	0.50	2600	390,000	67
Space Heating	1	560	0.50	3000	840,000	144
Space Cooling	2	250	0.30	2000	150,000	26
Service Hot Water	3	30	0.25	8760	65,700	11
HVAC Electricity	30	120	0.60	6000	432,000	74
Miscellaneous	10	95	0.33	4000	125,400	22
Totals		1,430			2,430,600	417

Additional Data Required

- Detailed equipment list
- Detailed weather data
- Equipment operating schedules

Additional Deliverables

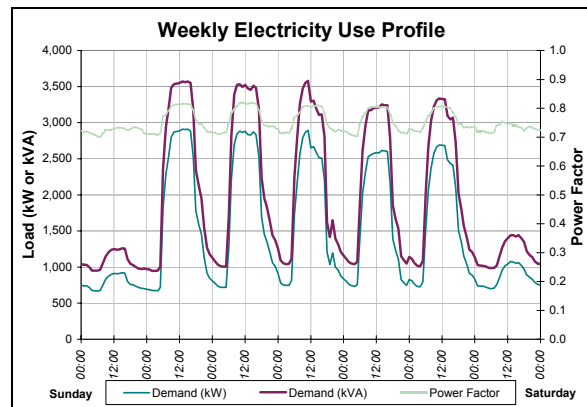
- Energy use and cost summary
- Detailed estimates of cost savings
- Measurement and verification plan



Engineering Audit

An engineering audit includes all the components of a benchmark, walk-through and investment-grade audit, with the addition of detailed analyses of specific systems within the facility. Each level of activity narrows the list of opportunities and an engineering audit focuses on key systems and equipment.

An engineering audit will likely include metering of specific equipment to further refine the energy use model and to more accurately assess the energy savings estimates for a particular initiative. Alternatives are explored and recommendations explained, together with a measure of the costs involved. The deliverable can range from the development of a general energy plan by which to implement specified projects, to a detailed benefit-cost analysis for each initiative.



Additional Data Required

- Specifications/operating curves
- Electric metering & flow/pressure monitoring

Additional Deliverables

- Depends on level: ranges from recommendations and detailed analysis to a detailed engineering design.



Summary

Each of the four levels of audit can be used to reach the energy management goals of a facility. The benchmark audit is best used to provide a general indication of the energy use within a building, in comparison with similar facilities. A walkthrough audit will identify specific systems within a plant that may offer energy and cost saving opportunities. The detailed audit provides an additional level of detail through an in-depth analysis of the energy use of specific equipment. An engineering audit consists of detailed analysis of each opportunity, which leads to an implementation plan or even to direct engineering design.

Audit Type	Scope	Objectives	Schedule
<i>Benchmark</i>	Billing analysis, comparison with weather data and occupancy, energy and cost intensities compared to similar buildings.	Preliminary assessment and data gathering to identify facilities that may have energy saving opportunities.	3-5 days
<i>Walkthrough</i>	Above, plus site walkthrough, preliminary end-use breakdown, identification of systems with energy savings potential and general recommendations.	Preliminary identification of specific energy saving opportunities within a facility.	5-10 days
<i>Investment Grade</i>	Above, plus compilation of equipment load inventory, lighting survey and an energy use model; detailed analysis of equipment operation and estimates of energy savings.	Detailed examination of entire facility, with an emphasis on developing the equipment list, compiling a load inventory and developing an energy use model.	2-10 weeks
<i>Engineering</i>	Above, plus extensive analysis of specific systems, which may include monitoring energy use and process parameters such as flow and pressure; detailed energy savings estimates and recommendations.	Engineering analysis of opportunities to identify specific projects, complete with a benefit/cost analysis and, in some cases, final design for retrofit or equipment installation.	3-16 weeks