

Energy Monitoring

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The trend toward energy performance contracting is stimulating demand for monitoring the use of energy in existing buildings. While this is inherently a mechanical engineering service, architects who offer energy-efficient design and consulting services will find it advantageous to offer energy monitoring services as well.

Energy monitoring services determine actual energy consumption in existing buildings. Clients track building energy use to help them manage their buildings more efficiently and profitably—for example, to control heating, ventilation, and air-conditioning (HVAC) and lighting systems more accurately; to provide data needed for a proactive equipment maintenance plan; or to provide a basis for charging tenants for utility use. The services may apply to a group of buildings, a single building, or a specific system or subsystem in a building.

In performance contracting, consultants contract to deliver specific reductions in energy use and costs through energy retrofit programs. Results are determined through a monitoring program. In new buildings, the trend toward validating the performance of building components and systems through commissioning also drives the market.

Building energy monitoring first emerged as a strong market during the 1973 Middle East oil embargo. Market opportunities can be expected to increase dramatically again with any significant shortages of supplies or increases in energy prices.

CLIENT NEEDS

There are many reasons a client may need energy monitoring services. The overriding motivation is usually to reduce operating costs, but specific reasons will vary for each project. Some clients require energy monitoring to verify results so they can enforce energy performance contracts with energy consultants. In other cases, energy monitoring is required in conjunction with energy-efficiency programs that are not necessarily performance-based. For example, a client may need to monitor the performance of an existing building in order to diagnose problem areas or identify opportunities to reduce energy use or demand. In such cases the energy use profiles of buildings and building components need to be established as a baseline before targets for energy reduction can be developed.

In other cases monitoring may be required to analyze the possibilities for savings through utility rate structure incentives, such as real-time pricing and peak shaving, or to provide a basis for billings under those programs. Owners of rental properties sometimes require monitoring in order to charge tenants for energy use.

For new buildings, energy monitoring is often conducted as part of building commissioning in order to calibrate equipment. Many clients use energy management systems that not only monitor conditions and equipment but also control the equipment to optimize performance, savings, and comfort.

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Summary

ENERGY MONITORING SERVICES

Why a Client May Need These Services

- ▶ To reduce operating costs
- ▶ To verify energy use for performance-based contracts
- ▶ To profile energy performance during building commissioning
- ▶ To diagnose energy-related problems or reduce energy demand
- ▶ To decrease use of energy from central plants or utilities
- ▶ To evaluate the potential for using alternative energy sources

Knowledge and Skills Required

- ▶ Understanding of building services, power, and control systems
- ▶ Ability to use metering and measuring equipment
- ▶ Familiarity of utility rate structures and energy costs
- ▶ Knowledge of applicable energy codes and standards

Representative Process Tasks

- ▶ Define monitoring time span
- ▶ Collect, organize, and analyze utility records
- ▶ Measure and document building energy use
- ▶ Identify conditions contributing to major energy use
- ▶ Document findings and recommendations

▶ **Energy monitoring is frequently part of building commissioning, particularly in larger, more complex facilities such as high-rise offices, hospitals, laboratories, and campuses with centralized energy systems.**

▶ **Energy analysis services can help build improved energy efficiency into the design process.**

▶ **Building energy use is an important consideration in sustainable design.**

The types of clients most likely to require this service are discussed in topic 18.11, Energy Analysis and Design. Within client organizations, facility managers, energy managers, and energy engineers can be good points of contact for selling these services, as reducing energy consumption is often one of their major professional responsibilities. Some consultants are successful in approaching owners of older facilities with less efficient systems and equipment—who probably do not have such staff—and selling them on the energy performance contracting approach. This approach is particularly effective when the consultant can contract to provide services that will pay for themselves within a short time.

As noted, energy monitoring is basically a mechanical engineering service, and many mechanical firms and energy engineering consulting firms offer or specialize in this service. Monitoring can be a necessary step in performing many other services. It is strongly related to energy design services, commissioning, facility surveys, maintenance programs, and sustainable design. Energy monitoring also may be required for general building design or documentation. The ability to offer these services enables an architecture firm to widen the scope of services for existing clients, which is a more efficient strategy for expanding the project base than seeking new clients.

SKILLS

Mechanical engineering is the discipline most closely associated with energy monitoring services. Knowledge of metering and measuring equipment, HVAC systems, and lighting systems is required. Where the project involves mostly lighting, power supply, or utility rate issues, it may be more appropriate to involve an electrical engineer with a good knowledge of lighting and power.

For some projects it may be necessary to involve a controls or instrumentation specialist who will be able to recommend exactly which equipment is best for a job and to provide measurement verification services. The mechanical or electrical engineer on the team should have a general knowledge of metering and measuring equipment but cannot be expected to be expert in all types of equipment.

Projects involving energy management and control systems will require a team member skilled in the use of proprietary energy management software associated with the energy management and control system equipment being used. Good support from the equipment vendor is an important factor in success.

The equipment needed to perform this service will vary according to the goals of the project. Equipment is available to measure virtually any building energy parameter. Sensors can measure temperature, electricity or gas consumption, fluid flows, humidity, and airflow speed. Infrared cameras and handheld devices assess heat loss through radiant surfaces. Portable data loggers can record sensor data periodically (for example, at 15-minute intervals) and upload the information when they are retrieved at the end of a test period. Data loggers are particularly useful for gathering baseline information for energy retrofit projects in older buildings that do not have built-in instrumentation and control systems.

Energy management and control systems provide automatic sensing and equipment controls. They are best used when equipment can be turned on, turned off, or modulated based on schedules, temperatures, pressures, light levels, or the presence of occupants. HVAC and lighting are prime candidates for such controls. Some of the common controls available to help reduce energy consumption include time clocks, occupancy sensors, programmable electronic thermostats, spring-wound timers, and photocells.

Energy management systems (EMSs) often are applied to the largest electrical loads, including HVAC equipment, cooling towers, pumps, water heaters, and lighting facilities. Control functions may include basic stop/start functions or more complex functions such as chiller optimization routines. These systems can be retrofitted and can interface with existing controls, such as pneumatic damper actuators. By tracking system operation using an EMS, a facility manager can perform diagnostics and optimize system performance.

PROCESS

Some of the major determinants of project scope include the size, number, age, and condition of the buildings involved; whether energy is derived from a central plant (steam, co-generation); and the number and type of meters installed.

Establishing a clear understanding of project objectives is always the first step. If possible, kick off a project by meeting with the end users of the data. For example, a maintenance engineer who wants information to establish a proactive equipment maintenance plan will have different data needs than a design team wishing to optimize occupant comfort and control. If the goal is to reduce building energy use by a target amount, the monitoring program will be quite different than if the goal is to reduce the lighting load only.

A key question is whether the client wants short-term monitoring or installation of permanent monitoring equipment, perhaps coupled with control mechanisms. Owners of very large or widely dispersed facilities are strong candidates for energy management and control systems, although such systems should be considered in any facility expansion or retrofit project.

Another question is whether the client wants only load data gathered or additional analysis services. For retrofit projects, analyzing the cost-effectiveness of various retrofit services, equipment options, or design options is an obvious adjunct to data gathering. In those cases it may be best to contract for a preliminary study that would involve initial monitoring, analysis, and recommendations. A follow-on contract would cover the retrofit work.

If clients want monitoring services only, the usual deliverables are reports on methodologies and findings and backup information (e.g., operation assumptions, input data, computer printouts of analyses).

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The AIA provides a contract document designed especially for alternative architectural services.

B102–2007, Standard Form of Agreement Between Owner and Architect without a Predefined Scope of Architect’s Services.

AIA Document B102–2007 is a standard form of agreement between owner and architect that contains terms and conditions and compensation details. B102–2007 does not include a scope of architect’s services, which must be inserted in Article 1 or attached as an exhibit. Special terms and conditions that modify the agreement may be included in Article 8.

The separation of the scope of services from the owner/architect agreement allows users the freedom to append alternative scopes of services.

AIA Document B102–2007 replaces and serves the same purpose as AIA Document B141–1997 Part 1.

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