Using Data Loggers to Meet LEED® Existing Building Certification Credits

Green building is no longer a small niche industry in the United States. Energy engineers, energy auditors, building commissioners, project managers, architects and designers all recognize that energy- and resource-efficient approaches to construction and operation not only make better and more responsible use of materials and energy, they usually save money in the long run.

Though much focus is on new construction, much can be done for existing buildings to increase efficiency and lower operational costs. The US Green Building Council's LEED for Existing Buildings Operations & Maintenance certification program was developed specifically to allow these buildings to attain recognition through documentation of building performance improvements.

Since data collection and documentation is a cornerstone of this certification, it's important to be aware of the data logging tools available for such applications. Choosing the best data loggers will make collecting data and providing documentation of building performance easy and affordable.

The ideal tools for such applications are battery-powered data loggers. These devices can monitor, log, and document equipment performance and environmental conditions unaided, for months at a time, and they are cost-effective and simple to use.

This guide will provide information about how data loggers can make satisfying many LEED for Existing Buildings O&M credits simple. Whether you are just getting started with the certification process by performing an assessment of an existing building's performance, or are plunging into documenting performance improvements for submission to the U.S. Green Building Council, battery-powered data loggers are the right tools for the job.

LEED Certification for Existing Buildings

The US Green Building Council's LEED rating systems address criteria which fall under broad categories such as Sustainable Sites, Water Efficiency, Energy & Atmosphere, Materials & Resources, and Indoor Environmental Quality.

There are pre requisites in most LEED rating system catagories which must all be satisfied for any level of certification.

Within each category are credits which describe how points may be earned for a given project. The number of points earned by a project determines the level of LEED certification for that project. The credits are presented in a standard format: the title of the credit is followed by its intent, the requirements for the credit, and potential strategies and technologies for meeting that credit.

(Excerpted from *LEED for Existing Buildings Operations & Maintenance*, April 2008)

Energy & Atmosphere Credit 2.1: *Existing Building Commissioning: Investigation and Analysis*

2 points

Intent

Through a systematic process, to develop an understanding of the operation of the building's major energy-using systems, options for optimizing energy performance and a plan to achieve energy savings.

Requirements

Conduct one of the following:

Option A. Commissioning Process

- Develop a retrocommissioning, recommissioning or ongoing commissioning plan for the building's major energy-using systems.
- Conduct the investigation and analysis phase.
- Document the breakdown of energy use in the building.
- List the operating problems that affect occupants' comfort and energy use, and develop potential operational changes that will solve them.
- List the identified capital improvements that will provide cost-effective energy savings and document the cost-benefit analysis associated with each.

Option B. ASHRAE Level II Energy Audit

- Conduct an energy audit that meets the requirements of ASHRAE, Level II, Energy Survey and Analysis.
- Document the breakdown of energy use in the building.
- Perform a savings and cost analysis of all practical measures that meet the owner's constraints and economic criteria, along with a discussion of any effect on operations and maintenance procedures.
- List the identified capital improvements that will provide cost-effective energy savings and document the cost-benefit analysis associated with each.

Potential Technologies & Strategies

Based on the building operating plan and systems narrative, confirm that all building systems and equipment are functioning as appropriate according to the equipment schedule. Conduct testing and analysis to ensure that building systems and equipment are functioning correctly. Identify opportunities to make no- or low-cost capital improvements to enhance building performance.

Earning a credit may involve monitoring and assessing more than one system in a building. For instance, addressing the following credit might involve monitoring energy use of the HVAC system, manufacturing or office equipment, lighting, and other systems.

The Energy & Atmosphere family of credits in this example covers a lot of territory, in that multiple systems must be monitored over time in order to earn points. Under Option B, data collection and documentation on many fronts is essential to not just this credit, but many in the certification program. The challenge, therefore, is to find a simple, low-cost way to gather the necessary data and document it for analysis and submission.

Data Loggers

Data loggers are well-suited to monitoring and documenting building performance. They are small, low-cost, rugged devices that can take unattended measurements of a wide variety of parameters 24 hours a day for months at a time. The data they collect is time-stamped, and can be easily downloaded to a personal computer for analysis, formatting and presentation.

Battery-powered data loggers consist of a logger and one or more sensors. The logger is typically smaller than a deck of cards, and can be easily attached to walls or suspended from equipment. The sensor or sensors are either built into the logger unit, or plug into the logger via a cable.

The ability to accurately measure and document systems performance in existing buildings is an important aspect of the LEED for Existing Buildings certification process. Hand-in-hand with that is the need for continuously-recorded baseline data to understand how, for example, a boiler/solar hot water heating system is performing over time in order to make energy improvements.

Applications Examples

Following are two examples of how you might use battery-powered data loggers in systems-monitoring applications contributing LEED credits.

Boiler Efficiency Monitoring

Inappropriate configuration or sizing of a boiler wastes fuel and inflicts excess wear and tear on components from too-frequent starting and stopping. The best time to monitor boiler performance is during a very cold period in the middle of the night. Though it's extremely useful to monitor activity for much longer periods, and LEED documentation requires it as part of the documentation for certain credits such as EAc2.1 – Existing Building Commissioning: Investigation and Analysis Option B ASHRAE Level II Energy Audit and EAc3.2, 3.3 .

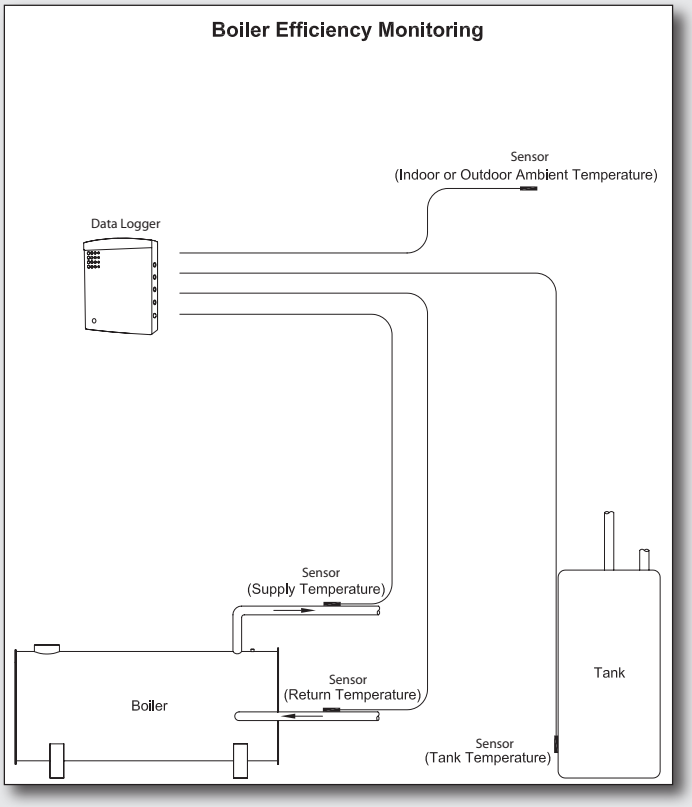

Figure 1: *Example of the placement of data logger and temperature sensors for boiler monitoring.*

One use of data loggers in boiler performance assessment (see Figure 1) is to monitor temperature throughout the system: temperature of boiler water supply and return, temperature in the hot water tank, and the ambient temperature. Employing data loggers for these monitoring applications enables all data to be time-stamped and documented, and that data can then be correlated with energy and fuel consumption for the entire unit.

Indoor Environmental Quality (IEQ) Monitoring

Monitoring and optimizing the quality of the indoor environment has been proven to promote higher productivity in the workplace, yield fewer sick days, and simply keep occupants more comfortable. Optimizing such thermal comfort, air quality and lighting characteristics can also save money and energy. The US Green Building Council puts a high priority on IEQ in all its certification programs.

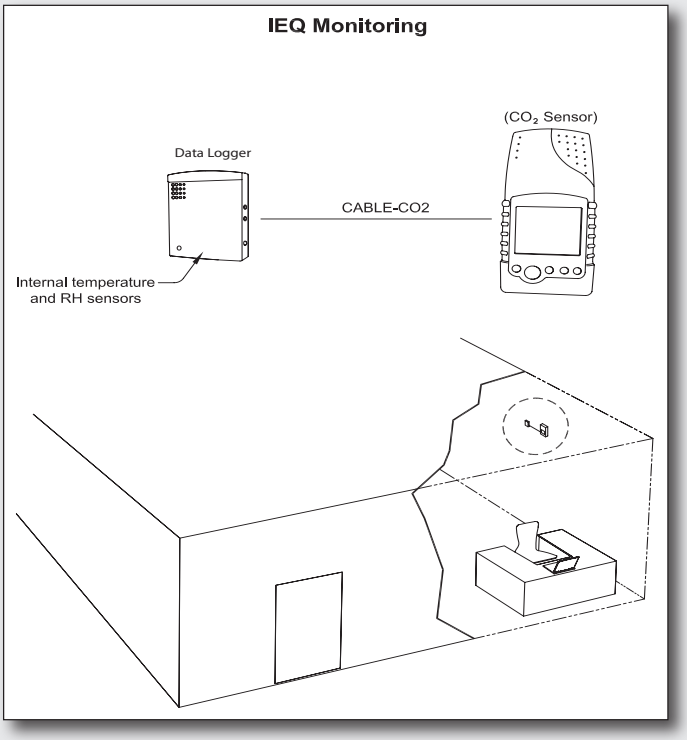

Figure 2: *Example of data logger and CO_2 sensor placement for IEQ monitoring.*

In Figure 2, a data logger is used to monitor temperature, relative humidity, and CO_2 levels in an office space. A sensor built into the logger records temperature and relative humidity, and an attached sensor monitors CO_2 levels; both are easily attached to the wall. All three parameters are monitored and recorded all day, every day, and that time-stamped data can easily be downloaded for documentation and analysis. Such devices are cost-effective, allowing for deployment in many building locations at the same time.

This data can be used to improve occupant comfort and also to distinguish real problems from random baseless complaints.

Before you choose the best data logger for a given LEED documentation challenge, here are several points to consider:

Measurement Parameters

Battery-powered data loggers can monitor a wide range of indoor and outdoor parameters, depending on the manufacturer. Options can include the following, singly or in combination: temperature, relative humidity, light intensity, CO_2, DC voltage, AC voltage, kW, kWh, differential pressure, events, light on/off, motor on/off, rainfall, wind speed and carbon monoxide.

Consider how many loggers you will need. Will you monitor motor runtime of four rooftop HVAC units at the same time, or will you monitor each individually as separate projects? Do you need to measure power usage in four circuits at once or in eight? Also consider cabling requirements; manufacturers often offer an assortment of cable lengths for connecting sensors to loggers.

Data Offload

For most building applications, data download is usually done on-site. In the most straightforward systems, data download is achieved by connecting a laptop computer equipped with the appropriate software to the logger with a cable. The software automatically recognizes the logger and downloads the data in less than a minute. Alternatively, data can be downloaded to a shuttle-type device. These small hand-held units can hold data from multiple loggers and relaunch them without users having to take a laptop out of the office.

Software and Documentation

All data loggers use software for setup and configuration, but some manufacturers demand more from their users than others. User-friendly loggers can be set up and launched by someone with no training in electrical wiring or programming. The user just connects the logger to a PC and the accompanying logger software automatically recognizes the device and asks a series of configuration questions. The user simply chooses a sampling interval and selects an immediate or designated future launch time. There is no wiring or programming involved.

Ask about the software that comes with a logger. Applications are generally Windows-based, but some manufacturers also make Macintosh versions. The software should enable you to quickly and easily perform tasks such as setting configuration parameters, designating launch times, and offloading data with point-and-click simplicity.

Check the software's graphing and analysis capabilities, including whether you can combine graphs to compare data between projects, or if you can view all of a site's data clearly in a single graph. Depending on the scope and type of data, the manufacturer may also have special application-specific software available.

Since data often needs to be passed into other software programs such as spreadsheets or modeling programs, make sure that the logger software allows you to quickly and easily export data with the click of a mouse. Also be sure that you can print graphs and tables for LEED documentation purposes.

Durability

While some data loggers sit comfortably in office hallways, others are subject to grueling environments. From winter rooftops to sub-basement boiler rooms, data loggers are often required to work under tough conditions.

Make sure a logger's enclosure is designed to withstand the conditions it will be subjected to. For example, in an office hallway a hard plastic enclosure should suffice. On the other hand, if a logger will be deployed outside, choose one with a waterproof enclosure.

Cost of Ownership

Today's battery-powered data logging devices are very reasonably priced, and can be a real value if you plan to use them over and over again in multiple applications. It is, however, important to look closely at the total cost of ownership when shopping around. Will the logger need to be periodically calibrated by the manufacturer, and if so, how much will it cost over time? How much does the software cost? Asking these questions will help you understand the true cost of owning the data logger over the long-term.

Conclusion

The goal of the US Green Building Council's LEED for Existing Buildings: Operations & Maintenance rating program is to recognize efforts to maximize performance efficiency of existing buildings. Satisfying the credits necessary to attain certification means being able to collect and document data on a wide range of building systems, and battery-powered data loggers are the ideal tools to use for such applications.

About Onset

Onset Computer Corporation has been producing small, inexpensive, battery-powered data loggers and embedded controllers since 1981, and has sold over one million loggers that are used around the world by over 50,000 customers. The company manufactures a broad range of data logger and weather station products that are used to measure temperature, humidity, light intensity, voltage, and a broad range of other parameters. Onset products are used widely in research, commercial, industrial, and educational applications.

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