Continuous Auditing—Taking Energy Auditing to the Next Level

Eric Oliver, PE, CEM

ABSTRACT

Building owners and managers are always looking for creative, cost effective ways to reduce their energy consumption, and thereby energy expenses. It is well known that the first step in an energy reduction strategy is a full assessment of the current operations of the building, typically accomplished by an energy audit. An energy audit involves a full walkthrough of the building by a professional auditor, typically certified as a Certified Energy Manager (CEM) or Professional Engineer (PE). As part of this walkthrough, the auditor identifies all areas of energy consumption, and develops a full list of energy saving strategies, also known as energy conservation measures, or ECMs. This article takes energy auditing to the next level, introducing the concept of "Continuous Auditing," where an energy expert analyzes real time building data over several months, identifying energy waste and recommending additional ECMs as new opportunities identify themselves. The tool for this process is real time monitoring, and the result can be 15% to 30% more energy savings than an initial energy audit alone.

INTRODUCTION

Imagine how healthy you would be if you had a team of expert physicians monitoring every joint, muscle, and tendon in your body at all times. You could be playing pickup basketball, shuffle right to guard a player, and feel a twinge in your knee. You keep playing, but when you get to the bench, there's a text message from your doctor saying "you sprained your knee. Put ice on it and take two aspirin." Or you're sitting at work, feeling a little light-headed, and the phone rings. It's your doctor, and he says, "You have a temperature of 100.5—go home and take some fever reducer and get some rest." With this kind of attention, you'd be healthier than you've been in your whole life.

Now imagine how energy efficient your buildings could be, if you

had energy experts monitoring every area of energy consumption, in real time, all the time. When an energy spike hits your building, the expert knows exactly where it's coming from, and calls your engineer to tell him to fix a damper, or turn off a bank of lights, or reset a thermostat. That building would be operating at its peak efficiency, all the time.

BEYOND THE AUDIT

A comprehensive (or ASHRAE Level II) energy audit is very effective at determining the most cost effective strategies for saving energy in a building, but there are some drawbacks. For one, the walkthrough audit gives the auditor an excellent snapshot of the building's operations at that time, but not the full picture of changes in operations over the course of the year. For example, if the building is audited in the winter, the auditor would likely not see how the chillers or cooling strategies function. Another drawback is that savings calculations for ECMs are based on assumptions for inputs such as runtimes, temperature setpoints, and use of override schedules. If these assumptions are not accurate, the savings may be underpredicted, or overpredicted. To achieve the maximum amount of energy savings with the most accurate calculations, it would be essential to survey the building over all seasons, with accurate before and after data for all energy-consuming systems.

The difference between energy auditing and continuous auditing is similar to the difference between building commissioning and Continuous Commissioning®. With building commissioning, mechanical, electrical, and controls systems are analyzed and tested all at once, before the building becomes occupied, to identify and correct any deficiencies. Continuous Commissioning® is defined as "an ongoing process to resolve operating problems, improve comfort, and optimize energy use for existing commercial and institutional buildings and central plant facilities"[1]. With continuous commissioning, major building systems are monitored on an ongoing basis, and failures or deficiencies with major equipment (such as overheating or power failures) are caught before they become major problems.

With continuous auditing, an auditor performs an initial building assessment and gathers data relating to all energy-consuming systems. Then, the building owner installs real time monitoring (RTM) equipment, ideally on all end-use circuits. These data are fed to a dashboard in real time, where the auditor can analyze trend data and look for

spikes and anomalies indicating energy waste. The auditor works with the facilities engineers and operators to mitigate energy waste and reduce energy consumption based on observations from the data. Over the course of 12-24 months, the auditor continues to monitor the building in real time, identifying ECMs and areas of waste based on new data. The net result is a building operating near its peak efficiency, over the course of all seasons.

With the ideal setup, the real time data from all circuits feed into a dashboard, where the energy experts can recognize when consumption is above normal, or above what's expected, and drill down to the specific circuit that is causing the energy waste. Figure 1 shows the real time consumption of a city hall building for one day in January[2]. As you can see, there is a spike around 2:00 a.m. that cannot be explained. Drilling down into the detailed consumption data, which can be seen by circuit, it becomes apparent (Figure 2) that the supply fan for one of the air handling units is spiking when it comes on. Implementing a slow-start into the existing variable speed drive will eliminate this spike and perhaps save energy.

Another example is shown in Figure 3. Looking at the real time data for the parking lot lights shows that 280 Watts of power is being consumed during the day, even though the parking lot lights are supposed to be controlled by photocell. A quick call to the engineer will lead to identifying the lights that are not controlled by photocell, and

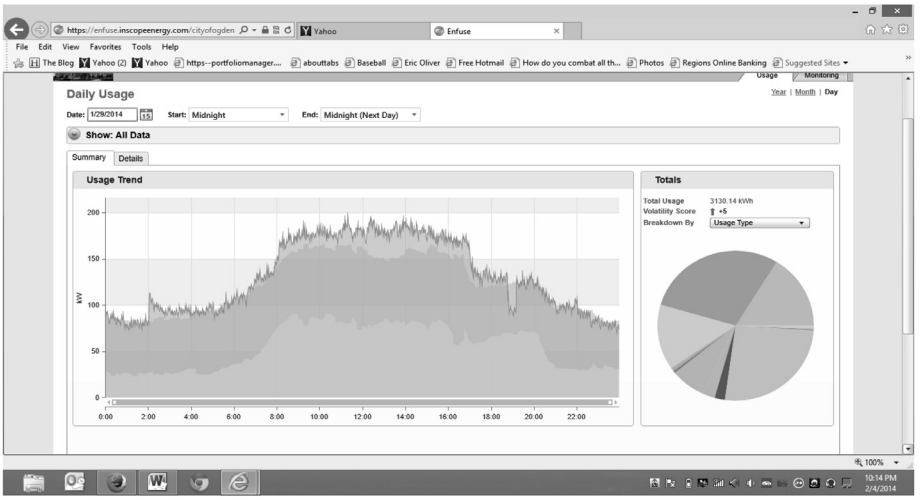

Figure 1. whole building real time energy data

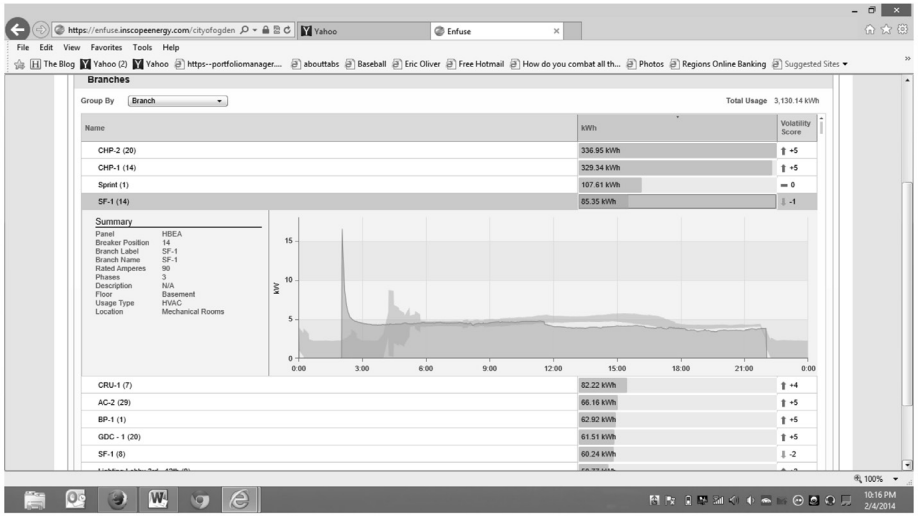

Figure 2. Supply Fan real time energy data

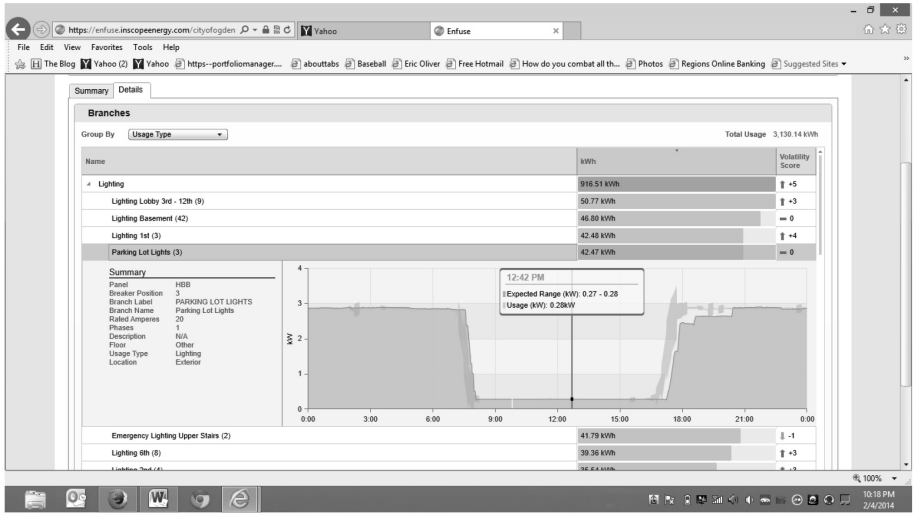

Figure 3. Parking lot lighting real time energy data

connect them to the photocell, saving energy and peak demand.

With continuous auditing, energy savings calculations are decidedly more accurate, since there are recorded data that will show exactly how equipment was operating prior to implementing the ECM. If the continuous auditor knows exactly when a recommended ECM is implemented, he can observe before and after data, and quantify

exactly the energy saving effects of implementation. Therefore, measurement and verification (M&V) of implemented ECMs is built in, as post-implementation data can be compared to pre-implementation data using the dashboard. The primary benefit of continuous auditing is that energy waste that may not have been identified during an initial walk-through, can be flagged and mitigated in real time, before it results in significant excessive energy costs.

For this particular study, the initial survey led to an initial set of now cost/low cost ECMs, which were projected to save 5% of the building's energy consumption. Each month, the real time data were analyzed, and new ECMs were identified and recommended. Over the course of the first 4 months of analysis, a total of 40 no-cost/low cost ECMs were identified and recommended. The total projected savings was 17%, summarized in Table 1. Many of the ECMs addressed issues that were not observed during the short initial energy audit.

Table 1

Month	# of additional ECMs recommended	Projected additional kWh savings
January, 2014	16	152,800
February, 2014	10	44,050
March, 2014	7	15,180
April/May, 2014	7	63,090
	40	**275,120 (17%)**

CONCLUSION

Implementing a continuous auditing program for a 12 month period can identify an additional 15% to 30% energy savings over what would be identified by a single one-time energy audit. These savings are often implemented with little to no additional capital expenditures since they are generally based on enhancements to controls or behavioral changes (such as leaving computers on at night). The initial cost of continuous auditing includes the installation of real time monitoring hardware, and the initial energy baseline assessment. The only other costs are small monthly fees for the monitoring service, and the return on investment is typically 2-3 years. Additional benefits include better operating equipment, identification of system malfunctions before they become real problems, and

a better understanding of how a building operates. Like a healthy body, your buildings will last longer and cost less to run.

Table 2

Energy Audit	Continuous Auditing
Facility assessment is a snapshot in time	Ability to analyze the performance of the building across time and seasons
Energy savings based on assumptions and projections for operations	Energy savings based on actual run-hours and performance metrics in real time
	Abnormal energy consumption identified and corrected before it wastes too much money
ECM M&V can be a separate Task Order	Post ECM-implementation performance measured and verified as part of the process.

References

[1] Continuous Commissioning, Texas A&M, http://esl.tamu.edu/continuous-commissioning

[2] Inscope International, Inc "Enfuse" software and dashboard, https://enfuse.inscopeenergy.com/cityofogden

---

ABOUT THE AUTHOR

Mr. Oliver is the managing director of Lilker EMO Energy Solutions (formerly EMO Energy Solutions). He is a Professional Engineer (PE) licensed in Virginia and Maryland, a Certified Energy Manager (CEM), and Leadership in Energy and Environmental Design (LEED) Accredited Professional with over 24 years of energy and utility management experience specializing in demand-side energy management, energy audits, sustainable design, facility assessments, and energy simulation modeling with experience in the private, utility, and government sectors. He has been responsible for managing domestic and international projects by conducting and overseeing a number of analyses, including facility energy and utility assessments and conservation and energy purchasing options. He is a former chapter president of the AEE-NCC chapter, board chairman of the Virginia Sustainable Buildings Network, and founding board member of the USGBC National Capital Region Chapter. He has conducted energy training seminars, developed energy awareness and education campaigns, and has been a presenter and moderator at several energy conferences. Eric can be contacted at eoliver@lilkeremo.com.