HOW ENERGY-USE DATA CAN DRIVE DOWN ENERGY COSTS

Facility executives have found that ready access to comprehensive data and powerful analytics can bring significant energy savings

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INTRODUCTION

Most buildings have a golden opportunity to trim operating costs by reducing energy consumption. But even though energy-efficient equipment and practices can deliver solid bottom-line returns, a variety of barriers make it difficult for facility executives to justify investments in efficiency measures.

A key to taking advantage of energy-efficiency opportunities is the use of data. Commercial and institutional buildings are capable of producing vast amounts of data. That data can serve to identify and remedy problems that lead to energy waste, to pinpoint and justify the best opportunities for upgrades, to establish priorities for action, and to monitor and verify the performance of energy efficiency measures.

This eBook examines the ways that leading facility departments are using energy performance data in conjunction with their building automation systems to improve energy efficiency. Having a way to capture and easily use energy data has enabled this diverse range of organizations to improve energy efficiency in ways that range from finding and fixing problems that wasted energy to monitoring the energy performance of building systems to implementing powerful analytics approaches to improve efficiency.

OPPORTUNITY FOR ENERGY SAVINGS

Advances in technology, new design strategies, and better operating practices are making it possible to slash facility energy use. Over the years, those gains have translated into more energy efficient commercial and institutional buildings. But the savings that have been achieved represent only a small fraction of the energy efficiency opportunity.

How much more opportunity is there for energy efficiency? A great deal, according to DOE data/ the most recent statistics from the U.S. Department of Energy. The average commercial building consumes 80,000 Btu per square foot, giving it an EUI of 80. The most efficient buildings, by contrast, have EUIs under 20.

But capturing those savings isn't an easy task for facility executives. One challenge is finding the best opportunities for energy efficiency. Large buildings are extraordinarily complex, and campuses even more so. Every facility is different. Energy may be wasted by a clogged air filter, a temperature setback that was overridden for a particular occasion and left that way, or a damper that is stuck open — problems that are easy to remedy but very hard for most facility executives to find.

There are many other energy-efficiency opportunities presented by upgrades of aging equipment. Improvements in technology have led to more efficient HVAC, lighting, and controls options. But, according to DOE data, less than 10 percent of commercial buildings had formal energy management plans and less than 15 percent had installed building automation systems. What's more, only about 20 percent of

existing buildings reported having implemented HVAC or lighting upgrades.

Most large commercial buildings already are equipped with building automation systems that can help manage energy use. The problem is those controls often are not properly programmed or have been allowed to deteriorate over time, creating unnecessarily large power bills. A 2017 report by the U.S. Department of Energy's Pacific Northwest National Laboratory (PNNL) found that if commercial buildings fully used building management and energy information systems controls, the average building could save 29 percent was the average savings achievable. And some building types could save even more. For example, secondary schools could save about 49 percent, while standalone retail stores could save 41 percent.

As might be expected, inefficient buildings have the most to save — between 30 and 59 percent. Typical buildings could reduce energy consumption 26 to 56 percent. But even efficient buildings could benefit; PNNL estimated that energy savings ranging from 4 to 19 percent would be possible even for efficient buildings.

BARRIERS TO ENERGY EFFICIENCY

Given the enormous cost savings possible from energy efficiency, it may be surprising that more organizations haven't upgraded their buildings. But significant barriers get in the way of energy efficiency. Consider the capital investment and operational expense structures of facilities. The cost of the initial design and construction of a building, whether it's a structure on a college campus, a major hospital, or a high-rise office building, involves a major capital expenditure. Too often, those projects are awarded to a bidder who meets minimum standards at the lowest cost, not to the bidder who will deliver the most long-term value in the operation of the building.

Even with a well-designed new building that has been properly commissioned, it isn't long before energy performance deteriorates. The problem is that organizations don't budget for ongoing capital investments. Instead, capital funds typically are freed up when a piece of equipment fails or is on the verge of failure. In fact, it can be difficult for facility executives to get funding even for low-cost steps that would improve energy efficiency performance.

The typical lease can be another obstacle to energy efficiency. In a triple net lease, the tenant pays for energy costs, but it's the landlord who must absorb the cost of capital improvements that reduce energy consumption. And it's the tenant, not the landlord, who reaps the benefits of energy efficient upgrades, even if the landlord paid for the upgrades that produced the energy savings. This split incentive — where the cost falls on the landlord, but savings goes to the tenant — has long been an obstacle to energy efficiency investments in commercial space.

One way to remedy that split incentive is to use "green leases." According to Green Lease Leaders, "Green leases, also known as 'high-performance' or 'energy-aligned' leases, create win-win agreements for building owners and tenants by equitably aligning the costs and benefits of energy and water efficiency investments for both parties." These leases are attracting growing attention among tenants and landlords looking to improve energy efficiency. But green leases still represent only a small percentage of all leases.

THE POWER OF DATA GOES UNTAPPED

One reason it is so difficult for facilities to get funding for energy efficiency improvement is that buildings are often viewed as a fixed cost within the enterprise. As a result, selling the boardroom on energy efficiency investments becomes a major challenge.

Data can be a powerful tool to justify funding for energy efficiency measures. Sophisticated analytics can help to identify the investments that will produce the highest return, while data monitoring can measure and verify savings, enabling the facility executive to demonstrate the bottom line impact of energy efficiency and helping to smooth the path to future energy upgrades.

While many facilities are capable of producing large volumes of data, they often don't use that data to analyze long term trends that can reveal opportunities for energy savings. This is typically a resource challenge.

Facility staff is often tied up responding to complaints, managing projects, and dealing with equipment failures — all important issues that need to be dealt with. Unfortunately, when a facility staff spends a large percentage of its time reacting to problems or putting out fires, it doesn't have the time to gather and analyze data. Since facilities rarely look at the data, they miss a unique opportunity to have the data provide a return on investment for continuous improvements.

In fact, facility managers may not even realize how much data, beyond daily equipment operations, is available to them, and so may not realize that there are gaps in the metering and monitoring of energy demand and consumption.

It gets to be a vicious circle. The need to react to problems robs facility staff of the time to learn how to take advantage of data. And because facility staff can't use data to prevent problems, the result is more time spent dealing with failures and complaints.

VALUE OF DATA FOR ENERGY EFFICIENCY

According to The U.S. Department of Energy's "Energy Data Book," HVAC systems account for 41 percent of a commercial building's total energy use. An HVAC system may initially be designed to be energy-efficient. Over time, however, the system will begin to drift away from optimum performance. As sensors go out of calibration, belts loosen and slip, and air filters get clogged causing increased effort on fans and motors, HVAC energy use rises.

Today, software can enable constant commissioning using fault detection and diagnostics to ensure that buildings are optimally tuned. And the investment in data continues to pay dividends through the life of the building.

With constant commissioning and fault detection and diagnostics software, the facilities department can make sure preventive maintenance is scheduled when it's needed and notify the facility manager in real time exactly when that maintenance is being performed by staff or outside vendors. In addition, as elements of the HVAC system drift out of tune as time passes, looking at performance trends for low-cost improvements with can yield significant savings.

A 2018 updated study from Lawrence Berkeley National Laboratory (LBNL) and the Building Commissioning Association examined almost 1,500 buildings and found that commissioning projects for existing buildings offered reliable cost-effective savings with a median simple payback of 2.2 years.

When facility managers get the boardroom's approval to purchase a new efficient chiller to replace one that is near failure, the building may see savings on energy consumption related to that chiller. But an investment in data can also have a powerful energy saving impact. If the facility staff can procure software to gather and analyze data, and then learn to tap the potential of that software by blending energy metering with equipment operations data, the return on investment isn't limited to a single piece of equipment.

For example, if data makes it possible to improve all air handling units by eliminating performance faults, the facility can potentially see a significant savings on the total energy budget. Financial people often refer to that broader effect as economy of scale.

A good example of the value of constant commissioning comes from California's San Leandro Tech Campus (SLTC) Phase I, a 132,000 square foot office building and a 120,000 square foot tenant improvement constructed according to Leadership in Energy and Environmental Design (LEED) Gold certification by the U.S. Green Building Council. Application of constant commissioning and fault detection through OSIsoft's PI System identified an 8 percent savings in its first three years of being open.

THE PI SYSTEM

OSIsoft's PI System allows facility management departments to move from reactive cost centers to proactive contributors to the organization's bottom line by improving overall building performance across many systems and subsystems nearly simultaneously. Real-time data access and visualization allow facility executives to monitor mechanical and electrical equipment, staffing resources, and utility metering and submetering data holistically. Through server-based technology, the PI System makes historical and real-time data instantly accessible to facility staff wherever they are.

More than 450 interfaces can be connected to the PI System. Both time-series and event-based data can be accessed from multiple systems or sources.

A highly scalable, open infrastructure allows the customized PI System to grow from as few as 250 data points into millions. That flexibility means facility management users can begin with an initial small-asset deployment and easily expand to accommodate future applications.

In addition, the PI System can include a selection of add-ons and compatible extensions to expand the initial system's impact on organization's overall environment, as well as the bottom line.

CASE STUDY

UC DAVIS USES DATA TO SAVE ENERGY

Today, many leading organizations have learned that data is invaluable in efforts to reduce energy costs. A good example is the University of California, Davis. Tracking building performance and its impact on energy use is essential for that institution, which spends $25 million annually on gas and electricity. The campus has its own utilities to serve about 1,200 buildings totaling 13 million square feet.

All University of California campuses want to achieve carbon neutrality by 2025 and UC Davis is on track to meet that goal.

Two teams within facility management use data to generate operational improvements. The Buildings Energy Engineering team implements energy savings projects and recoups financial savings to fund its operations. The Utilities Data and Engineering team supports utilities systems operations and growth.

The collaboration already has generated more than $500,000 annually in utility savings, with total potential energy savings projected to be an estimated $3.5 million within the next few years.

The PI System operates as a sophisticated energy information system. It has 150,000 tags that collect data from all utility meters, HVAC systems, central plant, water and wastewater, Wifi network, weather stations and analytics. The result is constant monitoring of building energy meters and the HVAC central plant's control systems. Electricity and gas usage data is collected, aggregated, analyzed, reported, and presented on a web-based dashboard with performance tracking.

The constant monitoring of building performance has resulted in significant benefits. For instance, staff noticed a spike in student housing natural gas consumption, which they quickly attributed to a gas leak in the laundry space. Fixing the leak avoided a major safety issue and produced immediate gas savings.

Because UC Davis measured and verified its energy savings through Pacific Gas & Electric's Monitoring-Based Commissioning Program, the campus was able to claim full rebates, actually generating a revenue stream in addition to energy savings.

CASE STUDY

NASA ZEROES IN ON ENERGY SAVINGS

Federal mandates set energy consumption baseline and goals for federal facilities. To meet those goals, NASA Langley Research Center developed a real-time energy management system that provides not only summary reporting and data extraction but also live feedback on power demand and energy consumption for its 130 buildings.

This vital information allows incremental adjustments to be made as necessary. Use of the PI System also allows custom dashboard displays that are meaningful to building operators and occupants.

Each fiscal year, NASA's goal is a 2.5 percent annual reduction in energy intensity from its 2015 baseline. The space agency is using data to find savings. For one building (1247D), NASA's facility department was able to demonstrate a 1,850 kwh demand in December 2015 that was reduced to just 200 kWh for the same week in December 2016. The annual savings from that one building are expected to reach 14,500 Mwh.

OSIsoft.

CASE STUDY

A LARGE MULTI-NATIONAL PHARMEUCITAL COMPANY FORESEES SAVINGS FROM GLOBAL ENERGY DASHBOARD

The pharmaceutical manufacturer has a vision for moving its enterprise into the digital-plant age, and part of that vision includes a global energy dashboard, using an Enterprise PI System and advanced analytics. The energy dashboard standardizes energy monitoring, reporting, and benchmarking.

In a pilot program, looked at a typical air handling unit (AHU) layout. A base AHU template and 10 derived templates for specific AHU types across its global properties were developed, as well as specific temperature faults for each AHU type. The templates were deployed at two sites initially to fine tune key performance indicators and fault calculations.

Four months later, AHU templates were operating at nine additional sites. As soon as data was connected and the templates applied, the energy dashboard went live. Pilot results led to a monthly prediction model based on 2012-2016 data that were normalized for weather and occupancy. Based on these results, the company expects about an 8 percent energy savings at any given deployment site.

Potential future development may use the PI System to capture the duration of energy faults and analyze zone conditions downstream of the AHUs. The PI System also can look at how those faults are affecting performance and then apply the cost of energy to determine how much the malfunction is costing.

CONCLUSION

Building performance data offers a tremendous opportunity to reduce energy costs throughout one building or across an entire portfolio of buildings. Energy performance data can identify operational problems that waste energy, highlight the best upgrade opportunities, and provide a window into the real world performance of a building system after upgrades are in place.

Today, leading organizations are taking advantage of the opportunity to use data to improve energy efficiency. They are implementing constant commissioning, fault detection and diagnostics, energy dashboards, and other ways to improve building energy performance and to measure and verify savings after energy efficiency upgrades.

To get the most out of data, facility executives need a system that can gather data from across the building, campus, or portfolio, analyze and report that data, and support tools to identify problems that waste energy.

ABOUT OSISOFT

OSIsoft is dedicated to helping people transform their world through data. OSIsoft's PI System captures data from sensors, manufacturing equipment and other devices and turns it into rich, real-time insight to improve productivity, make critical decisions and develop new products. Over 1,000 leading utilities, 90 percent of the largest oil and gas companies and more than 65 percent of the Fortune 500 industrial companies rely on the PI System to get the most out of their businesses. Worldwide, the PI System manages over 2 billion data streams. To learn more, please visit www.osisoft.com.

Visit our Facilities page to learn how our customers are using the PI System to improve their facilities, or visit our OSIsoft Overview page to learn more about OSIsoft and the PI System.

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