Big Data for Energy Efficiency

With the right energy-efficiency measures, districts can reduce energy use and costs, and shrink buildings' environmental footprint.

By Terry Bickham, CEM, LEED AP, CSDP

Doing more with less has become business as usual for school administrators and business leaders. They are constantly on the lookout for ways to reduce overhead costs while still creating the best possible educational experience for students, faculty, and staff. That endeavor includes providing the right physical environment for learning—an environment that is safe, secure, healthy, comfortable, and productive—without breaking the bank.

School district leaders can address all those factors at one time by improving the energy efficiency of their school buildings and reducing total operating costs. That's possible through the know-how of experienced energy engineers and innovative energy advisory services driven by the readily available building performance data that can be converted into actionable information. Districts can realize substantial energy-saving and cost-saving improvements with little or no impact on scarce capital or operating budgets.

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There is plenty of room for improvement in schools' energy performance. According to the Department of Energy, K–12 schools spend more than $8 billion on energy annually, making energy schools' second-highest operating expenditure after personnel costs. A typical public school district spends more on energy than it does on computers and books combined. Energy Star (www.energystar.gov) estimates that 20%–30% of that energy is wasted because of inefficient buildings and ineffective energy management strategies.

Implementing the right portfolio of proven energy-efficiency measures can help schools reduce energy use per pupil or square foot, trim waste, improve building system reliability, and shrink the building's environmental footprint. Energy and operating cost savings can be applied to other district priorities, such as hiring teachers, purchasing new equipment, or improving the physical structure.

The challenge comes in identifying, selecting, and prioritizing energy-efficiency measures that will have the greatest impact on energy consumption and the organization's budget.

Visualize the Invisible

Conducting a comprehensive energy audit at the outset of any energy-efficiency initiative is beneficial. Few school districts have the in-house resources, time, or

funding needed to conduct a comprehensive energy audit in the traditional sense. Nonetheless, it is critical for organizations to know and understand the current state before launching an energy-efficiency initiative.

Energy advisory services accelerate the audit process by making use of "big data"—the thousands of data points related to a building's energy performance that are readily available to most organizations. Using big data makes the invisible visible and lets energy engineers and their customers see where energy is being wasted compared with ideal operating conditions.

The use of big data may require a change of mind-set in the educational facility management field, where many facility directors lack access to all but top-level energy consumption and spending data. Some see only the impact of the monthly utility bill—12 data points per year—on their operating budget. Yet in this age of smart meters, submeters, building automation systems, and other data-gathering technologies, tens of thousands of real-time data points have become more easily accessible. In the current environment of increasing demands on scarce resources, facility leaders can create opportunities by using the data that are available and seeking more information, wherever it may reside.

Analyzing and converting all the data into usable information could be a formidable task, which is where advanced energy advisory services come in. These services use a disciplined process and advanced software that is quick, dynamic, and noninvasive. They dramatically reduce the time and resources needed to gather and analyze data, create recommendations, make decisions, and take informed actions designed to reduce energy use.

The effectiveness of these advanced platforms hinges on the integration of human talent. Experienced energy engineers can help organizations make decisions that really matter to the bottom line and increase their ability to fulfill their educational mission.

Assessments and Opportunities

For example, one supplier of indoor comfort solutions provides organizations with energy assessments: methods to analyze building performance and identify energy-efficiency potential. Those energy assessments combine advanced data analytics, visualization tools, and expertise to "see" and help prioritize opportunities on the basis of actual building performance. That quicker, data-based approach represents an alternative to— or confirms the need to conduct— a more intensive traditional audit without commensurate costs in time, resources, or dollars.

The assessment process starts with the collection of readily available energy-use data from interval or utility smart meters. The analytics software uses those data to create a dynamic, visual interface that allows for evaluation of energy use that can be adjusted for weather conditions, such as temperature, humidity, dew point, and other factors. Those publicly available weather data come from nearby airports and other weather stations.

Historical energy and weather data are captured in 15-minute intervals and can be interpolated to create several hundred thousand data points for a one-year period, giving energy engineers a granular view of actual historical data for the building being evaluated.

These data are used to create a highly accurate and highly intuitive 3-D graphic representation that enables the energy engineers to show facility directors precisely where, when, and how energy has been used—at a level of detail that is impossible to achieve without this type of analysis. Knowing exactly how energy has been used leads to identifying waste and opportunities for improvement. Then and only then are highly targeted physical inspections conducted to give energy engineers the complete picture, so they can propose the most appropriate portfolio of energy-efficiency solutions.

In many cases, the platform uncovers potential operational improvements that can be

implemented without significant capital investment. In fact, material savings in the 5%–15% range are achievable with relatively simple "tighten and tune" strategies, including optimizing building automation systems and addressing peak energy demand.

Interval data are also useful in analyzing building performance under various sets of circumstances to uncover anomalies and to identify improvement opportunities. A wide range of key measures can be used to make comparisons, including building load factors, peak energy usage, energy use volatility, and operating hours of heating, ventilating, and air-conditioning equipment.

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Comparisons can also be made between various schools in a district or for the same school over time, for various buildings on a campus, or between one school building and comparable or best-in-class buildings as identified by Energy Star. Such comparisons are valuable when it comes to prioritizing energy-efficiency projects, especially for organizations like school districts with multiple buildings and limited budgets.

Finally, energy assessment tools and intelligent services can be used to keep buildings performing efficiently by enabling regular analysis of interval meter data to ensure that energy-efficiency measures are delivering their promised benefits and to enable continuous energy-efficiency improvements.

Finding Millions in Energy Savings

A portfolio energy evaluation of 93 schools within a school district was undertaken to help district administrators identify which of the school buildings could benefit most from the implementation of energy-efficiency improvements on the basis of their total energy consumption and peak energy demand.

Data on each school were collected, aggregated, and analyzed. Performance comparisons were made with hundreds of schools from across the United States, and it was determined that the 93 schools in this study were well run, and many were already meeting several of the criteria for energy-efficient schools. Criteria included the proper definition of occupied and unoccupied periods throughout the school year, a common energy waster in the educational environment.

The individual schools were ranked according to various factors, including (a) their best normal daily energy performance, (b) demand reduction potential, (c) improved performance potential, (d) kilowatt-hours per pupil and square foot, and (e) kilowatts per pupil and square foot. Calculations were made to determine which schools showed the most potential for performance improvements based on real data.

Opportunities for further improvement included (a) making adjustments to building control systems, (b) adding or enhancing control systems, (c) upgrading equipment, (d) reducing peak loads, and (e) working with local utilities to ensure that the district was taking advantage of the most favorable rates. In total, annual savings of between $1.8 million and $2.6 million were identified for the schools studied. The detailed assessment of the entire portfolio combined industry expertise and the district's key performance goals (or indicators) to deliver a prioritized plan at a fraction of the cost and an even smaller percentage of the time and resources of traditional energy audits.

Results such as these show the potential for applying the principles of big data to energy-efficiency initiatives in school districts and other educational environments. Today's school administrators are under great pressure to do more with less—less energy, fewer people, smaller budgets, and less capital spending—while still meeting their commitments to students, communities, and other stakeholders.

Advanced energy advisory service platforms can provide unprecedented levels of data that can help organizations achieve their goals and meet the needs of their stakeholders with best-fit solutions.

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