Cutting Through the Complexity

How Building Owners Can Find the Right Way Forward in Energy Efficiency

By Sean McBride

Executive Summary

More energy efficient buildings benefit everyone: owners and operators, occupants, utilities, and all others interested in encouraging or funding improvement. With demand for energy soaring, concern about carbon emissions, and the demonstrable link between more efficient buildings and increased organizational effectiveness, the need to create and maintain clean, comfortable, productive environments at optimal cost will only grow more intense.

Yet operators are understandably uncertain about how to proceed. An already complex energy eco-system is evolving at a dizzying pace. Regulations are proliferating around the world, often without uniform standards across jurisdictions or geographies. Meanwhile, solution vendors fill the air with confusing claims and contradictory advice.

Nevertheless, waiting for the picture to clear up is not an option. Deferring action means forgoing the significant cost savings, greater occupant productivity, and longer useful life of assets that better building performance brings. Energy efficiency is a journey—the sooner started the better. Waiting for the next generation of technology not only sacrifices a significant net present value opportunity, but can also lead to the paralysis of doing nothing year after year as the latest technological promise remains always just over the horizon.

To cut through the clutter in the marketplace, mitigate the risk of making a misstep, and begin to seize the opportunities that the new worlds of energy and technology offer, owners and operators can take three simple steps:

- Define and prioritize energy initiatives in terms of the organization's strategic and financial goals
- Put the wealth of available energy metrics to work now
- Apply common-sense criteria to the selection of a solution

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With new clarity and confidence, building owners and operators then can embark on achieving best-in-class energy performance, providing a safer, healthier, and more productive environment, with cost savings that repay the investment many times over and free capital for other purposes.

An Energy Eco-System in Flux

It's not surprising that building owners and other interested parties feel overwhelmed by the changes in the complex mix of technology, markets, regulation, and solutions that make up the energy eco-system. Those changes are profound and they multiply the choices that operators face.

The smart grid, bringing together information and communications technology to improve the distribution of energy and enable price incentives for efficiency, offers significant savings to customers who take advantage of it. And the grid is not only getting smarter, it is rapidly growing more diverse as wind, solar, tidal, and geothermal join coal, gas, oil, hydro, and nuclear as sources of power. Over the next decade, older coal-fired plants will be replaced either by new, more efficient coal power plants or by cleaner natural gas, wind, and solar facilities, especially in the United States and European Union (EU), where coal power plants have been operating for decades.

In the five-year period 2008-2012, installed wind power capacity, for example, increased more than 66 percent in China, 29 percent in the U.S., and more than 13 percent in the EU. Renewables will also offer large private facilities opportunities to generate their own energy and sell the excess back into the grid. Building operators wonder how these changes in the generation and distribution of energy will play out—will decisions they make today about energy use be undercut or validated by developments tomorrow?

Building systems technology is also changing rapidly. Compared to indoor climate control systems that are just a few years old, current high efficiency chillers, rooftop units, air handlers and other building systems use significantly less energy to operate. Cost-effective strategies for energy efficiency now include flexible, intelligent heating, ventilation and air conditioning (HVAC) equipment, advanced controls, lighting and technology-enabled services—solutions that can reduce energy use in commercial properties by up to 25 percent. Continued refinement of fluorescent lighting systems along with the rapid development of solid state lighting (LED) is driving significant reduction in energy use compared to lighting systems installed only 10-15 years ago. Improvements in lighting controls such as occupancy sensors to schedule and monitor areas so that they are lighted only when the space is occupied are also driving energy savings.

In addition, energy reporting and dashboard solutions provide information on energy use and costs and greenhouse gas emissions. These systems can benchmark, monitor and reduce energy costs as well as set up alarms and exception reporting to make sure that buildings and building complexes operate at top level. Also, building automation systems will continue to evolve, simplifying comfort management, so that it is easier to maintain conditions that help keep employees productive, tenant occupancy rates high, and energy costs low.

Additional uncertainty in the energy eco-system results from regulations and standards that constantly change, grow more stringent, and differ from place to place. The changes can be as simple as cities requiring building owners to submit their energy and performance data or as sweeping as nationwide and region-wide initiatives like China's goal of a 15 percent reduction in energy intensity by 2015, Japan's aim to cut electricity consumption before 2030 by at least 10 percent from 2010 levels, or the EU's goal to achieve 2020 energy demand that is 20 percent below current levels. Along the routes to these various regulatory goals, owners can not only expect tougher rules but opportunities as well, in the form of tax and pricing incentives, opportunities they must understand how to seize.

Operators also face a bewildering variety of solutions and solution providers who inundate them with offerings, technology, and assurances. Combing through these offerings, weighing their merits, and projecting them against possible energy futures can be a daunting challenge.

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There is, in fact, a better way to take advantage of the opportunities that are arising, avoid the pitfalls, and improve cost structures and performance: Get back to the basics by starting where you are—with the strategic objectives of your organization and with the wealth of data at your fingertips, from which you can then develop clear criteria for sorting through solutions and deploying them.

Define and prioritize energy initiatives in terms of the organization's strategic and financial goals

Operating a building throughout its decades-long occupied life accounts for between 60 and 85 percent of total lifecycle costs. The first step in reducing those costs and improving building performance is to answer the question: performance for what? What is the mission of the building and what are the critical success factors for fulfilling that mission?

The answers will of course differ greatly for different kinds of organizations. A healthcare facility, an office building, a manufacturing plant, a government building, a school building—each has a different mission. For a hospital, for example, the mission of the building is to support the welfare of patients and the effectiveness of staff in achieving positive outcomes. Critical success factors for achieving that mission are indoor air quality, humidity and moisture control, and energy efficiency. For a chemicals manufacturer, the mission of a plant is to provide a safe, efficient, compliant, and cost-effective facility for continuous batch manufacturing, where critical success factors include uptime, temperature, humidity, and moisture control.

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The clear understanding of a building's mission and critical success factors, coupled with the data and analysis of current energy use—including the rate structure in its energy market—enables the identification of the greatest opportunities for efficiency and better building performance. Without undercutting critical success factors, consumption could be aligned with the optimal rate structure to avoid high-demand charges and other unnecessary costs. Load scheduling, load shedding, and other aspects of load management could be refined to take advantage of pricing or regulatory incentives while honoring mission-critical requirements like uptime.

It is then possible to put a stake in the ground by calculating the magnitude of payback from the opportunities that have been identified and prioritizing them. Many organizations simply rank initiatives by the size of financial payback that drops to the bottom line—a straightforward and easily understood way to proceed. But in addition to cost-savings, the calculation can include opportunities for cost-avoidance. What are the costs of absenteeism, for example, that result from an uncomfortable work environment? The total costs per hour of shutting down an assembly line, including wasted salaries, missed deadlines, and lost revenues? The cost of an outsized carbon footprint under particular regulatory regimes? And what is the upside in terms of greater productivity, increased revenue, improved reputation, and the freeing up of capital for other activities?

When all of these relevant factors are taken into account, prioritization can appear more challenging. The key to cutting through the complexity is to link energy initiatives to the strategic and financial goals of the organization and order initiatives according to the degree to which they contribute to those goals.

The difficulty arises in this phase of the process from the natural tendency to see a building's mission as identical to the overall objectives of the organization. Certainly, they overlap, but they are not identical. For example, the plant of a commodity chemicals manufacturer and the plant of a specialty chemicals manufacturer may have similar missions and similar critical success factors. But the two companies can have sharply different business strategies. The commodity manufacturer may seek to be the low-cost provider of high-volume/low margin products, while the specialty chemicals company seeks high margins on a low volume of products that are bundled with high-end consulting services for major customers. An energy initiative that is framed in terms of lowering energy intensity—the amount of energy consumed per product unit—speaks directly to the strategy of the commodities manufacturer while an energy initiative focused on uptime to ensure an uninterrupted supply of high-value products may be more important to the specialty manufacturer.

Whatever the strategic priority, for whatever type of organization, it should be possible to draw a direct line between energy initiatives and strategic and financial goals, enabling the weighting of initiatives accordingly. For example, a hospital whose business model depends on utilization rates for inpatient and outpatient services should greatly value the improved clinical outcomes that result from superior indoor air quality, not only as ends in themselves, but also because they make the facility a magnet for patients and physicians.

The process of linking energy initiatives to organizational goals forces the most compelling opportunities into the forefront. And conveying those opportunities in the strategic and financial language of the ultimate decision-makers greatly increases the likelihood that those valuable initiatives will be adopted.

Put the wealth of available energy metrics to work now

Aligning building efficiency initiatives to an organization's goals and priorities is the first step in realizing energy efficiency. Collecting and analyzing data is the second step to reducing energy costs and improving building performance. Many organizations already have data about energy performance available to them, but fail to take advantage of it. Smart meters, for example, found in many commercial and industrial settings, record consumption of electric energy by time of day and intervals of as short as 15 minutes. Yet building owners often ignore that valuable information, paying attention only to the total costs aggregated in their bill, instead of mining the data to build a fine-grained understanding of their facilities' energy use.

If the data does exist, it should be utilized. For example, data from smart meters can simply be requested from the utility. High interval energy and weather data can be used to provide quick, non-invasive energy evaluations of buildings, focusing on energy-use patterns and behaviors. Or a full-scale audit can be conducted to determine the current level of performance of critical building systems such as HVAC, water, lighting, electrical, mechanical, controls, and instrumentation.

Though not a substitute for a comprehensive audit, a useful starting point is the U.S. Environmental Protection Agency's Energy Star Building benchmarking tool. This online tool allows building owners to rate their buildings on a scale of 0 to 100. Ratings of 75 or greater are considered good, while those below 75 indicate an opportunity. While energy plays a big part in the score, indoor comfort is also taken into account, so that comfort is not sacrificed to operating cost.

Many of today's advanced building automation systems include web-enabled dashboards that make it easier than ever to collect and analyze relevant data. But however the data is collected, it should be put to work. It is not uncommon, for example, to see a roomful of control screens that are rarely viewed and never analyzed. This often overlooked data contains a wealth of possibilities. Most obviously, where utilities flex prices according to time of day and season, data can help facilities adjust their consumption habits to be more responsive to market prices and to contribute to a cleaner environment.

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For example, TIAA-CREF, one of the largest institutional real estate investors in the United States, has installed a rooftop thermal ice storage solution at the company's headquarters in midtown Manhattan. The system has an impact on the utility's source of energy and it reduces energy costs for the building owner because off-peak electricity is less expensive and the most efficient power plants run during off-peak hours.

Further, similar systems have been found to improve the reliability of the electrical grid because they shift peak cooling loads from periods of high-demand to low-demand. Power sourced overnight is more likely to be clean because it is derived from periods of high-demand to low-demand. Power sourced overnight is more likely to be clean because it is derived from nuclear or hydroelectric plants, rather than from coal-fired plants, which provide most daytime, on-demand energy. TIAA-CREF's innovative system will not only save $765,000 annually in energy and operating costs, but it also attracted a grant of $219,000 from the New York State Energy Research and Development Authority (NYSERDA) to help support installation of this energy-efficient technology.

Similarly, an analysis of energy and cost data for Rockefeller Center led the owners of this iconic commercial property to have a 41-tank thermal storage system installed that allows the building to shift peak cooling loads to off-peak hours by producing ice at night for daytime cooling. The system is saving approximately $2 million annually in energy and operation costs and it is estimated that carbon emissions have been reduced by 3.3 million pounds per year—the equivalent of taking 300 cars off the road each year or planting 450 trees. Like TIAA-CREF, the owners also received a grant, in this case $311,000, to help support the effort.

Organizations can begin a similar journey by using data to build a current profile of a facility's energy use—whether it's a manufacturing plant, a university campus, a hospital, a data center, or other complex operation—which can then be compared to the performance of the building historically. For greater clarity, the profile can be represented visually, highlighting deviations and abnormalities, providing a starting point for uncovering root causes of problems. In addition, a building's performance can be benchmarked against comparable buildings in its class, indicating where it stands in relation to top performers and how much room exists for improvement.

Identifying the right data, collecting it, and analyzing it offers the added benefit of preparing the organization for the future. As it becomes increasingly possible to accurately model the interaction of climate, behavior, and the energy market in particular buildings, that data will be the foundation for systems that optimize decisions about energy and implement those decisions through predictive controls and services. New predictive modeling technologies can compare system and component operating characteristics with many similar systems to evaluate performance.

Technicians can look deep inside HVAC components, uncover potential problems and predict sooner, and with greater accuracy than ever before, when components will fail. Automated HVAC fault detection and diagnostics (FDD) can detect and report significant faults in air handlers, chilled water systems, boilers, cooling towers, and other critical HVAC components, isolating problems that are wasting energy and providing early warning of possible failures.

It is difficult to exaggerate the promise of these predictive techniques and technologies. If worldwide energy-use trends continue, buildings will become the largest consumer of global energy by 2025, consuming more than the transportation and industrial sectors combined. Smarter buildings with highly instrumented and interconnected systems will be an important element in avoiding the strain on energy systems, high costs, and environmental degradation that will result if these trends aren't reversed.

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For example, the environmental impact of building design, construction, and operation accounts for an estimated 30 percent of India's energy consumption. Of this consumption, the major usage is due to HVAC and lighting. As the economy develops and the construction of commercial infrastructure accelerates, it is increasingly evident that the country needs to increase energy efficiency and sustainability. Smarter buildings with highly instrumented and interconnected systems will be an important element in the overall solution.

For example, Mumbai-based property developer K. Raheja Corporation is committed to developing environmentally responsible LEED (Leadership in Energy and Environmental Design) certified green structures through high-efficiency HVAC systems that drive down operating costs while improving indoor comfort and productivity. Such solutions, as they incorporate predictive features, depend for their effectiveness on the collection and analysis of data—data that is readily available now and can be put to work in a variety of ways.

Apply common-sense criteria to the selection, financing, and implementation of a solution

Building a compelling and comprehensive business case and converting it into action requires three additional steps: (1) identifying the right solution to realize the projected operational, financial, and strategic benefits; (2) designing optimal financing; and (3) determining who will do the work. These steps can be complicated by the sheer number of competing solutions and wide range of advice in the marketplace, the implications for the organization's balance sheet, and the choice of doing the work in-house versus going outside. But by adopting some common-sense criteria and asking some basic questions, decision-makers can arrive at the answer that best fits their needs, objectives, and resources.

First, any solution—from a one-off piece of equipment to comprehensive building systems and services—should meet some basic criteria. In addition to fulfilling the requirements of a particular energy initiative, the solution should be:

- **Scalable.** Built on open platforms, the solution should integrate seamlessly with existing equipment and controls—no matter what brand—and provide the latitude to easily expand into other systems within a building, multiple buildings, and buildings to be added in the future.
- **Evolvable.** The energy eco-system—technology, regulation, and the way utilities operate—will continue to evolve in ways that could render many solutions obsolete long before they have yielded the desired return on investment. Solutions should not only be fit for today's complex environment, but be designed to be adaptable. Providers who understand how the elements of the eco-system will change design that future into their solutions.
- **Sustainable.** Will the vendor be in business for the life of the building and be capable of providing maintenance, emergency service, or, if desired, comprehensive services? Many building control rooms are littered with dormant products from now extinct vendors. Whether the solution is intended to be a simple upgrade or a complete building automation system, it is important to make the right vendor choice for the long term.

Second, while it is often easy to find large opportunities for improvement, justifying their financing can be a stumbling block. Winning approval for a project that will be treated as a capital expenditure, for example, is typically more difficult than if it is to be treated as an operating expense. However, virtually any action taken to reduce energy spending is a sound financial decision. The Convention Centre Dublin, the first international carbon-neutral convention center, features a sustainable thermal ice-storage system that is reducing building cooling costs by an estimated 17 percent. Singapore's leading property developer, City Developments Limited (CDL), recently completed infrastructure upgrades to its Republic Plaza building, one of Singapore's tallest skyscrapers, which will save an estimated 4 million kilowatt-hours of energy for an annual savings of S$870,000. CDL expects full payback from the project within five years—much sooner if energy prices rise. Infrastructure upgrades at Procter & Gamble's Gillette plant in Lodz, Poland, are expected to fully recoup the investment within two years of their completion.

Such energy efficiency measures can literally transform an operating budget—producing short- and long-term cost savings to free up funds for better use. For example, utilities are one of the single largest line items in a typical university operations and maintenance (O&M) budget, costing millions of dollars every year. Lowering those costs could free money to help stabilize tuition or provide resources for core educational initiatives.

When considering financing, it's important to consider more than just the cost of purchase. Without factoring in such issues as installation costs, operating costs, service requirements and the expense of borrowing money, it's impossible to make a correct determination of the best way to fund the solution. An analysis of these and other factors that constitute total cost of ownership (TC0) can be used to assess all possibilities and identify funding alternatives, including grants and rebates designed to encourage energy efficiency. Westfield Culver City Mall in California, for example, converted to an energy-saving chilled water system that won $191,000 in rebates from Southern California Edison.

In addition, building owners should ask whether the solution provider is experienced with a wide range of financing vehicles and knows how to match them to the metrics on which the owner is judged.

Third, deciding to what extent to keep the project in-house or to enlist an external partner to manage and maintain it can sometimes present a deceptive choice. In some cases, a large organization with experienced in-house resources may simply wish to purchase some components and oversee their implementation. However, owners and operators should beware of seeking short-sighted savings at the expense of the added and significant long-term value that can come from working with a partner who can not only implement the project but validate results, identify additional opportunities, and drive for continuing performance improvement throughout the life of the building.

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From Simple Steps to Sophisticated Solutions

The simple steps recommended here for cutting through the complexity of today's energy eco-system lead to an overarching conclusion: The way forward in energy efficiency for building owners and operators lies in holistic solutions that leverage today's analytics, evolve with the energy eco-system, and turn building performance into business advantage. That simple exploratory process begins with an even simpler equation: saving energy saves money. But it ends with much more: greater capital flexibility, improved organizational and occupant effectiveness, a cleaner environment, and a superior reputation for sustainability.

Whether a cost-effective, productive workplace is the product, or a means to creating products, the evolving energy eco-system demands sophisticated solutions that support the full range of high-performance building operations. And while the solutions themselves may be complex, finding the right one doesn't have to be.

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