institute for building efficiency
an initiative of Johnson Controls

50001 REASONS TO IMPROVE ENERGY PERFORMANCE

Issue Brief

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INTRODUCTION

Management systems have been used to great effect in realms such as quality and environmental control. Similar systems for managing energy now have potential to help organizations reach their full potential for energy efficiency and savings.

Energy management has multiple benefits: cutting costs, reducing greenhouse gas emissions, enhancing property values, supporting sustainability commitments, increasing price stability, and others. Management systems provide a framework for optimizing use of energy-consuming assets, evaluating and applying energy-efficient technologies, and promoting efficiency throughout the enterprise. Key energy management disciplines include management responsibility, an energy policy, energy planning, focused implementation, monitoring and measurement, and management review.

One formal energy management system is the ISO 50001 standard, published in June 2011 by the International Organization for Standardization. The standard is based on a simple Plan-Do-Check-Act model. Some organizations may find that standard too complex for their purposes, but even in those cases its basic concepts can outline a process for effectively managing and continuously improving energy performance – in a building, in a campus, or across an entire building portfolio.

Research documents that organizations with energy management systems or programs that use proven management disciplines are more likely than others to take actions that measurably improve energy performance. Case studies demonstrate how specific companies have achieved major savings, met sustainability commitments, engaged employees, and achieved continuous energy performance improvement by following sound management disciplines.

MANAGEMENT SYSTEMS: THE MISSING LINK IN CAPTURING ENERGY EFFICIENCY

Almost everyone agrees that saving energy matters: It lowers costs, cuts pollutant and greenhouse gas emissions, builds public goodwill, and helps keep organizations competitive. Yet leaders struggle to use energy optimally, whether they run small companies with a few offices or global corporations using millions of square feet of real estate. One reason is that managing energy not nearly as simple as it seems. If what isn't measured can't be managed, it is equally true that what isn't managed can't be improved. The key element often missing in energy management is a framework – a structured and disciplined approach to establishing a baseline, formulating policies, setting objectives, devising action plans, and tracking progress. In short, a management system.

Without a management system, energy efficiency projects may be haphazard, efficiency gains often fade over time, and savings opportunities are easily missed. For example, a facility may install more efficient lighting but years later fail to notice a newer lighting technology that than could save even more. Temperature control setpoints optimized today may become obsolete and wasteful as building use patterns and configurations change. An energy management system provides a process for regularly reviewing energy usage, making adjustments, and improving continuously.

Organizations have used formal management systems to great effect in other realms, notably the International Organization for Standardization (ISO) standards for quality management (ISO 9001) and environmental management (ISO 14001). June 2011 saw the release of ISO 50001, a global standard for energy management (now available for download).[1] It aims to help organizations create systems and processes to improve their energy performance: optimizing use of energy-consuming assets, evaluating and applying energy-efficient technologies, and promoting efficiency throughout the enterprise and the supply chain. While the intent is for ISO 50001 to apply to any type and size of organization, its main value for some may lie less in achieving certification to the standard than in simply following the disciplines the standard prescribes. A structured management approach may be the key that helps unlock vast potential for energy savings in the world's factories and buildings. The ISO organization has estimated that ISO 50001 could influence up to 60 percent of the world's energy use.[2]

[1] http://www.iso.org/iso/catalogue_detail?csnumber=51297

[2] "Win the energy challenge with ISO 50001." International Standards Organization. June 2011.

TAPPING THE BENEFITS OF ENERGY EFFICIENCY MEASURES

With or without formal management systems, organizations are making strides toward improving their energy usage. The benefits and imperatives of managing energy are clear.

- **Cutting costs.** Managing energy effectively enhances cash flow, frees up capital for other initiatives and adds to profitability. Energy is usually the third-largest business expense after employee compensation and real estate, averaging 19 percent of total expenses.
- **Enhancing property value.** Especially in commercial real estate, research points to a "green premium" in rent potential and valuation for buildings shown to be energy efficient.[3]
- **Reducing greenhouse gases.** On average, energy use accounts for 75 percent of a company's carbon footprint.[4] Reducing fossil fuel consumption directly cuts greenhouse gas emissions. For organizations that report Scope 3 emissions, energy reductions affect a spectrum of upstream and downstream activities. For example, reducing site electricity consumption multiplies carbon savings almost tenfold, because so much energy is lost from source to site.
- **Improving sustainability.** Organizations worldwide are signing up for voluntary commitments to reduce energy and emissions. According to the Carbon Disclosure Project, 74 percent of Global 500 respondents reported emissions reduction targets in 2011, up from 65 percent in 2010.[5] Such commitments add value by creating shareholder and customer goodwill for demonstrating green leadership and showing concern for the environment and the threat of climate change.
- **Turning policy to advantage.** Governments are creating laws and incentives to increase energy efficiency, reduce greenhouse gas emissions, and expand clean energy. For example, the German government will require ISO 50001 certification or equivalent energy management measures for a range of organizations as of 2013, and will provide significant energy tax reductions for compliant organizations.[6] Organizations can prepare for new laws and policies in advance by getting sound energy practices in place today.
- **Price stability.** Organizations can hedge against energy price volatility simply by reducing their exposure through better energy management.
- **Increasing innovation.** Many organizations report that after they set energy reduction goals, occupants became engaged in energy management and found new ways to drive down consumption and cost.

[3] Institute for Building Efficiency, 2011, "Green Building Asset Valuation: Trends and Data"

[4] Sustainable Business, May 26 2011" ISO 50001: New Energy Management Standard"

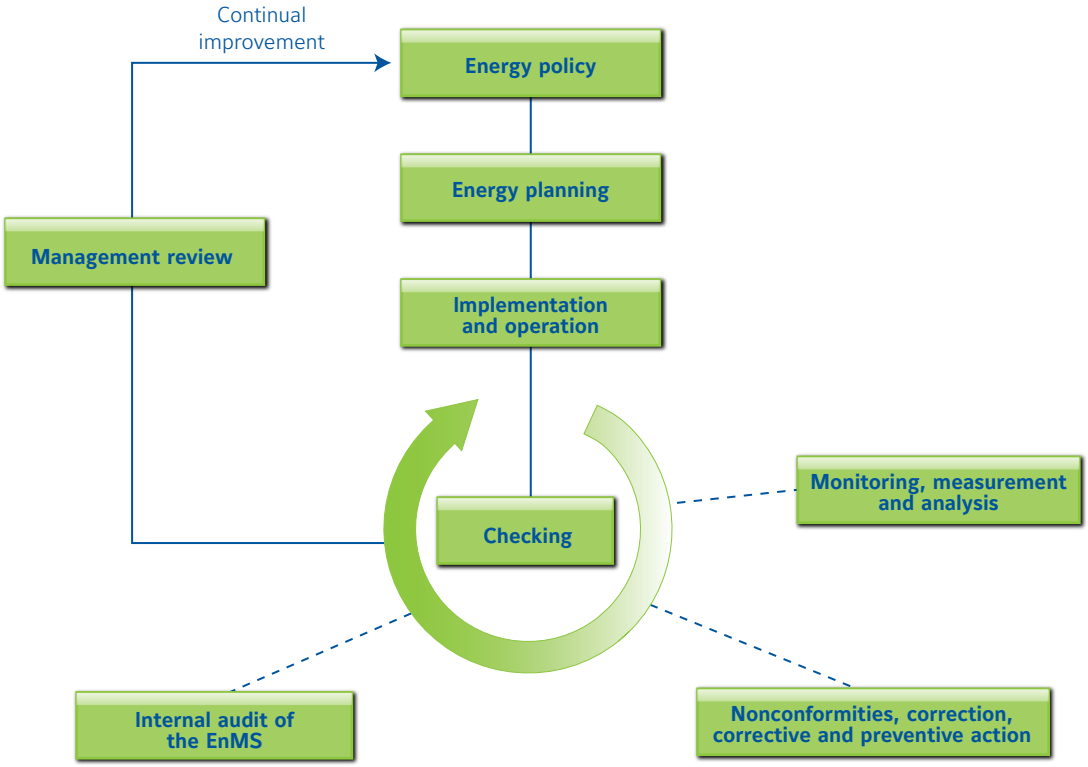
[5] CDP Global 500 Report 2011

[6] TUV Rheinland, http://www.tuv.com/de/deutschland/gk/managementsysteme/umwelt_energie/din_16001/din16001.jsp#tab6

HOW MANAGEMENT SYSTEMS CAN HELP

Management systems can help organizations make the most of these benefits. ISO 50001 provides a blueprint for energy management that can be implemented in one facility, on a campus, or throughout an entire global facility portfolio, including manufacturing plants, office space, warehouses and retail sites. The standard is based on the Plan-Do-Check-Act model. Companies can use it for certification, registration, and self-declaration of their energy management systems. It can be used independently or integrated with other standards in the ISO suite. The ISO 50001 framework (Figure 1) provides a useful reference for almost any organization designing an energy program. In some jurisdictions, incentives are offered for adopting ISO 50001 or an equivalent program.

Figure 1. ISO 50001 Framework for Energy Management



While conforming strictly to ISO 50001 may be beyond some organizations' needs, its basic components can help almost any entity understand what it takes to implement a successful energy management program.

Table 1. Key Components of the ISO 50001 Approach

ISO 50001 Component	Description
Management responsibility	Management leadership provides the foundation. Top executives can see how energy management fits with organization's long-term plans. They must engage to establish and implement the energy policy and see that energy management gets the appropriate resources. A management representative should execute the plan and report back to the leadership team.
Energy policy	The organization must develop an energy management policy to fit its needs and objectives. It should include a commitment to collect information, comply with legal requirements, and seek continuous improvement. This policy provides a framework for setting objectives during the planning process. It communicates the energy policies to all levels, including a focus on purchasing energy efficient products and services.
Energy planning	An energy plan should be developed and continuously updated. A first step is to analyze energy use, such as by reviewing utility data and performing an energy audit. Based on this analysis, the team should identify, prioritize and record opportunities, then determine key energy performance indicators and set the baseline. The organization is then ready to establish energy objectives, targets and action plans.
Implementation and operation	Energy management requires focused implementation that includes training employees on the benefits and how to take action, communicating internally and externally, and maintaining documentation. The system must establish criteria and a process to ensure effective energy performance. Besides reviewing ongoing operations, organizations should review energy performance in the design of facilities and systems. When procuring energy and equipment, they should evaluate the energy impact of decisions.
Checking	The checking phase helps ensure that the benefits of energy management do not wane. Monitoring and measuring of key performance indicators may directly lead to additional savings. This phase should include an internal or third-party audit and evaluation of compliance with the plan and policy. Nonconformities found should be promptly corrected.
Management review	Management should regularly review the energy management system, make sure the program is following the plan and meeting objectives, and adjust the policy, objectives, and resources as required.

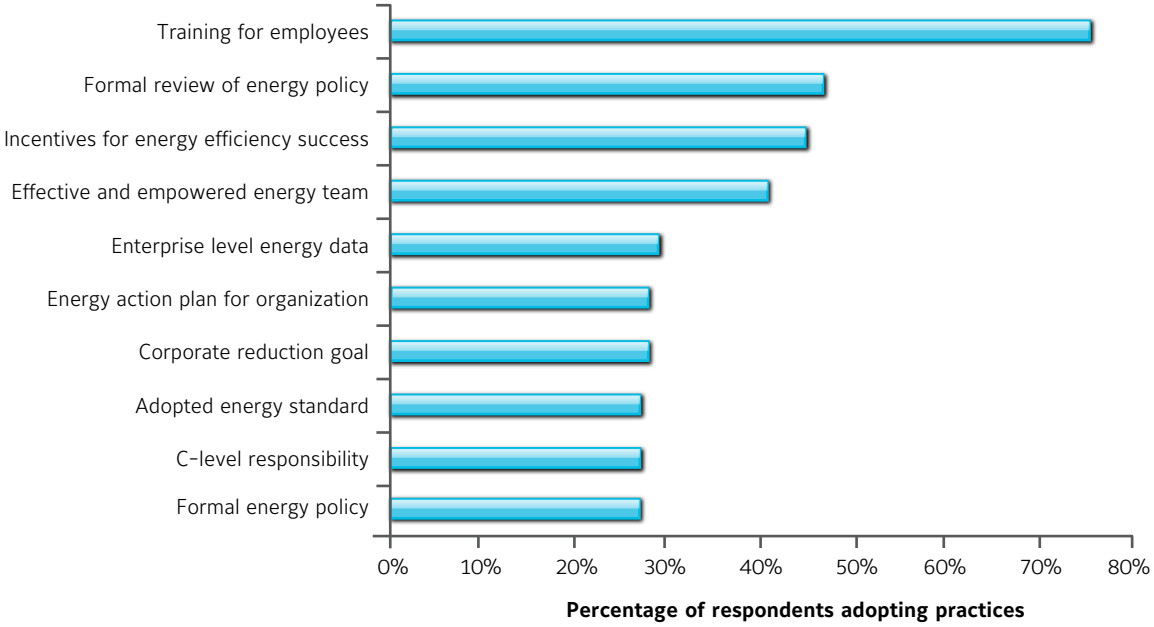
ENERGY MANAGEMENT PRACTICES CORRELATE WITH RESULTS

A survey from CoreNet Global and the Johnson Controls Institute for Building Efficiency, "Reducing Waste and Increasing Value through Corporate Energy Management,"[7] showed that corporate energy management is still in a nascent state. While most organizations have adopted at least one approach for managing energy consumption, very few have comprehensive, enterprise-wide energy management systems. On the other hand, according to this and other research, organizations that proactively implement energy management practices are more likely to take action to improve energy efficiency in a real estate portfolio.

[7] CoreNet Global and Johnson Controls Institute for Building Efficiency, *Reducing Waste and Increasing Value through Corporate Energy Management*, December 2010

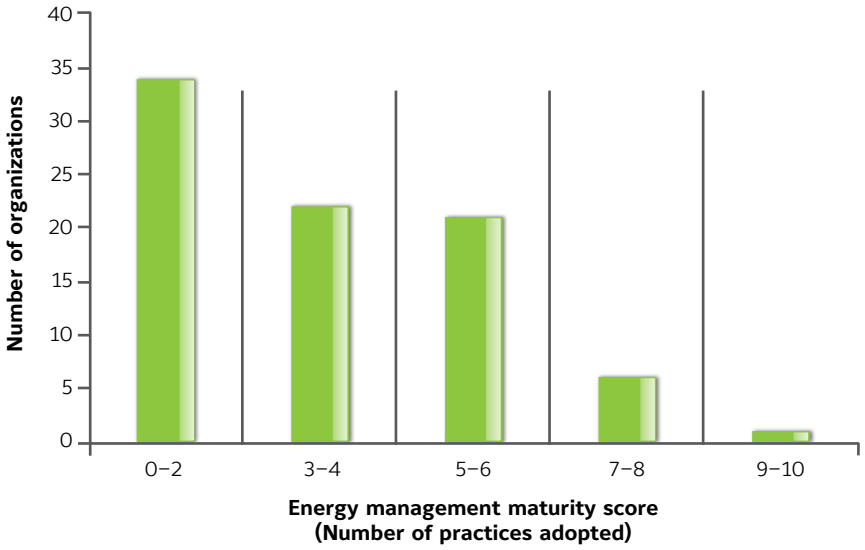
The CoreNet Global/Institute for Building Efficiency survey assessed the extent to which respondents followed ten specific energy management practices (Figure 2) similar to those prescribed by ISO 50001. Analyzing the results, the Institute assigned an Energy Management Maturity score (from one to ten) to each company, reflecting the number of practices it had adopted. Most companies scored below 5, indicating significant opportunity to improve and expand energy management systems (Figure 3).

Figure 2. Organizations' Adoption of Energy Management Practices



Source: "Reducing Waste and Increasing Value through Corporate Energy Management," CoreNet Global/Institute for Building Efficiency, 2011

Figure 3. Distribution of Corporations' Energy Management Maturity Scores



Source: "Reducing Waste and Increasing Value through Corporate Energy Management," CoreNet Global/Institute for Building Efficiency, 2011

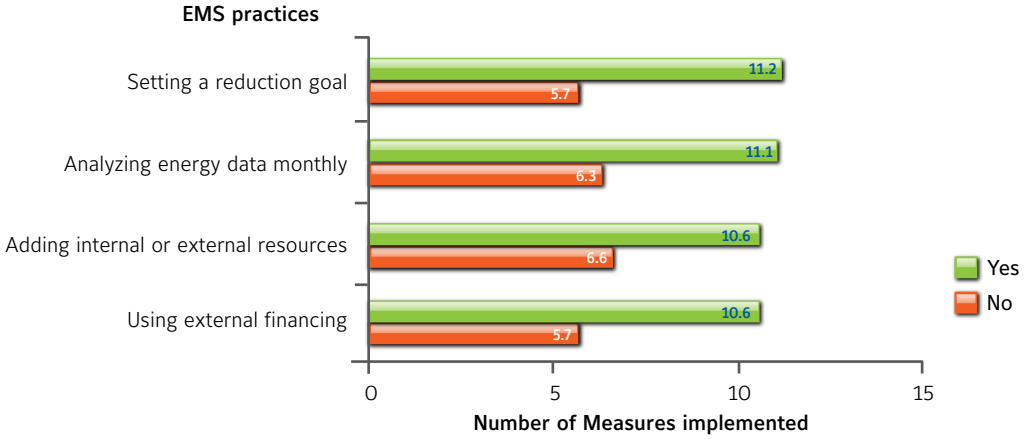
In this analysis, about 40 percent of the organizations were classed as non-adopters, following two or fewer of the management practices, and another 40 percent ranked as partial adopters (three to six practices). The remaining 20 percent – full adopters – used seven or more of the ten practices. These were the most likely to have taken energy efficiency actions and to have shown a link between organizational practices and results.

Similarly, the 2011 Energy Efficiency Indicator (EEI) survey from the Institute for Building Efficiency found organizations that had adopted key practices of an energy management system were much more likely to implement energy measures than those who had not. In this survey, the management system components included:

- Setting energy or carbon reduction goals
- Analyzing energy data at least monthly
- Adding internal or external resources to improve energy performance
- Using external financing to invest in energy projects

In general, the more of these practices an organization had adopted, the greater its energy efficiency activity. Further, each individual energy management system attribute correlated with implementing more energy efficiency, renewable energy and smart grid/smart building measures (Figure 4). The EEI survey included more than 4,000 global executives and building owners responsible for energy and investment decisions in commercial and public sector buildings.

Figure 4. Links Between Energy Management System Practices and Energy Efficiency Actions



Source: 2011 Energy Efficiency Indicator Survey, Institute for Building Efficiency

ENERGY MANAGEMENT DISCIPLINES AT WORK

Here are a few examples of how major companies are using full-blown energy management systems or key energy management disciplines to improve their energy and environmental performance.

Formal Energy Management System: The Dow Chemical Company[8]

The Dow Chemical Company was spending some $3 billion a year – 40 percent of its costs – to operate its plants. In the early 1990s, to enhance global manufacturing competitiveness, the company sought to reduce its exposure to energy volatility, reduce energy costs, and cut greenhouse gas (GHG) emissions from its processes. Dow formalized its energy management system in 1994 with a goal to reduce energy use per pound of product by 20 percent by 2005. The company applied Six Sigma continuous improvement tools along with U.S. Department of Energy programs like Save Energy Now, Energy Saving Assessments, and Superior Energy Performance and applied knowledge gained across business units. The company then began publicly measuring, tracking and reporting energy performance. Dow's manufacturing energy intensity, measured in BTUs per pound of product, has improved more than 40 percent since 1990, saving the company a cumulative $24 billion and 5,200 trillion BTUs.

[8] IBE Interview with Adam Muellerweiss, The Dow Chemical Company, May 2011.

Creating a Baseline: Starbucks Corporation[9]

To help develop a strategy to reduce energy consumption, **Starbucks** needed an energy baseline. In August 2007, the company hired a consultant for a six-month monitoring process in a representative sample of 19 stores. Starbucks found its beverage- and food-related equipment comprised much less of the energy load than expected – the biggest opportunities were in HVAC equipment and lighting. Another big discovery came from a greenhouse gas inventory assessment: Electricity use made up about 75 percent of the firm's Scope 1 and Scope 2 carbon footprint. Armed with its baseline, Starbucks set three aggressive environmental goals in 2008 for company-owned stores:

- Reduce energy consumption by 25 percent by 2010
- Purchase renewable energy equivalent to 50 percent of electricity used by 2010
- Reduce water consumption by 25 percent by 2015.

[9] "Energy and Water Conservation." http://www.starbucks.com/responsibility/learn-more/goals-and-progress/energy Accessed August 4, 2011.

Leadership and Employee Engagement: Marriott International[10]

Marriott International demonstrated a commitment to environmental stewardship in 2001, creating three Regional Directors of Energy to support commodity contracting, demand response participation and energy conservation efforts in the U.S. The company also developed an Energy and Environmental Action Plan (EEAP) program for its full-service hotels that enables onsite hotel staff to develop and implement operational plans to reduce environmental impacts. The EEAPs are supplemented by a spreadsheet-based tool with more than 170 energy-saving and environment-enhancing actions driven by staff behavior. By quantifying the value of the small behavior and operational changes, Marriott has given hotel managers and staff a straightforward tool and structured planning process for energy management.

[10] Global Superior Energy Performance Partnership." http://www.ipeec.org/task_gsep.html Accessed June 13, 2011.

Measuring, Tracking and Reporting: Johnson Controls[11]

Johnson Controls joined the U.S. EPA Climate Leaders program in 2003 and has been reporting to the Carbon Disclosure Project (CDP) since 2006. The company publicly committed to reduce its GHG emissions

[11] Case study, Johnson Controls Inc.

per dollar of revenue by 30 percent from 2002 to 2012. The company met its global GHG reduction target in 2008, after only six years, and committed to reduce its global GHG intensity by another 30 percent by 2018. Johnson Controls realized that to continuously improve the efficiency of its plants, it needed to establish a monthly performance scorecard. Today, more than 250 plant managers use the monthly scorecard to compare the energy required to produce an equivalent unit of manufacture across 40 different product lines. The performance of the top-achieving plants is averaged to create a benchmark, and improvement targets for each product line are set. With this plant-level information, the top performers across the company are recognized for their energy, water and waste reduction efforts at an annual benchmarking event.

Taking a Portfolio Approach: Diversey, Inc.[12]

Diversey, Inc. signed on in 2008 as one of 30 companies in the World Wildlife Fund Climate Savers program, committing to reduce its overall greenhouse gases by 8 percent from 2003 levels by 2013. Diversey committed $19 million to upgrade facilities, change processes, and rethink products to meet the goal. Treating that amount as an investment rather than a cost, the company looked beyond financial return with an "integrated bottom line" approach. Diversey used the dedicated funds for its energy efficiency program and developed a process that looked at payback period, net present value, and cost to reduce GHG. Taking a portfolio approach, the company identified low-cost avoidance measures, then efficiency measures, and then clean power generation with wind turbines and combined heat and power fuel cells at its headquarters. In the end, the company captured $32 million in savings and was able to make its emissions reduction target more aggressive, at a 25 percent reduction from 2003 levels.

Energy Policy: 3M

3M adopted a corporate energy policy for all its global operations as part of its Energy Management Program. The policy objectives were "to improve energy consumption efficiency, reduce cost, optimize capital investment for energy efficiency, reduce environmental and greenhouse gas emissions, and conserve natural resources."[13] Elements of the policy emphasize a focus on energy efficiency in manufacturing, workplaces, and employee behavior; development of energy efficient technologies; and support and cooperation with government agencies and utility companies. The policy helped 3M meet its energy reduction goals: total energy use in 2009 was 22 percent less than in 2000.

Integrating Management Systems: Cook Composites and Polymers Company (CCP)[14]

CCP's plant in Houston, Texas, worked with the U.S. Department of Energy Industrial Technologies Program to implement a management system for energy, have two major energy-using systems assessed for energy efficiency, and implement projects to improve efficiency. All this led to a 14 percent improvement in energy performance over two years. The plant is now certified at the Gold level in the DOE's Superior Energy Performance (SEP) program and has an ISO 50001 energy management system in place to proactively manage energy resources in the future and sustain energy performance improvements. The company integrated the energy management system into management systems for quality (ISO 9001) and environment (ISO 14001). It then developed an energy management policy, set energy performance improvement objectives, developed an energy profile for the Houston site, and calculated its energy baseline. Finally, the company conducted a self-audit and management review before a third-party audit that led to certification under SEP and the ANSI Management System for Energy (ANSI/MSE 2000:2008).

[12] GreenBiz Executive Network Presentation Summary, http://www.greenbiz.com/blog/2011/03/07/diverseys-portfolio-approach-toward-sustainability-roi?page=0%2C0

[13] Schultz, Steve. "Implementing a Corporate Energy Management System." June 3, 2010.

[14] http://www1.eere.energy.gov/energymanagement/pdfs/ccp_sep_case_study.pdf. Accessed Jan. 25, 2012.

EXTENDING THE REACH OF ENERGY MANAGEMENT SYSTEMS

Just as quality and environmental management systems were born and grew in the industrial sector, industrial companies in energy-intensive businesses have tended to be the earliest adopters of energy management systems. Programs such as the U.S. Department of Energy's SEP continue to succeed at reducing energy usage in industrial facilities.

At the same time, organizations in the commercial, government and institutional sectors increasingly take more programmatic approaches to energy management. While full compliance with ISO 50001 may prove to be unnecessarily complex for these entities, they could readily adopt its key features to make sure they maximize benefits from energy efficiency programs and policies.

Furthermore, ISO 50001 concepts ultimately could extend to span organizations' national or global enterprises, in much the same way the LEED green building certification program grew from a focus on individual buildings to cover campuses, communities, and now entire building portfolios.

As a worthy endeavor for the future, corporate facility owners and commercial real estate companies could use ISO 50001 as a starting point to create a simplified energy management system framework that fits their business processes and helps them operate their buildings more efficiently.

Energy efficiency is an imperative today. Sound energy management systems can help organizations of all kinds reach their full potential to cut energy costs, reduce emissions, and meet growing expectations for corporate sustainability.

APPENDIX: CASE STUDIES

Case study: The Dow Chemical Company

Company Profiled

The Dow Chemical Company, based in Midland, Michigan (U.S.), is a provider of plastics, chemicals, and agricultural products with annual revenues of $54 billion.

Situation

Approximately *40 percent of Dow's costs* came from energy to run its plants, costing about $3 billion dollars a year. In the early 1990s, as a way of promoting its global manufacturing competitiveness, Dow sought to reduce its exposure to energy volatility, reduce its large energy cost, and reduce the greenhouse gas emissions in its processes.

Action

Dow formalized its energy management system in 1994 with a goal to reduce energy use per pound of product by 20 percent by 2005. The company began institutionalizing a comprehensive energy management system by implementing continuous improvement tools like Six Sigma as well as U.S. Department of Energy (DOE) programs like Save Energy Now, Energy Saving Assessments, and Superior Energy Performance in order to meet that goal. As education, training, and validation of approach improved, the knowledge gained from these programs was replicated across business units. Dow then began publicly measuring, tracking and reporting energy performance.

Results

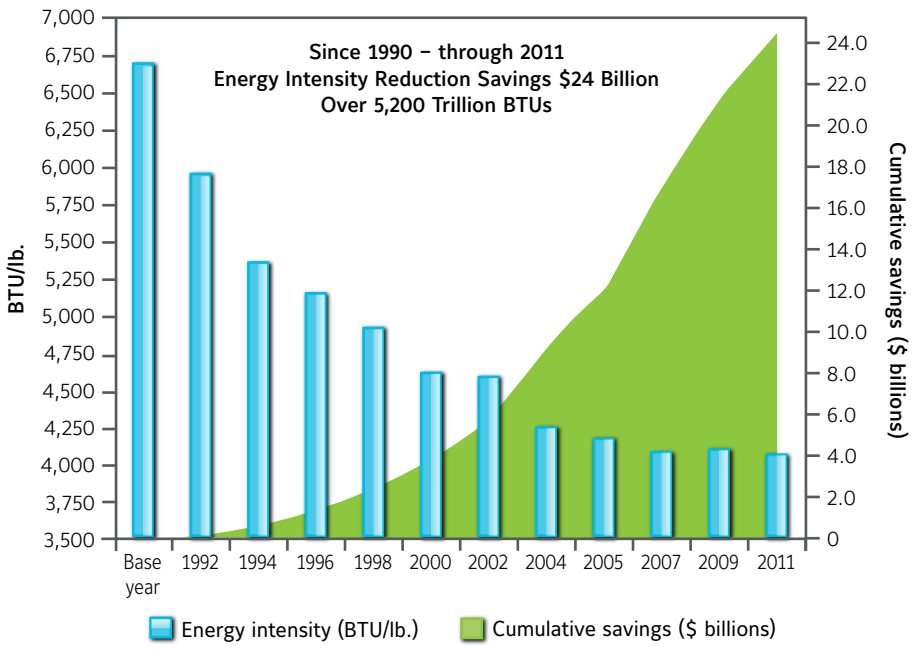
Dow's manufacturing energy intensity, measured in BTUs per pound of product, has improved more than 40 percent since 1990, saving the company a cumulative $24 billion and 5,200 trillion BTUs.[15] "We are accelerating our energy efficiency innovations as part of our global commitment to our company, communities and the environment," said George Biltz, Vice President of Energy and Climate Change at Dow. "These projects really represent the 'Power of And' – delivering environmental effectiveness and economic efficiency. We are harnessing Dow's extensive expertise in energy conservation to provide financial returns to our company and help fuel growth around the world."

[15] IBE Interview with Adam Muellerweiss, The Dow Chemical Company, May 2011.

Formalizing the Process

The Dow Chemical Company recognized early in its history that its profitability depended on reducing energy demand in its energy-intensive chemical processes. For example, Herbert Dow, the company's founder, collaborated with George Westinghouse to develop a high-efficiency cogeneration power plant in 1906. Fast forward to the early 1990s, when the company recognized the need to formalize its energy management program and, in 1994, made a public commitment to reduce energy intensity per pound of product by 20 percent by 2005. In order to drive the importance of meeting this commitment throughout the business, a Strategy Board of senior leaders was created to define Dow's approach to climate change and energy policy. Additionally, each of the company's 28 business units established its own energy reduction goals, provided resources for programs, and measured and rewarded individual leader performance in delivering energy efficiency. Andrew Liveris, Dow's CEO since 2006, is known for his commitment to sustainability and his ability to drill down into the details of the company's efforts.

Figure 5. Energy Intensity Performance



The Power of Partnerships

Through external partnerships, Dow has been a principal participant in the development of key energy efficiency best practices, programs and standards. Dow took advantage of outside expertise and processes to drive its energy efficiency programs. Dow began to use Six Sigma in 1999 as a corporate methodology to accelerate continuous improvement in quality, productivity, and efficiency. Dow has also committed to the DOE's Save Energy Now LEADER initiative, pledging a 25 percent improvement in energy intensity across its manufacturing operations. Through this commitment, Dow accessed the DOE's Energy Saving Assessment teams, who identified over $300 million in annual energy cost savings at 200 of its most energy-intensive manufacturing sites in the U.S.[16] In 2010, Dow was recognized for achievement at two pilot sites for the DOE's Superior Energy Performance program.

Table 2. Using External Programs to Drive Energy Reductions

	Six Sigma	Save Energy Now	Superior Energy Performance
Location	Freeport, Texas	Hahnville, Louisiana	Texas City, Texas
Action	· Found suboptimal boiler efficiency leading to wasted condensate · Identified opportunities to optimize plant heat integration, improve efficiency and emissions · Utilized engineering tools and brainstorming to identify actions for improvement	· SEN assessment identified steam system inefficiencies and quantified energy and cost savings · Detected failed steam traps and implemented repair project · Reduced peak load through optimizing steam meters' parasitic load	· One of the four original pilot sites for the SEP program in the United States · Used SEP process to translate process bottleneck improvement into energy improvement and improved efficiency of steam turbine generator · Implemented correct controls identified through SEP process[17]
Results	· Reduced energy use by 80 MMBtus per hour through improvements to distillation tower, process furnaces, boiler efficiency, and heat integration	· Annual energy cost savings were $1.9 million · Annual energy savings amounted to 272,000 MMBtu	· Isopropanol unit received Platinum Partner Certification with 17.1% energy intensity improvement in 3 years · Energy systems plant received Silver Partner Certification with 8.1% improvement in 3 years

[16] "DOE Conducts Energy Saving Assessment at Dow Chemical Co. in Ludington, MI." http://www1.eere.energy.gov/industry/saveenergynow/ Accessed June 6, 2010.

[17] Almagauer, J. "Testing the Elements of Superior Energy Performance." University of Texas. Summer 2010.

Spread and Replicate

Piloting and early engagement with external programs amplified Dow's energy savings efforts across the company: Six months after performing the Save Energy Now Energy Saving Assessments, participating plants reported replicating their efforts in other plants. The other plants added 10 percent cost savings to the original effort. Dow has used the assessment tools and training offered by the DOE across its sites by using a network: a small group of leaders attend the DOE training and spread the knowledge back to more sites in the company's portfolio.

Practice Assessment

- Energy efficiency must be a priority for companies whose costs are so largely made up by energy or whose margins are perpetually low. Bottom line growth can increase competitiveness by making capital available for other investments.
- Leadership openness is necessary for companies who want to access external programs like Save Energy Now or Superior Energy Performance. Transparency of data is imperative for program success at sites. (Not all industries or companies are able to reveal the inner workings of their business.)
- For companies that have sites laid out in a prototypical fashion, Dow's approach offers a tremendous example of prioritizing, incubating, and enabling replication. For industries like retail, where store locations are often designed and multiplied across many geographies, the ability to replicate can be extremely useful.
- It is important to embed a feedback loop in the scaling-up process to ensure communication of best business practices for energy efficiency projects across the organization.

Case study: Marriott International

Company Profiled

Marriott International, based in Bethesda, Maryland (U.S.), is a global operator and franchisor of hotels and lodging facilities with over $13 billion in annual revenues and over 150,000 employees.

Situation

Marriott operates and franchises hotels under 16 brands, including full-service and select-service lines, in 66 countries and territories. Looking to establish partnerships in setting a standard approach to meeting its environmental targets, Marriott became a U.S. EPA ENERGY STAR Partner in 2001. Large-scale efforts were initiated to get the majority of hotels in the Western Region documented in Portfolio Manager as a means to establish a useable energy baseline. The long-term goal is to improve energy management procedures and energy intensity through a uniform auditing and measuring process across the hospitality portfolio. In recent years, the company has moved toward using energy intensity data contracted through Advantage IQ as the baseline tracking metric.

Action

Marriott demonstrated its commitment to environmental stewardship in early 2001 by creating three Regional Director of Energy roles to support commodity contracting, demand response participation and energy conservation efforts in the U.S. Shortly after, the Western Region team created an energy tool and process to engage employees at each hotel. Since a global reorganization in 2010, the directors have been combined into the Americas Energy Group, and an energy and environmental plan is now an annual requirement for every full-service hotel in the U.S.. In order to participate, the hotel's team must download and use a spreadsheet-based tool to review over 170 energy and environment-related actions and select eight to 10 to implement each year. The intent is for the hotels to select challenging energy reduction goals.

Results

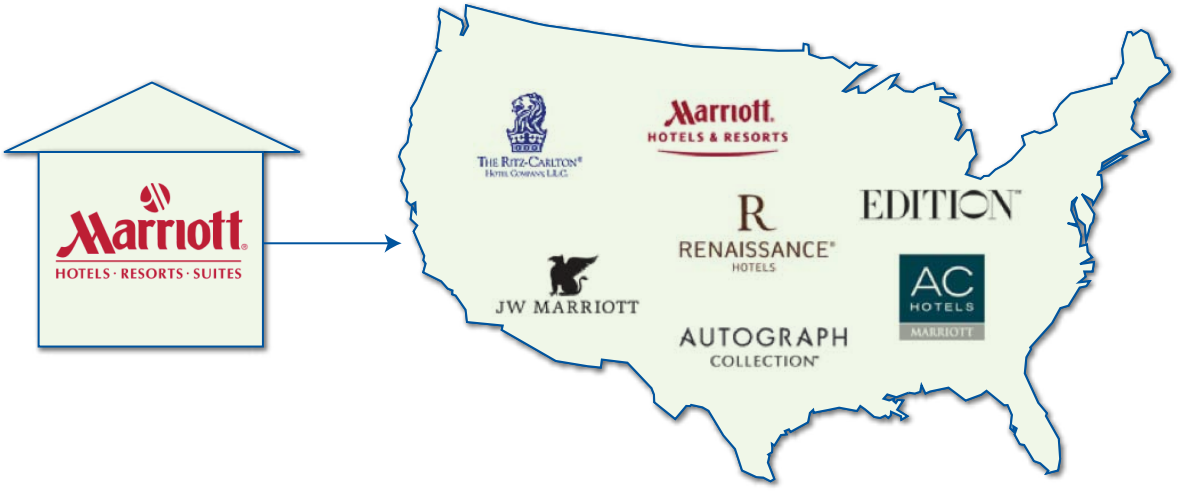
By the second year of Marriott's Energy and Environmental Action Plan program, nearly 2,300 actions had been submitted by over 250 full-service hotels throughout the U.S. Marriott estimates the savings from this effort at $650,000 annually. Marriott's other conservation programs, such as MRCx (retro-commissioning), demand response and Energy ROI projects, will bring an additional estimated $7 million in improved profits in 2011. Marriott is also serving on the Hospitality Committee of U.S. Department of Energy's Commercial Real Estate Energy Alliance and is a pilot site partner for the lodging category for the Global Superior Energy Performance program.[18]

[18] "Global Superior Energy Performance Partnership." http://www.ipeec.org/task_gsep.html Accessed June 13, 2011.

Optimizing In-sourcing

Marriott operates 250 full-service hotels in the U.S. The lodging leader has made a commitment to a 25 percent reduction in energy use and greenhouse gases from the baseline year off 2007. The idea for hotel-based and hotel-driven Energy and Environmental Action Plans (EEAPs) started over 10 years ago with the Western Region Engineering and Facilities team and Vice President of Engineering and Facilities for the Americas, Rob Bahl. Bahl formed the Americas Energy Group, a corporate Energy and Environment team made up of experienced facilities engineering staff and utility and environmental consultants, who have seen firsthand the reduction opportunities throughout the company's hotel portfolio. The team realized that with the many competing initiatives and deadlines in today's environment, expecting the facilities managers to surface capital ROI projects and drive correct energy behaviors at the property level was placing success in jeopardy. The reality is that competing proposals and immediate needs were taking precedence over energy conservation efforts. The concept that energy management knowledge and shared responsibility needed to be in the operational hands of the back-of-house staff was born of necessity. Hotel management needed to be involved and support operational changes while continuing to focus on satisfying guest expectations. Their combined efforts and full collaboration on new energy and environmental initiatives would most certainly benefit the bottom line.

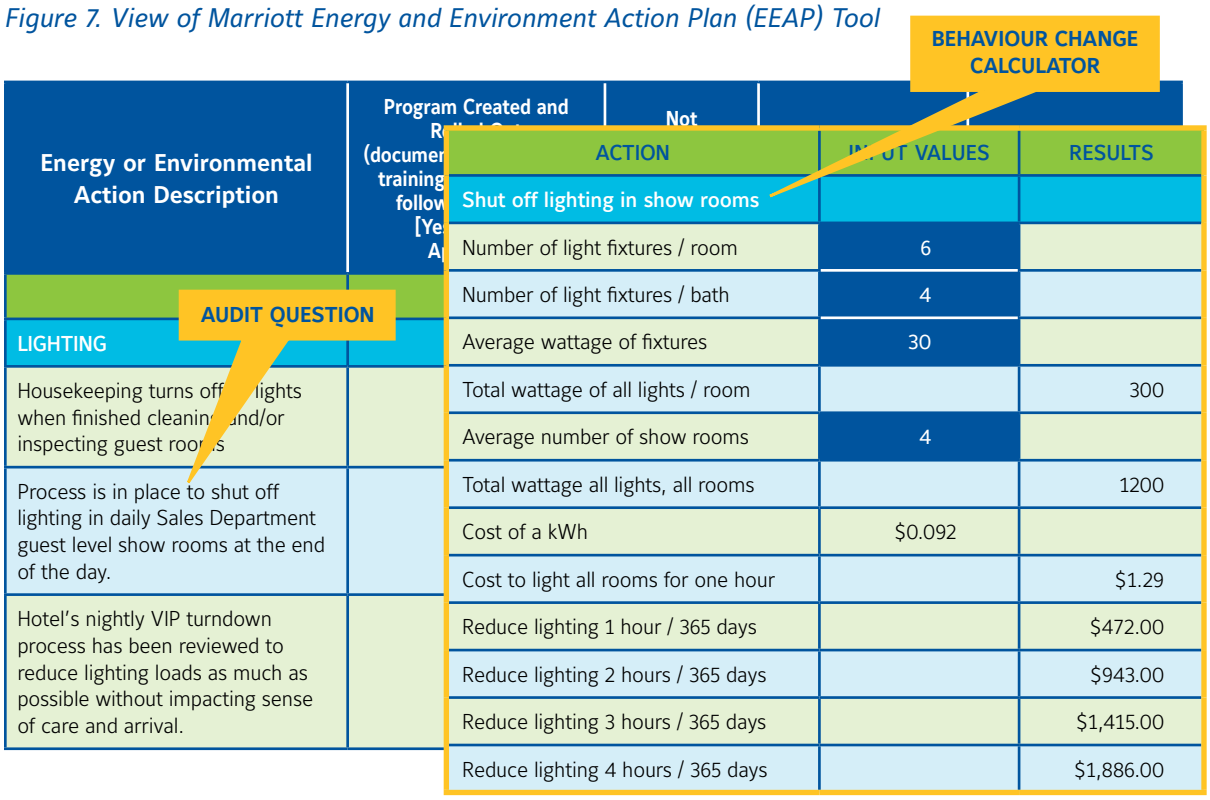
Figure 6. Marriott Managed Brands



The Tool for Success

Bahl enlisted Doug Rath, Director of Energy and Environment, to update and institutionalize the mechanism between the corporate directive and day-to-day hotel operations. Rath's 26 years of experience in facilities engineering at Marriott allowed him to tackle the project quickly, since he had seen the same opportunities for energy reduction over and over at hotel sites around the world. He created a spreadsheet-based tool with over 170 different energy and environment enhancing actions that would involve little to no cost and were able to be implemented by on-site hotel staff. For the environmental side of the audit tool, he enlisted another Energy Director, Marianne Balfe. The 170 actions have detailed links for additional information for decision-making, (some with a Marriott-created best practice Wiki) as well as calculators designed to value annual behavior change. For example, full-service hotel sales teams regularly use "staged model guest rooms" to show potential customers. Since the model rooms are shared space, there was unclear responsibility for shutting off lights at the end of the day. Because the rooms are prototypes, the tool estimates annual energy and cost savings of correcting this behavior by calculating the wattage of light bulbs in the room times the number of hours that the Sales Department guest rooms are not used in off-hours.

Figure 7. View of Marriott Energy and Environment Action Plan (EEAP) Tool

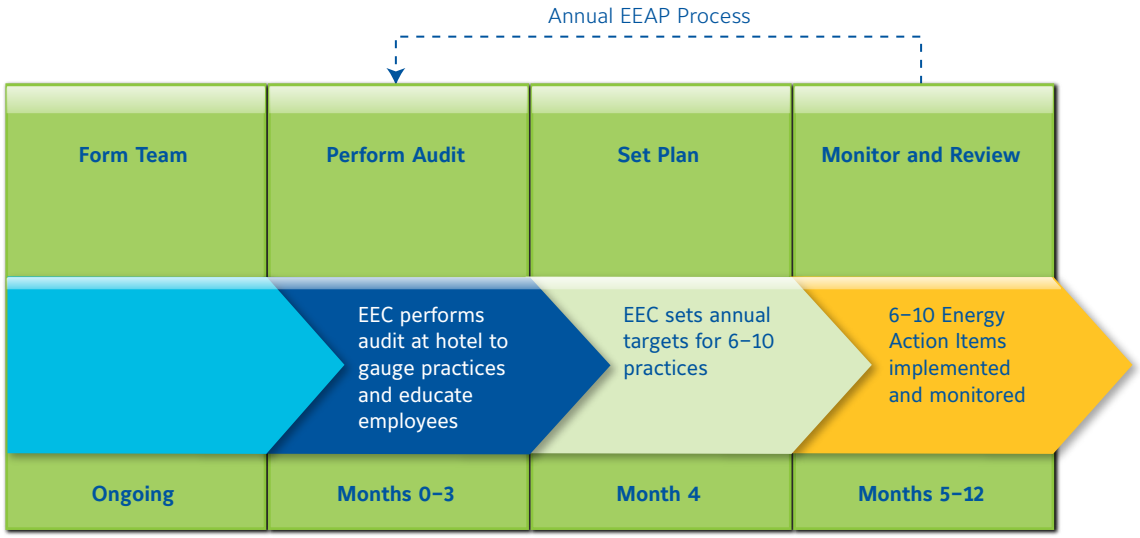


Planning Process

The tool is used at each hotel during an annual goal-setting and action-planning process. Each hotel is required to have a Property Energy & Environment Committee (EEC), which engages in a four-month process of creating an Energy and Environment Action Plan (EEAP) for the hotel. First, the EEC agrees to review 170 current hotel practices in 12 categories – from lighting to laundry to HVAC distribution – to find out if their hotel has rolled out an initiative for savings in that practice. The EEC reviews the practices by doing a series of walk-through tours in the hotel over a course of three months. According to Rath, this

walk-through process is key to engaging employees: "It is a powerful experience for every employee to see the audit. They learn about measures that they can do that make a difference." After surveying for current practices, the EEC selects eight to 10 items to implement in the EEAP for the coming year and sets quantifiable targets associated with each. The EEAP is then loaded into the corporate-level project management system, where the practices and targets are monitored and reviewed by the corporate Energy and Facilities team.

Figure 8. Marriott Energy Review and Planning Process



Practice Assessment

- Enabling employees to understand best practices, set targets and maintain actions to meet their targets is necessary when energy demand is driven more by behavior than by processes.
- Education is key – many people care deeply about the environment and their impact on it, but do not fully understand the optimal energy behaviors related to their day-to-day tasks and the bigger picture. Through the three-month audit process, the EEC touches operational actions throughout the hotel and is able to gain a clear understanding and help raise awareness about optimizing behavior.
- Quantifying the value of the small behavior changes – such as turning off lights, reducing under-utilized cooking burners, and minimizing the run time of laundry processing – across an entire hotel during its 365 day operations adds up to measurable energy and cost savings. Managers have expressed a need for a way to quantify their intended changes and ideas – and the Marriott tool makes it easy for them.
- Bottom-up involvement to meet corporate goals requires tight coordination, oversight, flexibility, and trust. Employees need to understand and buy into corporate goals – and getting involved in the EEC and including their input in the process is a great way to accomplish that.

> *"We give the associates the tools and then get out of their way – each hotel makes its goals and then strives to deliver them. The EEAP is all about teaching, educating, and engaging throughout our hotels. Getting everyone involved is powerful when a company has nearly 150,000 employees."*
>
> – Doug Rath
> Director of Energy and Environment,
> Marriott International

Case study: Starbucks Corporation

Company Profiled

Starbucks Corporation is a retailer of coffee, tea, food, and related products and the largest international chain of coffeehouses. Based in Seattle, Washington (U.S.), Starbucks posted nearly $11 billion in revenue in 2010, with over 17,000 locations in 50 countries and 137,000 employees.

Situation

Known for its social responsibility ethos and business success, Starbucks wanted to understand its third pillar of the sustainability triad – its impact on the natural environment. Because of the geographic spread of its stores, the company needed a simple yet accurate way to get a sense of the source of its environmental impacts.

Action

Starbucks already had piloted light emitting diode (LED) lighting options in its stores. It had executive buy-in to pursue energy reductions. In order to collect its baseline, the company hired an external consultant to find the primary sources of energy use in stores and help set reduction targets.

Results

By 2008, Starbucks had a sense of its greenhouse gas (GHG) emissions sources and began strategies to reduce impact. It set ambitious goals related to energy and water reduction and renewable energy procurement for 2010. In 2010, Starbucks purchased renewable energy credits equivalent to 58 percent of the electricity used in its North American company-owned stores.[19]

[19] "Energy and Water Conservation." http://www.starbucks.com/responsibility/learn-more/goals-and-progress/energy Accessed August 4, 2011.

Collecting a Latte Energy Data

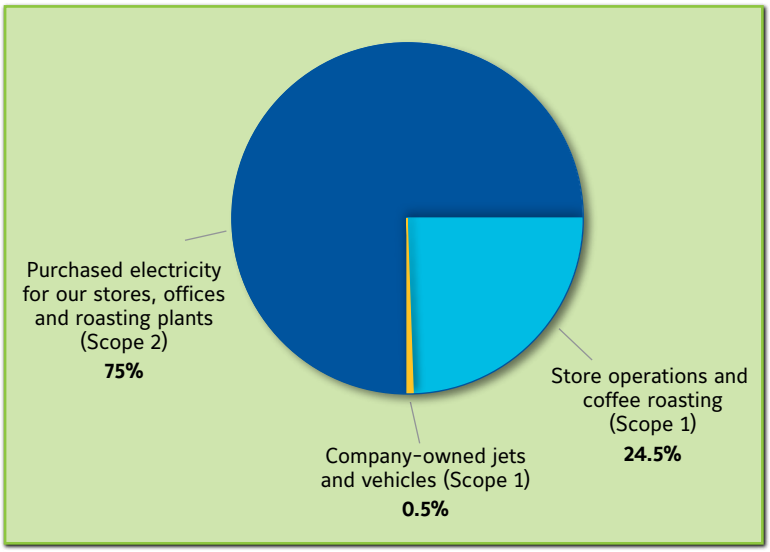
Starbucks needed to do an energy baseline to understand how to develop a strategy to reduce its energy consumption. The company realized that it did not have the internal expertise necessary to calculate its baseline, so it hired an external consultant, who began a six-month monitoring process in August 2007.

According to Brad Simcox, Starbucks Manager of Programs and Initiatives in the Global Energy & Resource Management team, much of the operational equipment in Starbucks locations is similar, such as pastry warmers, refrigeration equipment, lighting, and hot water equipment. Because of this, 19 U.S.-based stores were chosen as a representative sample of typical energy use. The 19 stores had geographic and store-type (drive-through versus café) diversity.

Starbucks discovered that its beverage-making and food-related equipment comprised much less of the energy load than expected – the biggest opportunities for reducing consumption came from HVAC equipment and lighting. The company found that the performance of its HVAC equipment was less predictable – although Starbucks does have a specification for company-purchased HVAC, water, and food and beverage equipment, all but a handful of the buildings the stores occupy are landlord-owned, meaning that the company has limited control over the type of HVAC equipment serving many of facilities .

The other big discovery for the company's operations came from its greenhouse gas inventory assessment, which was taking place simultaneously with the store energy assessment: Electricity use in Starbucks facilities makes up approximately 75 percent of its Scope 1 and Scope 2 carbon footprint (see Figure 9), and the stores consume the vast majority of the company's total electricity.

Figure 9. 2007 Greenhouse Gas Emissions – Scope 1 and 2 – from Starbucks operations.

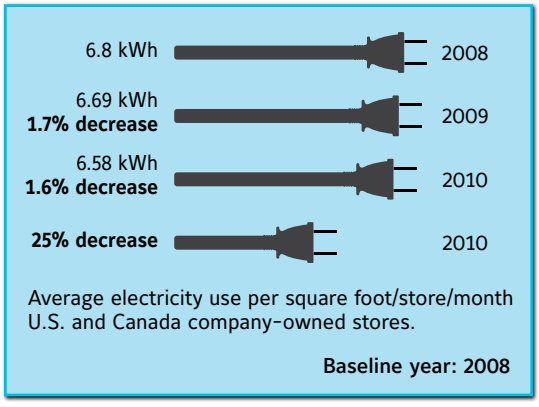


Source: Starbucks Corporation

Next in Line, Please

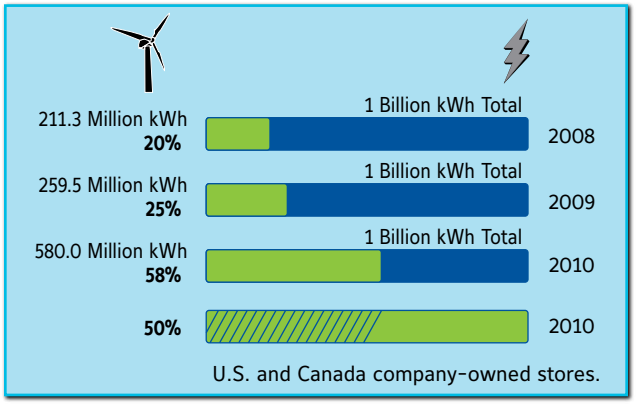
Armed with its baseline, Starbucks set three aggressive environmental goals in 2008 for its company-owned stores: 1) Reduce energy consumption by 25 percent by 2010, 2) Purchase renewable energy equivalent to 50 percent of the electricity used by 2010, and 3) Reduce water consumption by 25 percent by 2015. In 2010, the company realized its renewable energy goal but fell short of its energy reduction goal, achieving only a 1.6 percent decrease in average electricity use per square foot (see Figures 10 and 11).

Figure 10. Starbucks' progress on meeting its energy reduction goal.



Source: Starbucks Corporation

Figure 11. Starbucks' progress on meeting its renewable energy purchasing goal.



Source: Starbucks Corporation

Next steps for the Starbucks Global Energy & Resource Management team include piloting a number of initiatives that will optimize the controllable energy- and water-consuming devices in its stores, including an energy management solution. Starbucks completed a pilot phase for LEED-Volume certification and made a commitment in December 2010 that all new company-owned stores will seek LEED certification, in part by incorporating innovative features that conserve water and energy. Additionally, Starbucks has renewed and updated its commitment to energy reduction and renewable energy purchasing: the goal is to reduce electricity consumption by 25 percent and purchase renewable energy equivalent to 100 percent of company-owned stores' usage by 2015. Last, the chain has implemented LED lighting in its stores, expecting an 80 percent reduction in lighting energy consumption.[20] Starbucks has revised its energy goal of a 25 percent reduction in company-owned stores to be achieved by 2015, rather than by 2010.

[20] "Starbucks to cut energy consumption by 80% with LED lighting. http://www.envido.co.uk/resources/434-starbucks-to-cut-energy-consumption-by-80-with-led-lighting Accessed August 5, 2011.

Practice Assessment

- Creating an energy baseline requires time, patience, and knowledge about the best approach for a company. Starbucks used a sampling approach, since much of its energy use comes from standard equipment. Additionally, since Starbucks focused on its portfolio of over 17,000 stores with one use type (retail coffeehouses), it could synthesize its results with a high level of certainty. For companies with multi-use portfolios, a simple sampling approach may not be as effective – a more complex sampling technique may be required.
- Through its store assessment and greenhouse gas inventory, Starbucks gained key insights about targeting its next steps. For example, GHG footprinting confirmed that energy usage at its stores was a large contributor to emissions and thus a prime candidate for action.
- Starbucks' underlying commitment to sustainability allowed the team to get executive buy-in for energy management efforts and to seek improvements in the future. With baseline information, the company is ready to benchmark itself internally and externally to measure, verify, and report future energy projects and programs.

> *"If you look at our approach, it's not only understanding what the impact of climate change is, it's also a matter of addressing our own contribution to it by using less energy and using better, even greener energy."*
>
> – Ben Packard
> Vice-President of Global Responsibility
> Starbucks Corporation

Case study: Diversey, Inc

Company Profiled

Diversey, Inc. is a leading global provider of commercial cleaning, sanitation and hygiene solutions for business, manufacturing products and running service businesses in more than 60 locations across the globe.

Situation

Diversey made an aggressive commitment in 2008 to sign on as one of 30 companies to partner with the World Wildlife Fund (WWF) to reduce overall greenhouse gas emissions. As part of the WWF Climate Savers program Diversey had to develop an approach to meet its commitment to sustainability while still meeting the needs of shareholders. The company pledged to reduce emissions to 8 percent below 2003 levels by 2013.

Action

Diversey committed $19 million to upgrade facilities, change processes, or rethink products to meet the goals. Instead of looking at this $19 million as a cost, the company decided to approach it as an investment. The investment went beyond financial return: The company took a portfolio approach called the integrated bottom line that considered multiple factors, including greenhouse gas reduction.

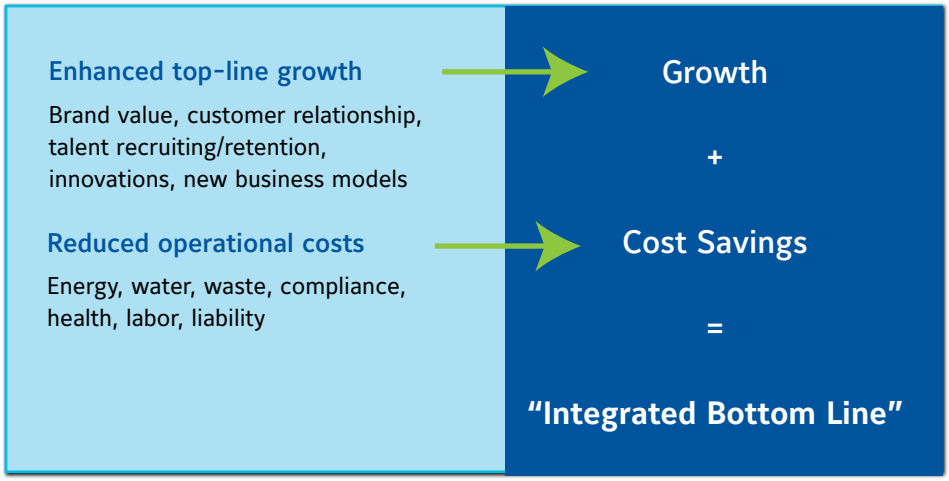
Results

Using the dedicated funds for the energy efficiency program and the process developed that took into account payback period, NPV, and cost to reduce greenhouse gases, Diversey met its goals and captured $32 million in savings. By taking a portfolio approach, the company was able to take low-cost avoidance measures, then efficiency measures, and finally add on-site generation. This approach allowed the company to make its target an even more aggressive 25 percent reduction from 2003 levels.

Dedicated Energy Efficiency Funds Can Be About More than Profit

Diversey decided to adopt an approach beyond financials when evaluating investments for the dedicated fund. Instead of only evaluating projects based on payback or ROI, the company took an Integrated bottom line approach. For these funds in addition to traditional financial measures, the evaluation looked at enhanced top-line and bottom-line growth.[21]

Figure 12. How to Measure Return – the Integrated Bottom Line



[21] GreenBiz Executive Network Presentation Summary, http://www.greenbiz.com/blog/2011/03/07/diverseys-portfolio-approach-toward-sustainability-roi?page=0%2C0

[22] GreenBiz Executive Network Presentation Summary, http://www.greenbiz.com/blog/2011/03/07/diverseys-portfolio-approach-toward-sustainability-roi?page=0%2C0

Create the Tools to Compare Projects Across Portfolio

In order to implement an integrated bottom line approach, it is important to analyze projects across all the relevant dimensions. Diversey set up a spreadsheet and data collection mechanism to gather financial as well as environmental data. For example Diversey looked at the source of power: A project at a facility that reduced "dirty energy" may be more likely to receive funding than a project that reduced "clean energy" – even if the latter project reduced more total energy.[22]

Figure 13. Tools for Opportunity Identification

Identifying a company's biggest opportunities for cost and carbon reductions begins with collecting data on consumption, cost, and emissions. The cost and "cleanliness" of the local energy will determine the attractiveness of the opportunity.

MODEL INPUTS:

Global Consumption Data (12-month Rolling)

	Electricity (kWh)	Natural Gas (mmBTU)	Fleet: Gasoline (gal)	Fleet: Diesel (gal)	Air Travel (miles)
Region 1	50,000,000	5,000,000	–	–	10,000,000
Region 2	10,000,000	1,000,000	500,000	6,000,000	25,000,000
Region 3	25,000,000	–	3,000,000	15,000	5,000,000
Region 4	40,000,000	2,000,000	4,500,000	300,000	15,000,000
Region 5	30,000,000	10,000,000	–	90,000	–
Total	155,000,000	18,000,000	8,000,000	6,405,000	55,000,000

Objective Weighting

Cost Reduction	50%
Carbon Reduction	50%

Performance Goals

Desired Payback	3	years
Energy Reduction	20%	target
Carbon Reduction	10%	target

Average Cost per Energy Unit

	Electricity (kWh)	Natural Gas	Fuel: Gasoline	Fuel: Diesel	Air Travel
Region 1	$ 0.05				
Region 2	$ 0.23				
Region 3	$ 0.17				
Region 4	$ 0.10				
Region 5	$ 0.15				

	Electricity (kWh)
Region 1	1.000
Region 2	0.400
Region 3	0.600
Region 4	0.700
Region 5	0.500

MODEL OUTPUTS:

Top 10 Opportunities	Cost Ranking	Carbon Ranking	Extended Ranking	Cost Savings ($)	Carbon Reduction	Energy Reduction	Units
Region 2 – Diesel Fleet	7.76	5.11	15.86	1,881,022	3,308	1,237,515	gal
Region 1 – Travel	11.00	1.29	12.29	2,666,104	542	4,300,168	miles
Region 3 – Electricity	3.72	7.17	10.88	901,345	3,004	6,008,965	kWh
Region 5 – Electricity	1.12	8.08	9.19	270,911	3,386	3,386,383	kWh
Region 2 – Travel	8.18	0.96	9.14	1,983,384	403	3,199,007	miles
Region 1 – Gas Fleet	2.61	5.10	7.71	633,307	2,139	897,875	gal
Region 4 – Gas Fleet	3.97	3.00	7.58	963,396	1,510	633,515	gal
Region 5 – Natural Gas	1.32	5.56	6.87	319,547	2,328	1,066,156	mmBTU
Region 5 – Travel	5.03	0.59	5.62	1,218,714	248	1,965,568	miles
Region 3 – Natural Gas	0.95	4.01	4.96	230,885	1,581	759,516	mmBTU
				11,068,517	**18,639**		

(continued on next page)

Figure 13. Tools for Opportunity Identification (continued)

PROJECT PORTFOLIO:

Integrated Objectives

Project		Financial Projections						Ranking		
Site	Project Description	Total Investment ($)	Annual Savings ($)	GHG Reduction	Payback	NPV ($)	GHG Value ($)	Cost Ranking	Carbon Ranking	Integrated Ranking
ABC	Project 1	1,254,000	228,400	2,000.0	5.5	366,247	637	13.1	40.9	54.0
XYZ	Project 2	–	250,000	250.0	–	1,720,936	–	14.3	5.1	19.4
XYZ	Project 3	–	250,000	250.0	–	1,720,936	–	14.3	5.1	19.4
ABC	Project 4	–	250,000	250.0	–	1,720,936	–	14.3	5.1	19.4
XYZ	Project 5	480,000	160,000	416.0	3.0	621,399	1,154	9.2	8.5	17.7
XYZ	Project 6	150,000	75,000	300.0	2.0	366,281	500	4.3	6.1	10.4
ABC	Project 7	115,000	38,333	300.0	3.0	148,877	383	2.2	6.1	8.3
XYZ	Project 8	393,000	130,200	38.0	3.0	503,263	10,342	7.5	0.8	8.2
XYZ	Project 9	112,800	50,700	225.1	2.2	236,206	501	2.9	4.6	7.5
XYZ	Project 10	500,000	125,000	–	4.0	360,468	n/a	7.2	–	7.2
ABC	Project 11	100,000	33,333	200.0	3.0	129,458	500	1.9	4.1	6.0
XYZ	Project 12	150,000	56,177	133.2	2.7	236,708	1,126	3.2	2.7	5.9
XYZ	Project 13	115,000	38,333	180.0	3.0	148,877	639	2.2	3.7	5.9
ABC	Project 14	40,000	30,000	200.0	1.3	166,512	209	1.7	4.1	5.8
XYZ	Project 15	135,850	31,730	145.0	4.3	82,571	937	1.8	3.0	4.8
		3,565,650	**1,747,207**	**4,887.3**	**2.5**	**8,471,675**	**1,208**			

Avoidance, Efficiency, Generation – Grab the Low Hanging Fruit and then Make Fruit Salad

Like any good portfolio manager, Diversey had a mix of low-risk, low-cost investments, as well as more expensive, longer-term investments. The company started with avoidance, looking for opportunities to change behaviors that would lead to reduced energy use. A simple example is daylight cleaning. Instead of cleaning at night and requiring lights, workers cleaned the buildings during the day. Next came efficiency, projects focusing on driving waste out of the system. Finally the company looked at generation where it made sense. Ultimately, Diversey took some of the savings from the avoidance and efficiency projects and invested it in wind and combined heat and power fuel cells at its headquarters.[23]

[23] IBE Interview with Jeramy Lemieux, Diversey, Inc, May 2011

Practice Assessment

- Dedicating funds to support GHG goals shows commitment and can be a very good investment
- Leading companies go beyond looking at payback and ROI when making investment decisions with dedicated funds. They look at a number of factors, including environmental impacts and, in Diversey's case, the integrated bottom line.
- Looking at a mix of projects in which to invest a dedicated fund in will ensure maximum impact for the dollar. Looking at a portfolio of projects may allow a company to invest in higher-profile, more visible generation projects that have longer payback but also bring other benefits to the organization and the planet.[24]

[24] http://blog.diversey.com/news-and-events/diversey%E2%80%99s-unique-portfolio-management-approach-to-sustainability/

"A great example of the integrated bottom line is investment in energy efficiency to address climate change. Diversey uses a unique portfolio management approach to deliver significant reductions in greenhouse gas emissions and an attractive economic ROI. This approach leverages existing capabilities, fosters growth and increases shareholder value."

– Dan Daggett Ph.D.
Manager of Corporate Sustainability
Diversey, Inc.

Case study: Johnson Controls

Company Profiled

Johnson Controls, a diversified manufacturer and solutions provider in the automotive and building industries, is based in Milwaukee, Wisconsin (U.S.). The company maintains operations in over 125 countries, and annual revenue in 2011 was $40 billion.

Situation

Johnson Controls joined the U.S. EPA Climate Leaders program in 2003 to help the company address its greenhouse gas (GHG) emissions impact and create an accurate inventory of its emissions. In 2006, Johnson Controls began participating and reporting to the Carbon Disclosure Project (CDP). In 2007, Johnson Controls submitted the inventory of its U.S. GHG emissions to Climate Leaders and publicly committed to reduce its GHG emissions per dollar of revenue by 30 percent from 2002 to 2012, for both its U.S. and global operations. To meet these ongoing environmental targets, the company realized that it needed robust yet simple processes to collect energy data, analyze energy information, and track reduction projects around the globe.

Action

Johnson Controls began using energy and emissions management software that stored and analyzed utility bill and other emissions-related data and tracked the environmental footprint for its global operations. Once that was in place, the company applied a continuous improvement process to drive best business practices and improve performance against six sustainability metrics.

Results

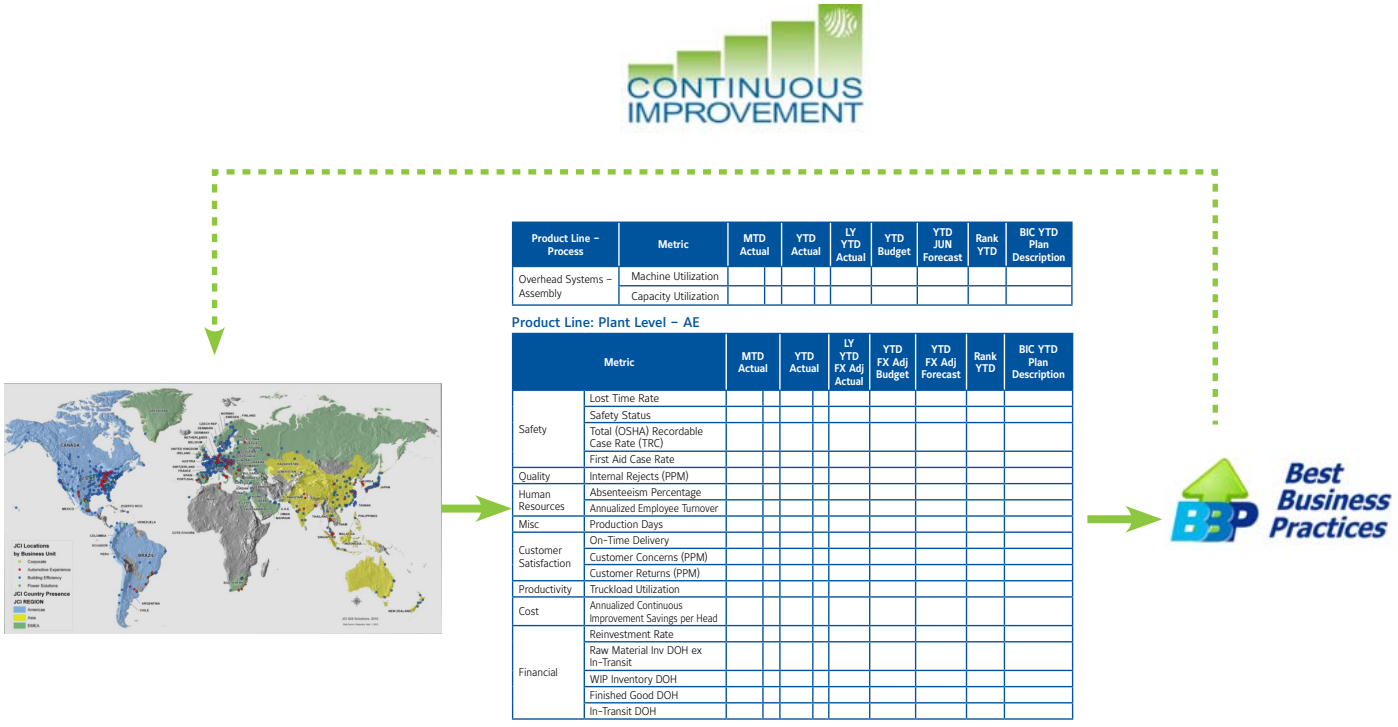
Johnson Controls met its 2002-2012 global GHG reduction target in 2008 after only six years. In 2008, the company committed to reduce its global GHG intensity by another 30 percent by 2018 and developed a Sustainability Scorecard that tracks GHG, energy, water and waste as well as two additional sustainability metrics related to ISO-14001 compliance and design for sustainability process implementation.

Establishing Equivalence

Johnson Controls realized that to effectively improve the efficiency of its plants in three major divisions around the globe, it needed to a way to compare products and processes in a scorecard. The Best Business Practices (BBP) team developed an equivalent unit of production (EQU) for over 40 product lines so that similar plants could evaluate themselves against each other. For example, assembly plants use the number of component pieces to be assembled to normalize the calculations among different plants. The BBP team also created a balanced scorecard across various metrics. More than 250 plant managers are responsible for reporting and optimizing across the scorecard within similar plants – for example, vehicle seating assembly plants would be compared each month against other seating plants.

Target setting occurs within each product line – the performance of the top-achieving plants is averaged to create a benchmark. The average for all plants is then compared to the benchmark, and the improvement targets for each product line are set. The BBP team develops strategies to help the plants achieve their targets, while the on-site Continuous Improvement (CI) team implements the strategies and is ultimately responsible for achieving the targets.

Figure 14. Continuous Improvement



Setting the Energy Benchmark

Johnson Controls decided that energy should be included as a metric in the plant scorecard and that EQUs should be used to benchmark similar plants against each other. Two teams were formed with members from Energy, Manufacturing and Continuous Improvement to visit a representative set of plants and measure the energy used for each of the major processes required for product manufacturing. The team also created an energy allocation tool for plants that produced multiple product lines (Figure 1) and a searchable database of energy reduction projects maintained by the CI team.

The energy intensity metric, along with metrics for water and waste, are rolled up into a plant-level Sustainability Scorecard and then aggregated further into an Enterprise Sustainability Scorecard that includes total GHG emissions. With this plant-level information, the company's BBP team recognizes the top performers across the global plants for their energy reduction efforts at a benchmarking event. At the event, teams discuss strategies for energy reduction that could be implemented across the portfolio. For example, in 2011, the top energy strategies included setting standards for compressed air performance and enhancing the Johnson Controls Energy Hunt program.

Figure 15. Partial sample of plant scorecard

kWh/min	Process step	Equipment	Small Foam			
			All lines – scheduled minutes	kWh/min	Total kWh	% of total
1.246	Molding	BUN Carousel (38 carriers)	23500	1.246	29,273	100%
0.732	Molding	PIP Carousel (32 carriers)		0.732	–	
0.483	Molding	Racetrack (36 carriers)		0.483	–	
0.006	Molding	HR conveyor/curing	23500	0.006	136	

Practice Assessment

- Johnson Controls' key differentiator in energy management is the relationship of energy improvement with BBP and Continuous Improvement. This approach matches well with organizations that are focusing on incremental improvement and have developed a culture around continuous improvement.
- Including energy, water and waste in plants' performance metrics highlights the importance of sustainability at Johnson Controls. Plant managers are given clear direction that their job responsibilities include improving resource efficiency.

The Institute for Building Efficiency is an initiative of Johnson Controls providing information and analysis of technologies, policies, and practices for efficient, high performance buildings and smart energy systems around the world. The Institute leverages the company's 125 years of global experience providing energy efficient solutions for buildings to support and complement the efforts of nonprofit organizations and industry associations. The Institute focuses on practical solutions that are innovative, cost-effective and scalable.

If you are interested in contacting the authors, or engaging with the Institute for Building Efficiency, please email us at: InstituteforBE@jci.com.

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