

ENERGY INFORMATION, GOAL-SETTING, AND ACTION

YOU CAN'T MANAGE WHAT YOU DON'T MEASURE



Issue Brief

Kelly Smith

Program Manager, Global Energy & Sustainability

KEY FINDINGS

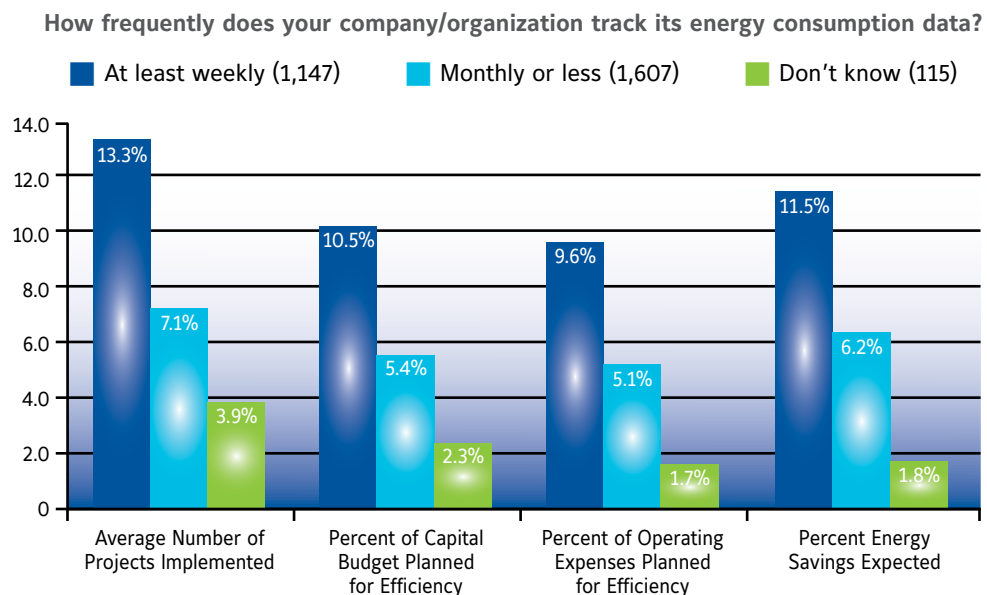
- Organizations that monitor energy consumption frequently are roughly twice as active in improving energy efficiency than those that monitor infrequently.
- The gap in activity between companies with frequent and infrequent monitoring holds for three key metrics: projects implemented, budget allocated for energy efficiency, and energy savings expected.
- Timely energy information correlates with a different paradigm for decision-making – lack of capital is not as great a barrier to energy efficiency among organizations that monitor frequently.
- The correlations between timely energy monitoring and action are strongest for the U.S. and Northwestern Europe and do not hold for all countries surveyed.
- There is a link between public carbon goals and energy efficiency similar in direction and size to the one between timely data and efficiency actions. Organizations with goals have done more projects, allocated more budget, and expect more energy savings than those without goals.

FROM DATA TO DECISIONS: THE LINK BETWEEN MONITORING ENERGY USE AND INCREASING EFFICIENCY

A recent survey of nearly 3,000 decision-makers in facilities worldwide confirms the connection between monitoring energy use and actively managing it. As part of the Energy Efficiency Indicator (EEI) survey, conducted in the spring of 2010 by the Johnson Controls Institute for Building Efficiency, respondents were asked how frequently their company or organization monitored energy consumption data, and then were asked other questions about their actions to improve energy efficiency. From an analysis of the survey data, a relationship became clear: Organizations that saw their energy data at least weekly were more committed to pursuing energy efficiency than those that monitored less frequently. They had adopted more energy improvements and planned to invest more and save more through efficiency in the coming year. This connection is summarized in Figure 1.¹

¹ A correlation does not mean that energy information causes better energy management. See Conclusions section for more discussion of correlation versus causality.

Figure 1: Commitment to energy efficiency versus frequency of tracking energy data



OVERVIEW

For more than a century, businesses in developed economies have paid for the energy they use to create products and services. The only access to energy information for most businesses is from monthly utility bills. With infrequent and non-actionable information coming weeks after the fact, organizations have come to view energy as a fixed line item in the budget – a static quantity that can be planned for but not altered.

Bucking this trend, some organizations have moved toward a paradigm of continuous energy improvement. Active energy management can include top-level commitment, detailed reduction plans, and a dedicated energy policy. No matter which specific actions are adopted, any effort to manage energy must be grounded with timely and accurate data about the organization's energy consumption. In practice, this requires a dedicated system for monitoring energy information, aside from the monthly utility bills. A modern energy information system requires interval meters that report consumption as it varies in time (as opposed to a single number for the month) and software that allows operators to see and interact with their data. An organization can purchase and install these components or have them installed as a service by the utilities or an energy service provider. Many organizations employ some combination of the two approaches.

For this analysis, respondent organizations were separated into two categories:

1. **Frequent Tracking** - those tracking energy at least weekly, implying that they have a dedicated information system for accessing usage data.
2. **Infrequent Tracking** - those tracking energy monthly or less often, suggesting that they use utility bills utility as the primary data source.

A comparison of these two groups across multiple metrics shows clearly that organizations with a dedicated system for energy consumption information were saving more energy and investing more in energy efficiency. The survey looked at three key metrics related to energy savings:

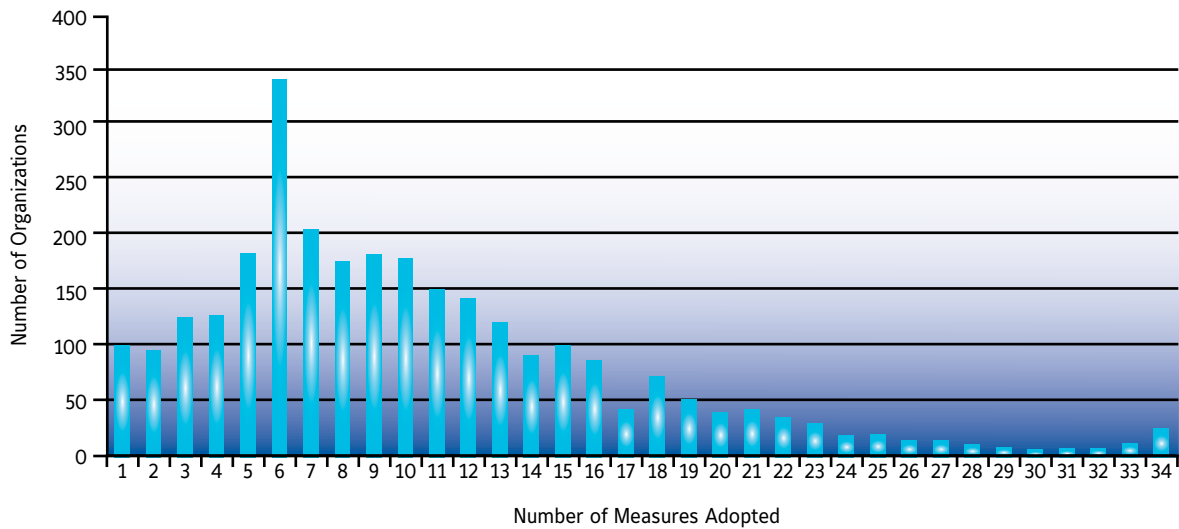
- Projects implemented
- Planned expenditures on improving efficiency
- Expected energy savings

PROJECTS IMPLEMENTED

Organizations that monitored energy use at least weekly had taken more action to improve energy efficiency and manage energy use. Respondents to the EEI survey were asked to select measures their organizations had adopted over the past 12 months, choosing from a list of 33 separate options and allowing for "other" measures, as well.

The results show wide variation: 635 organizations reported fewer than five measures adopted and a comparable number reported 14 or more measures adopted. Figure 2 displays the distribution, revealing a peak at around six measures.

Figure 2: Summary of measures implemented by survey respondents

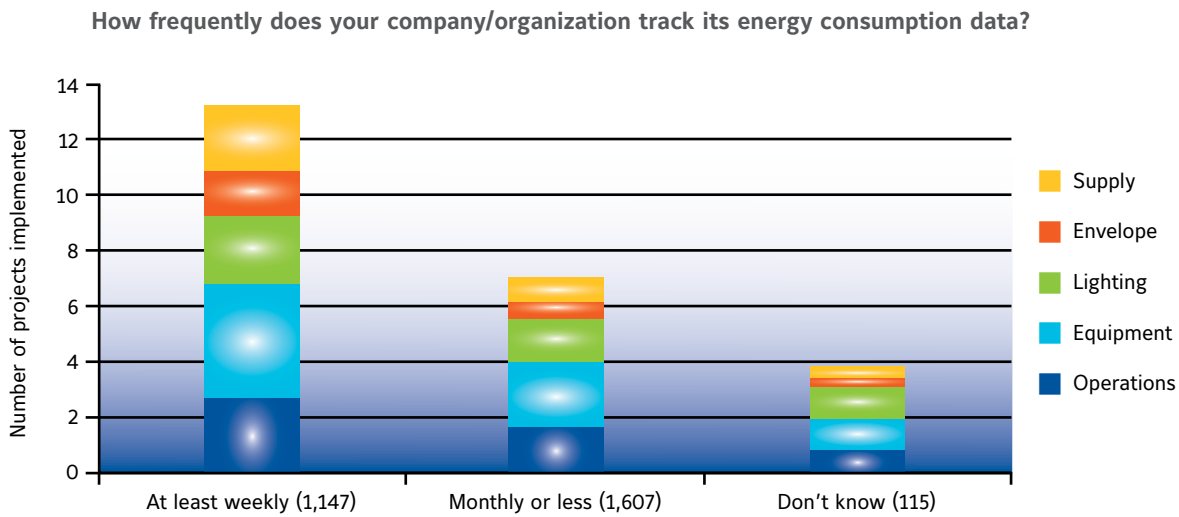


When comparing organizations that track energy data frequently against those that rely on monthly bills, a clear correlation emerges between monitoring energy information and taking action. While organizations that tracked energy monthly, quarterly, or less frequently reported an average of 7.1 measures, those that tracked more frequently reported an average of 13.3. The 33 measures asked about were divided into five categories:

- Energy supply – renewable and distributed energy, contracting with suppliers, etc.
- Building envelope – windows, insulation, roofing materials
- Lighting – lamps, ballasts, sensors, controls
- Equipment – chillers, fans, pumps, motors
- Operations – awareness campaigns, staff training, etc.

As shown in Figure 3, the link between frequent monitoring and more measures adopted held for all five categories of measures. Interestingly, the widest gaps are found in the measures typically considered to be significant changes that yield “deeper” savings: building envelope and energy supply. In each of these categories, organizations that tracked energy consumption frequently had adopted nearly three times more measures on average than those with less frequent information. Frequent monitoring also correlates with more education and training efforts and more upgrades to lighting and mechanical systems, although for these activities the gap is smaller.

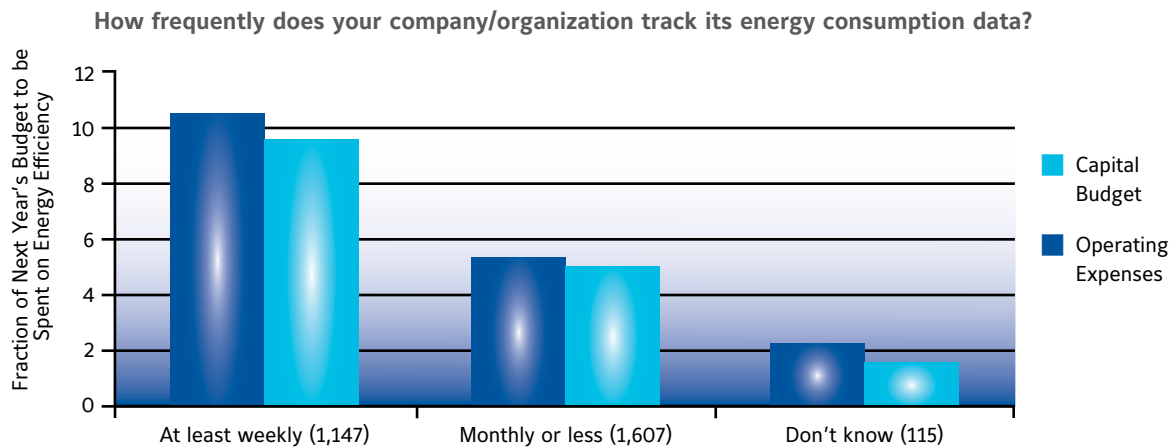
Figure 3: Types of measures implemented by organizations versus frequency of tracking energy data



PLANNED EXPENDITURES ON IMPROVING EFFICIENCY

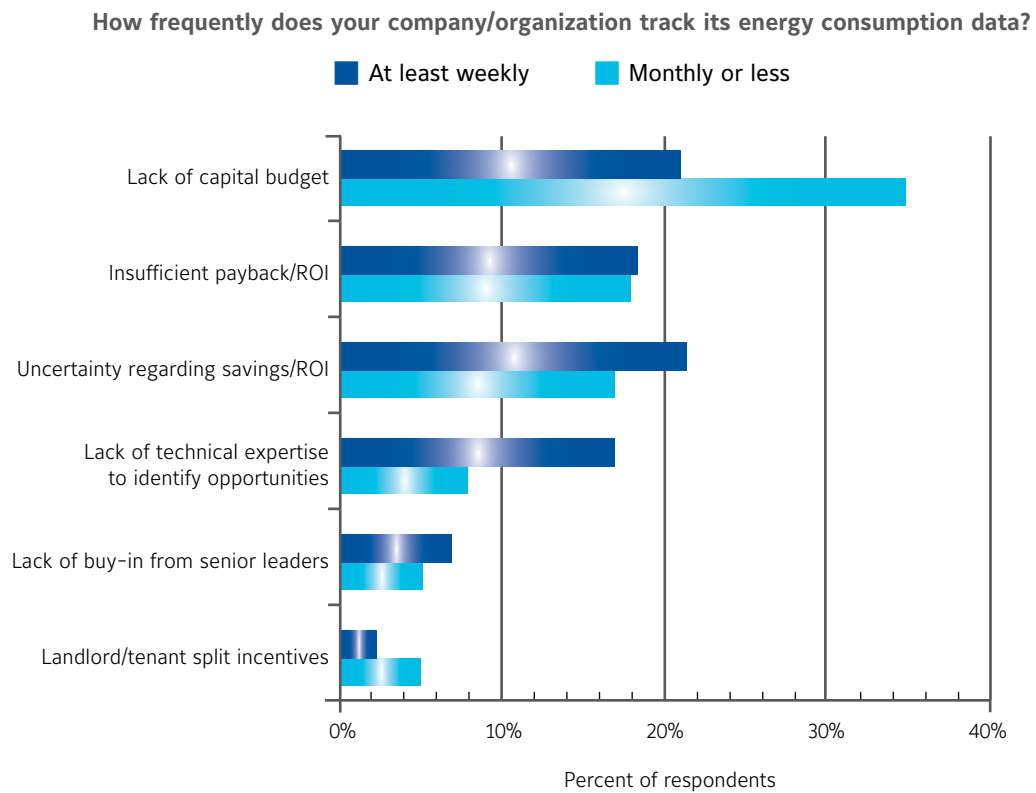
Organizations that actively monitored energy use were planning to spend more on energy efficiency. Figure 4 illustrates this gap, which held for both planned capital expenditures and the portion of operating expenses to be dedicated to energy efficiency.

Figure 4: Planned percentage of budgets for efficiency versus frequency of tracking energy data



When asked about the top barrier to saving energy in their organization, respondents identified lack of capital as the most frequent impediment to potential projects. But here again, the level of energy information available to an organization seems to make a difference. Figure 5 shows that organizations tracking energy use frequently did not consider lack of capital to be as formidable a barrier. The reason for this disparity is not clear. It is possible that frequent monitoring of energy use has led to a culture that emphasizes efficiency with top-level support, in turn reflected in higher budgets for projects. However, a self-selection process is probably at play as well: Organizations that have invested in frequent energy monitoring (stand-alone energy information systems can cost tens of thousands or even millions of dollars, depending on the functionality) have already demonstrated that they are more inclined to invest in energy efficiency.

Figure 5: Top barriers to energy efficiency versus frequency of tracking energy data



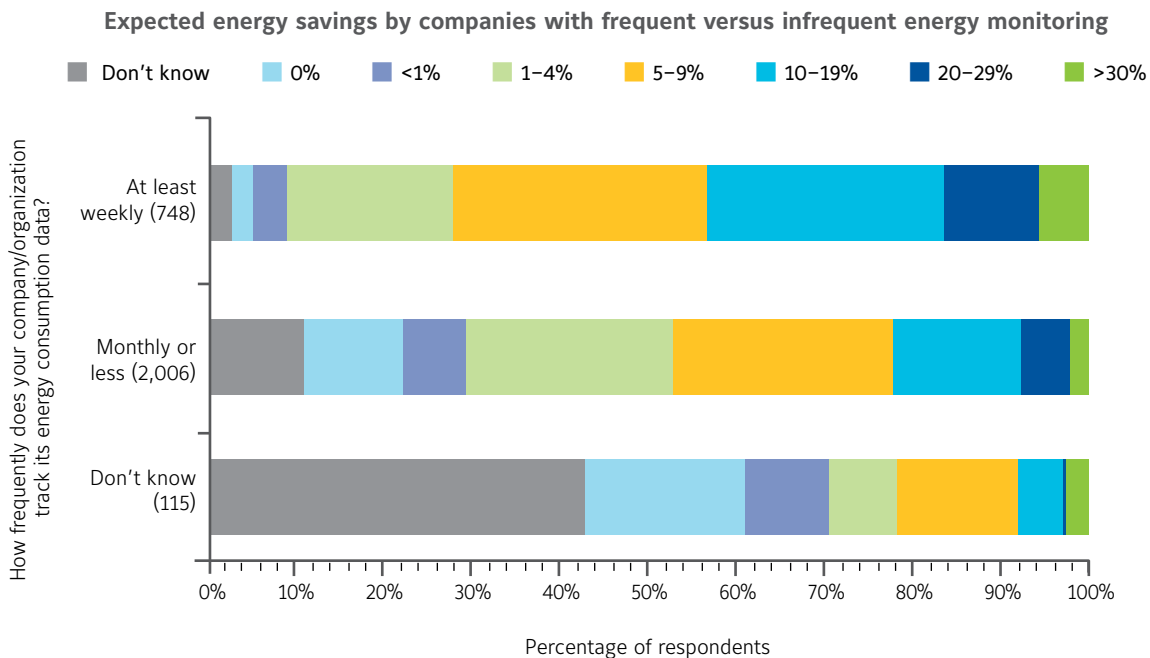
In addition, organizations that frequently tracked energy use appeared to be acutely aware of internal hurdle rates, such as financial payback. In fact, uncertainty about the savings and return on investment for a project was the highest barrier for this group. This final point is perhaps surprising; frequent monitoring should provide more certainty and rigor to energy decisions. But this question referred to projects being considered, a scenario where it is very common to find decision-makers equipped with little information besides the assurances of a product vendor or service provider. It seems that organizations in touch with their data are more demanding when it comes to the performance of projects, possibly because they know that the energy savings will be monitored over time, creating accountability. This finding supports the need for better data and documentation on the performance of energy-saving projects.

EXPECTED ENERGY SAVINGS

Organizations that tracked energy frequently expected higher energy savings than their peers that relied on monthly utility bills. In line with the difference in projects adopted and the fraction of budget planned for efficiency, frequent energy monitoring correlates with roughly twice the level of expected energy savings.

Figure 6 shows that organizations with frequent energy tracking planned to save significantly more energy in the next year than those with infrequent data. Nearly half of the organizations monitoring energy frequently expected at least 10% savings, and another quarter of them expected between 5% and 9%. In contrast, those that monitored energy monthly or less often expected small and uncertain savings: Nearly 20% of this group either expected no savings or did not know how much savings to expect. When energy is not monitored in a relevant and timely way, it is difficult to set expectations for improvement, and nearly impossible to set meaningful, quantitative goals to reduce energy consumption.

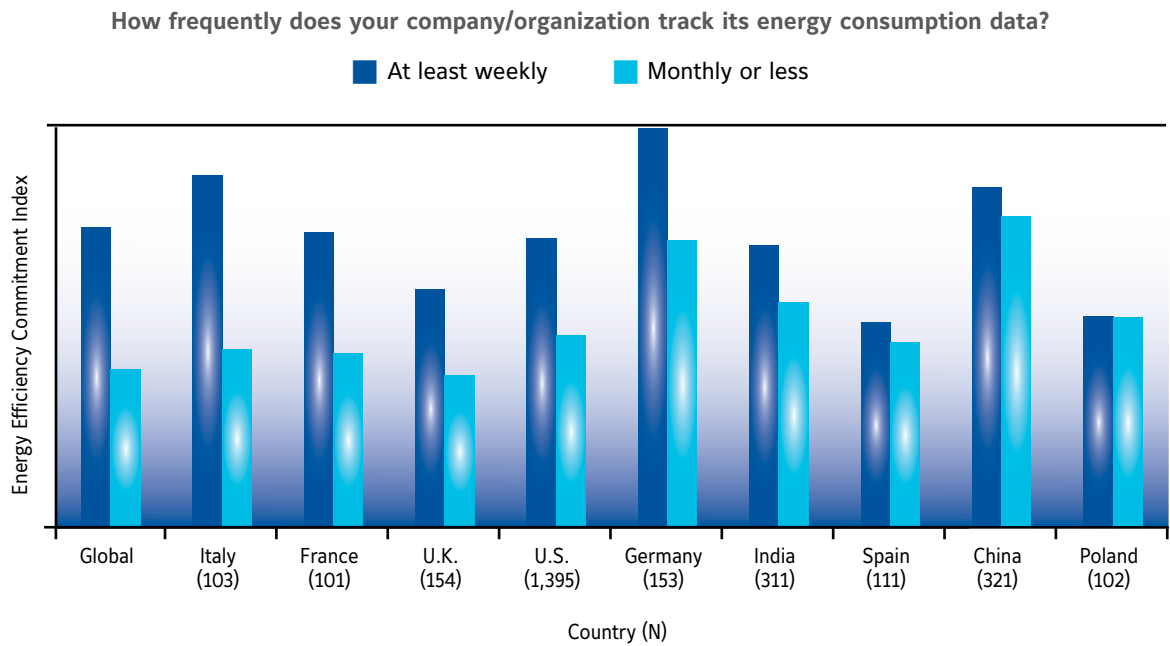
Figure 6: Expected energy savings versus frequency of tracking energy data



REGIONAL VARIATION

While the results of the global EEI survey demonstrate a strong connection between frequent monitoring of energy data and active energy improvements, the link was not consistent for all the countries surveyed. In some places, there was an even stronger connection between measuring and managing energy use than the global average results presented above. In other areas, there was no correlation at all. Figure 7 shows the gap between frequent monitoring and infrequent monitoring for each of the ten countries targeted by the survey. For simplicity, the four quantities surveyed were averaged to create an “energy efficiency commitment index” for each set of data. High values for this index result from many measures implemented, relatively high fractions of budgets allocated for efficiency, and high expected energy savings.

Figure 7: Regional variation in the correlation between frequent data and commitment to efficiency



As Figure 7 makes evident, the magnitude of the link between measuring and managing energy was not consistent across geographies. While there are many variable drivers and possible storylines behind these numbers, and while statistical caution should be applied due to a range of sample sizes, it seems possible that fundamental differences in the business culture around energy are at work. More research will better illuminate the differences between cultures and regions. Possible factors at play include:

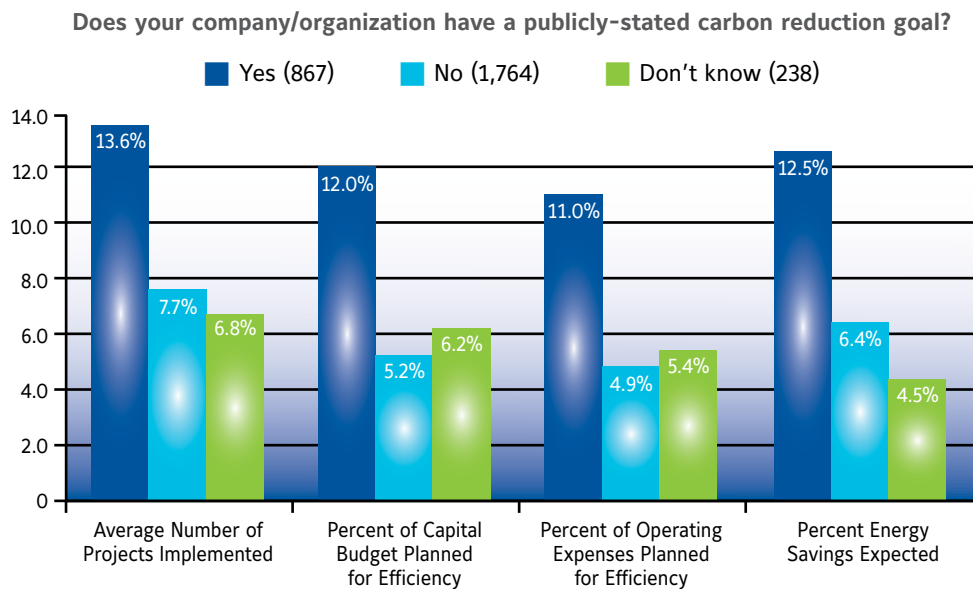
- **Macro interest in efficiency.** Across the board, respondents from China and India expressed a higher level of commitment to energy efficiency. As these countries experience drastic economic growth and compounding energy challenges, their governments have implemented aggressive plans for promoting and, in some cases, mandating efficiency. Under these circumstances, dedicated systems and institutionalized practices for energy monitoring are not necessarily prerequisites for implementing improvements.
- **Data-centric business culture.** In places like the U.S. and Western Europe, decades of academic research and trial and error experimentation have led to a body of business theory about efficiently converting resources into revenues. The recent advent of information technology in developed countries has served to enhance and amplify that theory, resulting in a culture in which organizations expect to make decisions based on quantitative analysis of relevant data of the kind that energy monitoring systems provide.

CARBON REDUCTION GOALS

Another component of successful energy management is goal-setting: Clear, quantitative targets for performance can drive cultural change, communicate commitment to stakeholders, and allow organizations to measure progress. While the EEI survey in 2010 did not ask specifically about energy management goals, a question about publicly stated carbon reduction goals can be used as a rough proxy. Although it is possible to seek carbon reductions without specifically targeting energy use, and vice versa, there is a strong connection between the two quantities for most organizations with commercial buildings.

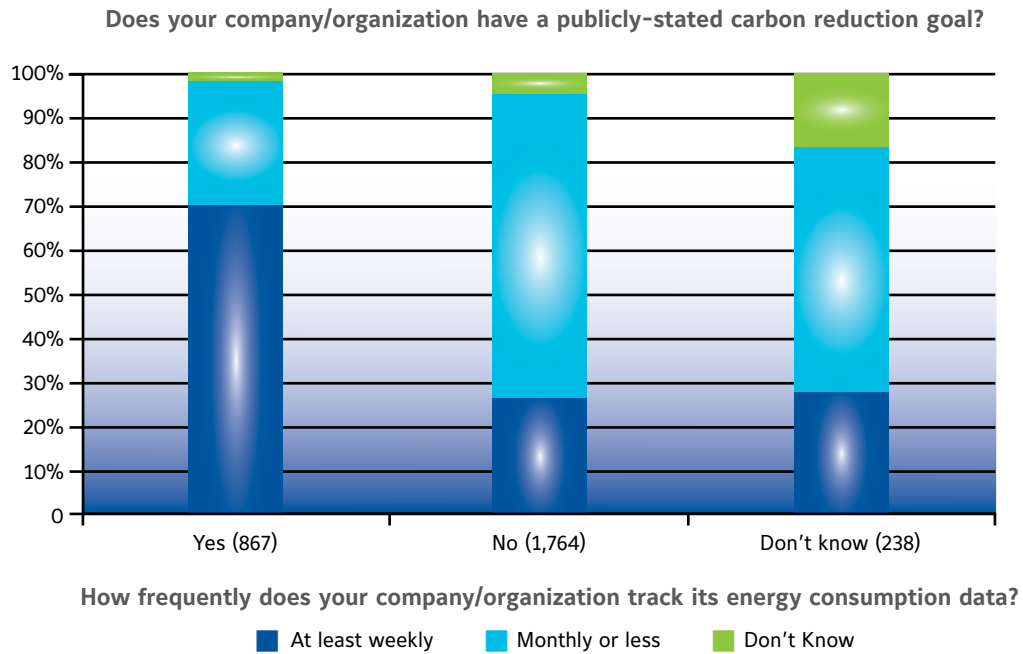
Indeed, examination of the responses to this survey question reveals a link between carbon goals and energy efficiency, similar in direction and magnitude to the one between timely data and efficiency actions explored above. Organizations with publicly stated goals for reducing carbon had implemented more energy projects and planned to spend more and save more in the coming year. As with energy monitoring, the gap is wide – more than double for planned expenditures on energy efficiency, and just slightly less for measures adopted and savings expected. Figure 8 summarizes the correlation.

Figure 8: Commitment to energy efficiency for organizations with and without public carbon goals



Of course, part of the reason these results look so similar to those presented above is that there was significant overlap between organizations that measured energy use frequently and those that had carbon goals. This link is illustrated in Figure 9. Note that 70% of the organizations with carbon goals were tracking energy use weekly or more frequently. In contrast, a large majority of those without goals were relying on monthly or less frequent energy data. If the question had asked about energy goals, the connection would likely be stronger.

Figure 9: Overlap between organizations that track energy frequently and have carbon goals



The overlap is to be expected. Organizations with goals need some way to measure progress, and organizations able to collect and analyze relevant data are more likely to set quantitative goals. Setting goals and monitoring consumption are both essential elements of energy and carbon management, part of the “virtuous circle” that will bring companies, governments and other entities to higher levels of performance, greater cost efficiency, and reduced environmental impact.

CONCLUSION AND IMPLICATIONS

This analysis shows that frequent monitoring of energy use correlates with a stronger commitment to energy efficiency, as shown in both past actions and future plans. Organizations that tracked energy use at least weekly (those with a dedicated system for accessing timely data) had implemented more energy-saving projects and planned to spend a higher fraction of their budgets on efficiency, when compared with organizations tracking monthly or less frequently. The gap is wide: The groups were separated by almost a factor of two. In addition, organizations with frequent energy information planned to achieve roughly twice the energy savings in the next year.

While these results demonstrate a correlation between measuring and managing energy, it is impossible to determine a causal relationship. One possibility is that energy information leads to more investment in energy efficiency. Because relevant and timely data can bring enhanced attention to energy and make areas for improvement more visible, this hypothesis is reasonable. On the other hand, it is equally reasonable

to imagine that pursuing energy reductions leads organizations to measure energy use more frequently, as good information validates the investments and helps communicate the results in a consistent and credible way. Both directions are likely at play, resulting in a “virtuous circle” of monitoring, managing, and reducing energy use. Regardless of the “chicken-and-egg” dynamics of the relationship, it is clear that frequent energy information and effective energy management go hand in hand. Future research is needed to shed more light on the causal effects between energy information and action.

There are many possibilities for how this process can help an organization reduce energy consumption and lower costs. Here are three examples:

1. A utility might attempt to boost energy efficiency across its service territory by installing energy information systems for its business customers. By providing access to timely information (many systems display data in 15-minute intervals, available the day after the energy was consumed), the utility encourages businesses to think differently about its consumption and begin to manage for real reductions.
2. More building owners are enrolling in demand-response programs, allowing them to shift consumption to off-peak times and monetize the benefits to the grid. As they participate, they find themselves looking closely at their electricity consumption and growing comfortable with making changes. One result has been an increase in energy-efficiency activities, reported by both service providers and researchers as a positive side effect of demand-response. This case illustrates the same “virtuous circle,” but with actions preceding the information.
3. Recent efforts to promote, institutionalize and standardize energy management encompass the entire cycle, from energy data and information to goal-setting, to quantifiable reductions in use. For example, a corporation implementing a Continuous Energy Improvement program would likely require frequent energy information and clear goals in seeking to reduce energy consumption and save money. Data would also be important in the adoption of the emerging international energy management standard (ISO 50001).

Just like energy information, goal-setting is an important piece of energy-efficiency achievements. Organizations that set carbon goals were much more likely to implement energy projects, set aside money for energy efficiency, and reduce consumption. Here again, it is impossible to tell whether the goals led to the activities, or if they were simply a side effect of organizations committed to managing energy. Both causal paths are imaginable, and the reality is probably some combination of the two.

Regardless of the path they follow, more organizations can benefit from an increased awareness of energy consumption. As businesses, government institutions and other organizations develop capabilities and habits around frequent monitoring of energy information, they will be better equipped to make decisions that lead to more efficient operations, saving money and reducing environmental impact while adapting to a future in which energy is not simply a fixed expense, but a key differentiator and lever for success.

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.

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