Tools to Build the Framework for Engaging Employees in Making Industrial Buildings Better

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ABSTRACT

There is a new generation of energy efficiency practice in town, and it demands a whole new toolkit. Successful energy conservation and efficiency program implementation are investing in new tools and approaches that promote *customer awareness of energy waste and inefficiency*. A statewide energy efficiency program is testing three essential new tools in the next three years. The first is a playbook for industrial companies on how to think about implementing an employee engagement program, using talk cards, opportunity tags, energy board ideas, and well-informed newsletter content. The second is the sleeping plant tour. This tactical approach involves touring a facility during its quietest hours, helping the facility's staff to uncover inefficiency with their own eyes and ears. Asking the plant manager if systems are turned off at the end of the work week is one thing, but investigating what is actually left running can be a big learning moment, and one filled with energy efficiency program opportunities. The third tool is energy management information systems (EMIS), which indicate to plant employees how well their facilities or systems are performing. EMIS especially allows facility operators to decide on changes and to investigate performance irregularities. This paper guides energy efficiency implementers through the steps for engaging industrial customers' employees in making significant building energy improvements.

Introduction

Energy efficiency programs, by and large, have been effective at using rebates and incentives to buy down the first costs of an industrial company's new capital equipment and product purchases. The practice has been widespread for more than a decade (Shirley 2008). But as those programs mature, what's next? A statewide energy efficiency utility, Efficiency Vermont, has turned its attention to the people inside the buildings, and is now offering advanced technical assistance to industrial company employees. With this assistance, these new partners are making effective day-to-day choices that affect their companies' energy use.

One facility manager described the opportunity and the challenge in a single observation. "I am accountable for the energy use of this facility, but everyone has the authority to use it." The question is: How can a company control energy costs when any one of its employees can start a motor, leave a process running during work breaks, or leave lights on when they go home? The answer rests with a productive collaboration between the energy efficiency program and the building operators. Together, they can ensure that all choices about energy use are well informed and contributing to the best interests of the business.

Although some energy efficiency programs (and their subcontractors) are steeped in such strategic energy management (SEM) tactics, many are not, even though this is a valuable next step for them to take. The crash course here contains lessons in the power of listening to customers as unique entities, and of being resourceful in meeting their needs.

The Problem

When it comes to energy conservation and efficiency choices, businesses need to build communication strategies that inform and encourage employee choices when they are at work. These are not one-size-fits-all strategies. In fact, even similar strategies deployed at two different businesses will vary in their resource requirements and outcomes. More important, Efficiency Vermont's and other programs' experience shows that the resources a business needs to carry out constructive communication strategies on energy conservation and efficiency can be onerous (Levin and Teiwes 2014). As a result, they tend to fall down the priority list. There are actually three reasons for this:

1. Communications on energy and energy efficiency topics can be confusing for workers whose technical capabilities are strong on manufacturing processes, but not so strong on seemingly invisible challenges (such as taking control of energy use).
2. Energy efficiency is not core to most businesses (saving energy does not produce more goods and services).
3. Compiling a good strategy requires specially skilled labor; further, strategy work is typically assigned as a transitory task to someone whose job is dedicated to an entirely different function.

Energy efficiency programs have tried for many years to help businesses engage their employees in making improvements in how energy is used in their buildings. Traditional tactics are often limited to providing companies with poster information on topics such as shutting off lights or motors when not in use. Dissemination is frequently indirect, with facts and tips shared in person with handouts, through the mail, or via a website with downloadable content. Most of the time this information is very generic and generally lacks appeal (Jones et al. 2011).

For Efficiency Vermont, this was demonstrated as facility managers reported feeling ill-equipped to implement employee engagement campaigns. One SEM program energy champion shared that, "The materials are good, but I don't know where to start." As a result, they put other priorities ahead of the employee-involved continuous energy improvement practices.

These tactics are applied despite a growing body of evidence showing that ongoing organizational engagement result in greater customer satisfaction and savings that persist and grow over time (SBW Consulting et al. 2017). Given the reports of poor customer experiences and the benefits of ongoing support, Efficiency Vermont sought to experiment with innovative engagement approaches that equip customers with the means to take concerted action.

Solving the Problem, with a Page Taken from Today's Food Entrepreneurs

VEIC, the Efficiency Vermont operator, partnered with Cascade Energy to develop the **Employee Engagement Toolkit** (Crumrine et al., 2016)**.** Together, they designed the Toolkit to help companies take the next step toward creating their own employee engagement plan. The Toolkit needed a simple design, and so Cascade Energy drafted the primary documents to imitate the directions one might find in a meal delivery service box for a home-cooked meal. The need was similar, as was the desire for appealing ways to keep interest alive: When you come home from a long day at work and need to put dinner on the table, what would you rather have: a basket of vegetables from your local community-supported agriculture source (and nothing in the refrigerator to go with them), or a box full of pre-assembled ingredients with a straightforward

recipe for making that meal? There is a lot of great energy management content available to end users, but they are not sure what to do with it, where to start and how to make it work within the existing operations of their plant. The Toolkit bridges that gap.

The Toolkit contains pieces that work together to help facility managers develop a communication strategy that can move their workforces toward more effective energy conservation. It contains:

- *Coaches' Guide* (the playbook)
- Posters
- Talk cards
- Equipment stickers
- Opportunity tags
- Thank-you notes

The *Coaches' Guide* directs facilities managers on how to use the tools, and offers step-by-step instructions for creating a communication board and for crafting newsletter content to disseminate information throughout each business. In many ways, this playbook helps guide facility and energy managers on how to carry out different strategies for communicating the importance of saving energy. The Guide also suggests several trial campaigns.

The posters can be used throughout the facility to highlight that energy savings and cost reductions are important to everyone, at all times, and should not be ignored. These posters convey:

1. Energy Efficiency, It Doesn't Work Without You
2. Energy Efficiency, Essential to Our Success
3. Energy Efficiency, Less Waste = More Resources for Growth

The facility can use talk cards during shift turnover meetings, to highlight the need for attention to energy, alongside attention to safety, quality, and production. One talk card highlights the average cost of compressed air leaks, and another discusses the per-hour cost of motor horsepower at the facility. The talk cards encourage employees to think differently about their daily work, by asking questions that prompt them to apply their newly learned knowledge and good energy habits:

1. What percentage of the energy needed to make compressed air ends up as useful work?
2. What can we do to reduce the energy waste from motors?
3. How can we reduce the lighting heat load in our refrigerated spaces?

Equipment stickers can be used in places that, in a timely way, call attention to operating status. For example, employees frequently might feel compelled to turn equipment off when they leave for the day, but are unsure if turning off a particular piece might cause damage to a process. Or alternatively, turning off a piece of equipment at the end of a shift might cause the next shift to start late because of the time it takes to restart a process. The stickers, when applied in a logical place on the piece of equipment, offer up:

1. Turn off when not in use
2. Use E-stop when idle
3. This machine costs $___/___ to run

Line workers or managers can use opportunity tags to mark equipment that is currently wasting energy or in need of repair.

The Employee Engagement Toolkit has been distributed to over 20 customers, in and outside of Vermont. Initial customer reactions have been positive. “This gives me confidence. My manager gets it, and I have a clear plan with employees,” said an energy champion in the Pacific Northwest. While it is too early to assess its uptake and impact on energy savings, testing and refinement will continue throughout North America.

Seeing Waste with Your Own Eyes

Seeing waste firsthand is the typical result of an Energy Treasure Hunt or a Kaizen event. These events encourage questioning of practices or equipment control settings that have been in place for, sometimes, many years. A Kaizen is a facilitated event that methodically walks participants through a facility, part of a facility, or various energy-using systems that are key to the host facility.

A different type of event that is a particularly appropriate experience for visual learners can be conducted when no goods or services are being produced. This technique is called a *sleeping plant tour.* It can effectively reveal significant opportunities for reductions in the base load of a facility. Factors such as fluctuating load or outside temperature that normally might affect energy use are absent in a sleeping plant tour. This non-productive environment can frequently offer up many hidden uses of system energy. Examples are: lights being left on, compressed air leaks, and fixed cooling set-points with no setbacks for unoccupied times. Becoming aware of these hidden instances of unnecessary energy use can help employees see energy waste firsthand.

Throughout such a tour, employees who were not familiar with their entire facility can walk around and ask “why”: “Why is this piece of equipment on? Why do you do it this way?”

Sometimes the answer to these questions is, “I don’t know. That’s just the way we have always done it.”

A Mini Case Study of a Sleeping Plant Tour

The outcome of a sleeping plant tour is typically a list of opportunities for employing low- or no-cost energy reduction measures. In one such a tour of a 75,000 ft2 facility conducted in 2016, teams reviewed facility drawings and assemble focus groups to address specific “systems” within the facility—that is, HVAC / compressed air, production, and facility (lights, computers, etc.). This sleeping plant assessment resulted in 35 opportunities identified for reduction, at a total cost of $1,050 to implement, with an anticipated annual savings of 158,087 kWh or $22,750.

The genesis of the sleeping plant tour was a discussion on potential energy savings opportunities, following a question from the director of manufacturing about lights on and noise emanating from the plant on the weekend, when there was no production and staff.

Pre-planning of the Event

This stage involved:

1. Collecting drawings, as appropriate, to facilitate the orderly review during the sleeping plant tour
2. Dividing participants into three groups, each addressing a "system," rather than the geography of the plant:
    a. HVAC / compressed air team
    b. Production team
    c. Facility team (everything else: lights, computers, and other non-production systems)

The Event Itself

The teams discussed common questions, prior to walking the plant floor, to help guide the investigation. They covered basic points. It is very common for employees in a plant every day to become desensitized to extraneous lights and sounds, viewing them as "characteristic" of the plant. The sleeping plant tour allowed staff to pay attention, under a different rhythm of the building, to specific questions that would not normally be asked during weekday run-times. Some of the basic questions are applicable across nearly all plants and industries:

1. Given indoor and outdoor conditions, what is on? Does it need to be?
2. Are there production-critical systems that need to be maintained (temperature / relative humidity)?
3. What is the maintained level of lighting? Are the 24 / 7 lights all needed? If not, how many can be switched or controlled with occupancy sensors? (The 24 / 7 lights are excellent LED upgrade opportunities.)
4. Are the exterior lights all on? Do they need to be?
5. Can most of the parking lot go dark after the last workers leave?
6. Is the air compressor still on? Does it need to be? If there is a flow meter, is the flow being recorded?
7. Are there setbacks on HVAC equipment for when the plant is sleeping? Is there a good opportunity for establishing setbacks? Is there a need for Wi-Fi thermostats or upgrades to the building management system?
8. Are exhaust fans on in restrooms? Can they be scheduled off, or tied to light circuits?
9. Is there exhaust from other processes? Is it on? Does it need to be?
10. Are computers and monitors shut down?

Characteristics of the Tour

The facilities manager did not publicize the sleeping plant tour ahead of time, so that employees and Efficiency Vermont staff could see the plant in its "normal" weekend state. The 6-person tour of the 75,000 square-foot facility took three hours to complete.

Best-practice notes from this particular plant tour:

1. Efficiency Vermont used an ampere meter, data loggers, and flow meters.
2. Having an electrician available to assist in any electrical connections for metering is critically important.
3. With a good pre-plan, appropriate monitoring and measuring tools, and a well-chosen team, the sleeping plant tour can be an eye-opening walk for all involved.

Outcomes

The cost effectiveness of this sleeping plant tour was dramatic, and suggests that this feature of the Toolkit offers very high value, particularly to maturing energy efficiency program administrators:

1. The group identified 35 separate opportunities for new energy savings.
2. Internal staff could address all opportunities, at a total cost of $1,050.
3. Annualized documented electrical savings totaled 158,087 kWh, and $22,750.

Making Energy Visible

VEIC uses another tool with its large industrial and institutional customers: Energy Management Information Systems, or EMIS. A building management system's ability to display real-time demand and energy use levels is very helpful for customers. The scope and scale of an EMIS depends on the customer's needs and budget. EMIS can involve sub-metering down to specific systems or even individual large users/motors as well as software solutions for accessing and using the information being collected, but at its highest level an EMIS should provide a facility-wide tool that lets them know how much energy they are using at any one time—but relative to what? Many factors in a facility drive energy demand. How do you know whether higher energy use values are due to hotter weather, causing the HVAC systems to work harder, or whether production levels are increasing, and the high levels are simply the cost of doing (more) business?

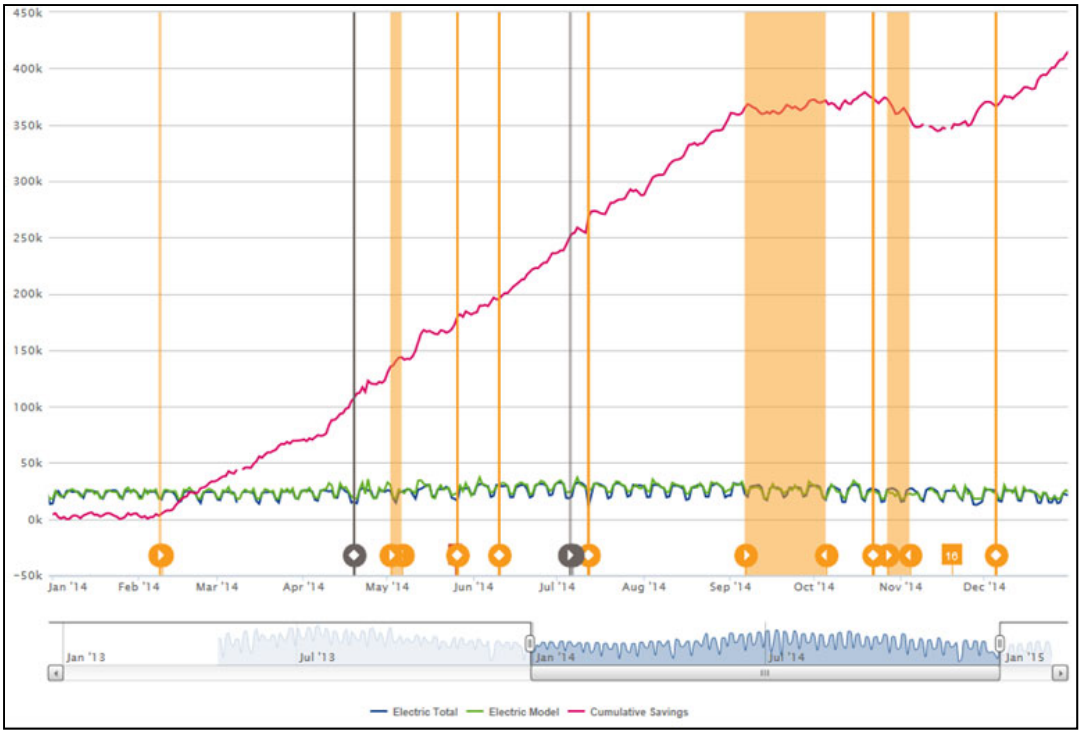

Figure 1. Predicted energy use, actual use, and cumulative energy savings in a facility energy model.

This is done by regression analysis of baseline data that incorporates key variables that drive energy use within a business. By normalizing energy to these drivers this tool can predict energy use from past information. In Figure 1, the green line is the predicted energy use; the blue line shows actual use. Comparing actual values to the prediction helps a customer see if the process is consuming more or less energy than estimated. This comparison is captured in the CUSUM, or cumulative sum of differences (red line in Figure 1). Customers can see the progress of their energy management efforts or easily see data inflection points in this line that reflect positive actions or should lead to a corrective action.

This tool helps a customer find something gone amiss—such as a large, compressed-air leak or a setback that has fallen out of sequence on cooling equipment—that causes energy use to go above the predicted amount. Conversely, if energy use goes far below the predicted amount, EMIS can help the facilities manager understand what is going right, so that it can be repeated. Positive changes in their CUSUM trend can help reinforce that their actions made a difference and use this to further engage employees to the benefits their actions have to the business. In one case a maintenance technician reviewing the EMIS screens on Monday morning saw the trend of the CUSUM turn negative. Understanding this this reverse trend indicated that something had changed in their process away from the typical, he enlisted the help of others on his shift to look around and find what's different. A technician came back to report a mixing process that uses a large amount of compressed air was left on over the weekend causing the lead compressor to run rather than the trim compressor.

The Vermont experience with EMIS in manufacturing facilities has shown that on its own, it is effective in predicting energy use and thus offers a way to prompt energy-saving actions by building energy staff.

Conclusion

Strategies for engaging employees abound, but most are limited in scope and uptake. Efficiency Vermont has been successful with its Toolkit, especially when it is used in conjunction with systems that visualize energy waste. These are tools that range from suggesting awareness strategies (both reminders and firsthand experiences), to technology aids that make the energy visible. Deploying all of these tools on one customer might not be as effective as mapping out which tools are most appropriate for a given customer. Nevertheless, full familiarity with the Toolkit means the tool belt is always ready for the next customer.

The next-generation tools for advanced and mature energy efficiency programs signal a shift in attention from equipment to the role of people in taking control of the next level of energy savings. The new tools require a greater investment in customer engagement for the energy efficiency program and in employee engagement for the industrial business. But the energy and cost savings easily eclipse those investments, proving their value. This is a high-opportunity versus cost approach that can be relatively easily replicated, given the right understanding of customers, their processes, and their needs.

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