The Cyborg Approach to Energy Intelligence: Combining Software Visualization of Interval Data with a Human Touch to Maximize Savings

Christopher Plum, Kevin Bengtson, Carl Nelson, Center for Energy and Environment
Lori Nielsen, Xcel Energy
Laura Silver, State of Minnesota

ABSTRACT

Analysis and visualization of real-time energy usage interval data is a key part of realizing the vision of "intelligent efficiency" in industry, helping customers understand where energy waste is occurring. However, in the authors' experience, effectively incorporating insights from interval data to reduce energy waste is not likely to happen without additional customer engagement and technical support, particularly for smaller industrial customers. This "cyborg" program combines access to software utilizing interval meter data in conjunction with components of level I, II and III audits delivered through an engagement process to achieve operational and prescriptive savings.

The pilot program uses an energy dashboard and customized recommendations of field engineers to engage these customers. The target business has a very lean management structure – the plant manager, energy manager, purchasing manager and chief financial officer are often all the same person. Getting the time and attention of this person is often a greater challenge than identifying cost-effective energy savings.

Results from 27 participating Minnesota companies in a utility service area that has not yet deployed "smart meters" to its customers are presented. The customer engagement process and approaches to the discovery of energy savings opportunities are described. Engineering analysis coupled with logger data, software and interval data captured using whole building monitoring are used to provide the plant managers with end use analysis of their energy patterns. This new information then allows the manager to engage in energy savings "experiments" and to see the results in near real time, leading to identified energy savings of 11%, including both traditional program based opportunities (6.4%) and low cost/no cost operational actions (4.6%).

Introduction: A Different Approach to Energy Management

While large industrial efficiency programs are among the most cost effective offerings of many utility companies (Bradbury et al. 2013), small to medium industrial businesses are not typically a primary focus of utility energy efficiency programs. This customer segment is expected to access energy efficiency program opportunities on a self-serve basis. The conventional thinking is that small to medium industrial customers are too expensive to serve (on a per kWh saved basis) because of program costs do not scale linearly with usage. Successful programs provide intensive management and support by utility representatives and consultants (Stearns, Clement and Kale 2013); the challenge is how to select elements of this approach for the large number of small to medium sized industrial customers and tap their potential for energy savings Table 1 shows that in Minnesota, small industrial companies make up 93% of the total industrial customers and use approximately 30% of the total industrial energy (KEMA 2012); this DSM potential study recommended this market segment as an area of opportunity.

Table 1. Distribution of Xcel Energy (MN) industrial customers by annual usage

Category	Customers	Percentage	MWh	Percentage	Average MWh
Small	2,721	93%	1,811,518	30%	666
Medium	88	3%	1,042,361	17%	11,845
Large	117	4%	3,283,121	53%	28,061
Total	2,926		6,137,000		2,097

Source: KEMA (KEMA, Inc.). 2012. Xcel Energy Minnesota DSM Market Potential Assessment. Final Report (3 Volumes) Oakland: KEMA.

Energy Intelligence is a Conservation Improvement Program (CIP) in Xcel Energy's Minnesota service territory (Minnesota 2104). Xcel has characterized this segment at difficult to serve and encouraged the pilot to test a variety of approaches to determine which work best with this customer segment, and what level of energy savings can be achieved. The program was approved by the State of Minnesota's Department of Commerce, Division of Energy Resources for the years 2013-2015 (Docket number 12-447.05). Because of the regulatory structure, the utility and state are essential members of the program's design team, participating in updates, supplying feedback and recommendations ultimately ensuring that all expectations are being met. A key feature of the pilot program is to gain insights into relevant programmatic challenges and regulatory questions.

Energy Intelligence was designed as an innovative full service program that could employ a mix of services not previously packaged into an energy efficiency program offering. It uses select components of energy auditing, existing building commissioning, and process efficiency, none of which are cost effective standalone products for small industrial customers. The program engages the customer with a relevant understanding of their energy use, identification of immediate saving opportunities, implementation support, and immediate verification of savings. The target customers do not have dedicated energy managers or energy management systems, policies or goals.

Program administrators hypothesized that providing the customer with on-demand web-based reporting of interval data would make Energy Intelligence engaging and insightful with a minimal need for personal services. Business as usual for these customers is defined by a once-a-month paper bill that includes an array of line item charges (usage, demand, transmission, fuel surcharges, fixed fees and taxes) received 5-6 weeks after the start of billing period. In contrast the program offers interval data from readings recorded electronically every 15 minutes that can be accessed in near real time. Interval data also provides the customer with a complete electronic history that can be reviewed, reported and analyzed.

The program is offered at no cost to participants and has no required energy savings goals. By itself, the existence of interval meter data will not save energy; the purpose of the pilot is to determine how to cost effectively leverage the information elucidated by the data to drive energy savings. As a pilot, there is latitude to continuously modify details of the program design in an effort to find the optimal mix of services to cost-effectively serve this customer group. Energy use monitoring equipment is installed on the participant's premise, a level 1 audit is performed, a web site is activated for access to the data, and program staff train participants on the use of and interpretation of the data. When opportunities are seen for energy savings that can be achieved through operational changes, program staff works with the participant to implement those changes. Energy Intelligence is designed to be an evolving program, using the plan → do

→ check → act methodology not just in service delivery, but also as a way to continuously improve the program design.

Program Design

Energy Intelligence focuses on providing small industrial customers with real time energy feedback and a mix of support services to cost-effectively reduce energy consumption. The goal of the program is to serve 70 businesses during the 2013-2015 period by installing equipment that is capable of providing 15 minute (or less) interval energy use readings via a web-based reporting system. There are three staff roles, project manager, field technician and (back office) mechanical engineer. The project manager provides personal training for participants on the use and interpretation of data, the field technician performs an energy audit and inventory and the engineer provides the technical support needed for the participants to utilize existing utility programs when opportunities are identified. Figure 1 illustrates schematically the program design.

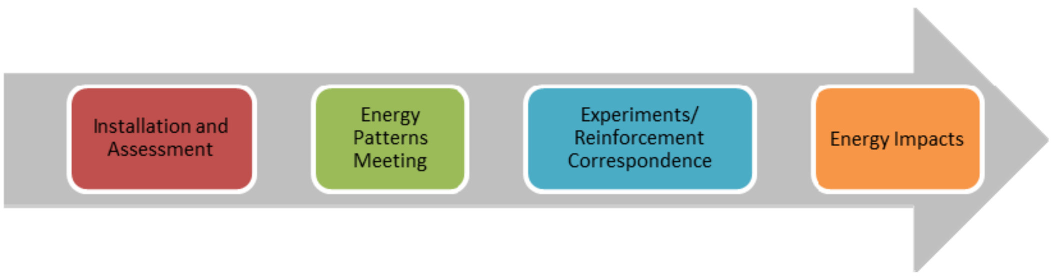

Figure 1. The Energy Intelligence participant experience.

Recruitment and Engagement

Energy Intelligence is intended to get decision-makers' attention without requiring much of their time by providing on-on-one communication and access to automated tools. The participant receives hands-on training from the project manager to ensure they can take full advantage of the new energy use information which is visible by time of day and end use.

Recruitment has been conducted using referrals from economic development authorities, electricians, word of mouth and cold calling. On average, three participants join the program each month. It is open to industrial customers with up to 500 kW of demand (and up to $200,000 per year for electric usage) who are not already served by a utility account manager and do not have a history of participation in any of the utility's conservation programs. These participant qualifications are nearly the opposite of the Montana's Strategic Energy Management pilot program that required participants already be engaged in energy efficiency activities, with dedicated energy managers on staff and a history of participation in utility conservation programs (Gilless, Brown, and Boston 2013). In fact, the program seeks to engage those customers who do not have the 'critical success factors' identified by most other successful programs (Crossman, Hamilton, and Lehoux 2011) – the intent is to find those customers who are unlikely to pursue energy savings activities on their own.

Engagement begins with recruitment (a "sales call") in which the project manager provides background about the program and interviews the customer to determine how well they appear to fit the target population for the program. If the project manager and customer agree to move forward, a participation agreement is executed and arrangements are made for the installation of the energy monitoring equipment. The project manager will meet with the participant in person (at least) twice more during the engagement, at the Energy Patterns meeting to review the energy profiles and plan experiments based on opportunities; and at the energy impact meeting to communicate the observed and modeled savings from proposed energy saving actions (the "identified savings"). A field technician will visit the site at least twice, first to perform an audit and place data loggers and then about a month later to retrieve the data loggers and follow up on any specific questions that the interval data may have raised. The visits of the project manager and field technician do not have to occur at the same times.

As originally designed, a participant engagement would last 3 to 9 months. Experience in the first two years of the program has lengthened the minimum period to 6 months because of the need to generate baseline interval meter data for each participant, so the first one or two months consist only of the gathering of interval data on energy use, and engagements have averaged 8 months.

Installation and Assessment

One objective of the program is to determine the value of meter level interval data in a utility territory where it is not commonly available. While interval meters (also referred to as "smart" or AMR meters) have been deployed nationwide, the distribution is not uniform. The majority of the individual site costs associated with installation of interval metering would be avoided if interval meters were already in place; however the utility investment would be much higher than the cost of this program. It is hoped that the results of the program will provide useful information about the benefits of interval meters.

In the absence of previously installed interval meters, Energy Intelligence has employed two methods of capturing interval data: (1) the installation of data logging appliances with current transformer (CT) technology installed on the participant's side of the revenue meter at the service entrance. This must be done by a licensed electrician. (2) The addition of a KYZ pulse board to the participant's current meter with the output terminated in a junction box. In both cases, the pulse from the device is collected by a pulse counter and transmitted via cellular connection to a database and dashboard service. The data is collected by the dashboard provider and also stored in our own database; neither the utility nor the participant is involved in the data collection, storage or display. The dashboard services are relatively expensive ($75 per month per service) because they are an individual participant subscription, and not a utility wide service, where economies of scale would lower the cost to an individual participant.

Once the monitoring equipment is put in place, the field technician visits the site and performs the site assessment At this time the project manager often interviews the staff in charge of both facility and production management. Data loggers are placed on select pieces of equipment which are monitored for about one month. The field technician returns about a month later to collect the loggers. The information gathered from the audit, data loggers and meter-level interval data are analyzed by the mechanical engineer.

Energy Patterns Meeting

After the energy monitoring equipment is installed on the participant's premise, a data visualization web site is activated for that participant. A sample screen is shown in Figure 2. The initial design emphasized training participants on the use and interpretation of the data; however experience indicates that few participants adopt this management tool as part of their normal routine. This should not be surprising, given the fact that a key selection criterion for the program was a lack of demonstrated interest by potential participants in energy management programs. However, while participants do not find the continuous feedback to be useful, they are still very interested in seeing and understanding their energy profiles when these are presented and explained by the project manager in the Energy Patterns report meeting.

The Energy Patterns Report presents an energy usage profile that includes three types of energy usage periods:

- A. Production Period. This is the period most participants are concerned about because it is the period of the day when peak demand occurs.
- B. Start-up and Shutdown. These are outside of the production period and often provide better opportunities for cost and energy savings without impacting production.
- C. Baseload. This period also provides opportunities for cost and energy savings without impacting production.

In the Energy Patterns meeting the participant and project manager discuss the energy profile and identify possible ways to reduce both total usage and peak demand. The project manager brings general expertise and knowledge based on experience with a diverse group of small industrial clients; this is augmented by the mechanical engineer's analysis of the specific data collected from loggers at the participant's site. The plant manager brings the detailed knowledge of the processes and activities essential to the business to the discussion. There are frequently surprising discoveries for both parties. For example, the magnitude of the baseload energy usage is a surprise for most plant managers and the observed schedule, based on actual staff work habits, are frequently different than what was initially identified in the participant interviews.

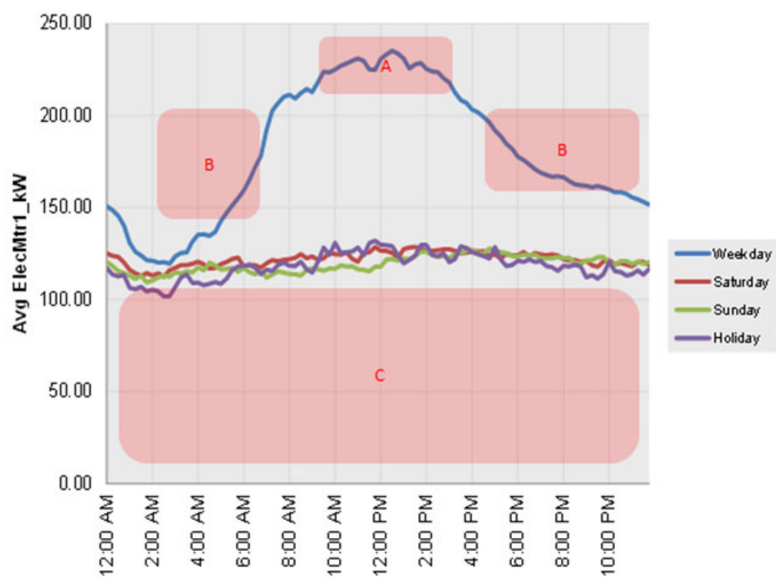

Figure 2. Energy Patterns Report. Shaded rectangles are areas with energy savings opportunities.

The plant manager's understanding that "We open at 7 AM," becomes a realization that the first staff arrives at 4:30AM and turns on the machines in a staged manner to avoid causing a demand spike. If there are immediate opportunities for energy savings through scheduling or low cost/no cost improvements, these are identified and participants may be encouraged to implement some immediately.

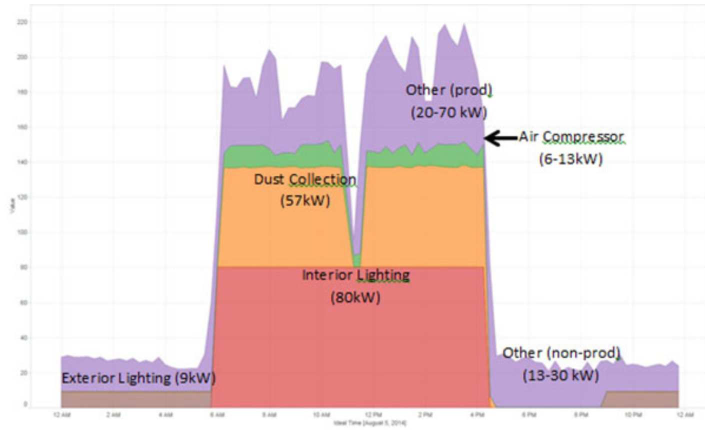

Figure 3. Energy breakdown by end use and time of day

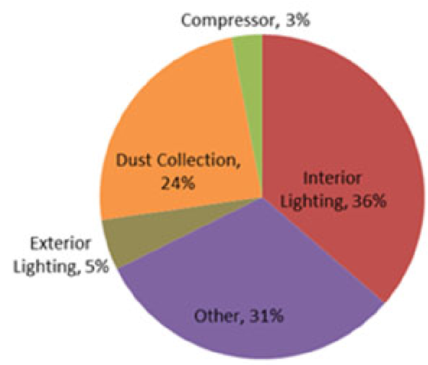

Figure 4. Total energy use breakdown

The engineer also combines the information from the data loggers with the total energy use data to give the participant an energy profile by end use. This is generally provided both in a use by time of day chart and a pie chart to allow comparison of the different end uses, as shown in Figures 3 and 4 above.

Experiments, Reinforcement and Correspondence

A major goal of the Energy Patterns Report is to identify one or more actions that the participant can try to save energy. These experiments are not necessarily permanent changes, rather ways to demonstrate that energy can be saved, or if the participant declines to engage in them are a sign that the participant is unlikely to take action as a result of the program and a cause for concluding their engagement. When the experiments are performed, the magnitude of actual savings is measured through a comparison of the pre- and post- interval data is measured and provided in a follow up report to the participant.

Figure 5 shows how a participant was able to visualize the results of their energy saving activities (reducing their baseload energy usage in unoccupied hours). During weekend nights when there is no production, the facility wide energy use was reduced by about 70% for three periods of about 12 hours each (Friday, Saturday and Sunday nights): because this clearly visible using the interval data the customer was able to see the results of their action on the Monday following the weekend. On the other hand, on a monthly bill, the energy savings (about 4% of total monthly energy) would be hard to distinguish from the normal variation in the customer's usage. The interval data allows savings to be measured in a manner consistent with IPMVP Option B.

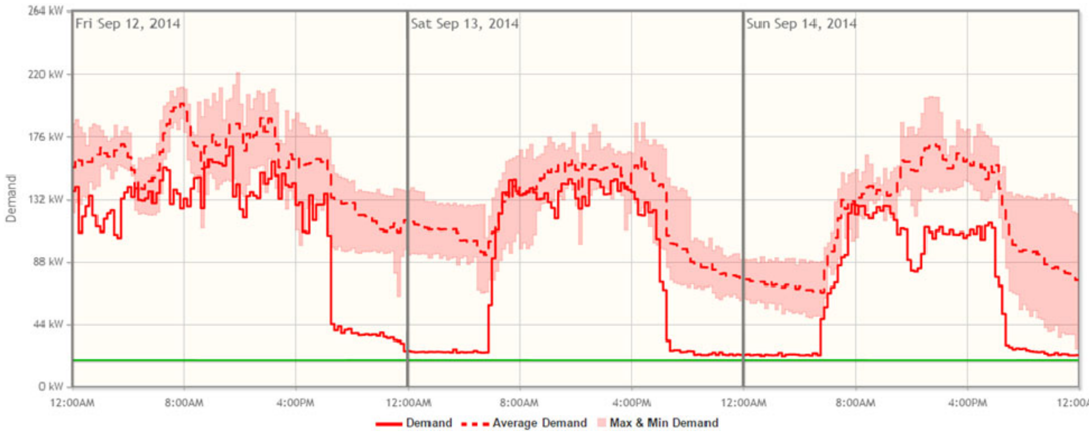

Figure 5. Results of change in customer behavior: turning off lights and equipment during unoccupied hours on weekend nights. Solid red line is after change; dashed red line is average of 5 previous weeks and shaded area is range of the 5 previous weeks.

In addition to the energy saved by the operational change, other opportunities identified for this metal machining company included compressed air optimization (8% annual savings), lighting upgrades (3% savings) and upgrade of a piece of manufacturing equipment (1% savings). The ability to see the actual energy saved with the operational change was instrumental in getting the participant to consider the other energy savings actions, none of which would have occurred without this program.

Measuring Success of the Pilot Program

The ultimate measure of success for the program will be through delivering savings that meet the utilities cost-effectiveness criteria. One purpose of the pilot is to gather the information needed to make such an assessment, including both program delivery cost and expected energy savings. The goals for the three year program are:

- Meeting participation targets (70 participants in 3 years)
- Identifying energy savings averaging at least 5% per site
- Quantifying energy savings opportunities for participants
- Following through with participants to improve implementation.

Results and Discussion

To date, 11.0% (1,139,000 KWh) in potential savings from the 24 completed participant sites has been identified. Savings are identified and quantified using both numerical analysis from the type of data shown in Figure 5 and from traditional engineering calculations used for utility program recommissioning and custom measures. Total energy savings identified range from 0% to 34% with an average of 11.0% +/- 8.8%. About half of the savings are due to measures which are included in Xcel Energy's current energy efficiency program offerings (average 6.4%+/- 6.1%). The savings also includes 4.6% (+/-5.8%) from low-cost/no-cost and operational measures (including recommissioning savings) that were identified using the interval data. Even though the operational savings include some based on actual measurements during participant experiments, they do not meet the criteria required for recognition under Xcel Energy's current program guidelines (typically three years of documented savings or inclusion in the utility's deemed savings database). Since we are just beginning the third full year of the pilot, and due to the short term of the engagement (a maximum of one year with access to interval metering) data has not been collected for a sufficient duration to measure persistence.

Table 2. Summary of energy usage of participants

Participants (25 sites to date)	Usage	Demand	Conventional (prescriptive) savings		Operational (behavioral) and EBCx savings	
	kWh	kW	kWh	%	kWh	%
Average	572,000	132	32,466	6.4%	27,479	4.6%
Maximum	1,900,000	477	132,777	16.4%	185,896	23.2%
Total	10,866,000		616,845	5.7%	522,109	4.8%

Participant Profile

The pilot has allowed us to define attributes of those participants who actively engaged with the program and have opportunities for energy savings include:

- A moderate to high level of interest of the key staff (often only one or two people)
- An operating schedule of 1 or 2 shifts
- A peak load of at least 40 kW
- Annual energy use of 400,000 to 1,500,000 kWh
- Presence of systems that frequently offer opportunity (compressed air, lighting)
- A maximum of three service points (meters).

The typical participant has one electric meter (the pilot sets a limit of 3 meters per participant) and spends $46,000 per year on electricity. The participants are from a variety of industries including: food, metal machining/fabrication, metal plating/anodizing, light assembly/distribution, chemicals, medical, printing, wood, plastics, rubber/adhesives; this distribution of industries is consistent with the distribution of Minnesota's manufacturers (DeWahl et al. 2010).

The importance of the relationship. One of the paradoxes facing the designer of a program for a small industrial customer is that the cost of a minimal level of in-person service is independent of customer size, but the lower energy use offers little ability to spread this cost over energy usage volume. A one day customer engagement can cost as much as 25% of their monthly bill for the average participant. So, while the active assistance of a consultant has been found to increase implementation of energy efficiency measures and improve outcomes in large industrial customers that already have staff with knowledge, experience and expertise regarding energy efficiency (Stevens et al. 2013), for small industrial customers the relative cost is much higher. Notwithstanding this, the need for external expertise is greater, not less since there is often only one person responsible for all operations, and energy is considered an uncontrollable cost that is not worth the time to manage.

Some successful conservation program approaches require the creation of energy teams, or at least a single energy champion who can join a cohort group with colleagues at other companies. Because the small businesses in our target audience don't have an energy manger or champion, these programs can't gain traction with them.

Finally, we found that simply providing the small business manager with an automated energy feedback tool and a small amount of training had minimal impact among the participants. Like their large industrial counterparts, these customers need an advisor who is clearly objective and competent to become a trusted advisor. As with all businesses these days, the value proposition of the program must be both clear and quickly demonstrated.

The relationship with the project manager is built upon a series of meetings, each of which is designed to show value to the customer and establish the project manager's credibility as an energy expert. The first meeting is really a sales presentation. At this time the project manager shows their knowledge of energy and energy savings opportunities and gains an understanding of the needs of the business. The second meeting between the participant and program staff is usually a very brief one with an auditor who assesses the facility by taking an inventory of key equipment, placing data loggers to monitor equipment, and performing a level 1 audit. While brief, this is a critical moment when the technician must come across as an expert who can recognize the key pieces of equipment and can ask intelligent questions. Once the logging and monitoring equipment have been in place for at least a month, the first Energy Patterns meeting occurs. If the first two interactions with the participant have properly established the credibility of the program staff, the recommendations made at the Energy Patterns meeting can lead to action by the participant. Some of these operational changes related to scheduling and setbacks can be implemented right away as experiments. In addition the project manager may recommend that the participant use the utility's established programs for compressed air, lighting or other equipment upgrades.

Using interval data allows participants who try an experiment see that it really does save energy in a specific time period as short as 15 minutes, and do so in near real time. An experiment in this program can be as short as a day or as long as several weeks. The participant can then decide whether to make permanent changes based on the results. If savings are readily visible in the interval meter readings (as in Figure 5) it is likely that the customer will make an evidence-based decision to implement the savings, while they would not if the only had a monthly bill where the change is generally too small and the information arrives too late. The interval data also helps the expert connect the customer with their energy usage and to see the impact of their savings efforts.

The benefit of automated real time feedback. The ultimate goal of this pilot program is to develop a cost-effective means of participant interaction to induce the implementation of energy savings. It has been hypothesized that real time energy feedback information can be used as a self-service tool by many managers of small industrial facilities, but our results do not show this. We did not find any correlation between the number of views and amount of energy saved (%savings = 9.9+0.2*(#logins) with R^2 =0.04). In addition, while the average engagement has been for 8months, over ¾ of the participants stopped logging in after two months. 80% logged in during the first month, and viewed the dashboard an average of once a week in that first month; however usage then fell off to 35% in the second month. The login data indicates that after an initial period of interest, the small industrial plant managers did not look at their energy use on the dashboard much more often than they reviewed their monthly bill.

In addition to the passive presentation of information on the dashboard, the program used active methods. High energy usage alerts were defined by the project manager and participant during the Energy Patterns meeting. When the specified demand level is reached, an alert is automatically sent by the dashboard to the participant via email. The alerts did result in participants taking actions (for example, shutting off equipment when it appeared the demand peak for the month would be exceeded, or turning up a thermostat on very hot days to reduce the cooling load). This communication of a critical event also reinforces the notion that the project manager is an expert who is interested in helping the business. However, while these alerts led to the avoidance of demand peaks, they did not necessarily lead to energy savings.

Production vs. non-production periods for savings opportunities. Process efficiency programs, such as the U.S. Department of Energy's Superior Energy Performance[1] consistently deliver significant savings in large industrial customers, but these programs are not easily adapted to small industrial customers (Gilless, Brown, and Boston 2013). Programs that focus on core process improvement using tools such as Kaizen events or industrial engineering analysis to remove or modify unnecessary steps (waste) in a standardized repetitive process are not broadly applicable to the small industrial producer who produces small batches of custom products, A two day analysis and optimization of a process that is used 40 hours a year is not cost effective. The plant managers we have worked with are generally unwilling to even consider changes to their core production processes: this is seen as a high risk activity that is not worth the relatively small value of energy savings. The program does use those aspects of process efficiency programs that apply to supportive activities, such as compressed air and HVAC systems.

Similarly, the businesses in this pilot have not been receptive to the cohort approach (e.g. energy management teams), even as they developed energy management expertise. This is primarily because of lack of time because additional meetings are often not a priority.

Program Challenges

Energy Intelligence identifies both traditional equipment upgrades that are accessed through existing utility programs and operational changes that may require one or more members of the participant's staff change their behavior. There are changes that can be done via automation, such as scheduling. However, while operational changes can be as simple as changing the schedule for turning equipment on and off with a timer or other automation (and thus become more of a prescriptive measure), none of our participants has had even this very basic level of automation.

The program has identified measurable savings (4.6%) achieved during participant experiments with operational changes. A major objective for the second half of the pilot is to find a cost-effective way to institutionalize and then estimate the long-term magnitude of these savings so they can be attributed to a standard utility energy efficiency program. At present, the standard for measuring behavioral savings calls for evidence of three years of persistence; using current methods, the cost of documentation of these savings would exceed their value. The program is exploring alternative methods that would lower this cost, such as:

- How to demonstrate persistence of institutionalized operational changes
- Finding low cost methods to measure and monitor savings

[1] http://www.energy.gov/eere/amo/superior-energy-performance

- Designing a statistically valid trial that can be used as the basis for reported savings.

Conclusion

This project found that for the participants, energy savings of ten percent or more is possible in small industrial customers, an opportunity for utilities to meet their overall conservation goals. To achieve these savings a personal relationship between a project manager with energy expertise is combined with interval data that provides the customer with new information about his operation. The operational data can be used to both make decisions to save energy and to measure those savings based on actual performance. Both behavioral savings due to changes in non-production operations and conventional savings through standard utility programs for lighting, compressed air, motors and drives contributed to the total savings potential.

A Note on Impact of the Availability of Interval Data on Program Cost

A primary goal of the project is to establish an expectation for the delivery cost of an effective small industrial program. As described above, to be effective, attributes of existing programs for much larger customers need to be adapted to bring create a cost structure that will meet utility cost-benefit tests. At the end of the pilot period, the plan is to have a cost per participant of under $10,000. Initially the cost of outreach and initial engagement is about 40% of the total program cost, administration is 8% and half the cost is for the technical services, which includes the cost of the equipment and software necessary to temporarily provide the participant with interval data.

Two methods of providing interval data were used by Energy Intelligence. (1) Temporary installation of current monitors in one or more electrical service panels and the addition of pulse counting hardware to the existing revenue meter. The pulse counting hardware is connected in the junction box that is installed next to the meter. The actual installation of the circuit board in the meter is performed off site and the meter head is swapped out at the participant's site. The cost for either of these installations is between $1050 and $1700 per metering point. For the CT method, most of the cost is electrician's labor; for KYZ pulse output board the utility charges a fixed fee to add the board. The KYZ pulse output board is the less expensive option, and the installation is both safer and permanent.

This program would have a lower cost if "smart meters" with historical data were available, as they are in many parts of the United States as shown in Figure 6. For the Energy Intelligence Program, the cost of this hard ware and software is about 20% of the cost per participant. With an AMI (smart) meter already in place the installation costs cited in the previous paragraph are avoided; more importantly it is possible to review historical data at the start of the customer engagement. In Minnesota the market penetration of smart meters is less than 1% at this time.

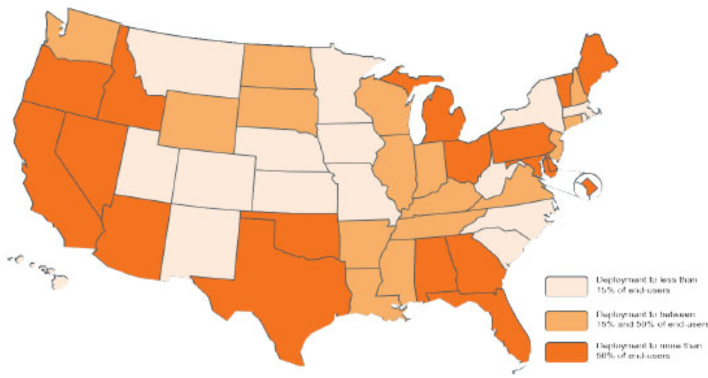

Figure 6. Nationwide smart meter deployment, Xcel Energy in Minnesota has less than 1% deployment. *Source*: IEE Report Utility-Scale Smart Meter Deployments: A Foundation for Grid Benefits. 2013.

References

Bradbury, J., N. Aden, A. Shrestha, and A. Chittum. 2013. "One Goal, Many Paths: Comparative Assessment of Industrial Energy Efficiency Programs." In Proceedings of the ACEEE 2013 Summer Study on Energy Efficiency in Industry, 6:60-72. Washington, DC: ACEEE.

Crossman, K., Hamilton, M., and Lehoux, G. 2011. "Industrial Energy Management: Lessons from Two Programs." In Proceedings of the ACEEE 2011 Summer Study on Energy Efficiency in Industry, 1:36–48. Washington, DC: ACEEE.

DeWahl, K, K. Larson, J. Becker, A.J. Van den Berghe, M.Jost, P. Pagel, and C. McComas. 2010. Energy Conservation Market Analysis: A study to identify energy conservation opportunities for Minnesota's manufacturers. University of Minnesota Technical Assistance Program. http://www.mntap.umn.edu/resources/reports/DOC/MnTAP_IndustrialE2Analysis.pdf

Edison Foundation. 2013. Utility-Scale Smart Meter Deployments: A Foundation for Grid Benefits. IEE Report.

Gilless, C., K. Brown, and S. Boston. 2013. "Cohort Approach Achieves Results with Small-to-Medium Business in Montana." In *Proceedings of the ACEEE 2013 Summer Study on Energy Efficiency in Industry*, 5:1–12. Washington, DC: ACEEE.

KEMA (KEMA, Inc.). 2012. Xcel Energy Minnesota DSM Market Potential Assessment. Final Report (3 Volumes) Oakland: KEMA http://www.xcelenergy.com/staticfiles/xe/Regulatory/Regulatory%20PDFs/MN-DSM/MN-DSM-Market-Potential-Assessment-Vol-1.pdf

Minnesota Department of Commerce, Division of Energy Resources. How CIP Works. 2014. At http://mn.gov/commerce/energy/utilities/conservation/How-CIP-Works.jsp

Stearns, T., S. Clement, and J Kale. 2013. "The Importance of Consultation with Utility Rebate Programs." In Proceedings of the ACEEE 2013 Summer Study on Energy Efficiency in Industry, 6:165–178. Washington, DC: ACEEE.