

Energy Trust of Oregon Kaizen Blitz Pilot Program

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ABSTRACT

Providing incentive funding for large energy efficiency capital projects in manufacturing facilities has been the mainstay of the industrial program at the Energy Trust of Oregon (Energy Trust) since its inception in 2003. By focusing primarily on equipment upgrades and process improvements, significant savings opportunities in low and no cost efficiency actions at plants have largely remained uncaptured. To remedy this issue, Energy Trust, in partnership with Cascade Energy Engineering (Cascade) began to evaluate the application of Kaizen concepts (continuous improvement) to the energy consuming systems of an industrial facility.

The use of the Kaizen approach in a one-week “blitz” format had proven very successful by Cascade in refrigerated warehouses and food processing facilities across the country. Energy Trust and Cascade collaborated to construct and roll out a pilot program focusing on prompt action of operations and maintenance opportunities and consisting of three elements: the Kaizen Blitz event where some actions are completed onsite, an action oriented final report with remaining action items, and one year of follow-up to ensure successful action item implementation.

Savings from the program are determined by tracking normalized facility energy use, both in detailed kW profiling and using monthly electric bill data. Early results indicate the program is able to generate very cost effective energy savings for both the customer and Energy Trust. Four customers have participated thus far with facility-wide savings on the order of 8% to 20%, all from no-cost and low-cost action items. Results, lessons learned, and recommendations for translating this approach to other applications follow.

Background

Kaizen Blitz

Kaizen is a Japanese word that means “change for the better”. The English translation is “continuous improvement”. Often used in conjunction with more comprehensive lean or six sigma manufacturing initiatives, a kaizen event (or “kaizen blitz”) typically has a simple tactical focus involving quick fixes and containment for obvious areas of waste. The kaizen approach involves using a team with direct responsibility for processes or specialized technical knowledge to solve problems. The traditional kaizen team is composed primarily of employees, but also includes vendors, contractors and consultants. The kaizen blitz process relies on the team taking objective measurements, making fact-based decisions and implementing the decisions quickly and sometimes immediately.

Kaizen, lean and six sigma tools have not traditionally been used to address energy waste, although a number of energy organizations, including Energy Trust, the Northwest Energy Efficiency Alliance and ACEEE, are exploring opportunities and partnerships that may leverage these well-established tools to realize operational energy savings.

Kaizen Blitz for Energy Savings

The kaizen blitz approach was initially applied by Cascade Energy Engineering to leverage their specialized technical expertise to realize low cost energy savings from the optimization of the biggest energy using systems in large food processing or distribution facilities; refrigeration, lighting and HVAC. Although headquartered in Portland, Oregon, Cascade developed this offering in response to the needs of two of their national accounts in this sector, who had established corporate directives to reduce energy use across their fleet of facilities, without allocating a capital budget to enable sites achieve these reductions. With corporate level support from these key account customers, Cascade implemented the kaizen blitz and related energy management programs at hundreds of grocery distribution sites nationwide over a 5 year period.

The Cascade kaizen blitz offering involved an multi-day, team-based intensive onsite effort that included identification of issues and development of recommendations that were either immediately implemented or added to an action list for implementation by onsite personnel and/or 3rd party contractors in the near future. In some cases, additional technical support was provided to assist site staff in implementing the action items.

The Energy Trust has contracted with Cascade to provide technical services for the Production Efficiency program since 2005. In 2007, Energy Trust identified the kaizen blitz approach as a potential pathway to achieve low cost, operational energy savings in Oregon industrial facilities and partnered with Cascade to design and deliver the Energy Trust Kaizen Blitz Pilot Program. The pilot was launched in spring of 2008.

Kaizen Blitz Pilot Design

Immediate Objectives and Design Criteria

The purpose of the first phase of the pilot is to test the participant reaction to the offering and results of the kaizen blitz approach with a small sample of Energy Trust customers. This represents the first test of the concept without program support from a central corporate office, as in Cascade's previous projects. Four to five sites with substantially sized refrigeration systems were targeted for this first year pilot. Selected facilities were to include a mix of warehouse and processing space and were to encompass a range of facility energy use from 2,000,000 to 20,000,000 kWh/ yr.

The pilot is testing the amount of operational savings resulting from these efforts and the cost of realizing these savings to participants and to the Energy Trust. Participant savings were expected to be 5% and 15% overall, with 2% to 5% savings potential for the blitz and the rest of savings achieved through implementation of the follow-up action items. The budget for technical effort at each site has been scaled relative to the site's annual energy consumption and therefore to the site's potential savings.

These savings results are also being considered to better understand the characteristics of a successful participant, including their motivation, commitment and capability in supporting the blitz and implementing the follow-up action items. This objective is well supported by the substantial amount of interaction Cascade and other Energy Trust program delivery contractors have with participants throughout the year-long pilot.

The ability of savings to be effectively evaluated at a whole building level for purposes of participant motivation and programmatic savings claims is also being tested through this effort. Interval data is used to show progress during and immediately following the blitz. This provides instant feedback to participants and helps drive momentum to implement additional actions.. Utility bill data is also obtained when available to validate the savings seen from interval data.

This approach to measurement of savings has included working with the Energy Trust Planning and Evaluation staff to provide input and feedback on pilot technical design, such as baseline development and approach to normalization of data for key facility variables. To address concerns about persistence of the low and no cost operational measures supported by the program, a conservative estimate of 3 year measure life is being applied to all energy savings resulting from the kaizen blitz pilot.

Delivery Roles

The Energy Trust Production Efficiency (PE) Program is delivered through the efforts of multiple regionally-based program delivery contractors (PDCs). The PDCs develop and maintain ongoing relationships with industrial sites in order to identify potential energy saving capital projects, motivate customers to proceed with these projects, provide project management support through implementation, validate savings and assist customers in accessing the incentives available through the program. The PDCs assist in the Kaizen Blitz pilot by recruiting and managing customer relations with participants, as well as providing seamless access to the PE program incentives for capital projects uncovered during the pilot.

The key delivery role in the Kaizen Blitz pilot is that of the Technical Service Provider (TSP), typically an engineer with specialized knowledge of the systems involved. The TSP provides technical support on a fixed fee basis, including engineering expertise for the initial blitz, development of the list of participant action items and monthly check-ins with facility staff during action item implementation. The TSP also prepares the baseline analysis of facility energy use, tracks monthly usage and analyzes savings, including normalizing for key variables such as production and temperature. Cascade served as the TSP for all 4 projects in the first year pilot effort.

Beyond the initial savings of 2% to 5% coming from the TSP's efforts in the blitz, the site management, facility staff, and their contractors have primary responsibility for implementing action items. As will be seen in Pilot Implementation and Preliminary Results section, the motivation and effort of participants has a direct impact on realizing the full potential energy savings afforded by the kaizen blitz approach.

Energy Trust Kaizen Blitz Pilot Scope and Financial Incentives

Recruitment is jointly performed by the PDC and TSP, who have an initial discussion with customers regarding the pilot. If there is customer interest, the TSP analyzes historical energy use and prepares the draft Participant Enrollment Agreement and a cost summary sheet for the provision of fixed fee technical services based on size, energy intensity and therefore potential savings. Energy Trust pays for 50% of the fixed fee technical services.

Given that these operational savings are both low cost and highly dependent on participant involvement, there is a need to ensure that customers are motivated to actively participate and follow through. This is accomplished through requiring the following:

- Customer commits to pay for 50% of fixed fee technical services by providing a purchase order to the Energy Trust. Participant cost has been \$7,000 - \$11,000 per site,
- Customer identifies a site Energy Champion and submits selection to Energy Trust for review and approval.

Once a participant is enrolled, the 3-5 day site visit (blitz) is scheduled and performed by the TSP along with the site's Energy Champion, and other potential participants including maintenance staff, technicians and contractors. Changes are made on the spot and action items for later participant completion are identified and compiled into a draft punchlist, which is provided to the participant.

After the blitz, the TSP reviews the punchlist and identifies the key action items required to achieve the bulk of the savings, flagging them as High Priority. Kaizen blitz energy savings are estimated through calculation or through the analysis of normalized electric meter interval data. Action item implementation savings are estimated for the package. Little emphasis placed on the calculation of energy savings by individual action item. Savings and implementation costs may be estimated for a few key action items, if those estimates are necessary to motivate action.

The TSP also lists potential capital projects and sends these ideas back to the PDC to take through the normal PE program process. Upon approval by the Trust, and within one month of the blitz, the TSP issues the final report, including the final action item punch list to the participant. This report is delivered by the PDC, who ensures that the participant understands the incentive requirements, including how payment is issued following action item implementation. The Trust invoices the participant for their 50% share of technical services at this point.

The participant has 14 months to implement the items on the punch list in order to be eligible for savings incentives. Participants are required to complete all High Priority action items in order to be eligible for an increased incentive of 70% of project costs. If participants do not implement all high priority items, incentives are reduced to 50% of project costs for items implemented. Eligible costs for the pilot include both invoiced expenses for time and materials and in-house labor costs, subject to review and approval by the Trust.

During the implementation period, the TSP contacts the participant regularly to answer technical questions and address barriers that arise during implementation, to gather data on energy use and production volume and to use this data to provide the participant with motivating feedback on the impact of their actions. The PDC may also participate or perform some of these ongoing support activities over the 12 month follow-up period.

Finally, the participant informs the PDC when they are done implementing punchlist items. The participant indicates which items were completed and provides invoices and accounting for labor. The PDC reviews invoices, reviews implemented items on site, prepares Energy Trust forms and shepherds forms back and forth between the Trust and the participant. A final report of costs and energy savings is prepared by the PDC based on the whole building or sub-metered data which had been updated or maintained throughout the follow-up period. Based on these final costs and savings, an incentive check is issued to the participant and delivered by the PDC.

Pilot Implementation and Results

Participant 1

Participant 1 is a grocery distribution center, which handles frozen, perishable and dry goods. At the first meeting with the customer in late January of 2008, the Corporate Energy Manager and onsite Facilities Manager both expressed interest in the pilot. They were presented with program economics including estimated costs and a range of potential savings. Simple payback was well less than a year under all scenarios. Customer commitment was fairly easy to obtain, and their interest was high from the start, as the scope of the effort supported their corporate push for increased efficiency.

The blitz. The blitz was held on May 5th – 9th, 2008 and involved 5 full days on site. Participants in the blitz included the TSP engineer, a refrigeration technician from their incumbent contractor and two in-house refrigeration system operators.

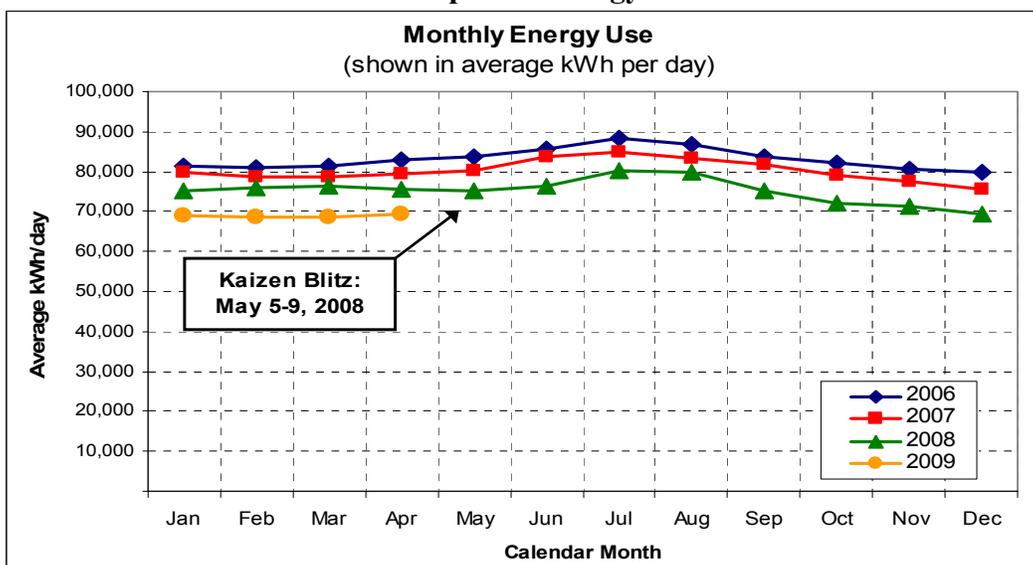
The efforts focused on distribution center energy usage. Onsite fluid milk dairy and bakery operations were excluded from blitz, but dairy and bakery energy use are represented in before and after energy tracking, since one meter serves the entire complex. Energy savings from the action items completed during the blitz were calculated at 6.7%. Total savings from all action items was calculated at 7% from refrigeration, 1% from freezer doors, 2% from lighting, and 1% from miscellaneous.

Action items implementation. Implementation of action items has been slow due to understaffing. Of the two key refrigeration operators responsible for implementation, there has been mixed response to the pilot. One proved cooperative and willing to try things outside his comfort zone. The other operator was more reluctant, was protective of his time and perceived the changes as adding to his ongoing maintenance burden. He has displayed a general resistance to change, but over time he has tried things and seen them work, so this resistance is softening.

Changes are occurring now, driven by the 12 month window for implementation allowed by the pilot. We expect the site to implement all “High Priority” action items in order to receive the 70% incentive and expect some but not all normal priority action items to be implemented.

Energy savings impacts of pilot activities. The baseline was established as the 12 months prior to the Kaizen Blitz: May 2007 through April 2008. Monthly energy use per day was used to track progress, removing the variation in the number of days per month. First year savings are approximately 2,275,000 kWh, which is 7.9% savings over the baseline. These savings represent a calculated avoided cost to the customer of approximately \$165,000.

Participant 1 Energy Use



Participant 2

Participant 2 is a fluid milk dairy with two pasteurizers and five product lines. Recruitment for the pilot required two meetings over 2 months with facility maintenance and management personnel. Although maintenance personnel were interested in participating immediately, management took some time to warm to the idea.

The blitz. The blitz took place in 5 days spread over the first two weeks of June, 2008. Participants in the blitz included the TSP engineer, a refrigeration technician from the incumbent contractor, and in-house staff including the chief engineer, lead electrician and the process automation specialist. Initial enthusiasm of the engineer and electrician was strong. The automation specialist provided some initial resistance during the blitz, but ended up becoming a key participant during the follow-up period. Management was in full support of the kaizen blitz process.

Technical focus and effort of the blitz was wide-ranging at the site and included the refrigeration system, chilled glycol system, chilled water system, HVAC, lighting, production equipment. Significant action items were completed while on site, yielding a calculated 4% savings. Total savings from the major action items was calculated at 7%, with total savings from implementation of all action items projected to be 8-10%.

Action items implementation. Implementation of follow-up action items started slowly, but momentum built as facility management began to see significant savings. By the third month following the blitz the rolling average savings were 15% with less than half the action items complete. A concerted effort to complete the remaining action items during December and January drove rolling average savings to 17%, with single month February savings hitting 28%. The Plant Manager was involved in the follow-up meetings, and he pulled in more people as the project grew in importance, including accounting and engineering management personnel.

The approaching end of a fiscal year drove the decision to push for completion and this participant became the first site to substantially complete all action items, receive the final inspection report and receive the 70% action item incentive from the Trust. 49 of 53 total action items were completed, including all 15 high priority action items. Total implementation costs were \$68,871, with 18% of these costs from in-house labor and 82% from vendor invoices. The 70% incentive from the Energy Trust came to \$48,910.

Energy savings impact of pilot activities. The 12 months prior to the blitz were used as the baseline for this facility. Development of the baseline required the collection of production data for normalization of facility energy usage (kWh per day per gallon of product).

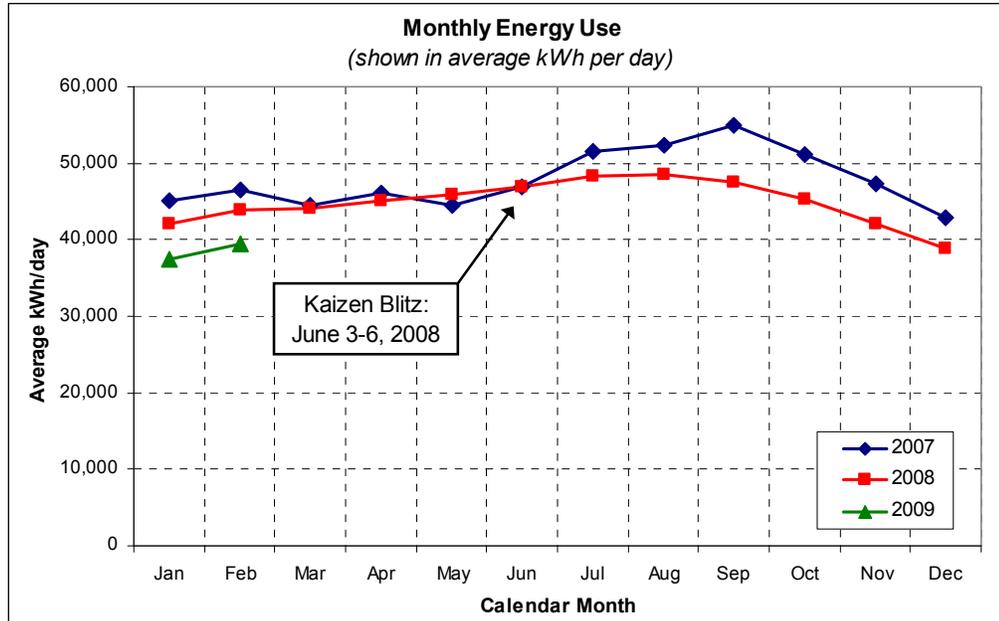
To the great satisfaction of all who participated, energy savings for this site has been nearly double what was projected in the kaizen blitz report. First year savings is projected to be 2,900,000 kWh, which represents \$200,000 in cost savings to the participant.

Participant 2 Energy Savings

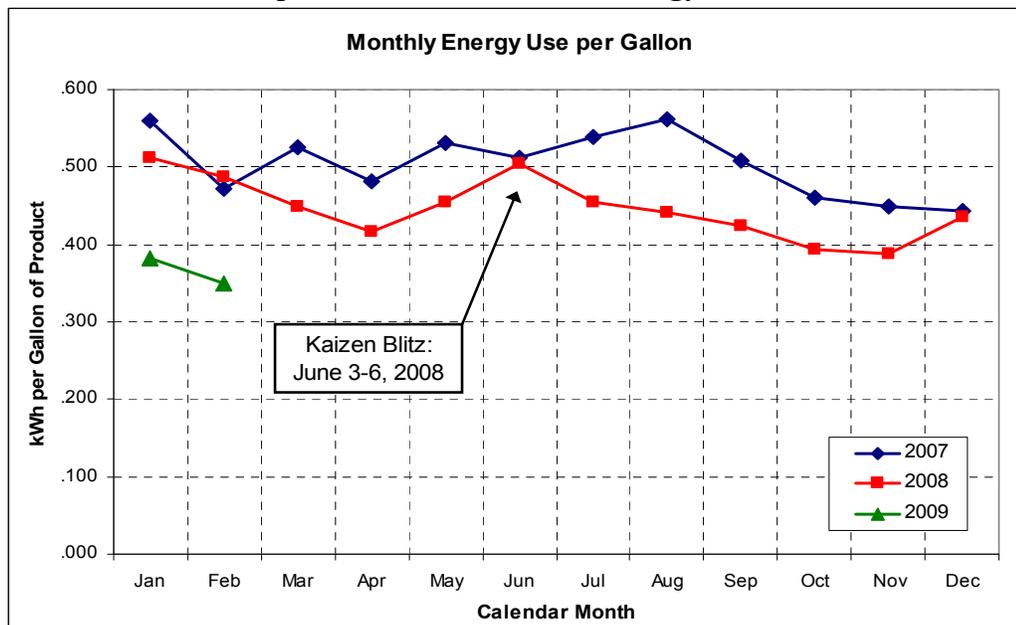
Energy Savings <i>from kWh/Gallon Improvement</i>		
Month	2008	2009
Jan 08		394,231
Feb 08		434,786
Mar 08		
Apr 08		
May 08		
Jun 08	21,781	
Jul 08	277,047	
Aug 08	405,204	
Sep 08	279,550	
Oct 08	236,992	
Nov 08	202,178	
Dec 08	19,920	
TOTAL:	1,442,671	829,017

Savings by Month	
2008	2009
	25%
	28%
2%	
16%	
21%	
16%	
14%	
14%	
2%	

Participant 2 Energy Use



Participant 2 NORMALIZED Energy Use



Participant 3

Participant 3 is a large food processor, who processes, packs and freezes vegetables. The energy loads at the site vary with the crop being processed. Packing season goes from June through October, and the facility loads are very light during the off season. The facility had implemented several large energy efficiency capital projects in the past, including measures associated with refrigeration, compressed air, hydraulics & battery chargers. The customer considered the kaizen blitz ROI and found it very attractive. The quick payback coupled with positive experience with the Energy Trust and Cascade through past capital energy projects were the deciding factors in the customer’s decision to participate.

The blitz. Due to the sheer magnitude of the facility, Cascade, Energy Trust and the customer agreed to focus the blitz on the area served by the two largest electric meters. The blitz effort was spread between June and August, 2008 in order to see the operation during processing of each crop. Participants included the plant manager, chief refrigeration operator and chief electrician.

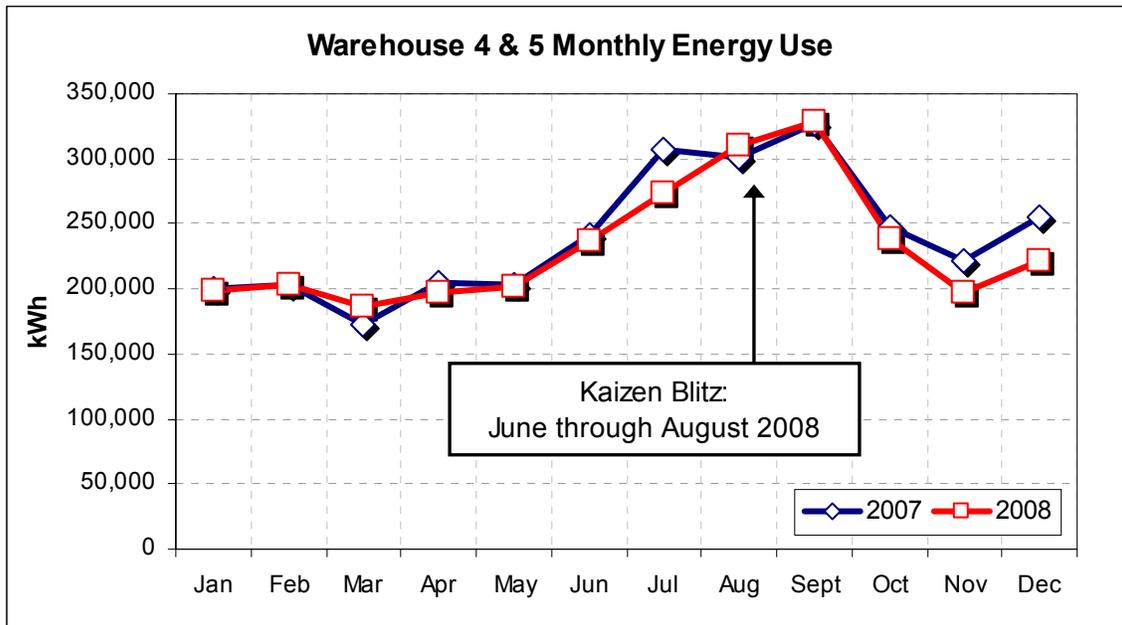
The blitz focused on refrigeration, compressed air, lighting & HVAC systems. Savings from the blitz effort itself were negligible. The action item punchlist is calculated to provide 12% savings based on 11% from refrigeration and 1% from other changes. The action item punchlist was unusual at this site, as 80% of the calculated savings are attributed to two high priority refrigeration action items (out of five total with calculated savings). If the facility implements all 22 action items, total kaizen blitz savings may exceed calculated savings by 10-20%.

Action items implementation. A few small action items have been completed. The facility staff is still considering the two large action items that account for 80% of the energy savings. Cascade is researching the barriers to implementation perceived by maintenance personnel. These personnel have been at the company for many years, and they have been reluctant to change, especially with a perceived risk of equipment failure and a fear of subsequent blame. Management has not yet required maintenance personnel to act, and Cascade is working with management and maintenance to provide an implementation path with mitigated risk that is agreeable to both parties.

Energy savings impacts of pilot activities. The baseline period used is the 12 months prior to the completion of the blitz in August 2008. Although there are some variations in energy use by crop, facility energy use is largely driven by total pounds of product through the facility. The intention is to normalize for pounds of product, but the customer has been less than timely with release of updated production data. Payment of any incentives on savings will be predicated on receipt of the required production data.

3,000,000 kWh per year of savings is predicted with implementation of all action items, but only 250,000 kWh per year of savings is estimated to have been achieved to date, as is shown in the following graph.

Participant 3 Energy Use



Participant 4

Participant 4 is a grocery distribution center handling frozen, perishable & dry goods. Their corporate parent company had previously initiated an energy management program with Cascade that included blitzes and energy tracking at most sites. They had also set a portfolio-wide 10% first year savings goal. The facility participated in the ETO Kaizen Blitz pilot to help them meet the corporate savings goal.

Multiple Energy Trust capital efficiency projects had already been completed, including refrigeration, controls, and warehouse lighting. Prior to joining the pilot, the facility was among the most efficient in the corporation (kWh / weighted cu-ft, weather normalized). However, based on the recent energy data used to develop the baseline for the pilot, the facility had been backsliding significantly for two months relative to the previous year.

The blitz. The blitz took place as a four day intensive effort from September 29 to October 2, 2008. Participants included the TSP, a technician from the incumbent refrigeration contractor, the facilities manager and the onsite refrigeration operator. Facility personnel were very supportive and had no reservations about making on the spot changes.

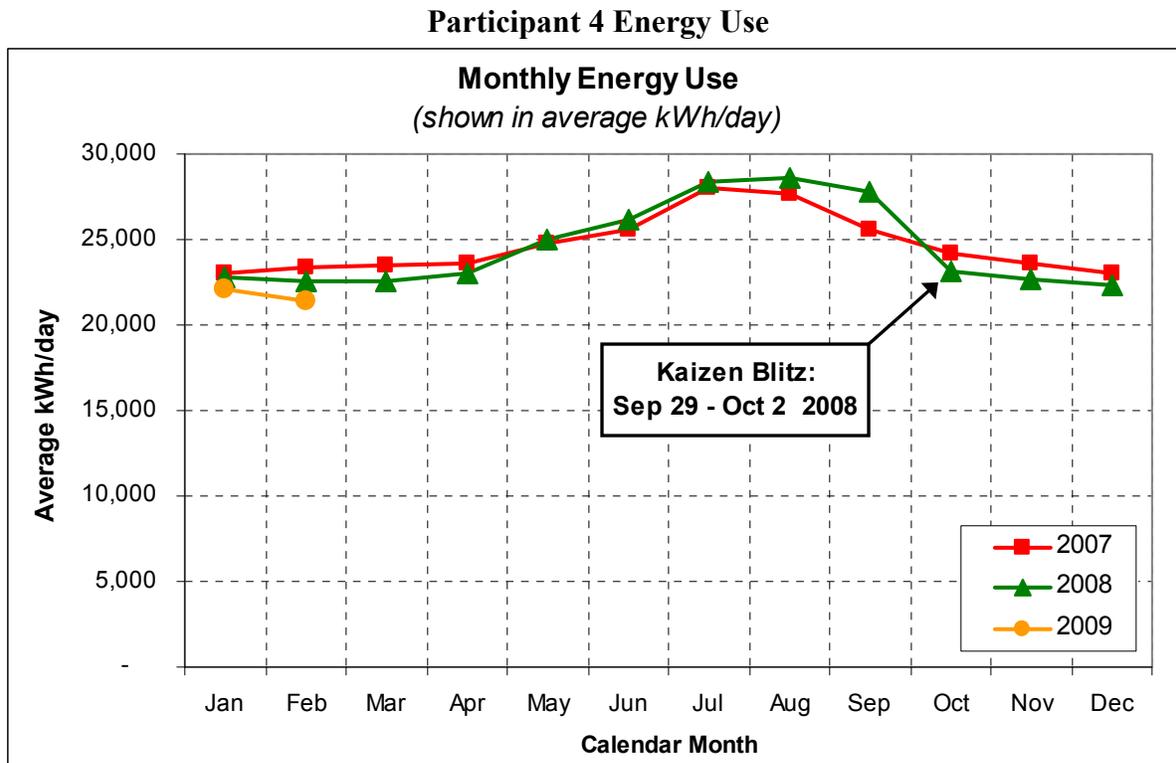
Extensive refrigeration system tuning yielded very visible first-month savings following the blitz of approximately 11% (relative to a predicted facility energy use extrapolated from energy usage of the previous month). Follow-up action items were identified which may provide an additional 3% to 5% savings.

Action items implementation. The 12 month implementation period began in November of 2008 and is proceeding. In check-ins to date, the facility personnel appear to be motivated to implement action items in order to meet requirements of corporate energy savings goals.

Energy savings impacts of pilot activities. The development of the baseline for this project is complicated by the finding of increased energy usage in August and September of 2008, the last

two months of the baseline period. This increase was found to be slippage of savings from previously implemented energy projects. The kaizen blitz pilot identified and remedied the measure failures, resulting in dramatic energy savings from the blitz relative to the previous two months.

The conservative approach to baseline is to use the 12 months prior to the blitz. In this case, it is likely that this baseline approach underestimates savings associated with the pilot effort. It is still too early in the implementation period to adequately project savings, but if the conservative baseline is used, savings could be 5% to 7% of site energy use.



Energy Trust Kaizen Blitz Pilot Phase 1 Preliminary Results

In composite, the four kaizen blitz efforts affected 80,000,000 kWh in baseline energy use. An average of 10.8% kaizen blitz savings was calculated, yielding 8,700,000 kWh/yr and \$478,000 in calculated savings. The participating facilities are well on their way to achieving the savings.

Lessons Learned

The Kaizen Blitz Team

The diagnosis and implementation of operational efficiency in industrial facilities requires a high level of technical expertise. The Technical Service Provider (TSP) must have the experience, knowledge and skills in order to quickly evaluate, analyze and adjust the energy using systems at a facility. Diligence is required on the part of the TSP to help facilities work

through barriers as they arise. Technical rigor is required, both to perform the work and to earn the trust of facility personnel. A knowledgeable technician must also be involved in the kaizen blitz, and in implementation of action items. The technician can be internal, or from a 3rd party.

Facility personnel will tackle kaizen blitz in their own way. Although the TSP can identify what needs to change, facility personnel may come up with creative or in some cases ingenious approaches to solving the problem, based on their intimate knowledge of the systems. They need to be afforded the leeway to do so.

Getting Results

Some facilities will fall short of the kaizen blitz savings estimates. Some facilities will “get it”, and will push beyond the action items, yielding superior results well in excess of the kaizen blitz savings estimates. It seems from this first small sampling of participants that motivated customers who have already demonstrated a commitment to energy savings may receive the most benefits from optimizing their operational efficiency through a kaizen blitz. But given time and continued support, most facilities will make changes and improve.

On top of the direct energy savings, kaizen blitz drives customer engagement. Participants in facility operations have increased excitement about energy efficiency, and have expressed interest in taking the kaizen blitz further and continuing to refine their operations. Management at the sites have taken notice and gotten involved, and in some cases corporate management has also plugged in, looking to leverage the site’s success in other facilities across the country. As a direct result of this effort, a sister facility of one participant has signed up with Cascade for a kaizen blitz. The corporate parent of both facilities is considering implementation of kaizen blitz across their 6 facilities.

The kaizen blitz approach can also yield capital energy upgrades. Two of the participants have identified energy efficiency projects during the course of the pilot which are now being studied and seriously considered for implementation. Since their participation in the kaizen blitz pilot has forged a stronger bond between Energy Trust and the customer, it is expected that these projects and those to come will be developed with the assistance and support of the Production Efficiency Program.

Conclusion: A Bigger Picture Objective

This focus on O&M savings and test of plant-level meter data for evaluation in the Energy Trust Kaizen Blitz pilot touches on very small pieces of the larger worldwide technological transformation related to energy information. Advances in metering, hardware and software are enabling new approaches to quantifying the energy performance of buildings. With normalization, whole building level measurement and evaluation approaches offer the potential for cost-effective delivery of operational energy savings programs. They may also allow for quicker and deeper savings to be realized than is currently possible in approaches which isolate systems and equipment into discrete measures which require the development of measure baselines and measure calculations prior to implementation. And these systems may more accurately represent the savings that are derived from actions taken at the site.

Simultaneously, the graphical representation of whole building or sub-metered data is better understood by building owners and operators than individual measure calculations and can enable their ongoing efforts to operate their plants more effectively and efficiently. The

combination of information with operator control may even represent the eventual end of all efficiency programs. But in the near term, these emerging technologies and practices offer potential long term solutions to issues such as persistence and evaluation of savings that have hampered O&M programs historically and may lead to near term radical rethinking of how efficiency programs are designed and delivered.