Utility Energy Efficiency Programs: A Truly Integrated Approach

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ABSTRACT

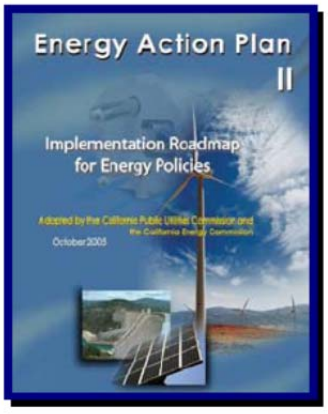
Utilities currently offer several energy efficiency programs that exist as separate entities. In order to ensure their continued effectiveness, an integrated approach needs to be incorporated into the program design.

In California, demand side management (DSM) has been a focus of the large utilities for several decades with a particular increase in emphasis over the last 15-20 years. Due to these programs' success, much of the "low hanging fruit" has been implemented. This creates challenges for the installation of more complex energy efficiency measures. As a way of advancing the existing portfolio, CA utilities now provide programs with a stovepipe structure for Retro Commissioning (RCx), New Construction, Demand Response (DR), Self-Generation, and Continuous Energy Improvement (CEI). Each program operates within separate guidelines, measurement and verification (M&V) requirements, and processes for incentive applications.

In order to provide a comprehensive solution for energy management in a facility, the approach of each utility program should be considered during all aspects of the project cycle and executed in an integrated fashion. Ideally, this integrated approach would empower program implementers to "dig deep" into facilities' systems, maximize the energy savings, and reduce the lost opportunities. This paper focuses on the identification and means to overcome today's barriers and challenges in a mature DSM environment and, through a series of case studies, illustrates the effectiveness of this innovative program design that can be incorporated by utilities across the country to speed the evolvement of their DSM portfolio.

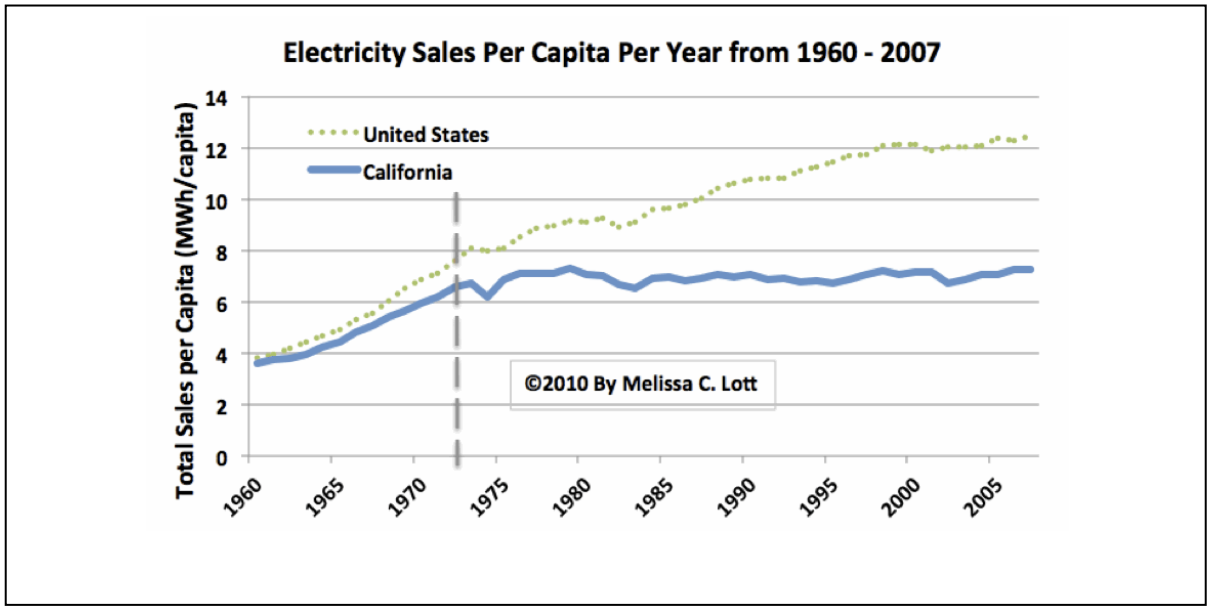
California Demand Side Management (DSM) Programs

In 1974, the California Legislature created the California Energy Commission (CEC) to address the energy challenges of the state. Since then, the CEC along with the California Public Utilities Commission (CPUC) have provided a mix of incentives, policies, and regulations to improve energy consuming systems. Energy efficiency incentive programs were available to the general public in 1998 with the advent of the statewide Standard Performance Contract (SPC) Program. In 2003 through the Energy Action Plan I, the CPUC and CEC identified energy efficiency as "first in the loading order" which identified cost effective energy efficiency as the primary generation source for unmet resource needs (EAP 2003). This concept was reaffirmed with the Energy Action Plan II. In this document, energy efficiency was identified as "the least cost, most reliable, and most environmentally sensitive resource" (EAP 2005). As the importance of energy efficiency increased in the 2000's, the advent of third party programs emerged as a viable method of continued success in energy efficiency (EAP 2008). In the 2006-2008 energy efficiency program cycle, the California Investor Owned Utilities



structured a portfolio with a $2 billion investment; the single largest in United States history. This commitment is a primary contributing factor in maintaining a relatively flat per capita energy consumption profile for the state, as depicted in Figure 1 below.

Figure 1. CA Per Capita Energy Consumption



Source: Lott, Melissa Christenberry. *Quantifying the economic and environmental tradeoffs of electricity mixes in Texas, including energy efficiency potential using the Rosenfeld Effect as a basis for evaluation*. Masters Thesis. The University of Texas at Austin, 2010.

While the funding commitment of the California Legislature, appointed officials, and rate payers continue to rise, so do the energy conservation goals. The longstanding history of energy efficiency in California is so robust that much of the low hanging fruit has been plucked and eaten over the years. In this respect, the past success can be a detriment to the ability of future programs to achieve savings. While technology continues to advance, often it's not fast enough to overcome the large achievements. Additionally, federal and state mandates continue to raise the bar of standards, which eliminates claimable savings and makes the performance of DSM portfolios increasingly difficult. Further complicating the landscape, energy efficiency program design must overcome several barriers that have evolved as the economic climate has shaped a new California and United States. For these reasons, utility program design must utilize an innovative approach to provide benefit to commercial and industrial clients and support implementation of energy efficiency projects that help them meet their own energy reduction goals.

Barriers that Integrated Programs Face and Overcome

In every economy, geographical area, and society, companies face obstacles when it comes to implementing energy efficiency projects, despite aggressive company energy reduction policies and "Go Green" initiatives. Even in areas where utilities and local governments offer lucrative incentives for energy saving projects, many facility managers and personnel do not take advantage of the "free money" that is available. Some common obstacles for companies include

the recent economic downturn, elimination of "low hanging fruit", a lack of available time and expertise of facility personnel, and a general perception that energy efficiency negatively impacts daily operations. Because of these obstacles, utility programs face challenges for gaining participation in their energy programs. In order to sustain participation, utility programs need to overcome these common barriers by implementing a unique and specific program design targeted for different market sectors.

Economic Downturn

Limited available capital. The recent economic downturn has significantly increased difficulty for customers to implement energy efficiency projects. First, a decrease in sales or occupancy reduces cash flow for the business and results in limited available capital to invest in facility improvements. One way that California utility programs have addressed capital concerns is by implementing programs that focus on retro-commissioning (RCx), which are low cost or no cost energy savings measures. While some programs are system specific, such as for compressed air, other programs focus on all systems within commercial buildings.

RCx typically requires a significant labor effort by seasoned energy engineers in the investigation stage. The success of RCx programs rely on an upfront investment in the program design for the investigation stage which is atypical of common retrofit programs. In addition to the payment of the investigation, the end-use customer typically receives incentives at a certain rate that either covers up to 100 percent of the project cost or reduces the simple payback period down to 1 year.

These retro-commissioning projects have provided great benefit to both industrial and commercial clients by allowing all companies to take part in energy efficiency projects and claim additional savings from measures that were previously disallowed in retrofit programs. One such example is with an HVAC system in which a hot water valve was stuck open, causing the HVAC system to simultaneously heat and cool air a majority of the time. The space required continuous conditioning and the RCx measure saved over $200,000 annually at an implementation cost of $15,000. Another example is a compressed air system project at a printing press in Southern California. Although the company has energy reduction goals, the amount of capital that was available to implement energy efficiency projects was limited. The compressed air retro-commissioning program offered by Southern California Edison provided consultant services to the printing company who identified several compressed air leaks and open blows. The consultant applied for the RCx incentive, implemented the project, and provided M&V services to the client at no additional charge. The project saved the facility 1,888,104 kWh and $235,470 annually, and cost a mere $87,634 to implement. Because of the RCx program structure, the company paid zero dollars out of pocket.

Employee turnover. Another effect the economy has had on energy efficiency projects is that there has been some employee turnover at facilities. Because the employees who are most knowledgeable about the facility's projects may no longer be employed, companies rely on utility programs to provide continuity to energy efficiency efforts.

Utility programs in California have been offering customized solutions to energy efficiency for several decades. The design of energy programs have evolved to provide an ongoing relationship with customers that is essential to programs' success. With a large customer oriented program that began in 2006, the customer/implementer relationship in several

instances is so strong that program engineers are on customer energy teams and attend as frequent as weekly meetings to discuss energy issues, potential new projects, and current project status. With continual support through the years, the implementers' engineers have learned a great deal about the facility's energy consuming systems and at times are the sole consistent voice in regards to energy projects. For instance, one large company located in Southern California has cycled through 4 facility project managers in one year's time. The company relies heavily on the facility project managers to champion the company's mandated cost improvement projects across their campus of 10 commercial office buildings. Because of the working relationship established between the utility program implementer and the facility project director, the existing cost improvement and energy efficiency projects are being completed as originally planned. As a result of these projects, the company will save an excess of $347,000 annually.

Lower sales, production, and occupancy rates. One final impact the recent economic downturn has had on the implementation of energy efficiency projects is that companies are suffering from lower sales, production, and occupancy rates. Because the current revenues are less than ideal, yet the facilities need to have the infrastructure to support full production and occupancy, many energy efficiency projects simply do not meet the company's payback criteria. In Industrial facilities, one way that California utility programs address this issue is by utilizing energy intensity as a means of adjusting the project baseline to allow the client the maximum incentive benefit. The energy savings and adjustment is based on the following equation:

$$Savings = \left(\frac{E_B}{P_B} - \frac{E_R}{P_R}\right)(P_R)$$

Where:
Savings = Incentable energy savings (kWh or Therms)
E_B = Energy consumption under baseline conditions (kWh or Therms)
P_B = Production under the baseline conditions (Widgets)
E_R = Energy consumption under retrofit conditions (kWh or Therms)
P_R = Production under the retrofit conditions (Widgets)

The concept can be applied to some commercial sectors. As an example, over the time of a year, in a similar manner to the industrial sector, the overall energy consumption of a hotel should be directly related to an independent variable, occupancy. Some factors such as weather and occupant behavior may influence the energy consumption metric and should be considered in developing the baseline and retrofit metrics. With this sector, we replace the production variables with occupancy.

$$Savings = \left(\frac{E_B}{O_B} - \frac{E_R}{O_R}\right)(O_R)$$

Where:
Savings = Incentivizable energy savings (kWh or Therms)
E_B = Energy consumption under baseline conditions (kWh or Therms)
O_B = Occupancy under the baseline conditions (Rooms or ft^2)
E_R = Energy consumption under retrofit conditions (kWh or Therms)
O_R = Occupancy under the retrofit conditions (Rooms or ft^2)

Such a calculation methodology allows business to take advantage of economic upswings that occur within the timeline of project implementation by adjusting the savings and incentive calculations, therefore increasing the cost effectiveness of the project. Another advantage to the approaches of California energy programs is that utilities can continue to encourage energy efficiency projects during tough economic times since they give their customers more opportunity to capture savings and are therefore more likely to progress towards their energy efficiency goals despite the economic climate.

Absence of Low Hanging Fruit

As the energy efficiency programs in regions mature, much of the easy and simple payback projects have already been implemented. Some of these include lighting retrofits and variable speed drive installations. With the upcoming Federal mandates on the elimination of T-12 manufacturing, this will exclude lighting upgrades in non-mature markets as well. The energy efficiency measures that remain are the intricate solutions that impact the critical systems for sales or health and safety. To overcome this barrier, program design must incorporate technical specialists for specific markets. For example, a program targeted at hospitals would require HVAC specialists that are also knowledgeable in hospital indoor air quality and regulations. The importance of not only being able to calculate savings for complex solutions such as an all variable chilled water system but also being able to "speak the language" of the hospital decision makers is critical. The impact of the trust that is built between the program implementer and the customer cannot be under-stated. Another example is a program targeted at the grocery industry having refrigeration experts to engage with the customer on complex projects such as refrigeration controls.

Available Time and Expertise

Limited time to devote to energy management. As companies downsize or cut costs, the responsibilities of facility and property managers often increase significantly. With these added responsibilities, the facility personnel are often stretched for time and are at most vaguely familiar with energy efficiency design and operation of systems. For these reasons, energy efficiency is not the primary focus of the facility and many projects remain unidentified. Even if projects are identified, it is often difficult for facility personnel to quantify energy savings, estimate implementation costs, and present the project economics to upper management without additional support. As a result, many projects cannot get off the ground even when their potential is realized.

By design, California utility programs provide energy engineers who conduct efficiency audits at no additional cost to the client. These audits often result in some low/no cost measures that the company can implement immediately, but more importantly, most audits unveil energy efficiency opportunities on complex systems that result in savings upwards of 40-50% of the system's usage. One client in Southern California manufactures wafers and operates a campus of two large commercial buildings that house clean rooms and office space. Even with a facility engineer on staff, many energy efficiency projects would not be pursued without the help of utility program engineers. As an example, one utility program engineer (implementer) noticed that there were several inefficiencies with the existing chilled water system that supports the clean room ventilation systems as well as the HVAC systems for the office spaces. The

implementer then completed a preliminary assessment of the system where the savings potential, implementation cost, and simple payback were estimated. These estimates were presented to the facility directors and piqued their interest in pursuing the project. At the presentation meeting, the facility directors admitted that they have recognized system inefficiencies for a while, but have not had the time or expertise to quantify the benefit the project could have to the company. As a result of the presentation, the implementer is preparing an incentive application for the system and the company plans to pursue the project. The projected savings are on the order of 3,000,000 kWh annually.

Limited expertise in energy management. Although these cases occur within industrial facilities, they are perhaps even more common in commercial buildings. Since commercial buildings rely primarily on maintenance contractors, facility staff, and property managers to keep the building or business running, the personnel do not have the contractual responsibility, time, energy, or technical capability to recommend energy efficiency projects. For instance, the day to day operators of a retail store (store managers, sales clerks, etc.) would not be apprised of energy efficiency practices and would be unlikely to make suggestions for projects. However, by providing engineering services at no additional charge to the client, California utility programs increase their program participation by providing audit reports to the client that can be used to promote projects to decision makers.

In addition to needing help with identifying projects and calculating their associated benefits, facility personnel need assistance managing the incentive application process. With an already limited amount of time in each day, facility personnel tend to view incentive applications as an additional responsibility that is often cumbersome and stressful. California utility programs address this issue by providing third parties to manage the entire incentive application process for the client. Again, as part of the CA utility programs, these services are offered at no additional charge to the client and are therefore well received. By providing this service to their clients, CA utilities increase participation in their programs, which helps them reach their annual energy reduction goals.

An example of this program benefit in practice could be a hospital that is planning to do a complete lighting retrofit. Because the hospital operates 24/7, prescriptive programs do not provide the maximum incentive for these facility types as their calculated energy savings often qualify them for a higher incentive than the prescriptive approach. However, submitting a customized application for the project involves many more steps in its process than the express or prescriptive application. In order to encourage the hospital to apply for the customized offering, the utility provides third party services to manage the application and review process to minimize impact on the hospital's facility manager. As a result, the hospital will receive approximately 120% of the prescriptive incentive by completing the customized application and the utility will realize that additional 20% in verified energy savings towards its annual goals.

Limited exposure to and understanding of current technologies. A final barrier that companies face related to available time and expertise of facility personnel is that projects can be very complicated and often involve the installation of new equipment. Without familiarity of the systems being considered and adequate time to research available technologies, facility personnel are at risk of installing inefficient systems, yesterday's design or strategies, or equipment that will not end up saving the facility any energy. Rather than relying solely on internal personnel or equipment salesman to identify this technology and calculate its effect on the building's energy

consumption, CA utility programs provide third party implementers that are staffed with energy engineers to assist in the calculations and system evaluations. While some engineers are affiliated with companies that sell equipment, others are vendor neutral, which offers the client an unbiased and trusted opinion regarding the available technologies.

One example of the implementer's role in recommending equipment is with an office building located in Southern California. Currently, this facility uses approximately 25 package HVAC units that are lined along the perimeter of the building to provide space conditioning. After completing an energy audit, the implementer recommended that the facility consider replacing the existing package units with a centralized chilled water system. The implementer then created an eQuest model to simulate the building's energy consumption and modeled two post-retrofit options that would meet the facility's design criteria: (1) a centralized chilled water system that utilizes their existing water cooled chiller, and (2) a centralized chilled water system that installed a new air cooled TuboCOR chiller to create redundancy and provide the best part load efficiencies. Prior to the implementer's involvement with this system, the facility manager was not aware of the TurboCOR chiller and did not understand how this chiller would be more efficient than a single compressor unit. As a result of the implementer's role in the project, the facility plans to move forward with the HVAC system upgrade, which will save them a little over 1,000,000 kWh and $90,000 each year. Such program successes of client participation and realized energy savings from implemented projects can be directly attributed to the innovative design of the CA utility programs, which provide great resources to assist clients with limited time and resources to devote to energy efficiency projects.

Perception of Impact to Daily Operations

During any economic period, production and occupancy are the number one considerations of most facilities as the bottom line of any business is critical to its survival. Because of this, any project that could negatively impact daily operations such as production, sales, or comfort is often dismissed. Unfortunately, many facility and property managers believe these perceptions and energy efficiency projects are a tough sell. In order to make energy efficiency projects more attractive to upper management, California utility programs work with facilities to develop the business case that can be presented to decision makers. These decision makers may not be engineers or up to date on current technologies. Additionally, they are more apt to consider the solutions because the program implementers are neutral and trusted advisors. In many cases, the CA utility programs factor non-energy benefits into the presentations such as improved indoor environment or product presentation.

Another perception of energy efficiency projects is that they negatively affect quality. For instance, hotel managers may fear that lowering the set point on domestic hot water heaters will cause discomfort for guests. However, in reality, lowering the set point by one or two degrees may not even be noticeable by the guests and the energy savings resulting from that change are significant. Another example could be a lighting retrofit in retail spaces. While some facility or salespeople may be concerned that the lower wattage bulbs would decrease light output and negatively affect sales, a lighting retrofit that utilizes high efficiency ballasts, good reflectors, and high output lamps may provide even better light to the space than the existing fixtures while saving energy. Once the projects are implemented, negative perceptions of energy efficiency projects are generally forgotten. However, a trusted, neutral advisor is key to overcoming the myths that may exist. Case studies provided by CA utility programs to their

clients showcasing such projects help to ease concerns related to their implementation. Also, because the programs have been in existence for many years, its successes have created an awareness of energy efficiency and potential benefits to facilities of all types.

Conclusions

Because of their differences in project approach, level of development, and engineering services offered, CA utility programs continue to deliver results that contribute to the CA energy savings goals after 15-20 years of existence. Although each energy efficiency program is slightly different, all programs provide the engineering support, resource, and expertise that allow implementers' engineers to develop trusting relationships with decision makers and facility personnel. Because of the comprehensive service provided to clients by CA utilities, most of these clients can and do move forward to implement energy efficiency projects, despite the "easy", "low hanging fruit" projects being picked over and the challenges associated with the suffering economy. Of course, this implementation creates a win-win outcome for both the end-user and the utility as goals of savings energy and money are met by both parties.

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