

California's Industrial Energy Efficiency Best Practices Technical Outreach and Training Program

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ABSTRACT

This paper describes the California Energy Commission's (Commission) energy policies and programs that save energy and money for California's manufacturing and food processing industries to help retain businesses in-state and reduce greenhouse gases through decreased energy use. The Commission's objective is to achieve 2 trillion British Thermal Units (Btu) per year in energy savings for California industry by the year 2010. These energy savings will come from implementation of projects that are a direct result of plant assessments conducted by the Commission, and from improved skills of industrial equipment operators attending United States Department of Energy (DOE)-funded industrial BestPractices workshops conducted by the Commission in partnership with industry and the state's utilities. In addition to energy and cost savings for California's industrial sector, this program will also reduce direct carbon dioxide emissions from industrial processes by over 110,500 tons each year.

Introduction

California is the sixth largest economy in the world and the third largest industrial energy consumer in the United States after Louisiana and Texas. Industries located in the state consume 6 percent overall (8 percent natural gas and 5 percent electricity) of the nation's total energy consumption of 33 quadrillion Btus per year. After Hawaii, California has the second highest electricity cost index. With 100 as the national average, California's index is 168 (United States Department of Energy 2006). In addition to high costs of energy, labor costs are 28.5 percent higher than the national average (United States Department of Labor 2006). With approximately 50,000 industrial plants and related businesses, California's industrial sector consumes 50 billion kilowatt hours (kWh) of electricity and over 6 billion therms of natural gas each year. This represents 19 percent of the state's total electricity and 47 percent of its natural gas consumption (California Energy Commission 2006). California's industrial sector is increasingly facing competition not only from global companies, but from other states as well.

The Commission is the State of California's primary energy policy agency and is responsible for promoting and implementing energy efficiency in the residential, commercial, industrial, agricultural, and institutional sectors. This is accomplished through regulatory actions and technical outreach activities involving direct technical assistance and training services for California's industry. The Commission also collects and publishes a database of energy usage data for the state as well as forecasts of future energy demand. This database has been useful for identifying the most energy-intensive industrial customers to target them for outreach activities and delivery of technical services.

Although energy efficiency standards for all new residential and nonresidential buildings built in California are regulated by the Commission, these regulations do not apply to industrial plants or their manufacturing processes. Consequently, no regulatory mechanism is in place to ensure energy efficiency implementation in the industrial sector. Energy usage in this sector can

best be addressed through the Commission's technology outreach, training, and technical assistance programs. To assist California's industrial sector, the Commission offers a package of programs and services targeting industry to help retain them in-state through reduced energy bills. The energy efficiency projects identified by the Commission, if implemented also helps industry comply with the mandate of California Assembly Bill 32 (Statutes of 2006) that requires reduced greenhouse gas emissions from manufacturing processes.

Partnerships

Mature partnerships have developed with California utilities to provide technical outreach to industry. Pacific Gas and Electric (PG&E), Southern California Edison (SCE), and the Southern California Gas Company (SoCalGas) are the major investor-owned California utilities that have partnered with the Commission to deliver energy efficiency services to California industry. These utilities are funded for this activity through the Public Goods Charge -- a surcharge levied on customer electric and natural gas bills by the California Public Utilities Commission, the agency that regulates the state's investor-owned utilities. The Commission also partners with the Sacramento Municipal Utility District (SMUD), Lodi Electric Department, and the Los Angeles Department of Water and Power (LADWP), all of which are municipal utilities that have funding for energy efficiency programs allocated in their annual operating budgets.

In addition to the state's utilities, the Commission also has established partnerships with a number of other organizations and companies, examples of which are listed below.

- California Industrial Assessment Centers (IAC): university-based regional centers (26 total nationally) funded by the DOE to conduct assessments of small- to mid-size industrial plants. The Commission's IAC partners are located at San Francisco State University, San Diego State University, and Loyola Marymount University (Los Angeles).
- Other California state agencies: Department of Conservation; Integrated Waste Management Board; Employment Training Panel.
- Manufacturer associations: California League of Food Processors (CLFP); California Manufacturers Technology Association (CMTA).
- Manufacturers: Del Monte Foods, Frito-Lay, Fetzer Wines.

Technical Outreach Activities: Training and Assistance

The Commission's *Nonresidential Market Share Tracking Study* (California Energy Commission 2004) indicates that industry has broad areas of interest and needs relating to energy efficiency. These areas of need include the need for more training and technical assistance to identify energy efficiency opportunities. The Commission is providing these services through various partnerships.

Industrial BestPractices Training

More technical training of decision makers is both desired and needed by industry to accomplish their energy efficiency goals and reduce operating costs. The Commission recognizes the need to help industry personnel learn basic as well as more advanced management best practices to optimize energy use at their manufacturing facilities. Beginning in 2004, the Commission's Industrial Energy Efficiency Program (IEEP) addressed this gap by providing this training. With funding from the DOE, the Commission conducts industrial BestPractices training workshops in partnership with the state's utilities and with California industry. The workshop format consists of a DOE Qualified Instructor providing the course instruction using DOE-developed training materials and software analysis tools. Training courses currently offered by the Commission, with the applicable DOE software tool in parenthesis are:

- Steam (Steam System Assessment Tool - SSAT; 3E Plus Insulation Tool)
- Process Heating (Process Heat Assessment and Survey Tool - PHAST; 3E Plus Insulation Tool)
- Compressed Air (AirMaster+)
- Pumps (Pump System Assessment Tool - PSAT)
- Fans (Fan System Assessment Tool - FSAT)

Each utility provides in-kind services for these workshops that include use of their training facilities and personnel, marketing of the workshops through utility mailers and websites, and publication and mail-out of training calendars.

Table 1 below shows the utilities that have partnered with the Commission to deliver these workshops and their respective regions of the state.

Table 1. Utility Partnerships

Utility	Workshop Location	Region
PG&E	<ul style="list-style-type: none">• Stockton Energy Training Center• San Ramon Conference Center• Campbell Civic Center	Northern Calif.
SMUD	<ul style="list-style-type: none">• Sacramento Energy Technology Center	Central Calif.
Lodi Electric	<ul style="list-style-type: none">• Lodi Civic Center	
SCE	<ul style="list-style-type: none">• Irwindale Customer Technology Applications Center• Tulare Agricultural Technology Application Center	Southern Calif.
SoCalGas	<ul style="list-style-type: none">• Downey Energy Resource Center	
LADWP	<ul style="list-style-type: none">• Los Angeles Headquarters	

To date, 42 BestPractices workshops have been given statewide that were attended by nearly 1,300 industrialists and others involved in industrial process energy efficiency. For the present round of DOE funding, the Commission's goal is to conduct 40 more BestPractices workshops throughout the state by the year 2009.

To monitor and evaluate the effectiveness of these workshops in influencing actual energy savings, a post-workshop attendee survey instrument was designed to determine the extent to which energy efficiency measures are actually being implemented at industrial plants using knowledge gained from the workshops. A beta-test version of the survey was recently administered to a sample of attendees of past workshops. The results of this preliminary survey indicated that energy efficiency measures are being implemented by 60% of the plants as a result of the Commission's training activity. The survey instrument will be revised based upon comments received during the beta-test phase and will be administered to all future workshop attendees approximately 6 months after completing the course.

Technical Assistance Activities

Expert assistance or guidance to perform both plant-wide and targeted system assessments is needed by manufacturers and food processors to identify opportunity areas to implement efficiency measures for saving energy. This is particularly true in small- to mid-size plants. To support this goal of assisting industry directly, three Commission Mechanical Engineers working in the IEEP trained, tested for, and received certifications from the DOE as Qualified Specialists in steam, process heating, and compressed air system assessments. With these certifications, in-house expertise is available at the Commission to directly assist industry with their technical needs. Although these services are also available through the private sector, this capability is unique for a state energy office. A total of a dozen industrial assessments have been completed to date by the Commission's Qualified Specialists.

The Commission teams with its utility, manufacturer association, state agency and IAC partners to identify industries and engage plant decision makers. "Action Plans" are then developed for the design and rollout of a comprehensive package of information, training and assessment efforts tailored to the plant's specific needs. Each partner plays a different vital role in this arrangement. The utility provides coordination with their customer, can provide monetary incentives for implementing energy projects, and brings in any available specialized services, e.g. natural gas sub-metering or flue gas combustion testing and analysis, that are necessary to support the assessment. The IAC's are able to quickly mobilize to augment staff resources from the Commission during the actual assessment. State agency partners have grant funding available for specialized equipment and operator training. The industrial site nominates a "champion" who communicates with their corporate structure, works directly with the other members of the team during the assessment, and learns the use of the appropriate DOE software analysis tool used during the assessment. This is done with the goal of instilling in a person actually working at the plant the knowledge and tools necessary to sustain ongoing energy efficiency analyses not only for their plant, but other plants within their corporation long after the Commission and utility teams have left. The Commission and/or its technical contractor serves as the technical and overall project lead and is responsible for overall project coordination between the partners and the preparation, publication and distribution of the final technical report.

Recent successful examples of this effective partnership arrangement between a plant, the Commission and the plant's utility involve a meat packing plant and steel rebar manufacturing plant in southern California, and a cheese processor in California's central valley. These plants were able to implement energy-saving projects identified and recommended through technical assessments conducted by the Commission and monetary rebates offered by their utilities. Engineering calculations, SSAT models and engineering verifications generated by the Commission were used as documentation by the utility for the design and installation of energy-saving measures resulting in rebate awards to each of the plants. Projects included boiler combustion efficiency improvements, increasing percentage of condensate returned, blowdown and condensate heat recovery, condensing flue gas economizer, and process furnace combustion efficiency improvements. These assessments resulted in annual savings to the plants of over 17,645,000 therms of natural gas, nearly 900,000 kwh, over \$2 million in energy cost savings, and rebate awards from the plants' utilities of \$900,000.

Three primary levels of service for technical assessments are provided by the Commission at no cost to industry. The level of service selected depends upon the circumstances, perceived energy efficiency opportunities, and readiness of the plant to implement energy-saving recommendations. In order of increasing cost, complexity and duration, they are:

1. Conduct targeted assessment of a single plant system (e.g. boiler and steam distribution system) using Commission Qualified Specialist expertise and supported by utility partners (one to three day duration)
2. Conduct targeted assessment of a single plant system (e.g. compressed air) using DOE Qualified Instructors under contract to the Commission and supported by in-house Qualified Specialist expertise (one day to one week duration)
3. Conduct plant-wide assessment of both electric and natural gas-consuming equipment and systems using DOE Qualified Instructors and supported by in-house Qualified Specialist expertise (several days to more than a week duration)

Also, as a fourth level of service, industry can request free assessments from the Commission's three Qualified Specialists under DOE's national "Save Energy Now" campaign. These three individuals are again under contract to the DOE in 2007 as national "Energy Experts" to provide "Energy Saving Assessments" (ESA) of the state's largest industrial plants. In 2006 the Commission completed four "Save Energy Now" ESAs under contract to DOE. The California ESAs conducted by the Commission identified over 855,000 MMBtu/yr and almost 25,400,000 kWh/yr in energy savings, over \$8.5 million per year in energy cost savings, and over 63,700 tons per year of reduced carbon dioxide emissions for California industry. It is anticipated that the Commission will again receive a number of ESA assignments from the DOE in calendar year 2007.

Table 2 below shows the latest results of the Commission's plant assessment activities conducted from 2005 through 2006 that identified energy and greenhouse gas emission savings for California industry. This list of assessments includes all four types of assessments described in the previous paragraph.

Table 2. Identified Savings from Plant Assessments 2005 - 2006

Plant	MMBtu/yr	kWh/yr	\$K/yr	Payback yr
Aluminum Casting	83,111	-	\$550,000	1.0
Aluminum Forging	841	-	\$63,100	1.0
Cheese Mfg.	68,157	897,010	\$686,800	2.5
Fruit Canning	-	1,042,018	\$57,300	2.0
Glass Bottles	-	7,272,727	\$400,000	0.25
Instant Noodles	7,000	750,000	\$180,000	2.0
Juice Bottling	16,500	1,400,000	\$400,000	1.0
Meat Packing	103,300	-	\$910,500	2.0
Paper Boxboard	159,775	3,509,184	\$1,570,000	2.0
Plastic Beverage Bottles	-	117,739	\$15,000	1.0
Portland Cement	584,100	20,992,450	\$3,255,300	2.0
*Steel Products Mfg.	5,000	-	\$455,000	n/a
Total	1,027,784	35,981,128	\$8,546,500	-
CO ₂ Tons/yr	79,783			

*Partial results only—project still in progress with greater savings anticipated

Monitoring and verification (M&V) of these projects is either currently underway or still pending. The DOE is conducting M&V of all ESA's conducted under their "Save Energy Now" program, including the four ESA's conducted for the DOE by the Commission (cheese manufacturing, meat packing, paper boxboard, and Portland cement plant in above table).

Preliminary results of DOE's M&V show that to date, out of the total of 200 ESA's conducted by the DOE at plants nationwide 54 have implemented the projects that were recommended (Quinn 2007), including the four ESA's conducted by the Commission (cheese manufacturer, meat packing, paper boxboard, and Portland cement). The Commission plans to conduct M&V on our own state-level assessments listed in the table above and any new assessments conducted in the future. Our M&V protocol is still being discussed, but it is anticipated that the results will be made available to the public as part of the case studies generated for each project that will be posted on the Commission's website.

A business model being emphasized by the IEEP this year is to combine the appropriate DOE Industrial BestPractices training with a plant assessment in the days immediately following the workshop. Working with our utility partners, an industrial site is identified that would be willing to host a post-workshop "hands-on" session at their plant. This plant ideally would be where one or more of their personnel are attending the workshop. The goal of this approach is to improve the sustainability of BestPractices training as well as enhance the chances of the plant implementing identified energy efficiency opportunities relatively quickly. The measurement and evaluation effort begun this year by the Commission to gauge effectiveness of the industrial BestPractices workshops will be expanded to this activity.

Lessons Learned

The Commission's IEEP has been an effective tool for assisting California industry to become more energy efficient. Some of the key "lessons learned", as reported by Commission staff in their discussions with industrialists, are summarized below as anecdotal evidence regarding the delivery of energy efficiency services to industry.

- Industrial BestPractices training provided by the Commission has been effective in helping implement and sustain energy efficiency in California industry.
- Plant assessments conducted by the Commission have been very useful to industry and led to greater implementation of energy efficiency by California industry.
- Utility rebates, especially those documented by Commission-certified engineering calculations, are very helpful in making a decision about whether or not a plant implements energy efficiency opportunities. There is generally no consistent Return on Investment (ROI) requirement universal to industry. Simple payback is still an important criterion in implementing energy projects. Generally, a simple payback of two years or less is the minimum acceptable. Utility rebates are useful in helping lower payback to the point where the project is attractive to implement.

There are still several areas, however, where gaps exist in the services and/or resources available to industry in California.

- Industry is looking for a “one stop shop” resource where current best practice information on energy efficiency as it relates to manufacturing processes can be found. Current informational resources are disaggregated and difficult to access.
- The state’s air emissions requirements are very stringent in many jurisdictions. This drives what physical adjustments can actually be made to burners in boilers and process furnaces to save natural gas.
- Recent state law mandating plants to inventory greenhouse gas emissions is generally accepted by industry as good environmental stewardship. But there are concerns that meeting this requirement could be burdensome and expensive.
- There is a shortage of trained and skilled workforce for industrial and food processing equipment operator and maintenance jobs, especially those that need knowledge of energy efficient equipment and operational practices. Current high school and community college curricula do not support education in the skilled trades or provide other high level vocational technical training related to industrial processes.

Future Activities

The Commission intends to continue with BestPractices training and plant assessment activities into the foreseeable future. Funding for technical outreach activities provided by the DOE under the State Energy Program (SEP) will make it possible to deliver 40 BestPractices workshops to California industry and conduct 20 plant assessments over the next two years. Additional funding provided to the Commission under “Save Energy Now” will make it possible for us as to exceed our SEP-stated goal of 20 plant assessments over the next two years.

In addition to continuing with previously programmed activities, the Commission plans to address gaps identified in the “Lessons Learned” section above. These new program offerings will include, but not be limited to the following elements:

- Significantly upgrade the Commission’s IEEP website to include:
 - ✓ Case studies of assessments completed by the Commission;
 - ✓ Directly link to other case studies and related technology information sources
- Establish an “Industrial Call-In Center” at San Francisco State University’s IAC to serve as a “one-stop shop” information clearinghouse and technology assistance resource for California industrial customers.
- Provide below-market rate low interest loans to the food processing and related industries for reducing their electricity and natural gas use by implementing energy-saving emerging technologies proven and validated by the Commission’s Public Interest Energy Research program. These technologies include:
 - ✓ Thermal heat pumps for process cooling,
 - ✓ Electrodialysis membrane systems for wine processing,
 - ✓ Enterprise energy management systems,
 - ✓ Ultra low NOx energy efficient boilers,
 - ✓ Integrated heating/cooling topping cycle cogeneration system,
 - ✓ Solar thermal systems, and
 - ✓ Food streams to biogas energy
- Assist industry in preparation of greenhouse gas emissions inventories by conducting benchmark studies on the most energy-intensive industries identified through the Commission’s North American Industrial Classification System database.
- Work with California’s community college system to ensure that technical curricula and degree programs offered by colleges reflect the need to turn out graduates who are trained, skilled and knowledgeable about energy efficiency and are ready to be hired by industry. Work with the state’s Employment Training Panel to ensure that community colleges have the funding necessary to support this goal.

Conclusion

California state government has placed itself in a unique position to assist industry in the state to shape their energy future. The services provided through the Commission’s in-house expertise and partnerships with California utilities and key trade allies often provide the impetus and coordination necessary to identify and implement energy efficiency projects. Most often than not, industry is simply too busy or not equipped to coordinate energy projects and need expert guidance and assistance to see projects through from identification through implementation. The desired outcome for state government is to provide the opportunities for achieving cost reductions and improved productivity from investments in energy efficiency to help retain California industry in-state.

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