PEER-REVIEWED PAPER

Toys in the sandbox: attracting industrial companies through effective design of energy efficiency programs

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Abstract

There has been a surge in energy efficiency program activity across U.S. states. While program spending and program activity has seen constant and significant growth since the late 1990s, existing programs typically focus on the residential and commercial sectors, where prescriptive incentives and rebates for common technologies have driven early savings from so-called "low hanging fruit" measures. As Clean Energy Portfolio Standards[1] ramp up over time and these easy-to-implement measures become less abundant, many state programs are now looking to the industrial sector as a large and relatively low cost source for energy efficiency resources.

However, regulators and program administrators in U.S. states have often struggled to create programs that overcome manufacturers' perceived concerns about industrial energy efficiency (IEE) programs. When new programs funded by utility ratepayers are being contemplated, large industries often resist paying into a public benefits fund that is used to fund programs. Some of the common reasons include the fact that industrial program offerings are not flexible enough to meet industrials' most pressing investment priorities and planning schedules, they are considered administratively complex and burdensome, and that utilities or third-party entities implementing programs have insufficient expertise in manufacturing and/or are not knowledgeable about key customer concerns and needs.

Program designers need to be aware of the issues and concerns that can limit industrial participation, and design programs that address these issues and better meet the specific needs of their industrial market. This paper will first discuss the types of IEE program operating in the U.S. today, then examine particular program design features and approaches that have been successful in the U.S. in responding to industry needs, and how these successful features can be applicable to programs in the EU and other countries. It will then cover a special type of program – self-direct programs that allow manufacturers to "self-direct" their own energy savings programs but still require that they invest money to deliver those savings. Finally, the paper will explore new emerging directions to expand and improve IEE programs covering the following issues: strategic energy management, whole-facility performance, natural gas efficiency programs and capturing non-energy benefits (NEBs).

Introduction

Industry[2] is a key energy-using sector in the United States, and much cost-effective energy efficiency potential remains to be captured in this sector. In the U.S., efforts to capture more of

1. Clean Energy Portfolio Standards include Renewable Energy Portfolio Standards (RPS), EERS and Alternative Energy Portfolio Standards (APS). EERS aim for quantifiable energy savings by recognizing that energy efficiency is a utility system resource and should be considered by the utility at the same time that supply resources are evaluated.

2. As defined by the Energy Information Administration, industry consists of the following types of activity: manufacturing (NAICS codes 31–33); agriculture, forestry, fishing and hunting (NAICS code 11); mining, including oil and gas extrac-

the potential energy savings in industry at the state level have grown in recent years. The energy efficiency programs offered to capture the cost-effective savings in industry vary substantially in operational mode, scope, and financial capacity, but also exhibit common threads and challenges. Practical experience and operational lessons learned from these programs are particularly rich, even though some of the programs are not well known.

This paper aims to provide an overview of the spectrum of industrial energy efficiency programs operating in the states and delivered by a variety of entities including utilities and program administrators, and to assess some of the key features of programs that have helped lead to success in generating increased energy savings. The paper also identifies new emerging directions in programs that might benefit from additional research and cross-discussion to bring further along. Given the richness of operational experience and wealth of ideas on program improvement among state practitioners and associated experts, continuing and more robust cross-exchange would be most worthwhile.

Why Do States Undertake Industrial Energy Efficiency Programs?

U.S. states have instituted energy efficiency programs funded by the public or by ratepayers to achieve a variety of benefits. A core, compelling reason is that energy efficiency represents a least-cost option for supplying energy services compared to other prevailing options, providing both consumers and society with cost savings. Additional benefits can include environmental gains, improved security against energy supply disruption or rapid price increases, and improved economic competitiveness.

Most state governments have determined that it is necessary to include specific programs that cover all customers as part of their overall energy efficiency efforts. Although the scope and nature of state programs vary substantially, the industrial sector is too important a part of the energy use picture to neglect. Industry accounted for about one-third of total primary energy consumption in the U.S. in 2012 (EIA 2013). The potential energy savings in U.S. industry is large – amounting to some 3,650 trillion Btu (McKinsey 2009). On a national level, nearly 10 percent of industrial customers participate in price- and time-responsive load management programs leaving much room for industrial participation growth (Aden et al. forthcoming, DOE, 2013). Aggregate national data indicate that savings from U.S. utility energy efficiency programs more than doubled between 2007 and 2012 across all sectors. In 2012 industrial savings reached around 30,000,000 MWh/year (compared with residential savings of 65,000,000 MWh/year and commercial sector saving of 45,000,000 MWh/year) (Aden et al. forthcoming).

Achieving industrial sector energy savings is often lower cost than overall, economy-wide energy savings – for both society as a whole and for program administrators. A study examining evaluation results across 14 states found that energy efficiency programs on average cost the sponsoring utility or program administrator about $0.025 per kWh saved and about $3.40 per million Btu of natural gas saved over the life of energy efficiency measures. When costs paid directly by participants are also included, the average cost of efficiency savings is about $0.046 per kWh and $6.80 per million Btu. This is far less than the cost of power from new central station generating plants, which can range from $0.07 to more than $0.30 per kWh (SEE Action Network 2011). Figure 1 illustrates that the industrial sector has the lowest cost of saved energy on a national level, although it is important to note that cost structures vary by program and sector at the state-level (Aden et al. 2013).

Many of the well-established ratepayer-funded industrial energy efficiency programs in North America, such as those of Bonneville Power Administration (BPA), BC Hydro, the Energy Trust of Oregon (ETO), or Wisconsin's Focus on Energy, have delivered reliable energy savings from industry at below the average costs they face for their programs overall. Programs in Wisconsin, Rhode Island, Oregon and the Northwest show that industrial programs can often be twice as cost-effective as programs targeting the residential sector. To realize increased low-cost energy savings in industry, however, requires a concerted effort developed specifically for the sector and focused efforts are needed to address these specific needs and circumstances.

States have found that specific programs can help deliver a larger slice of the energy savings potential in industry than can likely be achieved if industrial energy users pursue energy efficiency individually, with no program assistance of any kind. Industrial companies are often aware of profitable energy conservation projects in their facilities and many companies have a solid record of developing energy saving projects to save money. However, management focus is on projects that can payoff in one to two years, or less. Other projects that would be highly profitable over a longer timeframe are left on the table. Moreover, company staff often report that it is difficult to effectively navigate corporate project decision-making systems to get management endorsement for even quick payback projects. Small or medium-sized energy savings projects often do not compete well with other projects in garnering management attention and enthusiasm. And limitations on staff resources and knowhow can further hinder implementation of cost-effective energy efficiency measures.

In states where ratepayer-funded energy efficiency programs are in place, industrial programs can make a significant difference, not only by fostering higher implementation of quick payback projects, but also by providing financial incentives that improve the economics of what would have been longer term payback projects (3–6 years) that are well outside of the typical interest scope of industrial managers. Program incentives to help industrial customers capture the potential for large, additional energy savings can strengthen the alignment of company incentives with the broader interests of energy users statewide in developing low-cost resources for energy service supply. In addition, other intensive but highly cost-effective initiatives of key medium-term interest can be fostered through multi-year programming, such as development of new strategic energy management systems in industrial companies.

Even relatively simple programs providing technical assistance, fostering peer exchange, and disseminating practical

tion (NAICS code 21); and construction (NAICS code 23). This report principally focuses on the manufacturing sub-sector.

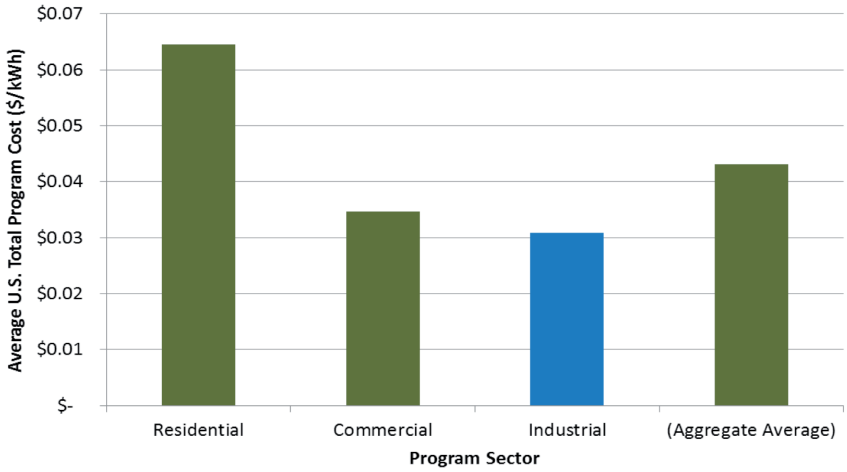

Figure 1. Average costs of energy efficiency programs by sector. To ensure consistency and comparability, this figure only includes the 182 organizations that reported residential, commercial, and industrial savings and expenditure data; transport sector energy efficiency program data are not included in this figure except as a component of the aggregate average. Source: Aden et al. (2013) based on EIA (2012).

information can make a difference by supporting facility or company energy management staff in their work and by drawing company management attention to energy cost saving possibilities. Increasing awareness of the non-energy benefits that often accompany energy saving projects also can help tip the scale in favor of project implementation.

The Wide Spectrum of Ongoing and Useful State Programs

There is wide variation in the types of industrial energy efficiency programs pursued by states, utilities and energy efficiency program administrators. The dynamics of local economies, existing regulatory frameworks, political interest, and characteristics of local industrial sectors help define what different states feel are the most appropriate approaches for industrial energy efficiency (IEE) programs.

This paper defines a state industrial energy efficiency program in broad terms as a program that provides information, services, and/or financial support to interested industrial facilities within the state for energy efficiency activities. Broadly speaking, there are two main types of IEE programs in the United States:

- Ratepayer-funded energy efficiency programs, that is, programs that are funded through the electric and gas customer rates, and
- Non-ratepayer-funded programs, which are funded by other means (federal resources, state operating budgets) and are often run out of state energy offices and universities.

This paper principally focuses on ratepayer-funded programs (funded by energy utility customers) due to their prevalence in the U.S. relative size in spending terms.[3] IEE programs provide a range of offerings such as technical incentives, equipment rebates and process-specific incentives, as discussed below. Some of these offerings apply to both ratepayer and non-ratepayer programs, for example strategic energy management programs or technical assistance and knowledge sharing. In other cases however, certain program offerings exist in only ratepayer-funded programs: for example, prescriptive and custom incentives and self-direct programs. Many states also mix a variety of different offerings and funding streams.

The National Association of State Energy Officials (NASEO) reports that at least 35 state energy offices operate some type of industrial energy efficiency program separate from, or in support of, ratepayer-funded programs (NASEO 2012). Forty-one states have ratepayer-funded energy efficiency programs, and 28 U.S. states operate ratepayer-funded programs with Clean Energy Portfolio Standards/Energy Efficiency Resource Standards or utility energy efficiency targets. Financial incentives and technical assistance are often provided to energy users to implement sufficient energy efficiency measures to meet specific statewide energy savings goals or pursue all cost-effective energy efficiency opportunities. As of September 2013, seven[4] of the 41 states with ratepayer-funded programs allow large industrial customers to opt out of all payments and services of these programs. Many states operate industrial programs within combined commercial and industrial ratepayer-funded programs.

Within this wide spectrum of successful – if diverse – experience, all states can certainly launch new programs, or improve upon existing programs, providing cost-saving benefits to industry and the state at large. However, a more comprehensive set of program offerings – including combinations of the approaches on the spectrum (Figure 2) – is likely to deliver greater overall energy savings. Moreover, because of the diversity of programs and experience, each state can learn from others

3. In a study of electric IEE program spending in 2010, the bulk of the spending (84 %) came from ratepayer-funded utility program budgets, with the remainder of the funding coming from state and federal budgets, universities, nonprofit organizations and other groups (Chittum and Nowak (2012).

4. These are Arkansas, Kentucky, Maine, Missouri, North Carolina, South Carolina, and Texas (Elliott 2013).

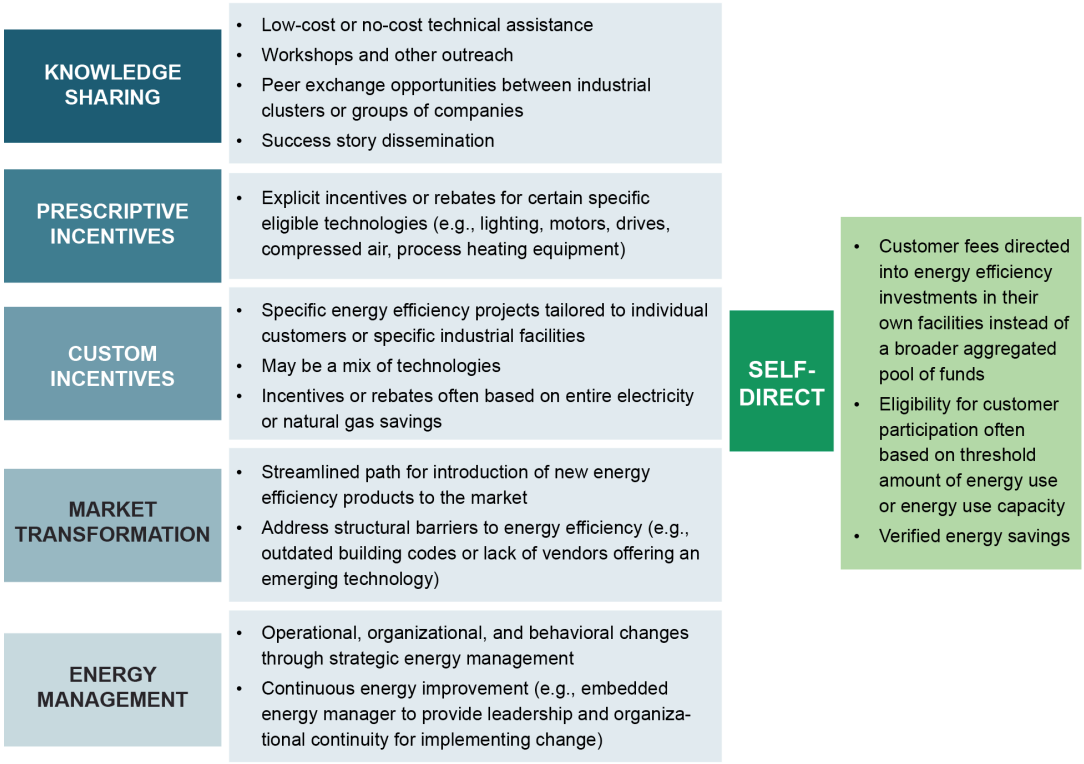

Figure 2. The Spectrum of State IEE Approaches. Program types adapted from Bradbury et al. (2013).

about new ideas and lessons learned in program design and implementation. [5]

The main types of offerings are illustrated in Figure 2 and described in further detail below.

TECHNICAL ASSISTANCE AND KNOWLEDGE-SHARING PROGRAMS

Most states operate some type of technical assistance and knowledge-sharing initiative aimed at increasing energy efficiency in industry. These may be imbedded within other programs or fully separate. The technical assistance and knowledge-sharing programs typically offer no-cost or low-cost expertise and advice to industrial companies on new technologies and practices, share analytical tools, disseminate success stories and case studies, and offer networking opportunities. Examples of effective programs in this category include:

- The Colorado Industrial Energy Challenge which has been effective in its public recognition of IEE performance and providing companies with an opportunity to showcase their energy efficiency achievements;
- The Industrial Energy Efficiency Network in the Southeast, which hosts an effective peer exchange forum that provides a strong driver to share lessons learned; and
- The West Virginia Industries of the Future (WV-IOF), which has been able to effectively leverage partnerships with academic institutions and DOE to provide training, technical assistance, and energy assessments to industrial staff.

PRESCRIPTIVE INCENTIVE PROGRAMS

Standardized prescriptive program offerings provide explicit incentives for adoption of specified higher-efficiency technologies in applications that are common among a variety of commercial and industrial energy users. For example PG&E, Northern California's largest utility provides rebates of $2 per thousand British thermal units per hour for water and steam process boilers (PG&E 2014). They are relatively straightforward to administer and can be applied across a broad base of customers. Prescriptive incentives are widespread throughout many states and are most often included as part of joint C&I rebate programs.[6] While these measures may apply to manufacturing facilities, they do not address the majority of industrial energy consuming equipment and processes. Some utilities have prescriptive measures for compressed air equipment, but in general a much larger percentage of energy savings projects specific to key industrial processes are categorized as custom measures (Seryak and Schreier 2013).

CUSTOM INCENTIVE PROGRAMS

These program offerings provide financial and technical support, usually for customized, often process-specific, project implementation designed to meet the explicit needs of specific industrial customers. They can unlock substantial energy savings beyond what is possible through targeting only individual pieces of equipment and are usually quite cost-effective. However, the projects are specialized and often far more sophisticated, requiring greater and more specialized program capacity

5. Comprehensive programs across states could also generate deeper savings and result in more equal treatment between industrial companies nationwide. However, because policy and regulatory requirements for utility ratepayer programs is currently made at the state-level, state-based action is the focus of this report.

6. The Database of State Incentives for Renewables and Efficiency (DSIRE) contains comprehensive information on rebates for specific technologies. See www.dsireusa.org.

to support and implement. CenterPoint Energy has a successful custom program that was designed to address a gap in CenterPoint Energy's program coverage by reaching out to energy-intensive industrial customers who cannot avail themselves of standardized energy savings measures. NYSERDA's longstanding technical assistance program – known as FlexTech – and its Industrial Process Efficiency (IPE) grant programs have assisted Irving Tissue, a tissue, paper towel and napkin manufacturer located in Fort Edward, New York, with increasing its new plants' efficiency. The company was considering a major plant expansion to improve productivity and competitiveness. To ensure that the new operation was cost competitive, Irving Tissue worked with manufacturers, suppliers, and NYSERDA to build energy efficiency into the new paper making systems. A proposed upgrade for a more efficient vacuum system would create significant energy and cost savings while delivering a higher quality product. However, the cost of the system was too great for the company to self-finance. The IPE program was able to provide grant funding not only for the vacuum but was also able to recommend the installation of efficient motors and variable speed drives. NYSERDA financed $1.8 million of the full incremental cost of $4.3 million for the efficiency upgrades. The new papermaking machine is saving 14,800,000 kWh per year over a standard paper machine. Other examples of successful programs in this category include Efficiency Vermont, ETO's Production Efficiency Program, and Xcel Energy's Process Efficiency program in Colorado and Minnesota.

MARKET TRANSFORMATION PROGRAMS

These programs aim to streamline the path from market introduction of new energy efficiency products or practices to their promotion and consumer acceptance. Adoption of the new products can be supported through increasingly stringent energy-efficiency codes and standards, technical assistance, and/or financial incentives. In the industrial sector, many may consider promotion of company strategic energy management systems as a market transformation-type of activity. An example of a successful market transformation program is the Northwest Energy Efficiency Alliance (NEEA). The initial phases of the process involve significant investments of time and effort to identify promising technologies and ideas (which is carried out in consultation with energy utilities, third parties and state agencies in the northwest), and develop and test operational approaches to promote them. This type of effort is difficult for energy efficiency program administrators to justify since the costs are high for initial savings return. However, when an idea takes off, savings can materialize quickly, especially since program administrators in the Northwest (e.g. ETO and the BPA) provide program support and leverage NEEA's market transformation solutions, pushing up market penetration rates and energy savings.

STRATEGIC ENERGY MANAGEMENT (SEM) AND ENERGY MANAGER SUPPORT PROGRAMS

Rather than focusing on technology and equipment, these programs seek to promote operational, organizational and behavioral changes resulting in energy efficiency gains on a continuing basis. SEM involves operation of cross-organization management systems internal to companies designed to identify and implement many energy efficiency measures year after year. Some states also have operated successful energy manager support programs, including programs to provide transitional funding for placement of energy manager staff and programs for energy manager training. Examples of SEM programs include BPA, ETO, Wisconsin Focus on Energy (WFE), Xcel Energy Process Efficiency Program and BC Hydro and AEP Ohio. An overview of the programs are provided in Table 1. Note that these programs' SEM offerings are often integrated into prescriptive or custom/process incentive programs but incentives for SEM can be different from custom or prescriptive incentives.

SELF-DIRECT PROGRAMS

Some states have chosen to include a self-direct option. Self-direct programs are defined in this paper as programs that allow qualifying industrial customers to "self-direct" fees that would normally be charged for a ratepayer-funded program directly into energy efficiency investments in their own facilities instead of into a broader aggregated pool of funds collected through a public benefits charge for energy efficiency programs. Qualifying consumers implement their own energy savings programs, typically without design and implementation assistance arranged through a program administrator. Not to be confused with "opting out", structured self-directed industrial customers are still obligated to spend money and deliver energy savings, either on a project-by-project basis, or over a certain amount of time. If states choose to offer a self-directed option, this paper recommends that company energy-saving obligations remain clear, and that energy savings measures, investments and savings amounts by self-directed customers be properly monitored and verified.

Lessons from Experience in Designing and Delivering Programs

Achieving success in industrial energy efficiency (IEE) programs requires significant upfront investment and steady commitment over a number of years. However the experience of the nation's strong IEE programs shows that the dedicated effort required is worth it in terms of generating robust and low-cost energy savings.

The industrial sector is heterogeneous and different plants have different needs, all of which takes time and skill to grasp. Both common technology, used in many subsectors, and process technology, varying by subsector, are important. Industrial plant staff are generally more sophisticated concerning energy matters, compared with residential and many commercial energy users. However, internal decision-making processes in industrial companies concerning energy efficiency investments or energy use behavioral change can be complex. Plant operational cycles must be understood and typically define project scheduling. Non-energy benefits may provide a key tipping point benefit in favor of pursuing a given line of projects, but such benefits may not be immediately obvious. The barriers and challenges of the industrial sector must be addressed if industrial energy efficiency programs are to create real value for their customers.

To overcome existing barriers and provide high value to industrial customers, programs require quality market assessments, steady and close interaction with customers, a critical

Table 1. Selected Energy Management and Energy Manager/Staffing Programs.

Energy Management Offering	SEM Incentives	Customer Size
BONNEVILLE POWER ADMINISTRATION – ENERGY SMART INDUSTRIAL PROGRAM		
– High Performance Energy Management (HPEM): Provides training and individual assistance to 8–15 companies for one year. Measurement and incentive funding is available for 3–5 years. – Track and Tune: Low/no-cost operations O&M with incentive funding over 3–5 years and include tools for interval data acquisition and performance tracking. – Energy Project Manager (EPM) Program: Funding of energy efficiency staff to support project identification and implementation.	$0.025/kWh for 3 or 5 years, for O&M savings	18,000 MWh/yr (guideline)
ENERGY TRUST OF OREGON – PRODUCTION EFFICIENCY PROGRAM		
– Industrial Energy Improvement (IEI): Year-long engagement provides cohorts of manufacturing companies trainings on SEM principles, tools, and practices designed to help companies manage their energy strategically. – Corporate SEM (CSEM): Focused on corporate sites, instead of the cohort model, CSEM provides training and on-site activities on SEM principles and practices (9–12 months). – SEM-Maintenance: Helps former SEM participants maintain, deepen, and continue the integration of SEM into their business' operations. – CORE Improvement: Offering similar to IEI in focus and structure but services and instructions are tailored to small to medium manufacturers. – ISO 5001 pilot implementation.	$0.02/kWh, $0.20/therm for 1 year of savings. SEM-Maintenance: $0.01/kWh, $0.10/therm	IEI/CSEM: Over 8,000,000 kWh/yr, or if eligible for gas, 500,000 therms/yr usage CORE: Spending between $50,000–$500,000 on total energy costs (electricity & gas combined)
WISCONSIN FOCUS ON ENERGY – INDUSTRIAL PROGRAM		
– Practical Energy Management: Provides best practice training events and applies its industry-specific Energy Best Practice Guidebooks to key cluster industries. – Staffing grants: Allow companies to hire a FTE.	Grants for energy staff	Customers with over $60,000 in monthly bills
XCEL ENERGY – PROCESS EFFICIENCY PROGRAM (CO & MN)		
Provides individual assistance in developing a 3–5 year energy management plan using the Envinta One-2-Five Energy Methodology that evaluates EI processes, benchmarks energy management practices, and provides an assessment prioritizing opportunities.	For capital projects only	>2,000 MWh/yr of savings potential
BC HYDRO – POWER SMART		
– Industrial Energy Manager: Offers funding for large customers to hire an on-site energy manager and a structured support group of local companies that share best practices. – Energy Management Assessment: Free assessment of opportunities, customized SEM action plan, and rating against the Energy Management Scorecard. – Various free energy management tools and training, employee awareness kits, and customer recognition through public media.	Co-funding of energy manager	>20 GWh annually
AEP OHIO – CONTINUOUS ENERGY IMPROVEMENT PROGRAM		
– Coaching assistance, tools and templates to help meet plant and corporate cost saving targets. – Custom statistical models to help measure and manage EI. – An Energy Coach to help identify and implement opportunities.	$0.06 per kWh (or $0.02 per kWh over 3 years)	>10 GWh annually

Sources: AEP Ohio (2013), Batmale and Gilless (2013), IIP (2013), Kolwey (2013), Russell (2013), Nowak et al. (2012), and BC Hydro (2013).

mass of knowledgeable staff and strategically engaged consultants, and operational stability. This requires upfront investment and a multi-year focus.

TEN PROGRAM FEATURES

The spectrum of program approaches discussed above recognizes that there are a range of program offerings designed to help manufacturers improve their energy efficiency. These can range from providing technical assistance to offering financial incentives for common technologies, or sponsoring an energy manager to guide a facility toward behavioral changes that result in more energy efficient operations and maintenance. In order to be successful however, there are ten IEE program features highlighted by analysts and practitioners that consistently add value to industrial customers, and contribute to program success, regardless of the specific approach chosen by a program administrator. These program features are:

1. Clearly demonstrating the value proposition of energy efficiency projects to companies

There are many direct and indirect benefits from energy efficiency projects. A key point in making the value proposition case to industrial company managers is to lay out in simple and concise terms the operating cost savings and other ben-

efits – including profits – that are being left on the table by not addressing cost-effective energy efficiency improvement opportunities. Many companies that have participated in IEE programs have experienced strong cost savings benefits, and successful IEE programs document how program offerings have helped their industrial customers' bottom lines. Success stories include:

- The NORPAC pulp and paper mill in Washington State, which cut its power requirements by 12 % per year through upgrades financed by BPA (BPA 2012);
- J.R. Simplot, which identified energy savings of $715,000 per year with a three-year payback (EPA 2013); and
- Irving Tissue, which, through participation in NYSERDA's industrial FlexTech and Industrial Process Efficiency (IPE) programs, was able to save 14,800,000 kWh per year (NASEO 2012).

2. Developing long-term relationships with industrial customers that include continual joint efforts to identify energy efficiency projects

All of the successful industrial energy efficiency programs have this feature in common. Maintaining relationships with key industrial customers is important in pure technical assistance programs as well as energy efficiency resource acquisition programs. It takes time and a steady relationship for program personnel to understand company circumstances and needs, and for company personnel to understand what a program can offer them. Projects tend to be identified over time, as circumstances change and opportunities arise. Synergies between different program offerings can be maximized on the platform of a mutual partnership relationship.

Maintaining quality long-term relationships is people-dependent. Most programs have found that it is necessary to have a stable and savvy program contact person for industrial customers to interact with, such as an account manager. Moreover, stability in program support and personnel over a number of years is critical. Satisfaction of industrial customers with program delivery and results often hinges on the level of trust established in relationships with program staff or experts hinge. Similarly, frustration is very common if staff or experts assigned for regular interaction with a key customer frequently change. Each time this happens, industrial company staff must once again start from square one, explaining their basic production system, needs, plans, past energy efficiency work, etc.

Due to the importance of long-term relationships, substantial investments in staffing or contracted expert capacity are necessary over a number of years to generate the best results. Contracting for program delivery capacity based on only short-term goals, with frequent changes in contractors, is not likely to succeed. Time and effort is needed to set up effective institutional systems.

3. Ensuring program administrators have industrial sector credibility and offer quality technical expertise

As discussed in the previous section, development of long-term relationships between industrial customers, program administrators and experts is important for IEE program success. Effective IEE programs also develop credibility with the industrial customer by employing staff and/or contracted experts that understand the customer's industrial segment, and have the technical expertise to provide quality technical advice and support on energy efficiency options and implementation issues specific to that industry and that customer. Addressing industrial companies' core needs requires understanding of a plant's production processes, operating issues, and the market context that the plant operates within. Effective industrial energy efficiency programs will adopt the language, engagement strategies, and metrics that are meaningful to the corporate managers who drive capital investment decisions. Understanding customer needs and their investment decision-making processes allows IEE program administrators to generate trust with their industrial customers, boosting IEE implementation rates while making better use of limited resources.

There are different approaches to ensure that this key program contact function is effective. Some program administrators rely heavily on in-house staff for this function, and others rely heavily on contractors to undertake day-to-day account-manager type functions. Some program administrators employ a mixed approach, using both in-house and contractor staff to maintain day-to-day dialogue and to provide technical support and assistance.

Access to specific subsector technical expertise for specific short-term assignment is almost always necessary. Effective programs maintain a network of specialized technical staff that can be drawn on for both program support and also for referral for specialized tasks needed by industrial customers.

4. Offer a combination of prescriptive and custom offerings to best support diverse customer needs

A combination of both prescriptive offerings for common cross-cutting technology and customized project offerings for larger, more unique projects can best meet diverse customer needs and provide flexible choices to industries. Prescriptive offerings – typically involving rebates for a portion of the cost of common technology equipment upgrades or certain other clearly defined actions – can be relatively simple for both customers and program administrators. However, custom approaches, usually involving support for both design and implementation, are needed for the larger, complex, or process-specific projects valued by many industrial customers. Xcel Energy's programs have been lauded by industrial customers for offering simple incentive applications for providing a full suite of programs – custom, self-direct, and process energy efficiency incentives. ETO has been successful in its ability to help its industrial customers realize deep energy savings with low-cost changes as well as through complex custom approaches. Rocky Mountain Power couples its custom Energy FinAnswer program with the complementary Energy FinAnswer Express program offering prescriptive rebates to target deep savings as well as quick wins. Efficiency Vermont, NYSERDA, and PG&E, among others, also provide both prescriptive technology and customized project development options.

5. Accommodating scheduling concerns

Program flexibility to meet industry project scheduling requirements is important to meet industrial customer needs. Typically, scheduling of capital project implementation must consider both operational schedules that dictate when production lines may be taken out of operation and capital investment

cycles and decision-making processes. Programs with multi-year operational planning can best accommodate company scheduling requirements and the ebb and flow of company project implementation progress.

For example, evaluations of NYSERDA's IPE program suggested that program managers should target specific industrial subsectors based on an understanding of a firms' hours of operation, capital plans, level of interest in energy efficiency and sustainability initiatives, and capacity utilization.[7] The IPE Program is positioned to take advantage of potential capacity investments by developing lists that classify industrial customers using NAICS codes to include evidence of plant capacity constraints, using capacity utilization data published by the U.S. Federal Reserve System. Companies with a high capacity utilization rate – relative to their historical averages – are prioritized for targeted outreach concerning large infrastructure investments. Firms reporting mid- or low-capacity utilization rates are targeted to increase the productive capacity of existing facilities, implement and/or adopt a strategic approach to energy management, and/or implement low- and no-cost operational improvements (Harris 2012).

6. Streamline and expedite application processes

Industrial customers may perceive the application and implementation procedures for industrial energy efficiency programs to be administratively complex and burdensome. Achieving the right balance between meeting key program administration needs for information and keeping program procedures simple and efficient may often require a continual process of evaluation and improvement.

As an example, BPA began using a third party to evaluate and then help streamline procedures to address industrial concerns about the application process. A third party also helps individual companies navigate application procedures.

7. Conducting continual and targeted program outreach

Even where industrial programs are well established, various industrial customers may remain unaware of the industrial program offerings that may be most applicable or useful for them due to staff turnover and internal demands. Steady and continual outreach and dissemination of information, such as examples of successful past projects, is important to encourage participation. Effective long-term relationships with industrial customers (feature #2) creates better information flow and can assist in program outreach efforts.

8. Leveraging partnerships

Successful industrial energy efficiency programs often partner with federal, state, and regional agencies and organizations to leverage their expertise, access to customers, and program implementation support capacities. Partnerships can help programs by providing technical expertise, program design and implementation guidance, and expanding program outreach and implementation channels. For example state energy offices can also complement and support ratepayer-funded programs through training, energy assessments, certification and recognition awards. SEOs use their established partnerships with other relevant stakeholders such as the Manufacturing Extension Partnership (MEP), DOE's Industrial Assessment Center (IAC) Database and resources provided by the EPA's ENERGY STAR for Industry program to inform thousands of investments in state and utility IEE programs.[8]

9. Setting medium to long term goals as an investment signal for industrial customers

Most state industrial energy efficiency programs have found that establishing and reporting on energy savings goals in three-year cycles is effective. Medium and longer-term goals and coordinated funding cycles set a framework for long-term programming, and can signal increased certainty to the market and program administrators.

Targets can drive significant efficiency program investment and can steer program administrators toward IEE programs in their search for savings over the long term. Programs with more ambitious savings targets require a more comprehensive set of offerings than those with less stringent targets. Programs with less stringent saving goals can often meet their targets through prescriptive incentives for single projects in the commercial and residential sectors. To meet more ambitious savings and tap into the large energy efficiency potential represented by the industrial sector, programs need to create multiple strategies, moving beyond single projects, diversifying program offerings, and engaging customers from all sectors to work on 3–5 year plans for continuous improvement, according to the options available to them along the spectrum of state IEE approaches.

10. Undertaking proper project M&V and completing program evaluations

Effective monitoring and verification (M&V) of project energy savings is critical to program administrators and regulators to assess the actual results of program activities and to measure the contribution of projects and aggregate programs for achieving their goals. Manufacturers also can obtain clear views of the results of investment. Both planning for M&V during the program design phase and periodic evaluation and adjustment in M&V approaches are important. If non-energy benefits can be included in project assessments, this can further improve understanding of these often important benefits in conveying the value proposition for future energy efficiency projects. There are opportunities for states to learn from each other in M&V protocols and their adoption. Finally, it is useful for programs to undertake periodic process and/operational strategy evaluations of their full range of activities, to assess where program efficiency and results can be further improved.

EMERGING NEW DIRECTIONS

Most states with active IEE programs continue to devote much effort to expanding and improving their programs. There are four key areas of particular interest for further program evolution. These are future directions of interest, rather than detailed pathways for immediate new implementation. Further research, regulatory guidance and implementation experience is needed.

7. The capacity utilization rate describes the extent to which the industrial sector's production capabilities are actually being used to produce the current level of output. In general, a high rate of capacity utilization is a positive indicator of economic health.

8. http://iac.rutgers.edu/database

Deepening programs supporting Strategic Energy Management in industry

Efforts to support implementation of SEM systems in industry are gaining momentum in U.S. state programs, as is also true in other countries. Successful implementation of SEM in many industries could have a dramatic impact on capturing more unrealized energy efficiency potential. By creating internal company platforms for continual identification and implementation of energy savings measures, benefits include more comprehensive identification and prioritization of energy savings investments (including across organizations), high-impact and low-cost behavioral changes, and operational and maintenance improvements, all contributing to the company bottom line. For example, use of greater sub-metering as part of a SEM initiative may allow previously unclear issues and their solutions to come to light, or enable a new energy intensity program to be put in place. In another example, cross-unit analysis of secondary energy production and use (e.g. compressed air or steam), involving the secondary energy systems managers and the production units that use the energy, may identify key secondary energy system or production line operational adjustments that may have significant energy saving impacts.

SEM implementation can be effectively supported through technical assistance and recognition programs or through ratepayer-funded energy efficiency programs. In the latter, one key common challenge is how to quantify and credit energy savings specifically achieved through SEM system development, through a "with and without project" type of comparative analysis.

Attributing savings to projects identified through SEM programs is challenging, but tracking success will be increasingly important as SEM programs become more widespread and their effectiveness is put under regulatory scrutiny. SEM M&V can also be a valuable tool for industrial managers, by making energy performance visible, meaningful, and actionable. To isolate the effect of SEM versus capital projects and other variables, program administrators and customers typically develop an energy use baseline and an energy (regression) model for the entire facility. The annual SEM incentive for the customer are made based on actual savings once equipment changes and other variables have been subtracted – i.e. savings from all capital projects are subtracted out (since capital projects receive their own incentives) – so that the remaining savings are credited to O&M. While SEM is broader than just O&M or operational efficiency, this approach that subtracts out the savings from capital projects is currently the most common M&V approach to credit financial incentives for SEM. Current programs deploying this approach apply traditional incentives for custom retrofit measures, where retrofit measure savings are subtracted from facility-wide savings, and then a lower incentive is paid on the difference (Gilless 2013). Programs that estimate and incentivize SEM program savings in this way include Northwest Energy Efficiency Alliance (NEEA), ETO, BPA, Rocky Mountain Power (PacifiCorp). This topic, and others relating to SEM programs, are worthy of further practical joint research and cross-exchange.

Developing approaches for providing energy efficiency incentives for whole-facility performance

Work on means to assess energy savings from SEM implementation could provide directions for taking energy efficiency programs even further, e.g., providing incentives and assessing savings credits for whole industrial facility performance, as opposed to performance of individual investments or measures. Under this new program model, utilities or program administrators could work with customers to agree on an energy baseline for a certain period (e.g., a year) and provide incentives based on improvements in energy intensity below the baseline. These types of pay-for-performance programs resemble power-purchasing agreements for renewables or white certificates schemes in Europe. They could also be closely integrated into national initiatives and provide greater applicability for a single company with industrial facilities in multiple service territories. They could also be linked to flexible compliance options within forthcoming greenhouse gas regulations for existing power plants under section 111(d) of the Clean Air Act.

Capturing more energy efficiency projects by expanding quantification and recognition of project non-energy benefits

While there is wide variation between projects, several studies have shown that non-energy benefits from industrial energy efficiency projects, such as broader productivity or quality gains, can be as high as or even higher than the energy cost saving benefits achieved by the projects. Awareness of the importance in quantifying or otherwise highlighting key and large co-benefits is growing. Even so, quantification of these benefits tends to occur mainly after project commissioning, as part of project evaluation efforts. Some co-benefits, such as water savings, are relatively easy to quantify, while others, such as safety improvements are more complex to assess.

ETO tries to address NEBs upfront and will help industrial customers to quantify NEBs to support the investment decision for projects that are of interest to the industrial customer but do not quite satisfy the cost-effectiveness test. For ETO, water savings is a common NEB to be quantified and is relatively straightforward to quantify relative to other NEBs, such as improved safety and employee morale (Crossman 2013).

If programs employed systematic ways to assess some of the non-energy benefits for key projects earlier in the project cycle, the clarity added to both the resulting total returns and shorter project payback could tip the scale on a variety of projects from "wait and see" to implementation. This is yet another area where practical joint research and cross-exchange could prove fruitful.

Continuing efforts to expand industrial natural gas efficiency programs

Although natural gas efficiency programs have been implemented in various states for years, effective coverage of the industrial sector is much less common than for electricity efficiency programs, even though industry accounts for about 26 % of total end-use natural gas consumption in the U.S. A key challenge is that most large industrial customers purchase their gas through third-party suppliers, rather than their distribution companies. Another challenge is the recent decrease in natural gas prices (even though many gas saving projects are still cost effective at current prices). Nevertheless, a number of states and Canadian provinces continue to serve as promising examples

in delivery of industrial natural gas efficiency programs, which other states may profit from reviewing. In addition, innovative concepts are under consideration to increase the effectiveness and the reach of gas efficiency programs. One such concept proposes to pool both gas and electric efficiency funds to allow participating manufacturers to implement larger and more holistic programs with the flexibility to deliver both electricity and gas savings.

THE IMPORTANCE OF CROSS EXCHANGE

The experience of various states gained in developing and implementing industrial energy efficiency programs is both diverse and rich. Often, however, valuable details of different programs – and the successes, failures, and lessons learned – are not well known or are poorly understood out of state, even though other state practitioners could benefit from these experiences. In addition, early ideas on new programs or improvements to existing ones are common among various practitioners. Opportunities for peer exchange on design and operational specifics could further programs' progress. Finally, there are benefits from greater mutual understanding that can be gained from increased cross-state exchange among different types of stakeholders in the industrial energy efficiency program practice, including regulatory agencies, program administrators, involved industrial energy users in different states, as well as associated experts.

Conclusion

Building on the improvements in energy efficiency in U.S. industrial sector that have occurred over the past decades in response to volatile energy prices, fuel shortages and technological advances is essential to maintaining U.S. industry's viability in an increasingly competitive world. The fact is that many opportunities remain to incorporate cost-effective, energy efficient technologies, processes and practices into U.S. manufacturing. Industrial energy efficiency remains a large untapped potential for states and utilities looking to improve energy efficiency, reduce emissions and promote economic development. Successful industrial energy efficiency programs vary substantially in operational mode, scope and financial capacity, but also exhibit common threads and challenges.

Gaining industry support for industrial energy efficiency programs is key, and one of the best means to gain increased industry support is by demonstrating the high value of efficiency programs to industrial customers. Industrial energy efficiency programs can effectively deliver value to industries in terms of lower costs, reduced environmental impact and improved competitiveness, and can help alleviate common resistance by industry to pay into ratepayer programs. In fact, in some cases industry self-direct efficiency programs have declined in favor of increased participation in program-administered offerings.

The development and operation of a highly valued industrial energy efficiency program requires a close understanding of the special needs of industrial customers, flexibility in program offerings and sustained engagement. In practical terms, this means helping industry to achieve concrete energy cost reduction benefits, improved competitive position, and additional non-energy benefits such as enhanced productivity and product quality from energy efficiency projects well above the costs of paying into the program. Flexibility in addressing project scheduling and investment cycles, provision of high quality technical expertise, and comprehensive offerings that include both prescriptive and custom incentives are also success features of programs.

In addition to responding to the needs of industrial customers, industrial energy efficiency programs that leverage strategic partnerships, have robust M&V and evaluation methodologies and seek to introduce more holistic program approaches, such as SEM and pooled gas and electric programs, will ultimately be able to help program administrators operate more effective programs or deliver significant additional energy savings.

States' experience in developing and implementing industrial energy efficiency programs is both diverse and rich. There are benefits from greater mutual understanding that can be gained from increased cross-state exchange among regulatory agencies, program administrators, involved industrial energy users, and associated experts.

Finally, while the regulatory contexts are significantly different between the U.S. and the E.U., the successful program features presented in this paper are certainly relevant to European industrial energy efficiency programs as well. Further, since many countries in Europe have successful programs themselves and longstanding experience, American and European cross-exchange on program implementation, progressing more holistic energy management program approaches and advancing emerging directions would certainly help to strengthen efforts to make more dramatic energy efficiency improvements in industry.

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