Trends in Industrial Energy Efficiency Programs: Today's Leaders and Directions for the Future

Anna K. Chittum, R. Neal Elliott, and Nate Kaufman

September 2009

Report Number IE091

529 14th Street, NW, Suite 600, Washington, DC 20045
(202) 527-4003 phone, (202) 429-2248 fax, aceee.org

CONTENTS

ACKNOWLEDGMENTS

The authors express their appreciation to the New York State Energy Research and Development Authority, Southern California Edison, National Grid, and Pacific Gas & Electric Company for their generous support of this study. They would like to thank Dan York, Katherine Friedrich, and Steve Nadel at ACEEE and Ted Jones at the Consortium for Energy Efficiency (CEE) for their help in guiding the general focus of the report. We thank Renee Nida for her editing of the final report, and the following people for their feedback as reviewers of various drafts of the paper:

Tom Antonucci	Southern California Edison
Tamara Gunderzik	Xcel Energy
Dan Trombley	American Council for an Energy-Efficient Economy
Kim Crossman	Energy Trust of Oregon
Kathey Ferland	Texas Industries of the Future
Harold Hayashi	Enbridge Gas Distribution
Miriam Pye	New York Energy Research and Development Authority
Keith Belton	Dow Chemical Company
Parminder Sandhu	Willis Energy Services
Sergio Dias	Sergio Dias Consulting
Elizabeth Dutrow	United States Environmental Protection Agency
Walt Tunnessen	United States Environmental Protection Agency
Craig Schepp	SAIC
Dana Levy	New York Energy Research and Development Authority
Leanne Whitehead	Tennessee Valley Authority
Sandy Glatt	United States Department of Energy
Scott Hutchins	United States Department of Energy
Vernon Knight	Tennessee Valley Authority
William Prindle	ICF International
Hale Powell	HPowell Energy Associates
Ted Light	Energy Trust of Oregon

GLOSSARY

British Thermal Unit (Btu): basic unit of energy; amount of energy required to raise the temperature of one pound of water by one degree Fahrenheit.

Building Commissioning (Cx): Commissioning is a risk reduction or quality assurance process for new construction projects that operates from pre-design through design, construction, and operations. The purpose of commissioning is to ensure that all components of a building have been designed, installed, and tested, and are capable of being operated and maintained in conformity with the design intent. (See ASHRAE 1996.)

Combined Heat and Power (CHP): method of using waste heat from electrical generation to offset traditional process or space heating. Also called cogeneration (cogen).

Decatherm = 10 Therms = 1 MMBtu

Demand Response: The reduction of customer energy usage at times of peak usage in order to help address system reliability, reflect market conditions and pricing, and support infrastructure optimization or deferral. Demand response programs may include dynamic pricing/tariffs, price-responsive demand bidding, contractually obligated and voluntary curtailment, and direct load control/cycling.

Deregulation: Allows a ratepayer to choose other electricity providers over a local provider. Deregulation efforts vary from reducing or completely eliminating a local monopoly on electricity.

Distributed Energy Resource: Electrical power generation or storage located at or near the point of use, as well as demand-side measures.

Distributed Generation: Electric power generation located at or near the point of use.

Electricity Distribution: Regulating voltage to usable levels and distributing electricity to end-users from substations.

Electricity Generation: Converting a primary fuel source (e.g., coal, natural gas, or wind) into electricity.

Electricity Transmission: Transport of electricity from the generation source to a distribution substation, usually via power lines.

Emerging Technology: A technology or practice that is not yet commercialized but is likely to be commercialized within about five years, or is already commercialized but currently has a market share of less than about 2–5%.

Energy Efficiency Resource Standard (EERS): A simple, market-based mechanism to encourage more efficient generation, transmission, and use of electricity and natural gas. An EERS consists of electric and/or gas energy savings targets for utilities, often with flexibility to achieve the target through a market-based trading system. All EERS's include end-user energy saving improvements that are aided and

documented by utilities or other program operators. Often used in conjunction with a Renewable Portfolio Standard (RPS).

Energy Independence and Security Act of 2007 (EISA 2007): Law covering issues from fuel economy standards for cars and trucks to renewable fuel and electricity to training programs for a "green collar" workforce to the first federal mandatory efficiency standards for appliances and lighting.

Energy Policy Act (EPAct): Law directing U.S. energy policy; first passed in 1992, major revisions were passed in 2005 and 2007.

ENERGY STAR®: A joint program of the U.S. Environmental Protection Agency and the U.S. Department of Energy helping residential customers save money and protect the environment through energy-efficient products and practices (http://www.energystar.gov/). Includes appliance efficiency standards and new building codes.

Green Building: Using design and construction practices that dramatically improve the efficiency of a building's use of resources—including energy, water, and materials—over the complete lifecycle of the building, while improving human health and productivity. Because "green" involves a complex web of interconnected objectives, it is difficult to evaluate whether a building is in fact "green."

Heating, Ventilation, and Air Conditioning (HVAC): The systems that provide thermal comfort and air quality in an indoor space are often grouped together because they are often interconnected.

Institute of Electrical and Electronics Engineers (IEEE): A professional association for the advancement of technology. Particularly interested in emphasizing standards to be applied universally across all electronics manufacturers. Designers of Interconnection Standard 1547, which is used as a basic interconnection model by a number of states and utilities. More information about the standard can be found at http://grouper.ieee.org/groups/scc21/1547/1547_index.html.

Integrated Resource Plan (IRP): A comprehensive and systematic blueprint developed by a supplier, distributor, or end-user of energy who has evaluated demand-side and supply-side resource options and economic parameters and determined which options will best help them meet their energy goals at the lowest reasonable energy, environmental, and societal cost. See http://www.energycentral.com/centers/knowledge/glossary/home.cfm.

Investor-Owned Utility (IOU): Also known as a private utility, IOU's are utilities owned by investors or shareholders. IOU's can be listed on public stock exchanges.

Kilowatt-hour (kWh): basic unit of electrical energy; amount of energy consumed by 1 Watt for 1 hour = 3,412 Btu.

Megawatt-hour (MWh) = 1,000 kWh (300 million MWh = ~one Quad).

NAICS: North American Industry Classification System, 6-digit code used to group industries by product.

O&M: Refers to operation and maintenance of a facility. Often improving O&M practices are a high-priority measure for increasing the efficiency of a commercial building.

Public Benefit Energy (PBE) Program: Refers to a program that encourages and in some cases offers incentives for energy efficiency and renewable energy via a pool of money collected from utility customers, ratepayers, or other means. PBE programs are generally authorized on the state level.

Potential: amount of energy savings possible

- **Achievable Potential**: Potential that could be achieved through normal market forces, new state building codes, equipment efficiency, and utility energy efficiency programs.
- **Economic Potential**: Potential based on both the technical potential and economic considerations (e.g., system cost or avoided cost of energy).
- **Technical Potential:** Potential based on technological limitations only (no economic or other considerations).

Quad = quadrillion Btu = 1,000,000,000,000,000 Btu, about 1% of current U.S. total energy use on an annual basis; enough energy to heat about 22 million homes for one year or to power 15.7 million cars annually (driving an average of 14,000 miles per year at 27.5 miles per gallon).

Regional Greenhouse Gas Initiative (RGGI): RGGI is a cooperative effort by Northeastern and Mid-Atlantic states to reduce carbon dioxide emissions. To address this important environmental issue, the RGGI participating states will be developing a regional strategy for controlling emissions. Central to this initiative is the implementation of a multi-state cap-and-trade program with a market-based emissions trading system. Similar initiatives are set up in the Midwest, through the Midwestern Greenhouse Gas Accord, and in the West, through the Western Climate Initiative.

Retrocommissioning (RCx): Retrocommissioning, or "existing building commissioning," is a process to ensure the functionality of a building that has not been previously commissioned. It is a systematic investigation of how a building's subsystems are being operated and maintained, and it is used to identify and solve optimization and integration issues. A **building tune-up** is similar but often goes one step further to execute more extensive improvement and repairs.

Retrofit: A retrofit involves the installation of updated technologies into an older existing building. Retrofits often involve either structural enhancements to increase strength, or replacing major equipment central to the building's functions, such as HVAC or water heating systems.

SIC: Standard Industrial Classification, 4-digit precursor to the NAICS. Out of use since 1997.

Watt (W): basic unit of power (especially electric power)
= 1 J/s = 0.74 ft-lbs/sec = 0.0013 horsepower

EXECUTIVE SUMMARY

As increased goals for energy efficiency savings are mandated in regions of the U.S. and Canada, and as the likelihood of a national-level energy efficiency standard (EES) in the U.S. increases, state lawmakers and utility regulators need to plan for achieving new energy savings. New commitments to efficiency can only be met with new commitments to efficiency programs, since, despite the cost-effectiveness of most energy efficiency projects, a number of market and educational barriers prevent many cost-effective energy efficiency investments from occurring.

The industrial sector in particular offers tremendous opportunity for energy savings, and a significant opportunity to instill the tenets of energy efficiency within facilities that, in turn, employ and influence millions of people. It has thus been an attractive target sector for states looking to reach new levels of energy savings through efficiency. The sector itself, working constantly to increase shareholder value and reduce expenses, has found energy efficiency investments to be an attractive avenue to achieve those ends. Additionally, as climate change awareness and mitigation strategies increase, energy efficiency will likely be increasingly prioritized as a critical solution to reduce harmful greenhouse gas emissions.

The industrial sector in particular represents a significant opportunity for energy efficiency, and in most cases the above-mentioned state efficiency targets cannot be met without a significant contribution from the industrial sector. The sector, while contributing substantially to the United States' gross domestic product, also consumes an immense amount of energy as it produces goods and materials for consumption domestically and internationally. In 2007, the U.S. industrial sector consumed nearly 32% of the country's energy. In the past three decades, the overall energy efficiency of the industrial sector in the U.S. has increased dramatically, and the energy intensity of the country—the amount of energy it takes to produce one dollar's worth of goods—has decreased by 50%. Though new technologies and practices have enabled this increase in efficiency, there is evidence that substantial efficiency still exists in the sector.

The industrial sector is a hard sector for energy efficiency programs to penetrate and encourage energy efficiency, however. This is due in large part to the heterogeneity of the sector, and the fact that industrial and manufacturing companies are first and foremost businesses—with goals that may not include energy reduction. While energy waste is a cost to industrial companies, and thus something that most industrial companies would like to reduce, it is often thought of on the periphery of the company's operations. In many cases, the decision-maker about energy use decisions is not the same person making decisions about the uses of capital expenditure moneys. Therefore, substantial capital investment in more energy efficiency technologies may not occur despite the fact that a facility or shop manager understands its usefulness. As the current recession continues to impact capital markets and long-term investment decisions, encouraging industrial companies to invest in energy efficiency is proving to be even more difficult.

In this environment we find public benefits energy programs running industrial-focused energy efficiency programs. As noted above, the energy savings goals these programs are facing are rising yearly, and the industrial sector can provide a substantial amount of savings to meet such goals. However, few such programs have historically served their industrial customers well. While good examples of industrial programs exist, and some programs have specific program elements that are laudable, a great many more are

constantly working to improve their program offerings and achieve more savings from their existing industrial clientele.

By speaking directly with numerous managers of current industrial-focused energy efficiency programs, we learn of current trends in the administration of industrial programs, and challenges these programs currently face. We learn of current best practices and good examples of particular sector- and region-focused program practices that are proving successful. We also learn of lessons particularly useful to those starting new industrial energy efficiency programs, and we learn about the impact and structure of today's self-directed industrial energy efficiency programs.

The industrial sector is critical to meeting our energy-saving and greenhouse gas reduction needs of the future. Its energy use is significant, and the energy-saving opportunities are substantial. Public benefit energy programs have been a very important component of past industrial energy efficiency savings, and they will play an even more critical role in achieving the industrial savings of the future. Giving these programs the resources and flexibility necessary to reach and serve their industrial customers is the best way to lock in industrial energy efficiency investments that will yield energy savings for years to come.

INTRODUCTION

As increased goals for energy efficiency savings are mandated in regions of the U.S. and Canada, and as the likelihood of a national-level energy efficiency standard (EES) in the U.S. increases, state lawmakers and utility regulators need to plan for achieving new energy savings. New commitments to efficiency can only be met with new commitments to efficiency programs, since, despite the cost-effectiveness of most energy efficiency projects, a number of market and educational barriers prevent many cost-effective energy efficiency investments from occurring.

The industrial sector in particular offers tremendous opportunity for energy savings, and a significant opportunity to instill the tenets of energy efficiency within facilities that, in turn, employ and influence millions of people. It has thus been an attractive target sector for states looking to reach new levels of energy savings through efficiency. The sector itself, working constantly to increase shareholder value and reduce expenses, has found energy efficiency investments to be an attractive avenue to achieve those ends (Shipley et al. 2002). Additionally, as climate change awareness and mitigation strategies increase, energy efficiency will likely be increasingly prioritized as a critical solution to reduce harmful greenhouse gas emissions.

Industrial energy efficiency programs administered by a number of different entities have been successful in achieving these savings in the industrial sector, bringing industrial companies into a more energy-efficient paradigm. These programs have been around for years, operating with varying degrees of efficacy, support, and market penetration. Though the industrial sector is not the easiest sector to reach, it is a sector that provides significant return on program investments. But new efficiency goals and mandates, along with increased interest in the cost-saving potential of energy efficiency investments, present new opportunities and challenges to the administrators of industrial energy efficiency programs. It was within this context that ACEEE decided to update its research into industrial energy efficiency programs throughout the U.S. and Canada.

The following research comprises information gathered from a survey of program managers, as well as additional primary and secondary research into industrial energy efficiency programs. We aim to present new and useful information about the operations of today's most effective industrial energy efficiency programs, and identify areas in which industrial energy efficiency programs might further improve. The intended audience for this paper includes: federal and state utility policymakers and regulators; managers and administrators of existing, new, or burgeoning industrial energy efficiency programs; lawmakers considering the development or expansion of energy programs focused on their constituent industries; and industrial firms looking to become more involved in the design and usefulness of local industrial energy efficiency programs.

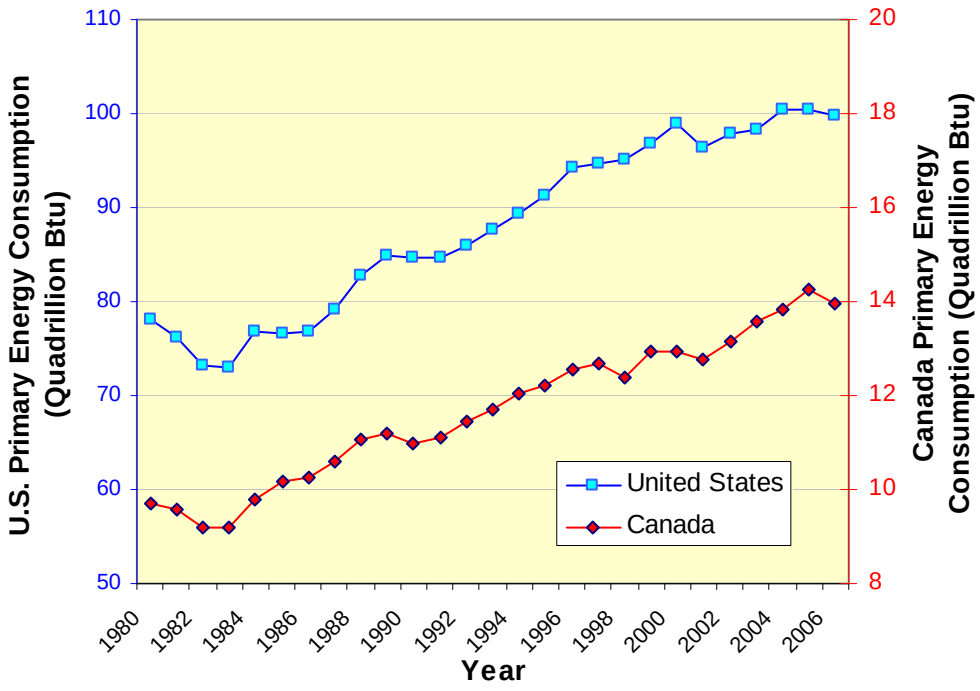
In this report we discuss how energy is used today within the industrial sector, why encouraging energy efficiency investments in the sector has historically proven a challenge, and what we know has worked in the realm of industrial-focused energy efficiency programs in the past. We will discuss the types of programs that are serving the industrial sector today, relying in large part on a review of industrial programs in 2008 and 2009 ("the survey") by ACEEE. Trends that were identified in the survey will be discussed and analyzed, and specific examples of unique and effective industrial energy efficiency programs will be discussed. Finally, we will take a look at some specific issues that will likely impact a growing number of industrial energy efficiency programs in the near future,

including considerations in the development of new programs and emerging challenges to industrial energy efficiency programs.

INDUSTRIAL ENERGY USE AND ENERGY EFFICIENCY IN THE UNITED STATES

The growing demand for energy in the United States and Canada, coupled with the increasing difficulty and cost—both environmental and financial—of deploying new energy generation and transmission resources, has spurred renewed interest in energy efficiency as a means of meeting energy demand. *Figure 1* shows the overall rise in total U.S. and Canadian primary energy consumption from 1980 to 2006. After reductions in the early 1980s, energy consumption in both countries has increased nearly every year since. The current economic recession will likely yield a temporary dip in energy consumption, but overall industrial energy consumption will remain a significant portion of U.S. and Canadian primary energy consumption.

Figure 1. U.S. and Canadian Primary Energy Consumption, 1980–2006



Source: EIA (2008a). Note that the countries' consumption trends are displayed on separate axes to show similar growth trends between the two, despite Canada's substantially smaller absolute consumption.

As the populations of the U.S. and Canada grow, the demand for total energy continues to increase in both countries. Because the industrial sector is such a prominent component of nationwide energy consumption in both countries, it offers substantial savings opportunities. For the purposes of this report, all subsequent statistics will reflect data and trends exclusively in the United States, unless otherwise noted. The U.S. can generally be used as a lens for industrial energy efficiency opportunities in the North American continental region at large.

While typical base-load generation produces electricity at a cost of $0.073[1] to $0.135 per kWh in the U.S., energy efficiency can achieve savings at an average cost of $0.03 per kWh saved (ACEEE 2009a). These economics have encouraged states to view energy efficiency as the least-cost energy resource available today. Consequently, the last few years have seen a significant increase in state-level activity that encourages or requires increased energy efficiency. To date, nineteen U.S. states have enacted energy savings targets and more than 20 states have established public/system benefit funds that include funding for efficiency (there is substantial overlap between these two groups) (Kushler and Witte 2007). Together, these policies mandate greater energy efficiency from their electric sector, saving residents money and reducing emissions from electricity generation (ACEEE 2009a).

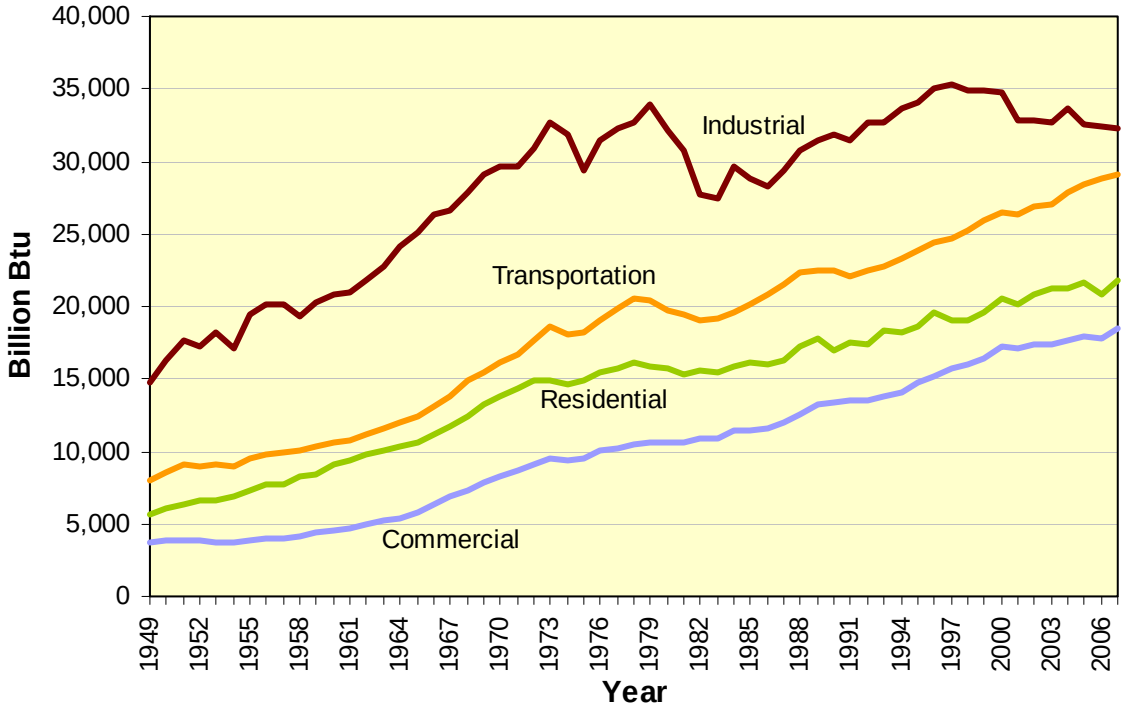
The industrial sector in particular represents a significant opportunity for energy efficiency, and in most cases the state efficiency targets cannot be met without a significant contribution from the sector. The industrial sector, while contributing substantially to the United States' gross domestic product, also consumes an immense amount of energy as it produces goods and materials for consumption domestically and internationally. In 2007, the U.S. industrial sector consumed nearly 32% of the country's energy. However, on average, American industrial firms have decreased their energy consumption almost every year since 1992, while increasing the gross industrial product every year during that period (BEA 2009; EIA 2009a). In the past three decades, the overall energy efficiency of the industrial sector in the U.S. has increased dramatically, and the energy intensity of the country—the amount of energy it takes to produce one dollar's worth of goods—has decreased by 50%. While it took an average of 9,130 BTUs to produce a dollar of goods in 1970, it took only 4,320 BTUs to produce the same value of goods in 2003 (NAM 2005).

This improvement in energy intensity can largely be attributed to increases in industrial energy efficiency; some estimates credit increased efficiency as responsible for nearly half of the reduction in energy intensity, along with a move away from the most energy-intensive industrial activities and products (NAM 2005; Shipley et al. 2002). While absolute energy consumption in the industrial sector has been declining, however, energy consumption at large in the United States and Canada has increased nearly every year for the past three decades (EIA 2008a). Given the industrial sector's continuing substantial role in American energy consumption and the remaining potential for savings within it, the sector offers significant opportunities for energy savings to benefit the whole country.

Figure 2 displays energy consumption in the United States by each of the four major sectors of the economy: residential, commercial, industrial, and transportation. As noted previously, the industrial sector accounts for almost one-third of energy consumption in the country. Additionally, a significant portion of the energy consumed by the transportation sector can be attributable to the movement of manufactured goods. Certain improvements in energy efficiency within the industrial sector—for instance, the use of lighter materials—could yield energy savings in the transportation sector as well (NAM 2005).

[1] All currency amounts in this report are U.S. dollars.

Figure 2. U.S. Energy Consumption by End-Use Sector, 1949–2007



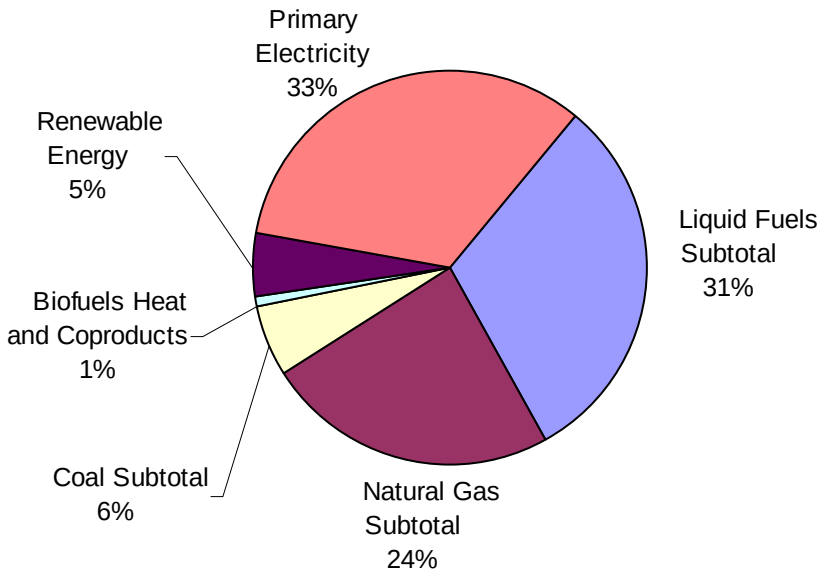
Source: EIA (2009a)

The industrial sector is also unique in the mix of fuels it uses (see *Figure 3*) and the way that different subsectors within industry use energy (see *Figure 4*). The industrial sector is by no means monolithic. Its heterogeneity, as discussed later in this report, makes it a difficult sector in which to maximize energy efficiency, as compared to other sectors. The distinct characteristics of each region, state, and city, and their respective industries, further complicates the matter, as a program designed to encourage energy efficiency in one state's most energy-intensive industry may be of little use to another state in addressing its own industrial firms.

Figure 3 displays the breakdown of industrial energy consumption in the United States by fuel source. Primary electricity, liquid fuels, and natural gas make up the vast majority of energy consumption within the industrial sector. *Figure 4* breaks down total manufacturing subsector energy consumption into industry groups, and their respective portions of consumption.[2] It should be noted that the industrial sector varies dramatically, both geographically and among subsectors and industries. Thus, while petroleum and coal products and chemicals manufacturers represent the largest segments of energy consumption within the U.S. industrial sector, some regions of the country host relatively few fossil fuels and chemicals manufacturing facilities. These regions' industrial economies may focus more on food, paper, or metals manufacturing, among others.

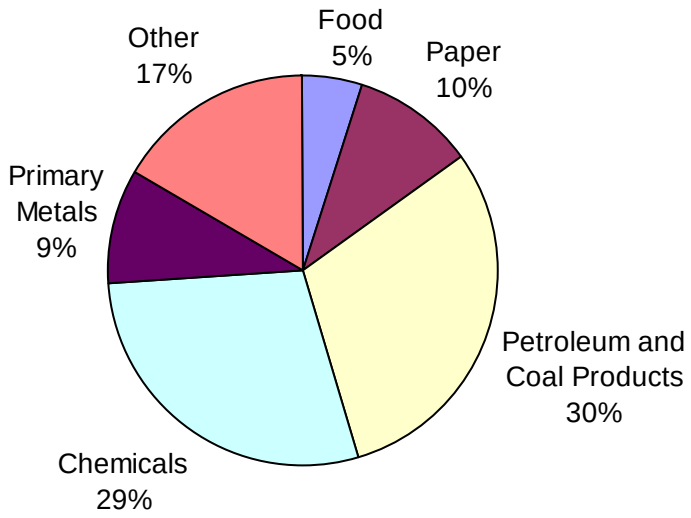
[2] The industrial sector comprises four subsectors: manufacturing, mining, agriculture, and construction. Each subsector is further broken down into individual industry groups, such as food manufacturing or paper manufacturing. Each industry group includes a set of industries, such as dairy product manufacturing or converted paper product manufacturing.

Figure 3. U.S. Industrial Energy Consumption by Fuel, 2002



Source: EIA (2009b)

Figure 4. U.S. Industrial Sector Energy Use by Subsector, 2002



Source: EIA (2006)

Current Economic Context

The current recession and economic downturn in general has presented a unique challenge to industrial energy efficiency programs, as macroeconomic cycles tend to impact investments in energy efficiency (Elliott et al. 2008). Industrial efficiency programs around the U.S. and in Canada are facing facility closures, company bankruptcies, and reductions in

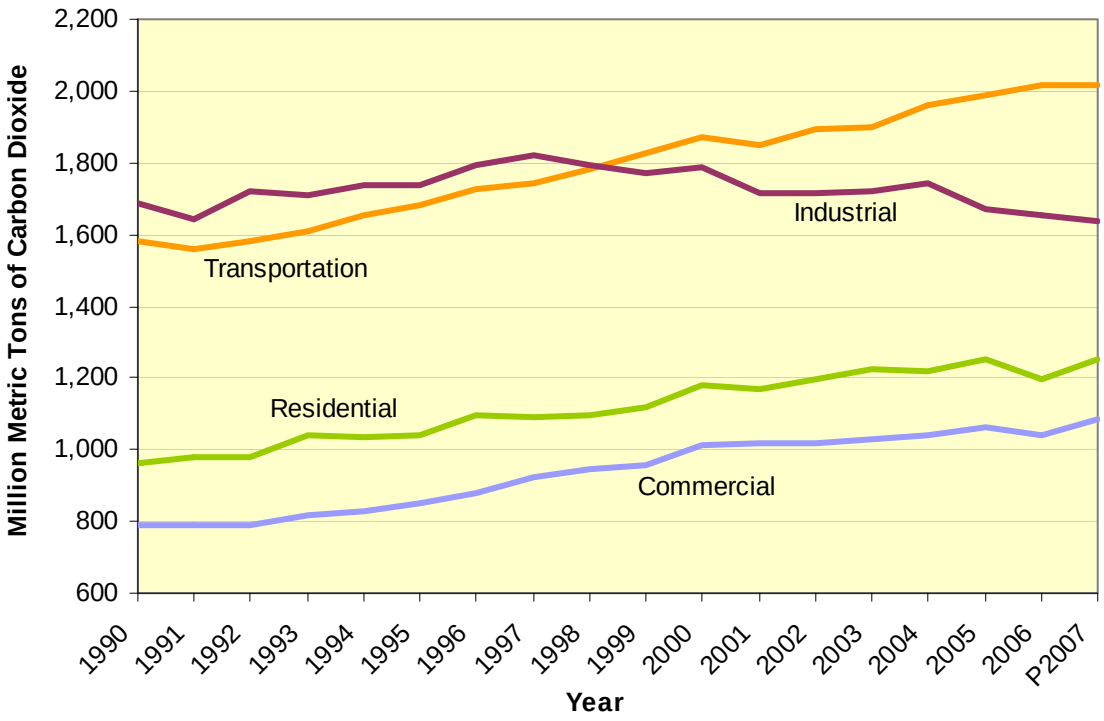
workforce, orders, and revenues. In this environment, firms are unwilling or unable to make energy efficiency investments, or for that matter any investments. While the absolute energy consumption of the industrial sector has dropped dramatically in the last year, it cannot be directly attributed to a more efficient use of resources, but rather to the contraction of consumer demand caused by the recession (EIA 2009c). As consumer demand drops, manufacturing firms need to make fewer products, and they operate their facilities at lower levels of utilization than is typical. Further, market “middle men” cancel orders in order to reduce inventories, which increases their cash on hand, but further depresses manufacturing production in most industries,

Emerging Greenhouse Gas Regulations and Markets

Over the past decade, a growing number of manufacturing firms have become increasingly concerned about greenhouse gas emissions—a significant change from several years ago when some led efforts to deny the existence of greenhouse gas-caused climate change. With some sort of greenhouse gas reduction regulations likely imminent, industrial firms are now looking to energy efficiency as a cost-effective way of reducing their emissions.

Industry's energy-related carbon dioxide emissions are indeed falling slightly. While rising more dramatically in other sectors, energy-related emissions from the industrial sector since 1990 have remained relatively consistent. This is largely attributable to U.S. industry’s net decrease in energy consumption. *Figure 5* shows energy-related carbon emissions in the U.S. by end-use sector between 1990 and 2007. Unlike in the other three end-use sectors, the industrial sector has not seen a net increase in carbon dioxide emissions over the last two decades. Still, industry accounts for approximately 27.4% of total energy-related carbon dioxide emissions in the United States (EIA 2008b).

Figure 5. U.S. Energy-Related Carbon Dioxide Emissions by End-Use Sector, 1990–2007



Source: EIA (2008b)

Energy efficiency reduces the amount of fuel that needs to be combusted to accomplish a given task, thereby reducing emissions attributable to a plant (NAM 2005). Though historically industrial firms have had only limited ability to monetize this reduction in greenhouse gases resulting from energy efficiency, new voluntary and proposed mandatory greenhouse gas reduction targets and trading markets could offer an immense opportunity for firms to monetize their future energy efficiency savings. This additional monetary benefit could help firms justify additional efficiency investments, as the additional cash flow could reduce payback periods and increase rates of return.

Several technical assessments conducted by ACEEE on the potential for energy efficiency in the industrial sector show tremendous opportunity in a variety of states. Recent analyses by ACEEE of the energy efficiency potential in Virginia, Pennsylvania, and Ohio found the potential for economic energy efficiency savings in all three states' industrial sectors to be 20–25% by 2025 (ACEEE et al. 2008, 2009a, 2009b). This is just an example of the kind of energy efficiency potential that exists today in the industrial sector, using only currently available technology.

Conclusion

The opportunities in the industrial sector for increased energy efficiency are significant (Shipley and Elliott 2006). The sector is a large, heterogeneous and complex one. For these reasons, encouraging energy efficiency in the sector has been difficult historically, but we've learned much from the past. That knowledge, combined with new understandings available

today, can help inform and guide people looking to increase industrial energy efficiency in today's firms.

WHAT WE'VE LEARNED FROM THE PAST

The Industrial Sector: How Energy Efficient Investments Are Made

Industrial firms are complex and diverse organisms. The sector boasts some unique attributes that serve to encourage energy efficiency: the cost of achieving energy savings in the sector tends to be lower than in many other sectors of the economy, and the industrial sector also tends to be more technically sophisticated than other sectors. The sector is also, as a whole, generally more knowledgeable about their energy use than other sectors due to the significant portion of total profits energy costs represent for many industrial firms. Some estimates put energy costs at about 2% of revenues, while others put it much higher (IAC 2009; Kleppert 2007). Industrial customers are often predisposed to be receptive to the idea of making energy efficiency investments for the impact such investments have on a firm's bottom line.

There is much efficiency to be had. It has been estimated that only 43% of all energy inputted into the industrial sector is actually applied to "process work"—the work that actually yields a good (NAM 2005). The remaining energy is lost or wasted in other ways, costing the firm and the economy a tremendous amount that cannot be recovered as a value-added end product. Some estimates suggest that, economy-wide, as much as 90% of all energy generated is wasted (David 2008). While some energy-intensive industries' manufacturing processes work nearer to their theoretical limits in a very efficient manner, even these industries still have great opportunities to increase efficiency.

Some of the reasons why industrial firms feature such great energy efficiency opportunities include: the high load factor of industrial firms generally, which can improve the economics of efficiency projects; the historic low energy prices that industrial firms have enjoyed, which has served to reduce the amount of efficiency firms have thus far invested in; and the generally high level of technical and specialized skills required to identify and implement industrial energy efficiency opportunities, which are thus not always pursued by those without the appropriate technical background (Powell 2009).

At any given point, a typical industrial facility can achieve energy savings of 10 to 20% considering currently available energy efficiency technologies within existing plants. According to one estimate, as much as 30% of those energy efficiency opportunities can be found in behavioral changes (such as changes in operating procedures or changes in maintenance activities), separate and distinct from investments in capital equipment (NAM 2005). Other estimates based on more recent data suggest that that number is much higher (Prindle 2009). So while it might seem easy to prioritize energy efficiency internally by instructing employees who make purchasing decisions to choose a more energy-efficient piece of equipment over a less efficient one, other savings opportunities are not as clearly identifiable.

These investments can often represent a significant portion of capital expenditure budgets, requiring extensive oversight from a variety of people in the firm, and careful consideration of related financial projections. These investments can represent significant risk to a firm, or may be perceived as such by decision-makers unfamiliar with the long-term benefits such an investment may provide. For these reasons, energy efficiency investments are made

carefully, with much consideration. If the investment will require a change to an existing product line or production process, the cost of the investment is likely to be higher than it would be had no such change been required. In some cases this can even make a cost-effective efficiency investment too costly and too risky to be a good business decision (Antonucci 2009).

Industrial firms are focused and most strongly measured on the products they produce first and foremost, which makes them quite different from other sectors, especially residential. In industrial businesses, energy efficiency investments are considered within the framework of the business as a whole and its unique characteristics. These investment decisions are treated like any other internal capital investment decision. Some firms are strictly concerned with the simple payback of an investment and make decisions about energy efficiency investments accordingly. Others are using more sophisticated types of financial decision-making approaches to evaluate these investments, such as calculation of return on investment (Elliott et al. 2008).

Regardless of methodology, firms typically set a valuation goal—often called a "hurdle rate"—that capital investments must meet in order to be implemented. Because these methods and goals will vary by firm and industry, using blanket justifications to sell an energy-efficient product or process (for example, "This motor has an average payback period of four years.") may not compel certain firms to make the investment. Companies also have absolute limits on capital budgets every year, so despite being cost-effective and able to satisfy a given valuation goal, a project may not move forward if the firm has exhausted its annual budget.

Industrial firms make capital investments for a number of reasons. Increasingly, many have looked to energy investments in particular to help them reduce costs and respond to increasingly stringent environmental regulations. This is a shift from how firms have historically viewed energy, which is as a fixed cost. A number of events caused firms to think differently about their energy use. These included the deregulation of the electricity market in the 1990s, the emergence of new air quality regulations in the 1990s, the oil shocks of the 1970s, and the growing preference for domestic energy resources in light of current political situations. The above-mentioned events created increasing economic incentives for energy efficiency, not least of which was a higher degree of price volatility in the energy market. That volatility is still felt today when weather, economic activities, and political happenings send primary fuel prices spiking or diving.

Industrial firms began to see their energy usage as a highly controllable cost, and the savviest firms have been investing in energy efficiency for decades as a way to reduce their exposure to energy price volatility (Schepp and Nicol 2007). Though many manufacturers still view energy as a fixed overhead cost, it is clear that a growing number of firms understand that energy is a dynamic cost that can often be better controlled, managed, and procured for economic and environmental benefit (NAM 2005; Turner and Doty 2007). The leading plants in energy efficiency are incorporating energy into their continuous improvement and quality control systems as a part of everyday business operations (Knight 2009).

While awareness of the benefits of energy efficiency has grown, not all truly cost-effective energy efficiency investments are being identified and made. Further, additional ancillary benefits to the firm that result from energy efficiency improvements are often not integrated into any of the above cost-benefit calculation. While these benefits can include positive

impacts on employee safety, overall waste reduction, customer satisfaction, and decreased maintenance, these benefits can also include significant quantifiable benefits such as increased productivity, improved product quality, reduced waste, and decreased operating costs (Pye 1998; NAM 2005; Elliott et al. 2008). As we look forward, new legislation controlling greenhouse gas emissions could establish a marketplace for greenhouse gas emissions that would help firms monetizing the ancillary benefit of greenhouse gas emission reductions.

Beyond the calculation of benefit—however that is calculated—industrial energy efficiency investments are heavily dependent on the individual plant's operational cycle. Industrial business cycles and plant operational cycles affect all capital investments in a firm. Because these cycles range anywhere from four to seven years on average, the timing of a major energy efficiency investment can be difficult to predict, especially by someone not engaged in the day-to-day activities of the firm (Elliott et. al 2008). Since the biggest opportunities for efficiency within the industrial sector are found embedded within entire production processes, understanding when those production processes are ready for new or refurbished equipment is critical.

The equipment that supports and underlies production processes is typically only completely removed and replaced at the end of a plant operational cycle. While some individual pieces of equipment may need to be replaced or refurbished in the midst of one of these cycles, such one-off opportunities do not offer the kinds of holistic energy savings potential that a full plant retrofit does. Thus, apart from the infrequent hiatuses in one of these major operational cycles, industrial energy managers have limited opportunities to achieve substantial savings at a plant (Elliott et al. 2008).

Many see the biggest opportunity to achieve efficiency savings in the development of a brand new facility, since each internal production process is a blank slate on which highly efficient and modern equipment can be placed. Though the construction of brand new manufacturing facilities does not occur as frequently as retrofits, such new and "greenfield" facility development offers a one-time opportunity to lock in energy efficiency for years or decades[3] (Elliott et al. 2008).

It's unlikely that we'll see many greenfield developments in the near future. Some industrial facilities are even being shut down entirely, as firms work to conserve cash and reduce expenses associated with operating an individual facility (Kean 2009; Parr 2009). These closures are responses to heightened uncertainty, which previous research suggests causes firms to postpone typical capital investments, as firms' decision-makers avoid committing to new capital equipment that could reduce near-term cash reserves, liquidity, and general flexibility (Elliott et al. 2008). Firms will need added assistance to make energy efficiency investments in this context.

The Role of Public Benefit Energy Efficiency Programs

Industrial energy efficiency programs have existed in the U.S. for decades, changing and developing to meet new needs and challenges. The programs exist to assist firms in realizing energy savings through project implementation and technical, educational, and financial assistance to firms that may not otherwise make energy efficiency investments

[3] A green-field manufacturing plant is a facility built on a site that was not previously used for manufacturing.

(Shipley et. al 2002). First developed in the 1970s as a response to the initial energy price shocks of that decade, energy efficiency programs have targeted industrial firms in addition to other sectors, such as residential and commercial buildings. The majority of these programs have focused on electricity only. This is primarily due to the fact that the electricity sector was the first supply sector to develop demand-side management efforts and integrated resource planning in response to imbalances of supply and demand. Energy efficiency programs became a significant part of these types of long-term plans in the 1980s (Jordan and Nadel 1993; Elliott 1995).

These programs were designed to help ensure that demand for energy did not outstrip supply. Though support and interest in such programs has waxed and waned (most notably in the late 1990s, when utility market restructuring eviscerated much of the utility energy efficiency program funding), interest in and funding for these programs has grown steadily since the latest energy crisis that emerged earlier this decade (Shipley et. al 2002; CEE 2008a; Eldridge et. al 2008). In 2008, budgets for such energy efficiency programs totaled $3.74 billion, a rise of 42% from 2006. About $1.45 billion of the 2008 budgets were specifically devoted to commercial and industrial programs (CEE 2008a).[4] Reliable data on the budgets for industrial-only programs has not recently been collected.

Today, energy efficiency programs are predominately financed by a pool of funds collected from small, mandatory, per-kWh or per-decatherm (DTH)[5] charges added to electric and gas distribution bills (Kushler et. al 2004). This funding mechanism is variously structured in different regions, but it is most often referred to as a “public benefits” or “systems benefit” fund. The funding is then used to pay incentives or provide technical assistance for specific energy efficiency or renewable energy projects administered by local utilities or other entities. Other utilities fund energy efficiency programs by rolling the expense of running the program into their overall expenses, and cover the expenses by including them in their rate calculations during rate cases. These are called “ratepayer-funded” programs.

Some energy efficiency programs are not funded either of these ways, and are instead administered as a marketing effort by a utility. These latter programs tend to be smaller (Elliott et al. 1996) and are not the focus of this report. Similarly, the federal government, through the Department of Energy, the Department of Commerce, and the Environmental Protection Agency, administers a number of programs that focus on manufacturing competitiveness, greenhouse gas reduction and energy waste reduction within the manufacturing sector. While these programs offer significant tools for reducing energy use in the industrial and manufacturing sectors, they also are not the subject of this report. All three of the above mentioned federal agencies, though, do at times provide tools and guidance for the public benefit programs discussed below.

Projects funded through public benefits funds or ratepayer funds are seen as public benefit projects because they serve to ease energy demand, decrease greenhouse gas emissions from fossil fuels, and potentially lower energy prices by avoiding the need to construct new generation and/or transmission assets, thereby benefiting the public as a whole. Usually every customer within a given customer class pays into the fund, which then is used to

[4] Note that these numbers are reflective only of members of the Consortium for Energy Efficiency which, though it represents the vast majority of industrial and commercial energy efficiency programs, does not represent the entire universe of such programs. Therefore, the numbers could be higher.

[5] A common measurement of heat used in the natural gas utility business. 1 decatherm = 1,000,000 BTUs.

finance energy efficiency and renewable energy projects for customers in that class. Some customer classes pay different amounts, dependent upon the types of services that are then offered to that particular class. In some cases, industrial firms can "opt out" of paying into these programs. In these cases, they agree to channel the money they would have otherwise paid into the public/system benefit fund toward energy efficiency investments or others types of energy investments in their own facilities instead. As discussed later in this report, this practice has increased over the past few years, and poses a particular challenge to the managers and administrators of today's industrial energy efficiency programs.

Several different types of entities administer today's industrial energy efficiency programs, including energy utilities, state public benefits fund programs, and regional market transformation organizations (York and Kushler 2003). State public benefits fund organizations, such as the New York State Energy Research and Development Authority (NYSERDA), are funded by the collected public/system benefits funds, while regional market transformation organizations, such as the Northwest Energy Efficiency Alliance (NEEA), are funded by regional utilities and energy planning entities. For the remainder of this report, we will collectively refer to public benefits- and ratepayer-funded programs simply as "publicly benefit energy" (PBE) programs.

There are currently seven main categories of program types targeted to the industrial sector in typical PBE programs (CEE 2006). Some are focused on capital expenditures, while others address operations and maintenance, or behavior. They are:[6]

- Training / education and awareness / general outreach,
- Technical assistance and auditing services,
- Prescriptive incentive programs,
- Custom incentive programs,
- New construction/renovation incentive programs,
- Standard performance contracting programs (also called "standard offer"),[7] and
- Other financial assistance programs.

Many programs offer a combination of several of these types of programs and provide support services along the way, so that when energy efficiency investments are made, the applicable funding mechanisms and technical support follow. In most cases, an initial assessment or auditing assistance is carried out first to identify whether opportunities for efficiency savings exist. Guidance toward specific funding mechanisms and support programs can follow, as can technical assistance and training to help implement the new investment or behavior changes.

Establishing an individual relationship between someone at the PBE efficiency program and decision-makers within the firm is one of the critical activities in which efficiency programs engage. Within a firm, budgets dedicated to energy investments must compete for funds with budgets for a multitude of other needs. Thus, the role of today's industrial program is often to help focus a firm on the unmet needs in their energy use and help firms translate

[6] A full description of these types of programs can be found in Appendix A.

[7] Standard performance contracting programs, or "standard offer" programs, are fully described in Appendix A. A standard offer program can generally be understood as an agreement between an energy efficiency program and an industrial customer to pay a per-kW and/or a per-kWh incentive for reduced demand and energy consumption due to the deployment of energy efficiency technologies or practices.

these needs to decision-makers within the firm (NAM 2005). A typical program will establish contact with at least one individual at the target industrial facility to build a relationship so that the focus on energy use can be ensured. This relationship is then often actively strengthened and leveraged to compel the firm to make more energy efficiency investments or make changes in employees' energy-using behavior.

Such a relationship can help especially in smaller firms, where there is no internal champion for energy efficiency already present. Small and medium-sized firms are defined in many ways, but a common definition for such firms is those that have either fewer than 500 employees or annual gross sales of $100 million or less. Industrial efficiency programs have historically experienced challenges in their efforts to address the needs of small- to medium-sized industrial businesses. These businesses present distinct and often unique cases to efficiency programs, and require more external support as managers navigate unique business needs or energy efficiency issues they may not have previously considered. In smaller firms especially, employees who would be most involved in making energy efficiency investment decisions are busy tending to other areas of the business and do not see energy expenditures as costs that they can actively address and reduce (Kleppert 2007). However, these firms present significant cost-effective efficiency potential, as many do not employ in-house energy managers who have identified all available opportunities (Shipley et al. 2002). As discussed later, industrial programs must actively seek out their smaller industrial customers, because they are the customers generally least aware of their energy efficiency potential.

The Present Challenge

As evidenced by the fact that a great deal of opportunity remains in the industrial sector for increased energy efficiency (Shipley and Elliott 2006), firms are not maximizing efficiency on their own. Realizing this opportunity is a complex endeavor, as both industrial energy efficiency program managers and decision-makers within industrial firms understand well. PBE programs have long focused on encouraging the industrial sector to make these investments, but their progress toward effective program designs has been limited. The majority of current energy efficiency programs specifically dedicated to the industrial sector have not achieved the potential for savings within the sector (Shipley et al. 2002).

As noted previously, budgets for energy efficiency programs are increasing in many regions, and many jurisdictions are being tasked with the development of industrial-focused efficiency programs for the first time (Sandhu 2008). As more utilities and PBE programs move to help their industrial customers achieve more energy efficiency, we believe a look at the past and current state of industrial programs could be useful to those interested in better serving their industrial sector's energy efficiency needs in the future.

The PBE program approaches that help promote, encourage, and assist energy efficiency investments in the industrial sector are as varied as the sector itself. While limited information exists about best practices in the design and deployment of industrial energy efficiency programs, industrial programs tend to craft and shape their industrial offerings in response to the immediate and apparent needs of their local manufacturing markets. This diversity creates a slew of location-specific programs that are sometimes difficult to translate as "best practices" to the industrial energy efficiency program community at large.

Still, some commonalities appear to exist among programs, offering insights into what approaches are effective. These similarities also mean that there exist collective

perspectives on the challenges inherent in any particular program approach, which can be useful to programs that are considering expanding into or augmenting a particular approach. What is ultimately apparent is that the most successful industrial programs are the ones that use a variety of tactics and channels to understand and meet their industrial customers' needs (Eskil 2008).

WHAT WE KNOW WORKS

From previous research, cited throughout this chapter, we have learned the attributes of industrial energy efficiency programs that generally lead to successful penetration in the sector. These are:

- Build and maintain lasting relationships with customers,
- Recognize the need for longer timelines and flexible services,
- Have partnerships in place to learn of new and expanding businesses,
- Coordinate multiple program offerings,
- Recognize the importance of behavior,
- Help firms understand the non-energy benefits of efficiency investments, and
- Provide follow-through assistance.

The list above represents our current understanding of industrial efficiency programs from existing literature. These elements can be thought of as a "wish list," applicable to industrial programs that have the resources and flexibility to develop an ideal industrial program. Many elements of program design are beyond the control of an individual program manager. Requirements and regulations promulgated by federal, state, and regional entities will certainly shape and impact an efficiency program to some degree. Finally, these above elements can manifest themselves in a variety of ways in any given program. In the next section, *Today's Industrial Energy Efficiency Programs*, we will discuss some more concrete examples of what's currently seen in today's efficiency programs.

Build and Maintain Lasting Relationships with Customers

Due to the varied characteristics of industrial firms, building lasting relationships with them in the interest of future energy efficiency investments requires a specialized and attentive approach that will necessarily vary from sub-sector to sub-sector. The specific attributes of each firm's place within its sub-sector, its supply chain, its own history, and its international market will influence how energy efficiency investments are considered and made.

Business owners and managers carefully screen their financial and business advisors, and they generally must feel comfortable doing business with someone before they allow that person into their operation. This is particularly true with their production processes, which represent the heart of their business. This need for trust is why it is critical that efficiency program managers and administrators develop personal relationships with business owners, and work hard to maintain those relationships for years. Industrial energy efficiency programs that hope to maximize energy savings across a wide array of industries and firm sizes will need to dedicate a significant amount of attention to the development and maintenance of those relationships. The most effective industrial efficiency programs have done just that, and have become stronger programs because of it. A well-integrated efficiency program representative can recognize an in-house "energy champion" (if one exists) and work across internal communication barriers. It is also important to develop

multiple connections within a company, so that the relationship could continue despite future staff changes.

Recognize the Need for Longer Timelines and Flexible Services

The time needed by firms to plan and expend capital investments can be significant. A large project will require an initial opportunity assessment, an analysis of the type of investment that should be made, the bidding out of the project to potential developers, and a process to determine the appropriate financing mechanisms. All of these steps must take place prior to the actual project deployment, which itself could take many months, factoring in the need to work around scheduled facility downtimes and reductions in facility utilization (Elliott et al. 2008).

Additionally, as noted earlier, energy efficiency investments are subject to plants' individual operational cycles, which might cause major capital investments to occur an average of every four to seven years. Some industries will have much shorter operational cycles, and others will have much longer ones. Particular industries will be hit harder by economic downturns or spurred by economic growth more than others. Successful industrial energy efficiency programs allow for flexible timelines to accommodate these different types of circumstances. This can mean that some firms will have periods when they are more in need of financing assistance than technical, and vice versa, depending upon their current state. To respond to this, having a suite of services that can appropriately serve firms at various times in their own cycles is important (Elliott et al. 2008).

Have Partnerships in Place to Learn of New and Expanding Businesses

As noted above, brand new facilities can offer the best opportunities for making new energy efficiency investments, since every aspect of the new business—the building envelope, the production process itself, and the equipment purchases—can be designed to maximize efficiency. Having no "sunk costs" in older capital equipment or dated production process designs leaves new facility managers with the freedom to consider all aspects of efficiency in the new facility. Some energy efficiency programs rely on utility customer service representatives to establish an initial relationship with industrial customers, and often the first point of contact between a new facility and the existing utility may not occur until the design of the facility is relatively advanced. In some cases, the first time a facility's energy manager speaks with a representative of the local utility, the facility is already being built. Programs that could have provided assistance to maximize a facility's inherent energy efficiency may not be utilized, locking in less efficient equipment and building design for years. Similarly, new firms that move into shell spaces and build entirely new production processes must develop a connection with their local energy efficiency program early in the development process in order to ensure that all possible tools to encourage maximum energy efficiency are used.

Existing relationships between industrial efficiency programs and economic development entities, real estate partners, and trade associations can facilitate conversations between an efficiency program and an incoming firm well before any ground has been broken. These types of entities communicate with firms about potential new facilities years before they are actually built. This is critically important, since the design of a new facility can begin to be set in stone years before the facility is built.

Coordinate Multiple Program Offerings

More mature industrial efficiency programs offer a suite of services to address varying needs of their customers at different stages of project development. The best of these programs fully coordinate all of their services, enabling a smooth transition from one to another when necessary. For instance, the New York State Energy Research and Development Authority's *FlexTech* program (Platt 2008) does this well by directly linking its technical assistance programs with a separate program that helps finance projects. Similarly, CenterPoint Energy's *Custom Rebate* program in Minnesota (Kline 2008) closely partners with its Engineering Assistance program, to directly link the energy assessment that identifies a savings opportunity with the investment that addresses it.

Some industrial energy efficiency programs have long taken a comprehensive and holistic approach to the development and deployment of industrial programs, in response to the unique nature of the industrial sector, but these programs were few and far between (York and Kushler 2003). Industrial buildings and campuses themselves can present myriad opportunities for efficiency improvements, as do the processes within. Looking at these types of opportunities simultaneously could increase the marginal utility of every dollar spent on energy efficiency, as administrative overhead and other costs of a combined approach can be lower than the cost of using one unique program at a time.

Recognize the Importance of Behavior

Since a good degree of efficiency can be achieved just by changing behaviors within a firm, efficiency programs can achieve greater savings when they work to alter internal behavior and leadership, beyond simply encouraging one-time investments. When firms and individuals within them recognize that reducing energy use is an effective strategy for reducing risk, saving money, and establishing themselves as "forward-thinking" corporations, they can act as advocates for efficiency beyond their own facilities and into their sub-sectors or geographic regions (NAM 2005).

Some program approaches, such as rebates, effectuate one-time changes, but do not always have a long-term impact on customer behavior (Shipley et. al 2002). Energy management programs, and other programs that attempt to internalize energy-related choices in institutions and individuals alike, can better lead to market transformation since an employee may go on to work at multiple firms or plants in his or her career. An energy management program in place at a single facility has the ability to reach many employees. Encouraging individuals to think about their energy-using behavior in the workplace can do much to influence their role as energy consumers throughout their lives (Hamann and Lloyd 2007).

Help Firms Understand Non-Energy Benefits of Efficiency Investments

Firms have to justify energy efficiency investments using a valuation mechanism, as noted earlier. If the potential investment will not generate enough savings or revenue to meet a specific firm's internal requirements, it will not be undertaken. Firms that make energy efficiency investments reap many benefits, beyond simple energy savings. Indeed, one study of 52 energy efficiency investments found that when those additional non-energy benefits were monetized and factored in, calculated payback for an investment dropped from 4.2 years to 1.9 years (NAM 2005). Firms generally look more favorably on a project with shorter payback periods, and PBE programs are perfectly situated to help firms

consider and calculate the non-energy benefits associated with efficiency investments (Elliott et al. 1997).

Provide Follow-Through Assistance

As noted in a previous assessment of effective efficiency programs, help with the follow-through of planned efficiency investments, including proper employee training and equipment startup assistance, is critical to maximizing the long-term savings of a project (Shipley et. al 2002).

TODAY'S INDUSTRIAL ENERGY EFFICIENCY PROGRAMS

To assess recent developments and trends in industrial energy efficiency programs, ACEEE undertook a review of industrial energy efficiency programs throughout the U.S. and Canada to assess current industrial energy efficiency programs trends, and identify which strategic approaches are proving most effective. While a significant amount of historical information about industrial energy efficiency programs exists, most of the information dates from the 1990s. Therefore, we felt it would be timely to revisit these programs, and explore the lessons learned by the newer programs in the field. The time for this review seemed particularly ripe due to the increased focus on efficiency savings that has occurred on the state and provincial level in the last few years.

The first challenge to this research was data collection. Data on the funding of industrial energy efficiency programs and energy savings in the U.S. is generally collected and reported to regulators by program managers. However, little disaggregated information is publicly available on the various program types or the details of programs operations. Such information is not often required for reporting purposes. Thus, a major thrust of the ACEEE research was to gain an understanding of the internal organization and structure of these programs.

The goals of our research were to:

- Determine the current and emerging trends within industrial energy efficiency program administration,
- Develop an understanding of the unique challenges facing new and young programs,
- Assess how industrial programs are responding to the current economic recession, and
- Explore how self-directed industrial efficiency programs are structured and managed, and how successful this approach is proving.

To meet these research goals, ACEEE conducted primary and secondary research. The primary research collection was done via survey, which was conducted by telephone and e-mail between July 2008 and April 2009. The survey gathered detailed qualitative information on 30 industrial-focused programs.[8] The primary respondents to the survey were the individuals at each targeted energy efficiency program responsible for the day-to-day management of industrial PBE programs. Respondents' official titles included "Industrial Program Manager," "Industrial Sector Manager," and "Energy Efficiency Program Manager,"

[8] The basic survey instrument can be found in Appendix C.

among others. ACEEE also compiled secondary data via a review of individual program Web sites and publicly available information from the Consortium for Energy Efficiency (CEE 2008b), energy efficiency-focused conferences, and information from prior ACEEE research.

The survey covered both Canadian and American programs, and programs both new and well-established. Programs of varying sizes and scopes were surveyed as well. The requirement to be included in the survey was the existence of a distinct industrial focus, separate from, for example, a commercial buildings program. The survey was largely qualitative in nature, asking respondents to gauge their own program's successes and challenges and discuss their program's scope at length. Success was, of course, defined differently by each respondent. The subjective nature of the responses were illuminating, and helped to identify particular aspects of programs that could not be easily described in more objective, quantitative terms.[9] A follow-up survey, collecting additional quantitative data, is suggested as a next step, and discussed later in this report.

Clear trends emerged that indicate industrial programs are quite dynamic, learning from and responding to their customers as they seek new savings across the industrial sector. As will be discussed, ACEEE feels there is substantial room for improvement among industrial energy efficiency programs, but most improvements already exist in some implementation of current industrial efficiency programs. Certain programs are aggressively leading the way and establishing best practices that can prove useful to newer programs or to programs looking to achieve an expanded reach or savings target.

Emerging Trends in Industrial Energy Efficiency Programs

While industrial programs have long used creative and innovative means to address their customers' needs, the survey and additional research shone light on some new trends. We define some of these as "trends" because of a noted increase in their use since previous studies. Others were considered "trends" by virtue of the fact that multiple programs were putting more resources or efforts into that particular approach. Many of these trends have been implemented in some form for several years, but have recently been more widely adopted, as industrial programs respond to rising efficiency goals and requirements set by regulators and legislatures.

Most of the respondents to the survey have been involved in the energy efficiency field for over five years, and were able to comment on the discrepancies between their programs today and industrial programs of the past. As a result they were in a position to highlight specific trends and shifts within their own programs, which, collectively, painted a broader picture of the trends in programs across the U.S. and Canada. The implications of these findings will be discussed in greater detail in the following section of this report.

Eight specific trends were identified in the survey. They are the emergence or growth of:

- Energy manager/management programs and employee behavior programs,

[9] Respondents were told that certain information could be "off the record" if desired, thus allowing program managers to speak candidly about the shape of their programs, as well as the concerns they had for the future of either their program or their local industrial sector at large. Some of this information is represented in the report's findings, but it is not directly attributed to a specific program if the respondent requested anonymity.

- Targeted industry sub sector-specific outreach and program deployment strategies,
- Natural gas efficiency programs,
- Coordination of industrial efficiency programs with regional energy efficiency efforts,
- Multi-stakeholder goals,
- Custom incentive programs, and
- Workforce challenges for programs.

We discuss each of these items in the sections that follow.

Energy Manager/Management and Employee Behavior Programs

For ACEEE's research purposes, energy manager and management programs are broadly viewed as those that support an actual individual or an internal organizational management structure responsible for paying attention to and advocating for the energy efficiency opportunities within a given firm or facility. Energy manager programs focus on identifying and empowering an individual to be the actual energy manager onsite, while an energy management program looks to integrate energy-saving actions into a firm's or facility's overall management structure. Many of these programs are based upon existing energy management or quality control standards. Examples of energy management standards and programs include the International Organization for Standardization's forthcoming *ISO-50001*[10] standard for energy management, the *Superior Energy Performance*[11] plant energy efficiency certification, the *Six Sigma* quality management strategy, and the federal *ENERGY STAR for Industry*[12] program.

Many of the PBE programs surveyed indicated that they recently added training of in-house energy managers to their list of technical assistance offerings, or were thinking about doing so in the near future. In an energy manager program, the selected energy manager may address energy-using behavior within a facility or firm, and can serve as a liaison to the energy efficiency program. Sometimes the energy manager will have energy management as his or her full time job, while in other cases a person will be tasked with encouraging energy management in addition to other tasks. Much of this is dependent upon the size and needs of a given firm. Some programs will help to financially support such a manager through a cost-share program, savings guarantee, or similar mechanism.

One such program was originally developed at BC Hydro and recently considered by the Ontario Power Authority. The program employs an energy manager, through a cost-sharing mechanism, for large energy users, paying no more than 80% of the cost of hiring an internal energy manager. The program is unique in that it allows multiple firms to share an energy manager. This aspect enables smaller facilities to enjoy the benefits of an energy manager without the need to fund an entirely new full-time employee. This particular program also allows a trade association or similar aggregating entities to apply for an energy manager and then share the manager with the associated or member firms (Smith 2008). A similar program is running at Enbridge Gas Distribution (Hayashi 2009).

[10] See http://www.iso.org/iso/iso_catalogue/management_standards/specific_applications/specific-applications_energy.htm for more about the ISO 50001 standard.
[11] See http://www.superiorenergyperformance.net/ for more about the Superior Energy Performance program.
[12] See http://www.energystar.gov/index.cfm?c=industry.bus_industry for more about the ENERGY STAR for Industry program.

Energy management can extend beyond just energy decisions made at a single facility. This type of energy management program approach integrates energy management priorities into existing corporate leadership priorities to stretch across facility or even state lines. Such an approach is especially effective in larger firms with multiple facilities and a common management platform, where no single person is responsible for advocating for company-wide energy efficiency.

The federal government's *ENERGY STAR for Industry*[13] program and the *Green Suppliers Network*[14] work to encourage internal energy managers to look beyond their own facilities to those of the rest of the firm, supplier companies, and even customer companies. These kinds of supply chain-wide efficiency efforts are in line with other types of non-energy partnerships entered into by industrial firms looking to maximize economies of scale in distribution and purchasing (NAM 2005). This approach has been successfully used by DTE Energy for many years in conjunction with its automotive customers (Elliott et al. 1996).

These energy manager/management programs go hand-in-hand with an increased emphasis on behavior-focused energy efficiency efforts. As noted earlier, a significant portion of potential savings in the industrial sector can be achieved merely by changing employee behavior, separate from making new equipment investments. In recognition of this fact, several of the surveyed programs are expanding and establishing distinct behavior-focused initiatives specific to the industrial sector. When large firms adopt energy management programs, or work to leverage existing corporate sustainability programs to extend to energy usage, they are very often working to implement smarter energy-using behavior across all its facilities and employees. These types of initiatives are often led or envisioned by executive-level leadership. Such high-level leadership is usually required in order to garner the requisite buy-in from all employees. These programs seek to create an awareness of the importance of energy efficiency among all employees, almost always first focusing on energy efficiency at home with the express intent that the change perspective will create an increased awareness in the workplace (Ehrhardt-Martinez et al. 2009).

While such behavior efforts supported by PBE programs are fairly new, these programs have a long history within larger companies such as Dow Chemical (Lovins and Lovins 1997) and 3M (ASE 2009). Many industrial firms have historically focused on energy-saving behaviors through operation and maintenance ("O&M") programs, but have done most of this work outside the scope of PBE programs. Firms have focused on O&M and other behavior-focused improvements for the financial savings, safety improvements, and production quality enhancements such efforts can yield. While few mature PBE-funded behavior-focused programs appear to exist in the industrial sector at this point, what the survey uncovered was a general consensus that more strongly addressing employee behavior among industrial firms would be necessary in order to achieve future savings goals by PBE programs.

Puget Sound Energy expanded their Resource Conservation Management program to their industrial sector customers, encouraging a suite of utility-saving (electricity, natural gas, water, sewer, etc.) behaviors. While this program is indeed a type of energy management program, the utility has specifically viewed it as a way in which to alter internal behaviors firm-wide (Younger 2009).

[13] See http://www.energystar.gov/index.cfm?c=networking.bus_networking_supply_chain for more on the ENERGY STAR program's Supply Chain Working Group.
[14] See https://www.greensuppliers.gov/gsn/home.gsn for more about the Green Suppliers Network.

For some PBE programs, energy management programs offer a tool they can use with customers who may currently be unwilling or unable to make large capital investments. At the Energy Trust of Oregon, the focus on energy management programs has, in part, been emphasized by the program's staff recently due to the fact that changes in operation and maintenance and other behavior-based activities can be done to a large extent with minimal capital investment. As companies find themselves unable to secure financing for large capital investments, O&M and behavior-focused programs in general could be viewed as increasingly useful tools in a PBE program's toolbox (Light 2009).

Industry Sub-Sector-Specific Outreach and Program Deployment

Increasingly, as industrial efficiency programs mature and develop a deeper understanding of their customer base, certain industries are identified as being well-suited for specialized, focused programs of their own. In some cases, industries are identified and targeted based on the fact that they represent a large percentage of system load. In other cases, industries are targeted because a utility or other energy program has a pre-existing relationship with an affiliated trade association or other entity, helping to foster a connection (Kline 2008).

A program with an industry-specific focus, wherein industrial clients are grouped and targeted by industry sub-sector, usually holds a specific employee responsible for that particular industry. This individual can then focus on developing relationships, attending relevant industry meetings and events, and becoming familiar with target firms and markets. At CenterPoint (Minnesota), PG&E, Enbridge, and Wisconsin Focus on Energy, targeted "markets" are well-known by the efficiency programs that serve them, because experts in specific fields have been hired by these programs to be their go-to resource for firms looking to better understand and control their energy efficiency (Kline 2008; Dugger and Ong-Carillo 2009; Hayashi 2008; Schepp 2009).

Some programs assign multiple industries to one staffer, or assign the largest industry to one staffer. In this way, firms know they have a real, recognizable person to call if they have a question or concern; they develop a working relationship with the individual, who in turn tracks the status of all of the projects the efficiency program is concurrently administering within a firm. This provides customers with continuity and the assurance that they will not need to reintroduce themselves and their firm each time they seek assistance from their local efficiency program.

A benefit of the industry-specific focus is that an individual tasked with a particular industry will become familiar with all of the investments each firm is making within the industry. When the program representative comes across a new challenge, it is easier to suggest a certain product or service if the case can be made that it has worked previously for a firm within the same industry. Firms are interested in their competitors' activities, and respond positively to information about successful projects at similar firms.

Most of the survey respondents with sector-specific programs noted that they combine their sector efforts with their generally older technology or end-use-focused energy savings efforts (e.g., motors, lighting, or compressed air). Many people refer to this approach as "cross-cutting," with programs at Xcel Energy, Efficiency Vermont, and Wisconsin Focus on Energy implementing this cross-cutting approach (Gunderzik 2009; Gaherty 2009; Schepp 2009).

Natural Gas Efficiency Programs

As noted earlier in this report, natural gas represents a significant portion of the average industrial firm's energy consumption. While energy efficiency programs have traditionally targeted primarily electricity consumption, a growing number of utilities and state public benefits fund organizations are now also targeting natural gas. U.S. budgets dedicated to natural gas energy efficiency programs at utilities and public benefit fund organizations have been rising rapidly in the last few years, with much of that growth found in the commercial/industrial sectors (CEE 2008a; Witte et al. 2009).

The rising spending on natural gas programs reflects new programs being started to address natural gas use, and new spending by existing programs to meet expanded program needs. National Grid has recently established and expanded new natural gas offerings, while other existing programs, such as PG&E, Vermont Gas, and CenterPoint (Minnesota), have recently ramped up their outreach efforts to meet new and higher savings targets (Dugger and Ong-Carrillo 2009; Harrington 2009; Kline 2008). Many of the natural gas programs surveyed noted concern about impending rising savings targets, and were worried that their programs would not be able to meet the targets despite their best efforts.

Coordination with Regional Energy Efficiency Efforts

An increase in the industrial-focused efforts of regional efficiency organizations can be found across the country. These regional entities, often funded by multiple utilities and other efficiency stakeholders, are able to dig deep into market transformation opportunities that utilities or government entities are unable to address. These organizations leverage the knowledge and experiences of a variety of partners, bringing together a wide variety of stakeholders, which, in turn, enables wide-reaching programs to succeed. PBE programs work hand-in-hand with these kinds of regional efforts to best meet their customer's needs.

The efficiency goals and support program developed by the Northwest Food Processor's Association (NWFPA), in conjunction with the regionally-focused Northwest Energy Efficiency Alliance and other partners, offer a compelling case for the use of regional partnerships to tackle energy use activities across an entire sub-sector. NWFPA leveraged funding from the State Technologies Advancement Collaborative (STAC)[15] and resources from the U.S. Department of Energy's (DOE) *Save Energy Now* program to establish a customized program dedicated to the unique needs of the northwest region's food processing industry. The industry collectively committed to a 25% reduction in energy use over the course of the following ten years, and NWFPA developed a range of online tools, workshops, and other resources for the participating firms (Dias 2008).

In some cases, the development of regional industrial energy efficiency leadership is so new that the programs are only just beginning to take flight. Both the Southeast Energy Efficiency Alliance (SEEA) and the Southwest Energy Efficiency Project (SWEEP) recently launched industrial efforts. SEEA developed an industrial leadership group to serve the region, holding a daylong gathering of individuals representing a multitude of interests. Participants included energy-intensive industrial firms, local utilities, the energy offices of the states in involved, and myriad DOE partners. These stakeholders agreed to the formation of a coalition to address industrial energy efficiency issues that they deemed worthy of their joint

[15] See http://www.stacenergy.org/about/index.htm for more about the State Technologies Advancement Collaborative.

attention. The coalition intends to operate as a consensus organization, enlisting a number of subcommittees to address both policy and technology issues (Taube 2008).

Similarly, SWEEP and the Colorado Energy Office are launching an industrial energy efficiency initiative this year, in response to a request embedded within the *Colorado Climate Action Plan*. This voluntary effort would ask industrial companies to set energy intensity reduction goals and engage in "all cost-effective energy efficiency projects." The plan also includes resources for technical assistance and an effort to recognize the most notable participants. SWEEP intends to support similar efforts in the other states it serves as well (SWEEP 2009; Geller and Goldberg 2009).

Multi-Stakeholder Goals

Because energy security, climate change issues, and general environmental concerns have begun to influence federal, regional, state, and local energy policies and programs, energy efficiency program managers have been tasked with a multitude of goals and objectives. Some are developed in-house as a means of encouraging the program to accomplish more, but many are developed externally by utility regulators or legislative bodies setting efficiency goals, environmental goals, energy security goals, and climate change-related goals in an attempt to mitigate the negative impacts of energy use and to reduce the need for additional sources of energy generation. Consequently, many program managers indicated in the survey that the goals they are now facing are more numerous and more difficult to achieve than in many years past, and are set by a wider array of entities.

In response to new goals in Minnesota, CenterPoint Energy has commenced a market assessment with other area utilities to help identify new ways to achieve customer savings and eliminate barriers to savings (Kline 2008). In response to new savings goals and funding for industrial programs, NYSERDA has dedicated additional funds to securing a partner to help increase outreach to its industrial customers (Zweig 2009). Many of the survey respondents noted that they did not believe that their regulators fully understood the degree to which new savings goals were posing a challenge to their programs. Furthermore, several programs encouraging efficiency and sustainability are operating in the same service area and with similar savings objectives, presenting additional challenges to industrial program managers.

For example, in the Pacific Northwest region, multiple entities are working together to achieve energy savings and advance market transformation in the industrial sector. A variety of utilities help administer efficiency programs in conjunction with the Bonneville Power Administration, which works closely with NEEA. NEEA, in turn, is a partner of the Energy Trust of Oregon, which collaborates with the Oregon Department of Energy. The entire region is guided by power plans developed by the Northwest Power and Conservation Council, and is served by an industrial assessment center, which is sponsored by the US DOE and operated out of the energy program at the University of Washington. Meanwhile, at the state level, Washington, Idaho, and Oregon all have their own sustainability goals, as do a large number of their counties and cities. Some of these goals are codified as targets for energy efficiency, others for carbon emissions reductions, and still others as simply a collection of state incentives and services designed to reduce energy consumption. In addition to these goals, the Western Climate Initiative calls for voluntary greenhouse gas reduction efforts in both Washington and Oregon (NWPCC 2009; WCI 2007; NEEA 2009).

Similar amalgams of complementary and competing energy-related efforts can be found in nearly every corner of the country. It is no wonder, then, that at least half of the survey respondents noted the increased difficulty of operating within multiple programs with disparate goals. With several programs functioning in the same region, it can be difficult for program managers to effectively reach out to their industrial customers through the din of so many other marketing and outreach efforts.

Custom Programs

The past decade has seen an increase in customizable programs (York and Kushler 2003), which was also reflected as a continuing trend in the survey. Programs have become more responsive to very specific customer needs, and as programs mature and familiarize themselves with their customers, further opportunities for customized approaches can appear.

While narrowly-focused prescriptive programs remain integral components of many industrial energy savings efforts, a general trend towards increased flexibility can be seen in a variety of programs. These more flexible services take several forms and seem to exist primarily in well-established and mature programs that possess an intimate understanding of their customer base. Nearly every survey respondent with a program older than a few years indicated that some form of custom industrial incentive program was available to customers. A near universal consensus was that, while custom programs tend to be more expensive to administer, they are the best way to reach the industrial sector and help industrial customers meet their most complex needs. Though these programs cost more and require greater resources to administer, they can often achieve savings that prescriptive programs cannot. Conversely, prescriptive programs are ineffectual at achieving savings outside of their particular technology--based scope. Industrial customers with needs outside of this scope are thus not adequately served by prescriptive programs.

Workforce Challenges for Programs

Staffing continues to be a difficult challenge for a number of programs. About half of the survey respondents indicated that they had a very difficult time filling vacant program positions and finding individuals qualified to serve as program administrators. Several respondents noted that it was difficult to find individuals who could learn the technical aspect of the job as well as the customer service skills necessary to be successful (Kline 2008; Eskil 2008). Further, at least five programs said that they had difficulty finding qualified people with appropriate engineering backgrounds, and that their needs to expand their programs could, in the future, be hampered by this challenge.

This challenge is also manifested in the resources that PBE programs are given in order to staff their outreach and technical assistance efforts. Several programs indicated that they have been encouraged by their regulators or their management to use external, contract employees when possible, because hiring in-house staff is viewed as more expensive. The implications of this will be further discussed in the next section of this report.

Conclusion

A variety of growing areas of effort among industrial energy efficiency programs emerged through the new research ACEEE has conducted in the past year. Most of these trends can be seen as responses to the increasingly complex needs of both the targeted industrial

sectors served by these programs and the increased energy and climate-related goals that are being developed as legislative leaders and the general public become more aware of the role that energy efficiency can play in meeting near- and longer-term energy and climate-related challenges.

MAKING TOMORROW'S INDUSTRIAL PROGRAMS BETTER

A review of previous literature and the findings from our primary research indicates that industrial PBE efficiency programs are constantly improving and appear to be better meeting the needs of their industrial customers than in the past. The growth of industrial energy efficiency programs is heartening, as a tremendous amount of energy savings is available in the sector as noted earlier. In this section, we will discuss the findings from our research and give recommendations on how these findings might be interpreted by an industrial efficiency program. A special section is included, discussing important lessons for new and expanding programs, as well as a detailed discussion of self-direct programs, which are becoming more common in states across the U.S., though not in Canadian provinces.

Based on the responses to our survey, it appears that many of the new and emerging trends can be linked to an increased awareness and responsiveness to a program's client base. Much of the funding for the expanding programs and new program elements is a result of the increased funding for energy efficiency in general that has been prioritized by state-level leadership. To date, 19 U.S. states have instituted energy efficiency portfolio standards, which generally require that a certain portion of each of the local utility's sales be provided through efficiency investments instead of new generation (Furrey 2009). As we have seen a rise in these kinds of standards and other supportive efficiency policies, industrial efficiency programs have clearly been seen as critical to finding and achieving energy savings in the industrial sector, where significant savings opportunities exist.

Many of the trends identified in the previous section reflect a general movement toward greater program flexibility. This flexibility can be found embedded within individual program approaches to their customers as well as in the program leadership itself, as programs respond to the multiple goals associated with both energy use and climate change. To a large degree, such flexibility is a result of leadership among regulators.

The trend toward energy management and behavior-focused programs by PBE programs can in some ways be viewed as a response to the deeper energy savings that reside in people's actions, and the need to create flexible programs that can be seamlessly grafted onto existing internal operations of any given company. Programs that look to address how energy is used, managed, and understood by people in a firm will, by necessity, need to work within the confines and constructs of a firm's day-to-day operations. This is a more nuanced and flexible approach to achieving energy efficiency than, say, offering incentives for the deployment of a certain type of technology that may or may not be an appropriate fit for a company. A flexible and expert consultant who is highly responsive to specific customer needs visits, and just happens to be paid for by the local utility. This comes across more like a private sector service and less like a heavy-handed government-sponsored program that some firms loathe.

The beauty of program-supported energy managers and corporate management programs is that these in-house or outsourced managers can also play a larger role in firm-wide sustainability efforts, which have, in many cases, received increased funding at the corporate level (Deutsch 2007). At Puget Sound Energy, the Resource Conservation

Program helps to fund an in-house manager, but extends the coverage of the individual beyond energy, to water, sewer, and solid waste issues (PSE 2009). The program not only helps finance an individual employee, but also provides resources such as accounting software, training, technical assistance, and assistance in developing company goals (Younger 2009). This kind of forward-thinking, broad program appears to be structured to maximize corporate buy-in. It structures and markets itself as a suite of tools supporting the kinds of activities the companies really ought to already be thinking about.

The same degree of personalized attention can be said about the higher number of sub-sector-specific outreach efforts that can be found among the surveyed programs. A deeper understanding of a program's customer base allows a program to respond to needs that are very specific to a sub-sector or market. This also brings a new degree of flexibility to the program, as the individual program personnel responsible for working with a certain sub sector often identify new needs and work to shape possible solutions specific to that sub-sector (Kline 2008; Schepp 2009).

Similarly, custom programs are inherently more flexible than prescriptive programs, and are more flexible in their response to customers' needs. While some of the newer programs have not yet developed custom programs, the more mature programs have been able to develop custom programs that they can take into the specific markets of their target areas.

We appear to be seeing this general trend toward more flexibility because growing savings goals require that industrial programs become more creative and find savings in areas that have proven hard to address with more simplistic, prescriptive program strategies. It is important to note that over half of the surveyed respondents indicated that their custom programs more effectively find and achieve energy savings than do their prescriptive programs. This observation should suggest to regulators that allowing their industrial energy efficiency program providers the freedom to be more responsive to their customers' needs, and providing them the resources to run more complex programs is critical to achieving all the possible savings in the industrial sector.

Related to these trends, several programs indicated that they were either implementing, or were hoping to soon implement, programs that allowed for longer timeframes between when a customer becomes eligible for a program and when the eligible project is actually completed. Southern California Edison is one program that features a codified three-year funding cycle in its industrial program (Lau 2009). Other programs' allowances for longer timeframes may not be so clear, with projects longer than one year requiring a special contract agreement to allow for the incentive or technical assistance to be stretched further, while other programs do not allow such long projects at all. As noted earlier, industrial companies can be in a variety of positions within their own capital investment cycle, and may not be ready to make a major investment for several years down the road. They may also need a significant amount of time to approve the investment internally, which, added to the time a complicated capital investment takes just to plan, purchase, and install, can well exceed one year.

There were some new developments in the natural gas arena specifically. The recent increase in the number of natural gas energy efficiency programs and corresponding natural gas savings goals may have been in part a response to the natural gas supply concerns after Hurricanes Katrina and Rita in 2005. The federal government itself committed new resources post-hurricanes in its expanded *Save Energy Now* program, and customers reeling from the high prices worked to curb their use of the fuel (Elliott et al. 2008). As

greater energy efficiency savings targets have been developed on the state level, natural gas savings targets are playing an increasingly important role in reducing all energy consumption in any given state.[16]

The research identified a few challenges worth noting. Efficiency programs administered by multiple entities stretch across organizations, time, and geography, as mentioned earlier. Some program managers noted that the savings their programs helped achieve cannot be credited to their programs for regulatory purposes, since they may not officially administer a particular program, but merely supply support services. Survey respondents also indicated that it was becoming more difficult to "claim" energy savings on behalf of their programs in the face of so many other programs.

One of the biggest unmet needs expressed by survey respondents and supported by other recent ACEEE research is the growing challenges that programs face in attracting and retaining workforce with industrial experience. About one-third of respondents noted workforce concerns as their biggest upcoming challenge, as individuals with specialized training and experience relevant to their industrial program needs are harder and harder to find. There are two basic categories of skills required in industrial energy efficiency program staff: the ability to conduct the administration, marketing, and outreach of the program; and the ability to use efficiency expertise to address more complicated engineering and technical issues. Some of the larger industrial efficiency programs actually split these two types of skills into two separate positions, though smaller programs have to hire people that can do a little of both. When programs must combine those functions due to limited resources, program managers report finding it very difficult to find individuals who have both the appropriate engineering and customer-service skills.

This perceived lack of adequate workforce for the energy efficiency sector was echoed by participants at the *2008 ACEEE Summer Study on Energy Efficiency in Buildings*. The Electrical Industry Training Institute, which provides training services to North American utilities, has noted an increasing need for training in demand-side management (DSM) applications, and has responded by expanding its curriculum to better meet the staff training needs of its utility customers (Sandhu 2008).

One of the concerns such a workforce challenge brings is that more programs seem to be looking to third parties to provide the services that their in-house staff cannot. While some programs, such as Wisconsin Focus on Energy, have long successfully used third-party providers to provide much of their services and outreach to the targeted industrial sector, others are feeling forced to use third-party service providers simply because they are cheaper in some cases than hiring in-house staff. Some program managers felt that this outsourcing is a somewhat disturbing development, because they feel that their industrial clients could be better served by hiring in-house staff. Further, as an industry, energy efficiency is growing, and some programs need to build their internal capabilities significantly to meet future savings challenges. Outsourcing that work could, in some instances, prevent the utility or public benefit fund organization from building the institutional knowledge that will be useful as the program grows and matures over time.

The challenge of finding and hiring appropriate workforce is exacerbated by the fact that many program managers are actually competing with their own industrial customers for

[16] For more detail on specific states, please refer to ACEEE's online database of Utility Sector Policies, available here: http://aceee.org/energy/state/policies/utpolicy.htm.

talented engineers. What is clear is that there is more demand for such talent than there are talented people to fill these roles. Historically, the DOE's Industrial Assessment Center program has helped fill the pipeline of potential program staff, and other university-based educational centers that focus on industrial energy efficiency have helped significantly in producing adept engineers. But even those graduates are not enough to meet the need. A current proposed expansion of the IAC program, supported by ACEEE, would go a long way toward helping produce more talented individuals to staff PBE programs (Trombley et al. 2009).

A Special Consideration: Current Economic Conditions

In these uncertain economic times, many program managers wonder how it is possible to convince manufacturers to make any capital investments, let alone energy efficiency investments. The situation today is quite different from the situation the industrial sector faced in recent memory. Over the past few years, fundamental shifts in energy markets, energy regulation, and carbon reduction-related energy costs have all increased the incentive for industrial firms to seriously consider making energy efficiency investments, separate from any macroeconomic considerations.

In the near term, the energy efficiency investment outlook in the industrial sector appears rather bleak. Multiple programs noted that the recession was already having a pronounced affect on their ability of their industrial customer to make efficiency investments, and nearly half of the programs surveyed noted that the recession would very likely negatively impact their ability to achieve program-led savings (Kline 2008; Ahmadzai 2009; Knight 2009; Schepp 2009; Dugger and Ong-Carillo 2009). This challenge is in addition to the rising energy savings goals that many of the same programs are already struggling to meet.

As consumer demand returns, it will be critical for energy efficiency program managers to know when their industrial customers are in a position to begin making investments again. As the U.S. manufacturing sector looks to emerge from the current recession and position itself as a more viable, cleaner alternative to global manufacturing competitors, the role of industrial energy efficiency program managers will be critical, and resources to help aid in their success should be a priority when lawmakers and regulators are considering how to achieve energy savings and carbon reductions.

Conclusion

Today's industrial energy efficiency programs are facing new savings challenges and must identify deeper savings in existing customer bases in order to satisfy the savings goals regulators and lawmakers have set forth. At the same time, new challenges to the programs, particular those surrounding workforce needs and the current economic recession, will increase the near-term burden on industrial programs. Regulators and lawmakers would do well to understand that in order to succeed, industrial programs will likely require greater resources and the freedom to be flexible in their approaches to the industrial sector.

STARTING A NEW INDUSTRIAL PROGRAM

There are many areas of the country that are, for the first time, developing some type of PBE industrial energy efficiency programs. While the future managers and administrators of those programs were not targeted in this research, there was enough information gathered from our surveyed existing programs to put together a list of important considerations when

starting a new industrial program. What follows is a list and discussion of critical lessons learned by existing programs that new and emerging programs may wish to consider. These lessons are:

- Get to know your customer,
- Help your customer get to know *you,*
- The importance of persistence and trust,
- Start with assessments—and build internal capacity to do more,
- Identify internal champions, and
- Don't overlook small companies.

Get to Know Your Customer

The most important element of any successful industrial energy efficiency program is a clear understanding of the customer. Every fledgling energy efficiency program must first ensure that the industry to be served is well-defined, described, and understood. In industrial programs these needs are more critical, as the diversity of the sector requires specific nuances to be catalogued in every industry. Program managers and designers should know whether area food production firms are engaged in heat-intensive packaging processes of commodity items, or if they are producing ready-to-eat meals that require little packaging but extensive refrigeration. Program managers should know whether local steel mills engaged in the production of steel are using scrap metal or if they are creating steel from iron ore, which is more energy-intensive. Program managers should know whether the local wood furnishings firm is preparing for an expansion into new product lines and facilities, or if it's conserving cash and considering a future reduction in workforce. Knowing this kind of information helps an industrial program better sell its products and better understand what a particular firms' needs are at a particular time. A targeting study that focuses on profiling these key industrial customers and their relationships can prove an important foundation for this program development (Eldridge et. al 2008; Rufo et. al 2008).

In its beginning stages, Wisconsin's Focus on Energy industrial program asked detailed questions of its most energy-intensive industries to learn about opportunities for energy savings in each industry. Once its key, major energy-consuming industries were identified, Focus on Energy assembled industry-specific stakeholder groups consisting of "industry experts" to help hone in on the unique energy issues and opportunities in each industry. These groups included corporate managers and engineers with knowledge specific to the target industries. Focus on Energy referred to each industry-specific group as a "Cluster," and designated a "Cluster Leader" and "Cluster Engineer" for each industry. These two leadership positions were given to individuals possessing extensive experience in the management or technical issues germane to each industry. Among other things, each Cluster reached out to and included additional stakeholders such as trade associations and other industry leaders to build a larger industry-specific network. That network was leveraged continually to gain more knowledge about the industry, develop joint research activities, disseminate program information, involve external experts, and invest in joint deployment activities (Schepp and Nicol 2007). Developing a strong channel for the collection of feedback is one of the simplest ways to ensure that programs are not operating inside a vacuum.

Deep knowledge of an industrial customer base is gleaned over time, and as programs grow, mature, and reach new customers, this body of locally-specific knowledge becomes

richer. The survey clearly revealed the degree to which older industrial energy efficiency programs are familiar with their customers. The majority of respondents could quickly refer to multiple projects or potential projects by company name, sector, and particular energy challenge or need. But this was clearly a strength found to a greater degree in the more established programs.

Help Your Customers Get to Know You

Before being able to convince firms to accept free or subsidized services, program managers must market their program, assuring potential customers of its value, dependability, and efficacy. Our survey indicated that there is still work to be done among mature existing programs as well as for newer programs. A majority of respondents acknowledged that their programs could be better marketed and/or made more accessible to customers. Efficiency programs must present themselves to customers, gain exposure, and make themselves easily accessible and clearly available (Shipley et. al 2002).

A recent anecdote clearly illustrates the importance of proactive outreach. A Michigan-based manufacturing company indicated to the authors that they were interested in their local energy efficiency program, and had a number of potential energy efficiency projects that they figured would be good fits for their local PBE program's industrial incentive programs. However, the company had a very difficult time determining which projects might be attractive to their local PBE, what kind of timeframe they needed to work within, and how the incentives themselves were actually structured. They also were unsure how confident they could be that a proposed project would be approved, and were wary of the paperwork involved in the project applications without knowing whether their projects might be funded. Though an initial outreach to the PBE program was made, there has been no follow-up with the customer and the PBE program has made no attempt to continue to engage the customer and address their questions. As a result, the company remains very confused about the PBE program offerings and is considering not applying for any of the incentives.

Reaching out to third parties, such as trade and technical associations, real estate agents, local economic development entities, and other partners is a good way to increase visibility and outreach efforts. Sometimes program information can be better disseminated and is better received when it comes from consultants and not-for-profit entities (Shipley et. al 2002). It's therefore important that new industrial efficiency programs leverage all available channels to reach potential industrial customers, and encourage referrals from other types of organizations that will have contact with their potential customer base.

Customers are increasingly using the Internet to find information about energy efficiency programs and tools, but many survey respondents noted that the Web sites were ineffective in fully describing and promoting all available services. A good example of the use of the Internet can be found at the Bonneville Power Administration,[17] which hosts a *Technical Service Portal* that allows industrial customers of all the utilities it serves to use one Web page to request technical assistance and customer project proposal assistance. Customers, technical consultants, and utilities can develop usernames and save their applications for services on the portal, allowing them to add a new request for service without the need to fill in all the associated company and contact information more than once. The portal also

[17] See https://secure.bpa.gov/EE_TechServiceProposals_Ext/ for BPA's Technical Service Proposals Portal.

provides links to all available services on one page, making it easy for customers to understand all of the available offerings for the sector (BPA 2009; Eskil 2008).

The Importance of Persistence and Trust

Simply having a clear understanding of an industry, however, does not ensure that a program will be able to optimally penetrate an industry. Industrial programs must earn the trust of its industrial customers, since program auditors and technical advisors may very well need to advocate for major, expensive facility investments that can be perceived to represent a business risk. Energy efficiency program managers can consider themselves akin to financial advisors in the degree to which they must cultivate trust to achieve success. Ultimately, the role of a program manager is to encourage a firm to make investments or changes that may not have otherwise been made. These investments or changes are significant business decisions, and are not taken lightly by the decision-makers within industrial firms (Shipley et. al 2002).

Industrial customers are loath to let an outsider into their facility to offer advice—especially if that individual is employed by the local utility company, which some industrial customers already view with enmity. Trust is critical to overcoming such historical animosity, and is often only developed through persistence. The average industrial efficiency investment project can take years to plan, finance, design, and build, so persistence must be exhibited by the program at large to ensure the project's satisfactory completion (Elliott et al. 2008).

Exhibiting an understanding of the needs of the individual industry and firm is paramount to building trust with the customer. As discussed earlier, an understanding of a firm's own investment cycle is critical to determining when new capital investments are likely to be made, and critical to understanding how to best encourage efficiency investments. But even within the industrial sector, different industries move through investment cycles at varying speeds. For instance, a glass manufacturer may wait ten years or more before making any major new operational investments at a plant while a biotechnology company may make substantial plant investments every two years (Elliott et al. 2008). Creating a program that from its onset allows for a flexible and extended timeframe in which firms can make investments helps build immediate trust among industrial customers. In Illinois, ComEd's one-year-old industrial energy efficiency program recently revised its program so that future years will allow for the flexibility to carry projects over year-end timeframes to better accommodate its customers (Baker 2009).

While a good example of a regional partnership, the previously mentioned efficiency program administered by the Northwest Food Processors' Association is also a good example of how to secure buy-in and establish trust when reaching out to potential customers. The unique attribute of this partnership is the degree to which multiple efficiency and industry support programs, administered by many different entities, are leveraged to build shared trust. While some efficiency or economic development programs act rather territorially, the Northwest Energy Efficiency Alliance and the NWFPA eagerly encourage its various participants to seek resources within and outside of the scope of the project (NWFPA 2009). In this case, the NEEA, NWFPA, and DOE-funded State Technologies Advancement Collaborative all identify potential industrial partners and work collaboratively with local stakeholders to spread the word about the program. The critical element of this endeavor is that the leadership for the project as a whole came from within the food processing industry itself. This comprehensive buy-in by the industry has been the most important contributor to the success of the endeavor thus far (Dias 2008).

The above point—the decision-makers within the industrial sector respond well to others within their own sectors or areas—is critical. A recent study of energy managers and decision-makers within industrial firms found that after hearing from individuals in similar positions or running similar production processes, shop floor managers and other industrial stakeholders were more likely to be receptive to energy efficiency suggestions (Prindle 2009).

Start with Assessments—and Build Internal Capacity

Industrial firms will nearly always welcome free or reduced-cost energy or technical assessments or audits—especially smaller firms that either do not have the financial resources to fund these themselves, or have not even previously considered one. An audit helps firms to get a better sense of where their energy is coming from and where it's going. Industrial customers will generally consider an energy efficiency investment only after they have determined that, in fact, the investment will produce significant benefits to the firm. Audits can be the first trigger to motivate firms that have scarcely examined their energy use, beyond viewing it as a simple fixed cost, to do so. While audits will not result in every potential cost-effective efficiency investment being implemented, they can encourage efficiency just by identifying opportunities (Shipley et. al 2002). In a recent survey of industrial firms in Ohio that had recently received an initial energy audit, nearly 60% of those firms indicated that, as a result of the audit, they would implement new energy-savings projects (ACEEE 2009b).

Further, starting with an assessments/audit program allows a program some time to build up specific technology- or sector-skilled employees to help with the more technical aspects of actual project implementation. Building the capacity to respond to and implement the projects identified in assessments is critical to the growth and impact of a PBE program.

Don't Overlook Small Companies

It is often tempting for industrial program managers to focus only on the largest industrial energy users in their service territory in order to comply with current and future mandated savings goals. Small to medium-sized industrial firms also can offer important energy savings opportunities, and can often be well-accommodated with simple prescriptive incentive programs that are relatively easy to administer. Smaller firms may require some level of further guidance on how to utilize those programs, but generally such programs can help facilitate the deployment of needed technology (Shipley et al. 2002). Because these projects generally require less administrative overhead, it may be in a program's best interest to strengthen outreach to smaller firms that are prepared to take advantage of their less labor-intensive program offerings, a step that can directly follow an energy audit. Further, smaller companies have generally implemented fewer energy efficiency projects in the past, so more opportunities may be available.

Looking Forward

Existing industrial programs and existing literature provides extensive help to managers of new industrial energy efficiency programs. Each program will obviously need to be tailored to meet specific, local needs, but certain best practice elements exist that nearly all industrial efficiency programs can deploy. Best practices can be found in numerous places. Nearly all survey respondents indicated that they receive a host of information about best

practices from publicly available resources such as DOE's *BestPractices*,[18] or the EPA's geographically-specific *Best Practices*.[19] Some surveyed programs, such as the Bonneville Power Administration, rely on external resources such as *E Source,* a service that provides syndicated information about pressing energy issues to subscribers or consultants. Most respondents also noted the importance of communication among programs, both at industry energy efficiency-focused conferences and in discussions fostered by groups like the Consortium for Energy Efficiency.

While these types of resources are useful, most program managers noted that they have a strong interest in gaining a better understanding into what their peer organizations are doing. It is often difficult to identify "best practices" that are transferable to the unique needs of an individual region or industry. Being able to discuss in-depth and at length how other programs are finding success would be useful for program managers wishing to better understand whether a supposed "best practice" might work well within their program (Sandhu 2008). By learning from other programs and discussing shared challenges and opportunities, new programs can use the existing knowledge base to build programs that will achieve the energy savings needed for the future.

SELF-DIRECT POLICIES

A special area of interest in this report's research was the expanding role of self-direct programs found among industrial energy efficiency programs.[20] Self-direct programs (sometimes known as "opt out" programs) are those that allow the largest users of energy to either not pay their portion of the PBE funds, or to get a credit back on some or all of those funds. While the authors will not take a position on whether self-direct programs are a desirable policy direction, we will explore the lessons that can be learned from the current self-direct programs on how to craft the most successful self-direct program.

According to interviews with public service officials, self-direct program administrators, and industrial energy efficiency program administrators, self-direct programs are generally developed in response to large industrial customers asserting that existing industrial PBE efficiency programs are not effectively meeting their needs. This opinion is often expressed when PBE-funded efficiency programs are being initially designed and considered, and rests largely upon a widely held (particularly among large industrial firms) opinion that large industrial firms are better positioned to implement energy efficiency than PBE programs because of their familiarity with their plants and processes. Large industrial organizations have published multiple papers and submitted extensive testimony asserting such a fact (e.g., ELCON 2008). While some survey respondents indicated that their customers have at times been disappointed and felt ill-served by their programs, there is evidence that many of the PBE programs are meeting their savings targets and the needs of their customers effectively. Just how effectively is difficult to determine.

[18] DOE's BestPractices program can be found here: http://www1.eere.energy.gov/industry/bestpractices/.

[19] A number of EPA's Best Practices can be found using this page as a starting point: http://www.epa.gov/cleanenergy/energy-programs/index.html.

[20] For more detailed information on self-direct programs and a full rendering of ACEEE's current analysis of these programs, please refer to Chittum and Elliott (2009).

Self-direct programs are typically allowed only with the understanding that those firms who choose to not fully pay into a PBE fund will instead use those same funds to pay for and make energy efficiency investments in their facilities. Self-direct programs are typically allowed or disallowed at the state level, leaving individual utilities and PBE-funded programs to determine the mechanism by which such a program will be administered and monitored.

At best, self-direct programs can be highly flexible industrial energy efficiency programs whose administrators work diligently to achieve and verify measurable savings in the industrial sector. They at times tend to nearly resemble the best custom incentive efficiency programs and, in fact, are sometimes structured to allow an industrial customer to enjoy the best of both the self-direct program and the PBE-funded program. At worst, self-direct programs are "easy out" programs that let the largest customers off the hook for paying PBE funds, and, according to a majority of survey respondents with knowledge of the local self-direct options, do not feature any mechanism by which the claimed savings of the self-directing customers are verified.

Self-direct programs pose perhaps the greatest challenge when they represent the above-mentioned "worst" version: when they lack a mechanism to consistently verify that savings claimed by self-directing firms are, in fact, achieved. Utilities and regional planning entities depend on the savings that self-directing customers claim they will achieve: indeed, they build these savings into their supply curves (Eskil 2008). They also can divert funds from PBE programs, requiring PBE program managers to adjust and regroup each year to respond to new customer losses.

ACEEE research indicates that at least 17 states have active self-direct programs for large industrial customers. A few of these, most notably Oregon and Washington, feature some self-direct programs that act nearly like well-structured custom incentive programs, and are in the views of both industrial customers and PBE program providers alike often better equipped to serve the needs of industrial customers than a regular PBE program could. Most, though, allow customers to self-direct with considerably less measurement and verification than is required of firms participating in standard PBE programs.

An examination of these 17 self-direct programs yields substantial information about achieving industrial energy efficiency through today's PBE programs. For instance, in Utah, eligible industrial customers may petition to opt out of the PBE programs entirely by claiming that there is no cost-effective energy efficiency left to be achieved in their facilities. To date, no firm has attempted to make such a claim and opt out of the program entirely (Bumgarner 2009; Case 2008). This reality is in stark contrast to claims made by large industrial firms that they have implemented all cost-effective efficiency and therefore do not need the assistance of PBE programs.

In Oregon, when PBE programs were attempting to determine how to work with their steel industry, which comprised one single customer, it was determined that allowing the firm to self-direct the PBE funds was in the best interest of both the PBE program administrators and the firm itself. In this way, the PBE program didn't have to use significant resources to develop a program for one customer, and the steel firm was able to utilize some PBE-funded resources for its energy efficiency needs. This is an example of how knowing the details of the target sectors can help shape the design of programs offered (Gordon 2009).

An intriguing feature of some of the best designed self-direct programs is an ability to allow a firm to use some PBE resources for one project and self-direct other projects. In these cases, firms can determine that one project may be a good fit for an existing prescriptive incentive program, and another project might not be covered or allowed through any other PBE funded program. Therefore, the firm can self-direct part of its PBE funds to cover the self-direct program, but continue paying a portion of the PBE funds to allow them to be eligible for the prescriptive incentive. Colorado's Xcel Energy offers this type of construct, offering a great example of how to structure an industrial energy efficiency program with a high level of flexibility and room for autonomy when necessary (White and Gunderzik 2009). It is also evidence that there are multiple ways to build effective industrial programs.

What can be seen from an examination of today's successful self-direct programs is a growing convergence between this approach, and the most advanced and well structured custom incentive programs. This similarity is especially true in self-direct programs that allow industrial customers to still take advantage of some of the PBE-funded assistance and incentives. In a way, a good self-direct option is a way to ensure that all energy efficiency investments that would be beneficial to be implemented from the perspective of a firm can be implemented. When a firm is considering an investment that isn't a good fit for existing financial incentives or other assistance, they can choose to self-finance and take advantage of what might be at times be a lower cost of capital and freedom to play with longer investment timelines if needed. A well-administered self-direct program will offer some sort of assistance to customers to help them determine whether a particular project is a better fit for self-direct or the PBE program.

In places where there is strong industrial support for the self-direct option, it's worthwhile to explore the popularity of the option to determine if it is a reaction to perceived inadequacies of the local PBE industrial program. In Wisconsin, where the self-direct option exists, industrial customers do not feel compelled to use it because they feel better served by the Focus on Energy programs. In fact, since the option has become available, only one firm has considered it and, after a thorough examination of the benefits and costs of self-directing, elected to stay in the PBE program. Other states have frequently used but poorly structured self-direct options, and in those states many companies prefer to self-direct their funds because no one holds them accountable to prove any energy savings. This is detrimental to the energy needs of a given state, and an indication that the local PBE program may not be doing an adequate job of serving its customers.

What we can learn from this is that there are many areas in which the PBE-funded industrial energy efficiency programs could do much to better serve their customers. There are also places where the PBE program administrators believe that there are instances in which a self-direct program would be useful, and in fact would encourage the formation of a well-structured program to take the burden of dealing with the largest facilities off of their program staff.

The choice of whether to include a self-direct program or not in any given state's PBE programs is clearly up to the state regulators. But as evidenced from this survey, today's industrial energy efficiency program managers are keen to develop a solution to the "self-direct problem" that doesn't alienate their large industrial users and doesn't deprive their programs of important resources and learning experiences that come from spending time in large industrial facilities. In some states with well-structured self-direct programs, the

knowledge gained in the self-direct projects and the lessons learned through the measurement and verification of self-direct project savings are conveyed to PBE program managers so that they can learn from the self-direct projects and add to their institutional knowledge.

As noted in prior work on self-direct programs (Chittum and Elliott 2009), the appropriate question to ask about self-direct programs is not whether or not to have self-direct, but how to best structure a self-direct option, if desired, to fit the needs of the industrial community and those of the existing PBE-funded programs. In instances where there exists no PBE program for industrial customers, the goal should first be how to create an industrial energy efficiency program that can best serve the industrial customers. If a self-direct option is deemed necessary to meet certain needs—political or otherwise, there exist multiple examples of well-structured programs that achieve certifiable savings and are well-received by the industrial community. Designers of new industrial PBE programs have plenty of programs on which they could model their own.

FUTURE WORK

While the research conducted for this report yielded new insights into what makes an effective industrial energy efficiency program, a dearth of industrial-focused efficiency program data is still felt among energy efficiency practitioners and researchers. Standardized evaluation, measurement, and verification data, which programs collect to understand the impact their work is having on the sector, is very limited and does not exist in a format easily comparable across geographies, sectors, and programs. Having a more standardized collection of data on energy saved, dollars invested, and program budgets for all programs as well as other details specific to a program would help programs and researchers of the efficiency sector compare apples to apples and better identify unmet needs and areas in which progress is being made. Such comparisons and analyses are very difficult to do now, because each utility or energy efficiency entity collects and compiles its data in its own unique fashion.

Aggregate data on specific program and project approaches (including custom incentives and energy assessments) is also needed to better understand the exact impact these approaches have on industrial energy savings at large. Individual programs collect this data and deliver it to their regulators and internal management, but a comprehensive compilation of this information does not exist. A national database would be incredibly useful to policymakers and program designers.

Self-direct programs, too, could add to the available data and literature by better determining which investments are being made by self-directing customers. In states like Ohio that are now considering a self-direct program, the regulators, utilities, and customers are all concerned about how customer investments will be evaluated (ACEEE 2009a).Too few programs currently collect such data, so it is difficult to assess whether self-direct programs are more or less cost effective than conventional PBE programs.

Programs are struggling to quantify and prove savings related to management, operations, and maintenance programs, as well as the employee behavior-focused activities. As emissions of greenhouse gases become a major concern to industrial customers (and a source of new costs to running an industrial business) more industrial customers will be

looking to their local energy efficiency programs to help them understand how they can position themselves ahead of the curve. Additionally, the growth of voluntary tradable energy efficiency credit markets requires better measurement and verification of such harder-to-quantify projects. Developing basic data and methodologies to address these kinds of concerns would be useful to energy managers around the U.S. and Canada. Superior Energy Performance, a program under development by U.S. industry, federal agencies, NGOs, and state partners, is addressing this methodological gap in industrial measurement and verification.

We also suggest that a follow-up survey be undertaken in several years covering the research reviewed in this report to assess the success of the new industrial programs that will emerge in response to new efficiency goals. In addition, we suggest that specific and focused research on self-direct programs be conducted to determine how effective different self-direct structures are. Only then will we truly know the impact of these programs and be able to compare them to PBE industrial programs.

Industrial energy efficiency programs have historically struggled with these data collection challenges, but as we look to greatly expand the reach and scope of PBE programs across the U.S. and Canada, it's quite clear that new programs could benefit from a strengthened data collection effort. The frequent refrain of "you can't manage what you don't measure" is quite apt in the case of industrial energy efficiency.

CONCLUSIONS

The industrial sector is critical to meeting our energy-saving and greenhouse gas reduction needs of the future. Its energy use is significant, and the energy-saving opportunities are substantial. PBE programs have been a very important component of past industrial energy efficiency savings, and they will play an even more critical role in achieving the industrial savings of the future. Giving these programs the resources and flexibility necessary to reach and serve their industrial customers is the best way to lock in industrial energy efficiency investments that will yield energy savings for years to come.

The industrial sector is indeed a challenging sector in which to encourage energy efficiency. The manner in which energy efficiency investments are made is complex, and in some ways unique to each individual firm, and even each facility. Firms need to better understand their energy use, their energy opportunities, their energy challenges, and the benefits that energy efficiency can bring. A well-structured PBE programs can help them find answers to these issues.

Numerous examples of industrial energy efficiency programs exist that have "gotten it right" in the development and deployment of their programs. Successful programs today are ones that:

- use multiple approaches to reach their industrial customers,
- give industrial firms a high degree of latitude in determining their best path toward efficiency,
- provide a suite of tools that allows the firm flexibility in moving forward on that path,
- solicit feedback from their industrial customers, and
- provide substantial technical and business assistance as their customers consider important business decisions.

While many of the trends and approaches identified as successful in this paper could serve as valuable additions to an existing industrial program, they take on a high degree of importance for new programs that are establishing themselves in the near future. These programs are expanding into markets not historically served by industrial energy efficiency programs, and will serve as important conduits for new information about the best ways to secure energy efficiency in the industrial sector. Helping these new programs learn from more established programs is a role that ACEEE and other organizations, like regional energy efficiency partnerships and alliances, could play.

In addition to new trends and primary data, the research conducted for this report illuminated the level of dedication and commitment that today's industrial program managers show toward their cause. Industrial programs are facing increasing efficiency deployment goals that, coupled with the current economic recession, are proving difficult to achieve in many areas. Despite this, program managers remain, on the whole, enthusiastic about prospects for new efficiency in their sectors and convinced that there is substantial potential for more savings. These programs need the resources and support to achieve those savings for the benefit of all.

BIBLIOGRAPHY

[ACEEE] American Council for an Energy-Efficient Economy. 2009a. *Energy Efficiency Resource Standard (EERS) Retail Electricity and Natural Gas Distributors*. March 17. http://aceee.org/energy/national/FederalEERSfactsheet_Mar09.pdf. Washington, D.C.: American Council for an Energy-Efficient Economy.

——. 2009b. "A Survey of Industrial Energy Users in Ohio." Survey results prepared for ACEEE by Graphet, Inc. February. Unpublished. Washington, D.C.: American Council for an Energy-Efficient Economy.

Ahmadzai, Haris. 2009. Union Gas Limited. Email survey. April 24.

American Council for an Energy-Efficient Economy, Summit Blue Consulting, ICF International and Synapse Energy Economics. 2008. *Energizing Virginia: Efficiency First*. Washington, D.C.: American Council for an Energy-Efficient Economy.

American Council for an Energy-Efficient Economy, Summit Blue Consulting, ICF International and Synapse Energy Economics. 2009a. *Shaping Ohio's Energy Future: Energy Efficiency Works*. Washington, D.C.: American Council for an Energy-Efficient Economy.

American Council for an Energy-Efficient Economy, Summit Blue Consulting, Vermont Energy Investment Corporation, ICF International and Synapse Energy Economics. 2009b. *Potential for Energy Efficiency, Demand Response and Onsite Solar Energy in Pennsylvania*. Washington, D.C.: American Council for an Energy-Efficient Economy.

Antonucci, Tom. 2009. Southern California Edison. 2009. Personal communication. July 2.

[ASE] Alliance to Save Energy. 2009 (accessed). *A Culture of Excellence: Corporate Energy Management at 3M*. A Corporate Energy Management Case Study. http://ase.org/uploaded_files/industrial/3M%20Case%20v07.pdf. Washington, D.C.: Alliance to Save Energy.

Baker, Roger. 2009. *Energy Efficiency Programs in Northern Illinois: Business Programs Overview*. Presentation delivered to the 2009 Symposium on Market Transformation. March.

[BEA] Bureau of Economic Analysis. 2009. *Gross Domestic Product by State.* http://www.bea.gov/regional/gsp/. Washington, D.C.: Bureau of Economic Analysis.

Belton, Keith. 2009. Dow Chemical Company. Personal communication. July.

[BPA] Bonneville Power Administration. 2009. "Industrial-Sector Info," BPA website. Accessed May 1, 2009. https://secure.bpa.gov/EE_TechServiceProposals_Ext/Sector_Info.aspx?QS_SectorID=Indu.

Bumgarner, Jeff. 2009. PacifiCorp. Personal communication. May.

Case, Patti Lynn. 2008. Rocky Mountain Power. Personal communication.

[CEE] Consortium for Energy Efficiency. 2006. *Types of Energy Efficiency Programs*. http://www.cee1.org/ind/industrial-program-planning/TypesOfEnergyEfficiencyPrograms.doc. Boston, Mass.: Consortium for Energy Efficiency.

———. 2008a. Consortium for Energy Efficiency's 2008 Annual Industry Report. http://www.cee1.org/ee-pe/2008/us_combo.php. Accessed May 1, 2009. Boston, Mass.: Consortium for Energy Efficiency.

———. 2008b. Consortium for Energy Efficiency's industrial committee program pages. http://www.cee1.org/ind/industrial-program-planning/. Accessed June 2009. Boston, Mass.: Consortium for Energy Efficiency.

Chittum, Anna and R. Neal Elliot. 2009. "Implementing Industrial Self-Direct Options: Who Is Making It Work?" In *Proceedings of the 2009 ACEEE Summer Study on Energy Efficiency in Industry*. Washington, D.C.: American Council for an Energy-Efficient Economy.

Craft, Rebecca. 2008. Consolidated Edison Company of New York. Personal communication. July.

Crossman, Kim. 2009. Energy Trust of Oregon. Personal communication. July.

David, George. 2008. Remarks delivered at 16th Annual Star Award Celebration, United Technologies Company. September 25. http://www.utc.com/utc/News/News_Details/CRNews/2008/2008-9-25.html

Deutsch, Claudia. 2007. "Companies Giving Green an Office." *The New York Times.* July 3, 2007.

Dias, Sergio. 2008. Formerly with the Northwest Energy Efficiency Alliance. Personal communication.

———. 2009. Sergio Dias Consulting. Personal communication July.

Dugger, Patsy and Angie Ong-Carillo. 2009. Pacific Gas and Electric. Telephone survey. February 26.

Dutrow, Elizabeth. 2009. United States Environmental Protection Agency. Email communication. July.

Ehrhardt-Martinez, Karen, John A. "Skip" Laitner and Kenneth Keating. 2009. *Pursuing Energy-Efficient Behavior in a Regulatory Environment: Motivating Contexts for Policymakers, Program Administrators, and Program Implementers.* Prepared for California Institute for Energy and Environment and the California Public Utilities Commission.

[EIA] Energy Information Agency. 2006. *End Uses of Fuel Consumption (Primary Energy) for Selected Industries, 1998 and 2002 (Trillion Btu).* May. http://www.eia.doe.gov/emeu/efficiency/mecs_trend_9802/mecs9802_table2b.html. Washington, D.C.: Energy Information Agency.

———. 2008a. "World Consumption of Primary Energy by Energy Type and Selected Country Groups (Quadrillion Btu), 1980-2006." *International Energy Annual 2006.*

December-June. http://www.eia.doe.gov/iea/wecbtu.html. Washington, D.C.: Energy Information Agency.

———. 2008b. *U.S. Carbon Dioxide Emissions from Energy and Industry, 1990-2007.* DOE/EIA-0573(2007). December 3. http://www.eia.doe.gov/oiaf/1605/ggrpt/carbon.html. Washington, D.C.: Energy Information Agency.

———. 2009a. *Energy Consumption by Sector, 1949–2008.* June 26. http://www.eia.doe.gov/emeu/aer/consump.html. Washington, D.C.: Energy Information Agency.

———. 2009b. *Energy Consumption by Sector and Source.* DOE/EIA-0383(2009). March. http://www.eia.doe.gov/oiaf/forecasting.html. Washington, D.C.: Energy Information Agency.

———. 2009c. *Short-Term Energy Outlook.* August 11. http://www.eia.doe.gov/emeu/steo/pub/contents.html. Washington, D.C.: Energy Information Agency.

ELCON (The Electric Consumers Resource Council) 2008. *Financing Energy Efficiency Investments of Large Industrial Customers: What Is the Role of Electric Utilities?* Policy Brief. http://www.elcon.org/Documents/Publications/PolicyBrief12-16-08.pdf. Washington, D.C.: Electricity Consumers Resource Council.

Eldridge, Maggie, Max Neubauer, Dan York, Shruti Vaidyanathan, Anna Chittum and Steven Nadel. 2008. *The 2008 State Energy Efficiency Scorecard.* Washington, D.C.: American Council for an Energy-Efficient Economy.

Elliott, R. Neal. 2005. *Utility/Industrial Partnerships: An Alternative Path for the Design of Industrial Programs*. Washington, D.C.: American Council for an Energy-Efficient Economy.

Elliott, R. Neal, Skip Laitner, and Miriam Pye. 1997. "Considerations in the Estimation of Costs and Benefits of Industrial Energy Efficiency Projects." In *Proceedings of the 32nd Intersociety Energy Conversion Engineering Conference,* Honolulu, HI. July.

Elliott, R. Neal, Miriam Pye, and Steven Nadel. 1996. *Partnerships: A Path for the Design of Utility/Industrial Energy Efficiency Programs.* Washington, D.C.: American Council for an Energy-Efficient Economy.

Elliott, R. Neal, Anna Monis Shipley, and Vanessa McKinney. 2008. *Trends in Industrial Investment Decision Making*. Washington, D.C.: American Council for an Energy-Efficient Economy.

Eskil, Jennifer. 2008. Bonneville Power Administration. Personal communication. November 14.

Ferland, Kathey. 2009. Texas Industries of the Future. Email communication. July.

Forsyth, Craig. 2009. Manitoba Hydro. Telephone survey. March 12.

Furrey, Laura 2009. *State Renewable Portfolio Standards and Energy Efficiency Resources Standards.* Presentation delivered to the Keystone Energy Efficiency Alliance. June 10. http://aceee.org/energy/national/Keystone_6.10.09.pdf.

Gaherty, Dan. 2009. Efficiency Vermont. Email survey. April 24.

Geller, Howard and Marshall Goldberg. 2009. *Energy Efficiency and Job Creation in Colorado*. Boulder, Colo.: Southwest Energy Efficiency Project. April.

Gunderzik, Tamara. 2009. Xcel Energy. Email survey. April.

Gordon, Fred. 2009. Energy Trust of Oregon. Telephone survey. April.

Hamann, Mark and Byron Lloyd. 2007. *Manufacturing Energy Efficiency Program*. Presentation at the 2007 ACEEE Summer Study on Energy Efficiency in Industry. http://www.aceee.org/conf/07ss/Presentations/2007_ACEEE_MEEP.pdf .

Harrington, Scott. 2009. Vermont Gas. Email survey. April 14.

Hayashi, Harold. 2008. Enbridge Gas Distribution. Telephone survey. October 23.

——-. 2009. Enbridge Gas Distribution. Personal communication. July 14.

Hutchins, Scott. 2009. United States Department of Energy. Personal communication. July.

[IAC] Industrial Assessment Center database. 2009. Quantitative analysis conducted on the Industrial Assessment Center's database of student energy assessments, 2003-2007 data. All data available here: http://www.iac.rutgers.edu/database/assessments.php. Industrial Assessment Program, Industrial Technologies Program, Office of Energy Efficiency and Renewable Energy, United States Department of Energy. Accessed March.

Jaehn, Wendy and Jay Roble. 2008. Midwest Energy Efficiency Alliance. Personal communication.

Jordan, Jennifer and Steve Nadel. 1993. *Industrial Demand-Side Management Programs: What's Happened, What Works, What's Needed*. Washington, D.C.: American Council for an Energy-Efficient Economy.

Kean, Owen. 2009. American Chemistry Council. Personal communication.

Keena, Kevin. 2008. National Grid. Telephone survey. November 13.

Kleppert, Anna. 2007. *Growing Off the Grid: Using Smarter Energy Policy to Retain New York City's Industrial Sector.* Unpublished master's thesis. Columbia University, New York, NY.

Kline, Angie. 2008. CenterPoint Energy. Telephone survey. November 12.

Knight, Vernon. 2009. Tennessee Valley Authority. Email survey, April 8.

Kushler, Martin and Patti Witte. 2007. *A Review and Early Assessment of Public Benefits Policies Under Electric Restructuring—Volume 2: A Summary of Key Features, Stakeholder Reactions, and Lessons Learned to Date*. Washington, D.C.: American Council for an Energy-Efficient Economy.

Kushler, Martin, Dan York and Patti Witte. 2004. *Five Years In: An Examination of the First Half-Decade of Public Benefits Energy Efficiency Policies*. Washington, D.C.: American Council for an Energy-Efficient Economy.

Lampley, Louis Jr. 2009. Commonwealth Edison. Email survey, April 23.

Lau, Henry. 2009. Southern California Edison. Email survey. April 11.

Levy, Dana. 2009. New York State Energy Research and Development Authority. Email communication. July.

Light, Ted. 2009. Energy Trust of Oregon. Personal communication. July 22.

Lovins, Amory B. and L. Hunter Lovins. 1997. *Climate: Making Sense and Making Money.* http://www.rmi.org/images/PDFs/Climate/C97-13_ClimateMSMM.pdf. Old Snowmass, Colo.: Rocky Mountain Institute.

McKane, Aimee. 2008. Lawrence Berkeley National Laboratory. Personal communication. October.

[NAM] National Association of Manufacturers. 2005. *Efficiency and Innovation in U.S. Manufacturing Energy Use.* http://www.nam.org/~/media/Files/s_nam/docs/234500/234421.PDF.ashx.

[NEEA] Northwest Energy Efficiency Alliance. 2009. “About the Northwest Energy Efficiency Alliance.” http://www.nwalliance.org/aboutus/index.aspx . Accessed October.

[NWPCC] Northwest Power and Conservation Council. 2009. Draft Sixth Northwest Power Plan. http://www.nwcouncil.org/energy/powerplan/6/default.htm. Portland, Oreg.: Northwest Power and Conservation Council.

[NWFPA] Northwest Food Processors Association. 2009. "Energy Portal." http://www.nwfpa.org/eweb/startpage.aspx?site=Energy&design=no

Parr, Michael. 2009. DuPont. Personal communication. March 22.

Platt, Brian. 2009. New York State Research and Development Authority. Telephone survey. December 9.

Powell, Hale. 2009. HPowell Energy Associates. Personal communication. June 22.

Prause, Elaine. 2008. Energy Trust of Oregon. Telephone survey. November 25.

Prindle, William. 2009. CF International. Personal communication. July 17.

[PSE] Puget Sound Energy. 2009. *Resource Conservation Manager*. Program brochure. http://www.pse.com/SiteCollectionDocuments/business/3642_RCMFinal.pdf. Accessed May 3.

Pye, Miriam. 1998. *Making Business Sense of Energy Efficiency and Pollution Prevention.* Washington, D.C.: American Council for an Energy-Efficient Economy.

———. 2009. New York State Energy Research and Development Authority. Personal communication. July.

Rufo, Michael W., Michael Ting, Michael Messenger and Michael Wheeler. 2008. “Energy Efficiency as the First Resource: Opportunities, Challenges, and Beating the Next Bust.” In *Proceedings of the 2008 ACEEE Summer Study on Energy Efficiency in Buildings*. Washington, D.C.: American Council for an Energy-Efficient Economy.

Sandhu, Parminder. 2008. Personal communication. July 10.

Schepp, Craig. 2009. Wisconsin Focus on Energy. Email survey. April.

Schepp, Craig and John Nicol. 2007. "Wisconsin’s Industrial Cluster Initiative Lessons: Three Years Later." In *Proceedings of the 2007 ACEEE Summer Study on Energy Efficiency in Industry*. Washington, D.C.: American Council for an Energy-Efficient Economy.

Shipley, Anna Monis and R. Neal Elliott. 2006. *Ripe for the Picking: Have We Exhausted the Low-Hanging Fruit in the Industrial Sector?* Washington, D.C.: American Council for an Energy-Efficient Economy.

Shipley, Anna Monis, R. Neal Elliott and Adam Hinge. 2002. *Energy Efficiency Programs for Small and Medium-Sized Industry*. Washington, D.C.: American Council for an Energy-Efficient Economy.

Smith, Andrew. 2008. Ontario Power Authority. Telephone survey. October 9.

Socks, Michael. 2008. Efficiency Vermont. Personal communication.

[SWEEP] Southwest Energy Efficiency Project. 2009. “About SWEEP,” SWEEP website. Accessed June 5. http://www.swenergy.org/about/index.html.

Taube, Ben. 2008. Southeast Energy Efficiency Alliance. Personal communication. October 7.

Trombley, Dan. 2009. American Council for an Energy-Efficient Economy. Personal communication. April 17.

Trombley, Dan, R. Neal Elliott, and Anna Chittum. 2009. "Expanding the Industrial Assessment Center Program: Building an Industrial Efficiency Workforce." In *Proceedings of the 2009 ACEEE Summer Study on Energy Efficiency in Industry*. Washington, D.C.: American Council for an Energy-Efficient Economy.

Turner, Wayne C. and Steve Doty. 2007. *Energy Management Handbook*. 6th Ed. Lilburn, Ga.: The Fairmont Press, Inc.

Vrabel, Tim. 2009. Efficiency Maine. Personal communication. March 23.

Wallner, John. 2009. Northwest Energy Efficiency Alliance. Personal communication. July.

[WCI] Western Climate Initiative. 2007 Governor's Agreement. http://www.westernclimateinitiative.org/component/remository/func-startdown/12/.

White, Shawn and Tami Gunderzik. 2009. Personal communication. June 16.

Witte, Patti, Dan York, and Katherine Friedrich. 2009. "Survey of natural Gas Efficiency Programs." Washington, D.C.: American Council for an Energy-Efficient Economy.

York, Dan and Martin Kushler. 2003. *America's Best: Profiles of America's Leading Energy Efficiency Programs*. Washington, D.C.: American Council for an Energy-Efficient Economy.

York, Dan, Marty Kushler, and Patti Witte. 2008 *Compendium of Champions: Chronicling Exemplary Energy Efficiency Programs from Across the U.S.* Washington, D.C.: American Council for an Energy-Efficient Economy.

Younger, Bill. 2009. Puget Sound Energy. Email survey. April 10.

Zweig, Jessica. 2009. New York State Energy Research and Development Authority. Personal communication.

APPENDIX A: TYPES OF PROGRAMS

Marketing/outreach/awareness: These programs take many forms, but generally these programs work to increase awareness of the benefits of energy efficiency among those that have decision-making power, such as business owners. These kinds of programs can include billboards and in-bill "stuffers," targeted Web sites, and outreach efforts to labor unions or other local gatherings of industrial customers or industrial employees.

Technical assistance and energy audits/assessments: These programs generally offer free or low-cost energy audits and assessments, as well as project design assistance for customers interested in making actual efficiency investments. Sometimes in-house program staff conduct these audits, and other times a third party is contracted to provide them.

Prescriptive incentive: These programs provide a financial rebate for the purchase of particular types of technology deemed to be efficient, through defined standards such as NEMA premium motors or through other means, such as certain product lines from a particular vendor. Incentives are generally paid directly to the customer, though sometimes the funds are directed towards the vendor of the product.

Custom incentive: These programs offer a financial rebate when customers retrofit, replace, or renovate a production line or part of the production process equipment. These incentives are generally based upon a certain amount per saved kWh, or a certain percentage or amount of the overall project cost. In many cases a program will follow up after implementation to ensure that the estimated savings has actually occurred.

New construction: As their name suggests, these programs offer financial incentives for builders of new industrial buildings (or substantial renovations of existing ones) to build the building itself more efficiently than they would have otherwise built it. These programs may offer any of the above-mentioned offerings as part of their incentives and assistance.

Energy manager/management: These programs take two primary forms: support for the hiring of an in-house energy manager at a facility, or support for the implementation of an energy management program facility- or company-wide. These programs frequently address the human behavior of those tasked with operating equipment or managing a facility's internal activities, and the impact such behavior has on energy use.

Standard performance contract: These programs provide funding to projects that will save a certain amount of kW or kWh as designed. Third-party providers, called ESCOs (Energy Service Companies), are often used by industrial firms to design the project and submit the application. These programs are often subject to third-party measurement and verification requirements.

Financing assistance or education: These programs either directly provide financial products to help a firm fund an energy efficiency investment, or they provide assistance to a firm seeking outside financial assistance for a project. These kind of programs can include traditional loans, loan guarantees, packaging of certain projects for ease of financing, reductions of interest rates, and loans that can be partially paid back with energy savings.

APPENDIX B: INDIVIDUAL PROGRAM DESCRIPTIONS AND SUMMARIES

Southeast Energy Efficiency Alliance

The Southeast Energy Efficiency Alliance, a nonprofit organization since 2007, promotes energy efficiency for a cleaner environment, a more prosperous economy, and a higher quality of life in the Southeastern region of the United States. The Southeast Industrial Energy Efficiency Coalition, a project of SEEA, brings together industries, utilities, state energy offices, industrial assessment centers, national laboratories, and others to help industries sustain growth by operating with a higher degree of energy efficiency. The Coalition works to drive industrial energy efficiency improvements in the region by: connecting industry to financial and technical resources; fostering cooperation and communication among industrial users, utilities regulators and decision-makers; engaging university and national laboratory resources to develop, demonstrate, and deploy breakthrough technologies; and promoting best practices and training in energy efficiency.

Ontario Power Authority

The Ontario Power Authority (OPA) is a crown agency of the Province of Ontario that administers energy efficiency programs to electric customers. Electric ratepayers themselves fund these efficiency activities. The entire authority is tasked with achieving a reduction of 6,300 MW by 2025 though conservation and demand management activities, with the reductions to be found across all sectors. Industrial customers represent about 30% of OPA's electricity consumption. M&V is generally outsourced to a pre-screened group of certified, contracted M&V professionals. The industrial program itself is just now being finalized.

Puget Sound Energy

Puget Sound Energy (PSE) is an energy company that provides electricity and natural gas in the Puget Sound region of the Northwest. PSE's custom and prescriptive programs are funded through conservation riders that are included in utility tariffs. The utility is bound to annual efficiency targets set by the Washington Utilities Transportation Commission. PSE's cross-cutting industrial programs focus primarily on the deployment of mature technologies, and offer assistance with retrofit opportunities, as well as case-by-case energy auditing. It can enter into grant agreements for projects extending beyond one year.

The industrial sector accounts for approximate 6% of PSE's gas and electricity demand, and its industrial programs are administered jointly with its commercial programs. Measurement and verification are conducted internally, and a self-direct program allows large industrials to use a dedicated funding pool or submit projects with reserved funding using a RFP process. Major Account representatives engage customers regularly and Energy Management Engineers maintain direct relationships with plant engineering staff. To reach out to customers, PSE uses individual contacts, email broadcasts, an electronic newsletter, its Web site, meetings, and conference sponsorships. Because targets will become more stringent in the coming years, PSE is looking for new opportunities to increase efficiency.

Southern California Edison

Southern California Edison (SCE), the largest subsidiary of Edison International, is an investor-owned electricity utility that services much of Southern California. The industrial

sector is covered as part of SCE's Energy Efficiency Programs, which are funded by ratepayers through the Public Good Charge (PGC). All industrial customers must pay the PGC. SCE and other IOUs have Statewide Industrial Programs specifically designed to serve the industrial market segment, which accounts for about 14.5% of the total electricity consumed in SCE's territory. The funding level for the Industrial Statewide Program is $101 million for the 2010–2012 funding cycle.

The California Public Utilities Commission (CPUC) sets energy efficiency goals for SCE's programs; for the three-year funding cycle between 2010 and 2012, SCE is to achieve 3,316 GWh savings and a 727 MW demand reduction. There are both prescriptive and custom programs. While the prescriptive program is easier to sell, the custom program is generally more suitable because each project is site-specific. Projects are both technology- and sector-based, depending on the individual program, and the emerging technologies (ET) program focuses on technology assessments, field demonstrations, new technologies, and net-zero energy buildings.

SCE employees provide technical assistance and audits to customers, and both field engineers and ET program staff provide technical support to internal program managers and account managers. For the current funding cycle, efficiency program savings will be verified by outside contractors directed by the CPUC energy efficiency divisions. A total of 67 SCE employees are focused on the industrial market segment. Account managers and account executives promote energy efficiency measures to customers, providing face-to-face introductions of programs, fact sheets explaining the benefits, technical seminars, display booths, and a program Web site. SCE's efficiency programs themselves have struggled to meet demand reduction goals, as load-shifting technologies are a part of SCE's separate demand response programs.

Energy Trust of Oregon

Energy Trust of Oregon is a nonprofit organization that was formed in 2002 to implement cost-effective energy conservation. It is overseen by the Oregon Public Utility Commission, and receives funding primarily through a public purpose charge paid by customers of Oregon's four largest investor-owned utilities. Energy Trust has a dedicated industrial/agricultural program that caters to all sized customers. Under the same Oregon legislation that created the public purpose funds, energy users with over 1 MW of average load are allowed to self-direct their share of public purpose funds through the Oregon Department of Energy. Self-directors may participate in the industrial program at 50% incentive levels relative to full participants if projects are not banked as self-direct credits with ODOE for 3 years.

Energy Trust's industrial offerings include both prescriptive and custom financial incentives, technical assistance, new construction, and energy management assistance. About 75% of the incentives Energy Trust pays out to the industrial sector are custom, and the industrial sector itself represents about one-third of Energy Trust's energy conservation budget. Energy Trust deploys strong measurement and verification activities, including an evaluation of an investment one year after its installation. It is very engaged with vendors and trade associations that work within the industrial sector, and allow a long timeframe (up to three years) for the implementation of some industrial efficiency projects.

New York State Energy Research and Development Authority

NYSERDA is a public benefit corporation funded primarily through collected System Benefits Charges on ratepayer bills. In 2007 New York launched an Energy Efficiency Portfolio Standard, which bolstered the funds NYSERDA was able to devote to energy efficiency programs. New York is currently operating with an overall goal of a reduction in energy use of 15% by 2015. For the most part, industrial programs are administered in conjunction with commercial programs. The Existing Facilities Program, which offers both prescriptive and custom incentives for industrial facilities, is being expanded as a result of this new goal. Custom incentives under the program range from 12 cents to 16 cents/kWh, depending upon where a customer is located. In addition, industrial process improvements are eligible for the same 12 to 16 cents/kWh per unit of production. In certain cases, NYSERDA also offers incentives for gas projects as well as CHP installations specifically.

The new EEPS funding for NYSERDA industrial projects has yielded a number of changes at NYSERDA, including a renewed focus on process improvements and a substantial effort to strengthen outreach to the industrial sector through a contracted third party. NYSERDA also offers incentives for more energy-efficient new construction of industrial facilities and processes. There is currently no self-directed option in New York. NYSERDA also conducts some substantial research and development activities, but the majority of the recently expanded effort devoted to industrial work is geared toward deployment of mature technologies.

National Grid

National Grid is a London-based investor-owned utility. It offers electric and natural gas services to areas of the northeast United States. In Massachusetts, National Grid collects a public benefit charge from all ratepayers to fund efficiency programs. Currently, though Massachusetts does not have an official efficiency target, it sets annual efficiency goals that each investor-owned utility aims to meet. Focused primarily on electric efficiency in Massachusetts, National Grid doesn't engage in research and development but is instead focused on the deployment of more mature technologies in its industrial sector customers.

National Grid's industrial-focused efficiency efforts address process efficiency improvements with prescriptive and custom incentives. It offers prescriptive incentives for elements of production processes such as motors, compressed air, and variable speed drives. It does not address each industrial sub-sector by market but instead uses its in-house engineering staff and customer service representatives to serve its customers. Service is, however, divided geographically. In generally National Grid reports a challenge finding enough experts with particular expertise to serve its customers.

Xcel Energy

Xcel Energy, Inc. is a public electric and natural gas utility based in Minneapolis that serves customers in Colorado, Michigan, Minnesota, New Mexico, North Dakota, South Dakota, Texas, and Wisconsin. The utility has industrial energy efficiency programs in Minnesota, Colorado, Wisconsin, North Dakota, and New Mexico, and all are governed differently with different regulatory nuances, have different markets, and are at different points in their lifecycle. A demand-side management program was started in Minnesota in the 1980s and in New Mexico in 2009. Funding mechanisms, efficiency mandates, investment timeframes, and incentives vary from state to state.

Xcel Energy uses prescriptive and custom programs fairly evenly. Programs are both technology- and sector-based. Programs generally look to drive customers to the next level of efficiency, as opposed to what is currently standard in the marketplace. There is some focus on the demonstration of emerging technologies. Xcel Energy offers both technical assistance and energy audits, and offers trainings to energy managers, though there is no specific energy manager program.

The industrial sector varies from state to state, but it is generally around 30% of Xcel Energy's total load. Xcel Energy currently has about 12 people working on industrial marketing, and they are supported by a number of employees in the regulatory, communications, and sales fields. However, there is still a deficiency of staffing for the needs of the programs. Xcel Energy has Business Solution Center phone agents for small customers and assigned account managers for large customers. To promote their programs, they use state energy offices, nonprofit organizations, economic development agencies, real estate entities, trade associations, mass marketing advertising, trainings, direct mail, and a Web site. In 2007 Xcel Energy launched a program targeted specifically at the large industrial market. It is a more holistic approach to energy management that provides customers with additional resources to develop and implement a sustainable energy management plan that incorporates both their technical opportunities and energy savings that can be achieved by modifying their business practices.

Conservation goals will be growing aggressively over the next few years, and Xcel Energy is thus in the process of redefining how it does business. This includes implementing a more aggressive approach to finding opportunities for natural gas conservation.

Rocky Mountain Power

Rocky Mountain Power is a subsidiary of PacifiCorp, which was acquired in 2006 by MidAmerican Energy Holdings Company. Rocky Mountain Power is an investor-owned electric utility that offers industrial customers the same DSM programs offered to other sectors. It serves industrial customers in Idaho, Utah, and Wyoming. Efficiency programs are funded through a public benefit fund charge on each ratepayer's bill.

Rocky Mountain Power allows the largest industrial customers to self-direct their public benefit funds into a very structured and well-considered self-direct program. The self-direct program has substantial oversight over customers that choose to self-direct, including verification of claimed savings.

Wisconsin Focus on Energy

Focus on Energy is a nonprofit organization that is overseen by the Public Services Commission of Wisconsin (PSC) and works with eligible Wisconsin residents and businesses to install cost-effective energy efficiency and renewable energy projects. Its primary funding is derived from utility-collected ratepayer funds. The PSC's current mandated industrial savings goals are 15,378 kW, 95,126,529 kWh, and 4,487,083 therms, and there are several market enhancement goals as well. Focus on Energy has a program specifically for industrial efficiency, as the industrial sector accounts for about 30% of the system load in the state. Generally, timeframes greater than one year are allowed for energy efficiency investments. Both prescriptive and custom programs are offered and complement each other well, and custom programs tend to help spawn new technology. Focus on

Energy programs are both technology- and market sector-based, though custom programs tend to be more market sector-focused than technology-focused.

Focus on Energy supports mature technologies if adoption rates are low and there is a strong program in place for identification, verification, promotion, and incentives. Some Focus programs also provide demonstrations for emerging technologies. Field-based technical support is offered, including third-party review of vendor proposals, onsite energy management, technology assessments, measurement and verification, information and education, and project application support. While the option exists for large customers to opt out, very few do, based on sheer economics. Approximately 25 full-time employees work in the industrial program, with about half in the field directly interacting with customers. Customer outreach efforts include TV, radio, mailings, service announcements, e-mails, presentations, a Web site, special events, and calls and visits to customers. The recent economic downturn has posed an especially great challenge, along with the inability of many customers to provide staffing and capital for large projects.

Efficiency Vermont

Efficiency Vermont is a statewide provider of energy efficiency services and is operated by an independent, nonprofit organization under contract to the Vermont Public Service Board. Efficiency Vermont is funded through an energy efficiency charge on all Vermont electric ratepayer bills. Industrial customers can self-direct, and they are required to prove their savings. Efficiency Vermont is operating under three-year resource acquisition targets, which mandate both MW and MWh savings. The commercial and industrial program is structured to allow for substantial time horizons—beyond one year—for energy efficiency investments. Both prescriptive and custom programs are offered; prescriptive programs have more participants, while custom programs see more savings. Programs are both technology- and market-based, and they undertake both mature technology deployment and demonstration projects. In 2008, over $850,000 of incentives were awarded for the commercial and industrial program, which accounted for about 8.5% of the total savings achieved by all Efficiency Vermont programs that year.

Efficiency Vermont helps to train and support energy managers located internally at the firms it serves. Its efficiency projects are subject to regulatory verification. The organization provides dedicated account managers to the largest industrial customers. There are approximately 20 of these managers, though staffing to meet customer demand is a current challenge. In order to maximize marketing and outreach efforts, Efficiency Vermont employs dedicated business development specialists, and develops relationships with industrial customers through an account management system. Efficiency Vermont specialists strive to sustain active working relationships with architects, engineers, vendors, contractors, and suppliers. Current challenges also include the quantification of legitimate efficiency leads in order to maximize internal resources, and the need to ramp up on large system data loads.

Tennessee Valley Authority

The Tennessee Valley Authority (TVA) is a federally owned corporation created in 1933 to manage the Tennessee River system, generate electricity, and provide other services to the Tennessee Valley. TVA sells wholesale electricity to 158 power distributors and about 60 large customers. TVA has recently established a goal of 1,400 MW reduction on summer peak demand by 2012, though there are currently no goals for kWh reduction, and reductions must come at a lower cost than a new power plant. Efficiency programs are

funded not by a public benefits fund but by wholesale electricity sales. Programs are being developed for the industrial market sector to help achieve the demand reduction goal. The industrial sector currently makes up approximately 25% of the total system load, and industrial programs are administered jointly with those in the commercial sector.

Currently, all TVA industrial efficiency programs are custom programs for directly-served and distributor-served customers larger than 5 MW. Programs are both sector- and technology-based, with a focus on the deployment of mature technologies, though more demonstration of emerging technologies is anticipated. The Major Industrial Programs (5 MW and above) offer $100 per kW saved off the power system's summer peak, and participants are encouraged to use the Department of Energy's *Save Energy Now* assessments. Industrial programs for customers smaller than 5 MW are still under development.

Manitoba Hydro

Manitoba Hydro is the electric power and natural gas utility in the province of Manitoba, Canada. Its efficiency program, which deals primarily with electric power, is funded by profits from electricity exports to the United States. It reports to the Manitoba Public Utilities Board and is subject to annual reviews of progress toward the Board's goals. There is a one-year cap on the payback period for energy efficiency projects, and all its programs are custom. There are financial incentives and rebates for project studies as well as project implementation, and cash incentives based on savings. Manitoba Hydro employs six staff members to cover the industrial sector, and they address all customers sufficiently. Manitoba Hydro carries out its own measurement and verification processes. Key account representatives spread word of the efficiency programs to customers through seminars, newsletters, and other means, and work closely with equipment vendors. One challenge that Manitoba Hydro faces is that the very low electricity rates in Manitoba makes it difficult to encourage energy efficiency.

Commonwealth Edison

Commonwealth Edison (ComEd), a unit of Exelon Corporation, is the largest electric utility in Illinois, serving the Chicago and Northern Illinois area. ComEd recovers its industrial efficiency program costs through an automatic adjustment clause tariff. A state act mandates reductions of 1,166,497 MWh and 32.8 MW. ComEd is responsible for achieving 75% of the savings, while the Illinois Department of Commerce and Economic Opportunity must implement the remaining 25%.

ComEd programs, which are about a year old, are both prescriptive and custom, though the majority of achieved savings are currently through prescriptive programs. Incentives for the prescriptive programs are offered on a per-installed-measure basis while incentives for the custom program are calculated on a per-kWh savings basis. While the current portfolio focuses primarily on mature technology deployment, ComEd is permitted to spend 3% of its portfolio costs on emerging technologies.

ComEd offers technical guidance to customers for specific energy efficiency projects upon request. Measurement and verification efforts are outsourced, and there is no self-direct option for firms who wish to opt out. There are currently four industrial program managers, and they are supported by implementation contractors. Additionally, customer service representatives serve the commercial and industrial sectors and promote the energy

efficiency programs through regular contact. The programs rely on trade allies for industrial applications. Trade allies receive a quarterly newsletter and attend conferences and Webinars to stay current on program details.

Bonneville Power Administration

The Bonneville Power Administration (BPA) is a federal agency based in the Pacific Northwest that transmits and sells wholesale electricity in four states. Its industrial energy efficiency program is funded by publicly owned utilities, BPA retail wheeling services, and other miscellaneous revenue sources. BPA operates under a mandate of a reduction of 1,400 MW on power systems during summer peak demand. Its industrial services include but are not limited to: feasibility and detailed energy studies, plant assessments, and custom incentive projects that require measurement and verification activities.

BPA will soon be working with on an expanded industrial efficiency program that will include energy management and project support. BPA currently can fully fund certain technical services for facilities of all sizes, as well as a "green motor" initiative. BPA and its contractors maintain a very strong relationship with their industrial customers, and are able to communicate back to their program administrators about what is needed. BPA uses strict measurement and verification protocols, using both internal and external resources. BPA notes, as many other programs have, that challenges have arisen from the current economic recession as well as a lack of qualified workforce.

Efficiency Maine

Efficiency Maine is a program run by the Maine Public Service Commission. It was formed in response to the state's 1997 Energy Conservation Act, which directs the Commission to fund and administer energy conservation programs. Efficiency Maine funds its programs through system benefit charges collected from each electric ratepayer. An exception to this is the largest industrial consumers, who as a class don’t pay into the system benefit charge and instead contribute to energy conservation programs through the Regional Greenhouse Gas Initiative. They are then not permitted to partake of any of Efficiency Maine’s efficiency programs. Though there are no mandated efficiency goals to meet, Efficiency Maine offers prescriptive and custom incentives for electric energy efficiency investments in the industrial sector as well as energy audit services. Incentives are also offered for new commercial/industrial construction and major renovations. The program primarily works to encourage consumers to consider higher efficiency in purchases and technologies. It administers its residential, commercial, and industrial programs jointly.

In 2009, the Maine Legislature passed LD 1485, An Act Regarding Maine's Energy Future, which sets aggressive goals to end Maine's dependency on foreign fuels. The law established the Efficiency Maine Trust and Board, which brings together Maine's energy policies and programs under one roof. The Board will design, coordinate, and integrate energy efficiency, weatherization, and alternative energy programs in the state for all energy consumers.

Union Gas

Union Gas Limited is a Canadian natural gas storage, transmission, and distribution company that services northern, southwestern, and eastern Ontario. It is a regulated utility and its efficiency and DSM programs are paid for through customer rates. Efficiency goals

and targets are set by the Ontario Energy Board. Industrial programs are jointly administered with commercial programs, and customers receive funding only once a project is completed, allowing for multi-year cycle projects. Union has both prescriptive and custom programs. Custom programs are more predominant and typically achieve higher savings. Union's focus is primarily on deployment of mature technologies, but it also focuses on demonstration projects. Employees provide technical assistance to industrial customers, but do not provide energy audits. Union account managers support energy managers and some of them are even part of industrial energy managers' teams.

The industrial sector represents about 55 to 65% of Union's total gas load, though this figure varies each year, depending on projects. Measurement and verification efforts are outsourced to a third party, and there are no self-direct programs for large customers. The Union industrial staff consists of 20 employees. Outreach is conducted by internal customer representatives, who offer regular visits, along with technical experts. This outreach is augmented by yearly training sessions for customers that focus on savings, reducing consumption, and awareness of new efficient equipment. Union has also partnered with 360 Energy Inc. and Canadian Manufacturing and Exporters to promote its programs. Challenges have included a high rate of free-ridership and the general challenge of the current recessions. Union will add new elements to program offerings in 2010.

CenterPoint Energy

CenterPoint Energy is an electric and natural gas utility serving markets in Arkansas, Louisiana, Minnesota, Mississippi, Oklahoma, and Texas. It has efficiency programs in both Minnesota and Arkansas and funds programs in the greater Houston area. However, Minnesota houses CenterPoint's only industrial energy efficiency program. Industrial consumption among the utility's Minnesota natural gas customers is 22% of the entire system load. The efficiency program there, which covers both the industrial and commercial sectors, is funded by ratepayers through a tracker mechanism, which is a cost-recovery mechanism. Its energy efficiency goal has shifted from one of spending to one of savings, with a 1 to 1.5% savings goal for a three-year throughput. Typically investments are made in a one- to seven-year payback timeframe, and incentives are not given for projects with a payback of less than one year.

CenterPoint provides engineering assistance for customers who cannot afford their own engineers, offering up to $2,500 up front, with a total of $5,000 for the implementation of a project. The utility reimburses industrial customers for a portion of the installation costs. Between 1999 and 2006, CenterPoint gave an average of 60 industrial process rebates each year, which covered 50 distinct technologies. The industrial and commercial program employs six account managers in the industrial program, who manage three to five market segments each and engage in one-on-one sales with firms. The segment-based account managers are able to intimately understand end-use technologies particular to their sector and transfer their knowledge from one customer to another. They hold technical seminars with customers and trade allies, and are very active in several trade associations.

Measurement and verification is generally internal, but an outside engineer does M&V for projects greater than 20,000 decatherms in expected savings. Both pre- and post-implementation M&V is required. CenterPoint's efficiency programs in Minnesota find themselves understaffed, and have special difficulty in finding staff with both sales and technical experience. CenterPoint has also faced great challenges with the recent

recession. In 2007, the number of projects it undertook was down to 19, and in 2008 it dropped to just 12.

Vermont Gas

Vermont Gas Systems is a natural gas utility that provides service to customers in the state of Vermont. Its efficiency program has been around since 1992 and is funded by ratepayers, and efficiency savings are required by a regulatory mandate by the Vermont Public Service Board. Vermont Gas's industrial programs, which are jointly administered with commercial programs, are structured to allow for substantial time horizons beyond one year. Both custom and prescriptive programs are offered, though custom programs are used more frequently, and are more effective for achieving savings. Vermont Gas programs offer incentives of 25 and 50% of the incremental costs of installed cost-effective natural gas-saving measures. Programs are both technology- and sector-based, and while their focus is mainly on mature technologies, they have funded cutting edge technology at a higher incentive level.

Vermont Gas offers walk-through audits and technical and code review of building plans. They support energy managers within industrial facilities, but do not train them. The commercial and industrial sectors represent 61% of sales throughput. Measurement and verification are informally carried out internally, and formally carried out by thorough external consultants. Vermont Gas employs representatives in a Marketing Department, a call center department, and a service department, and key account representatives and commercial services engineers engage in periodic outreach to customers. Programs are promoted through brochures, a Web site, trade shows, a customer newsletter, and print newspaper ads. Vermont Gas's greatest challenge is workforce to meet customer needs—though record savings levels have been reached for three of the last four years.

Enbridge Gas Distribution

Enbridge Gas Distribution, which develops and delivers energy efficiency programs for its natural gas customers, is a subsidiary of a larger investor-owned energy company. Enbridge currently provides customers incentives for energy efficiency, and recovers all DSM program costs used to provide efficiency programs through its regulated rates. Industrial customers can take advantage of a variety of services including technology-specific assessments such as steam trap assessments and technical assistance and financial incentives up to $100,000 for the implementation of energy-efficient projects. Enbridge also assists companies in funding the cost of an energy manager. Enbridge maintains an in-house staff of nine engineers (Energy Solutions Consultants), who assist industrial customers through the various programs and the incentive process, perform site visits and energy audits, and provide energy-efficient solutions to address customer needs. Enbridge can also provide customers with access to a network of energy contractors, equipment suppliers, and energy consultants.

Pacific Gas and Electric

Pacific Gas and Electric is an investor-owned utility that provides both electric and natural gas service to California businesses and residents. It is regulated by the California Public Utilities Commission, which oversees as PG&E and other utilities collect a mandated public benefit fund from ratepayers to help pay for energy efficiency programs.

PG&E offers a suite of services for the industrial sector, including prescriptive and custom incentives, technical assistance, energy management assistance, training programs, and incentives for onsite generation. The industrial program is administered on its own with its own dedicated staff and markets its programs with a sector-based approach. California does not allow large industrial customers to self-direct their public benefit funds, so PG&E addresses industrial firms of all sizes. An emerging technology program supports the deployment of demonstration projects, while the existing incentives focus to a large extent on more mature technologies. PG&E has some internal staff to conduct M&V activities, though much of the substantial cost-benefit analysis is done by CPUC staff.

APPENDIX C: UTILITY INDUSTRIAL ENERGY EFFICIENCY PROGRAM QUESTIONNAIRE

1. How does your state fund energy efficiency programs? What is your exact funding mechanism?

2. Are you operating under any sort of energy efficiency mandate or goal (e.g., Energy Efficiency Resource Standard)?
    a. If yes, what type of program?
    b. What specific goals are you required to achieve and in what timeframe?

3. Is your program funding structured such that you can allow for substantial time horizons (over 1 year) for industrial energy efficiency program investments?

4. Are you primarily a natural gas or electric utility?

5. Are your programs custom, prescriptive, or both?
    a. If both: Is one type more predominant than the other?
    b. If both: Which do you feel is most effective for achieving savings?
    c. If applicable: What incentives and/or rebates do you offer?

6. Is your program technology-based, sector-based, or both (cross-cutting)?

7. Do you focus on demonstration projects at all, or do you focus primarily on deployment of mature technologies?

8. Do you offer technical assistance and/or energy audits?

9. Do you train or otherwise support energy managers located internally at the companies you serve?

10. Are your industrial efficiency programs jointly administered with your commercial programs?

11. What percentage of your total system load is industrial?

12. Is your measurement and verification (M&V) of efficiency savings done internally or outsourced?

13. Are there special programs for your largest customers? (e.g., do your industrial customers retain the option to “opt-out” or “self-direct” their payments into what would have been the public funding mechanism for energy efficiency programs?)
    a. Are these customers who self-direct required to prove that they saved a certain amount of energy on their own?

14. Do you think your industrial programs in general are convenient? How could they be more convenient for customers?

15. How large is your industrial-focused staff? Do you have enough staff and resources to adequately address incoming requests and achieve savings goals?

16. Do you have internal customer service representatives that help market your efficiency programs?

17. How do you develop and maintain a lasting relationship with your industrial customers?

18. How do you promote your programs? Which entities do you partner with to spread the word about your programs (e.g., through state energy office, nonprofits, economic development entities, real estate sector)?

19. Do you think there is a part of the market or a certain sector that you feel you've been missing?

20. Are there any particular challenges your program is currently facing that you are working to address?

21. What has changed in your industrial program offerings in the last few years?

22. Do you have any future ideas or goals for your energy efficiency program? Anything particular about your program that you find to be unique or exciting?