One Goal, Many Paths: Comparative Assessment of Industrial Energy Efficiency Programs

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ABSTRACT

Industrial energy efficiency programs are understood to be some of the most cost-effective efficiency resources available. Despite this, there is little public data on which types of industrial programs are most cost-effective, and why. This paper summarizes new research conducted on industrial energy efficiency portfolios administered by utilities and public benefit organizations throughout the U.S. Using several standard performance metrics, such as cost of saved energy and benefit-cost ratios, we show how different industrial efficiency programs compare with one another and also in comparison with residential and commercial programs. Industrial programs prove to be relatively cost-effective, yielding significant portions of total energy savings. We also discuss possible reasons for observed differences in program performance.

Introduction

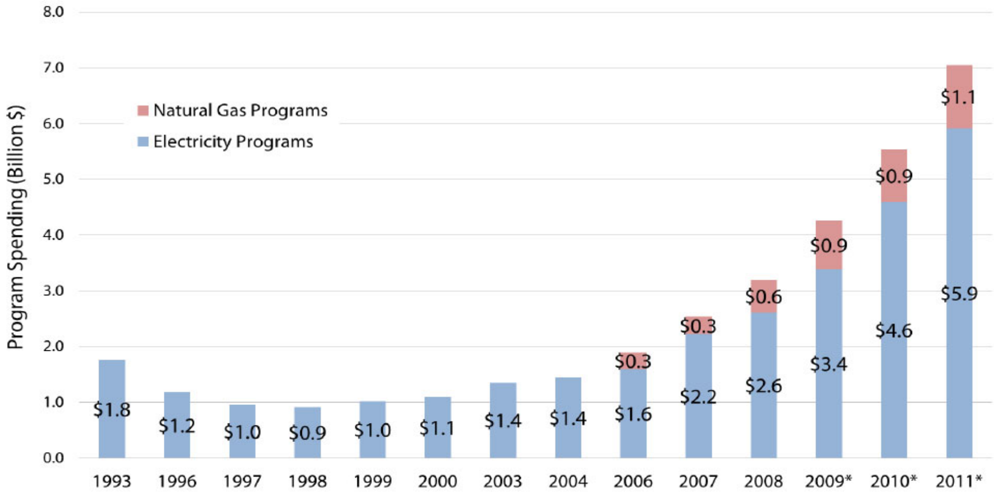
Around the country, energy efficiency (EE) goals for utilities and public benefit organizations are rising and more states are prioritizing EE as an energy resource just like coal or natural gas. Presently 44 states have ratepayer funded EE programs, with annual targets of increasing ambition, in many cases (ACEEE 2013). Anecdotally, EE program managers have indicated that they are having more and more difficulty identifying new efficiency opportunities in the residential and commercial sectors. As their efficiency goals rise, they are more interested in acquiring efficiency resources in the industrial sector, due in large part to its reputation as a sector in which EE resources are low-cost.

Meanwhile, many large industrial customers continue to resist these programs and the related ratepayer funding mechanisms, such as system benefits charges and EE riders. Sample system benefits charges for EE programs range from \$0.0009/kWh to \$0.0056/kWh; large industrial customers have successfully argued in some states that the charges – which can add hundreds of thousands of dollars to annual electric costs – are burdensome and the programs do not meet their needs (Chittum 2011). While some industrial consumer groups have advocated for provisions allowing them to opt out of ratepayer-funded EE programming, other industrial customers have touted their benefits and advocated in their defense (e.g., Neubauer et al. 2013).

Energy Efficiency Program Background

Between 2000 and 2011 total U.S. program spending on electricity and natural gas efficiency programs grew at an average annual rate of 18%. Figure 1 illustrates the growth of overall program spending from \$1.1 billion in 2000 to \$7.0 billion in 2011. As states increase the ambition of their EE and renewable energy resource standards, efficiency programs are growing to identify and implement savings opportunities (Bradbury and Aden, 2012).

Figure 1. Annual Electric and Natural Gas Energy Efficiency Program Budgets in the U.S.



Source: Foster et al. 2012.

Over the 1990's and 2000's rising energy prices spurred renewed interest in EE. Cost estimates suggest that industrial sector efficiency projects are among the cheapest and quickest ways to reduce greenhouse gas emissions (e.g., McKinsey 2009). There is a growing recognition that industrial EE resources are some of the more cost-effective energy resources available to utilities and states as they plan to meet future load growth or efficiency targets required by many state laws. Still, a great number of utilities offer commercial and industrial efficiency programs jointly and do not offer specific programs that target and address industrial firms' specific needs (Chittum 2012). This suggests that there are ample opportunities for utilities and public benefit organizations to increase their outreach and acquisition efforts in the industrial sector to keep rates low for all customers and help industrial firms reduce their costs.

By virtue of their low costs, industrial EE programs help keep energy costs down for all consumers. The better utilities, public benefit organizations, and states become at prioritizing and capturing available industrial EE resources, the better society can continue to meet energy demand growth in a low cost and low emissions manner.

Need for New Research

In states such as Indiana, West Virginia, and Iowa, the future of industrial EE programming is currently being hammered out in legislatures and regulatory agencies. ACEEE and WRI outreach and technical assistance to these and other states has revealed a dearth of data available for stakeholders struggling to understand the potential role of industrial EE in these states' energy futures. While policy makers may have a general sense that the industrial sector offers cost-effective EE opportunities, there are few comprehensive assessments of the role industrial EE plays in a state's efficiency portfolio.

Additionally, some states have embraced new industrial EE program types, some of which have not traditionally been part of utilities' industrial EE portfolios. How these programs (e.g., strategic energy management and combined heat and power) compare to others is largely unknown outside of the particular entities running the programs. These new types of programs are viewed in some cases as true resource acquisition programs, and are meeting the resource needs of states such as Oregon, Massachusetts, and New York.

Unfortunately, little nationwide data exists on the cost of saved energy in the industrial sector versus other sectors, and how the types of industrial programs and policies impact and influence the performance of industrial programs. Industrial programs' cost of saved energy, cost-effectiveness and energy savings performance is rarely, if ever, comprehensively compared to that of programs targeting the residential and commercial sectors.

This paper represents the first step in answering the question of how industrial programs compare with each other and with programs for other sectors. It also discusses how different types of industrial programs are used by industrial customers, and which types of programs are proving to be more cost-effective than others. The data and analysis presented here represent preliminary findings from a more in-depth, forthcoming report by WRI and ACEEE.[1]

Types of Programs

This research began with a review of established types of programs that target the industrial sector. Table 1 highlights program attributes, which utilities and public benefit organizations must consider when choosing programs to best meet industrial customer needs.

Table 1. Typology of Industrial Energy Efficiency Programs

Program Type	Strengths	Weakness
Prescriptive Incentive	Technology-specific	Limited ambition; not universally applicable
Custom/Process Efficiency	Facility-specific, flexible	Inconsistent assessment data
Strategic Energy Management	Systemic	Long time frames can be difficult to mesh with program funding periods
Market Transformation	Scattered, small, amorphous	Supply-chain and vendor orientation
Self-Direct Programs	Flexible, often low-cost to utility	Some questionable M&V; may overlook opportunities

Table sources: Chittum 2011; York et al. 2013

Prescriptive incentive programs are some of the most common industrial programs, and are often administered concurrently with commercial programs. Specific technologies, such as motors or lighting, are identified as eligible and explicit incentive or rebate amounts are assigned for each technology. **Custom efficiency programs** usually offer incentives or rebates based on a facility's entire kWh or therm savings, and so can credit savings acquired via a wide variety of technologies or modifications. **Strategic energy management programs** help support the deployment of holistic energy management strategies, including metric development and

[1] A joint publication between the authors of this Summer Study paper will be published later this year, featuring more in-depth profiles and discussion of a dozen specific programs from around the country. The preliminary findings presented here are based on data from published documents. The final report will also include discussion of policy implications and recommendations.

metering capabilities. These sometimes include specific programs that encourage best practices in the operation and maintenance of equipment. **Market transformation programs** work to strengthen the path between EE products and systems and the ultimate end users. **Self-direct programs** put the burden of project engineering on the individual firm in exchange for more autonomy over how a project is developed and, sometimes, higher rebate levels.

There are significant variations among these program types, and certainly other types of programs all together. A forthcoming report will describe in greater detail the wide varieties of programs targeting industrial customers. However, most programs can be roughly categorized into one of the above types.

Judging Performance

Recognizing that how a program is "performing" might not be fully revealed in certain metrics, there are some metrics that can aide in the comparison of one program to another. The aim of this research is to understand how different programs are serving their customers, serving other ratepayers, and serving society in general. It is also to understand how different program structures and policies are impacting these performance metrics. To that end, four metrics are being collected for ratepayer-funded programs:

- **Cost-benefit test results**. Within the U.S. there are three types of commonly-used tests for quantifying EE program cost-effectiveness that range in their scope of consideration. On the micro end of the spectrum the Participant Cost Test (PCT) compares the costs and benefits of EE projects and programs for individual consumers. At the macro end of the spectrum the Societal Cost Test (SCT) includes resource savings and non-monetary costs and benefits of efficiency programs for a broader group of society. The most frequently used assessment method is the Total Resource Cost (TRC) test, which seeks to answer the question "Will the total cost of energy in the utility service territory decrease?" (Kushler et al. 2012). Results of these tests are usually presented as benefit-to-cost ratios, with a number of 1 or greater representing a determination that the program benefits outweigh the costs[2].
- **Cost of saved energy**. Many programs also report the cost of saved energy through an EE program as an amount of dollars per kWh or therm saved. The typical cost of saved energy metric includes consideration of measure life and an appropriate discount rate, and reflects the cost of energy to the utility. The "levelized" cost of saved energy is a cost that is comparable across multiple utilities by reflecting the costs within a certain time period and considering certain assumptions. A wide-ranging survey in 2009 found the median levelized cost of saved energy across all sectors to be about three cents per kWh, or well below the cost of new generation resources (Friedrich et al. 2009).
- **Participation rates**. Some publicly reported participation rate data reflects the percentage of eligible customers that participate in a given program while other data reflects the percentage of *targeted* customers who participate. Additionally, different program types will be inherently better suited for certain types of industrial customers. To maximize energy savings from industrial customers, it would be useful to better understand which types of programs are most appealing to

[2] For more detailed discussion, see Henriksson and Soderholm (2009).

certain types of firms or subsectors of industrial customers. These data are rarely reported in public filings and more research will be needed to fill-in these data gaps.

- **Saved energy**. Most programs must report annual or program period saved energy, which will be the measured or deemed savings minus some amount attributed to "free riders," which are savings that were not actually caused by the program itself. Sometimes these saved energy amounts also include some measure of "spillover," which are savings that were not a result of direct program-to-customer activity but were instead caused indirectly through program activities (Chittum 2012).

New Research

This research collected as many of the above metrics as possible from targeted EE programs. We focused on programs marketed primarily or significantly to industrial customers, including both industrial-specific programs such as process efficiency programs, and ones such as lighting programs that address both the commercial and industrial sector concurrently. To the extent practical, performance metrics are also presented along-side results from similar programs that target residential customers, for comparison.

Methodology

The primary goal of this research is to understand how programs targeting the industrial sector specifically are performing relative to each other as well as relative to EE programs targeting other sectors. This paper is based on secondary-source research, which consisted of reviewing publicly available evaluation reports, annual reports, and system planning documents such as integrated resource plans. This research was not an attempt to conduct a census of all industrial EE programs in the country. Instead, this is an initial review of six programs administered by a geographically diverse set of utilities and public benefit organizations.

Table2 identifies the entities targeted and some of the programs within each entity that were included in this analysis. EE stakeholders in each region of the country were asked to help identify target programs. These utilities and public benefit organizations were identified as leaders in the administration of industrial EE programming, and as those with significant history of administering such programs to the industrial sector.

Table 2. Assessed Programs

Utility or Organization Name (State)	Program Name
Focus on Energy (WI)	Business Incentive, Large Energy Users
Xcel Energy (CO)	Recommissioning, Self-Direct, Large Commercial and Industrial Standard Offer
Xcel Energy (MN)	Recommissioning, Industrial Process Efficiency, and Custom Efficiency
Pacific Gas & Electric (CA)	Energy Solutions for Manufacturing Facilities

American Electric Power (OH)	Custom Incentive Program, Prescriptive Program, Self-Direct
Rocky Mountain Power (UT)	New Facilities, Energy FinAnswer, Self-Direct, Energy Project Manager Co-Funding

The overarching questions we sought to answer included:

- How cost-effective are various industrial-focused EE programs?
- How do savings impacts compare among different industrial programs administered by each utility or public benefit organization?
- What kind of participation rates does each type of program see?
- What is the cost of saved energy and total saved energy for the target programs, and how does it compare to others?

While these questions could not be definitively answered for all programs, some general trends and common findings were revealed.

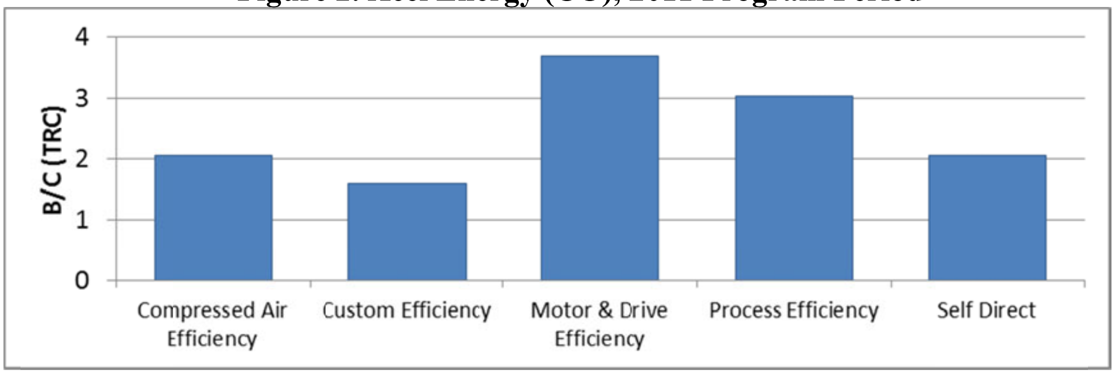
Preliminary Findings

Industrial EE programs have cost and savings profiles that differ from residential, commercial, and agricultural programs and also vary among utilities and states. To describe utility, customer, and society-scale data, this study presents findings along the four parameters described above. In general, the research offered substantive support for the claim that industrial efficiency is often among the cheapest EE resource available to utilities today. Earlier research has found that the average cost of saved energy for utility programs was $0.025 per kWh (Friedrich et al. 2009).

Cost-Benefit Test Results

Figure 2 shows some of the benefit-to-cost ratios of Xcel Energy's main industrial-focused programs in Colorado. In this case, the motor and drive efficiency program proves to have the greatest benefit to cost ratio, perhaps reflecting the small amount of utility resources put toward achieving those savings.

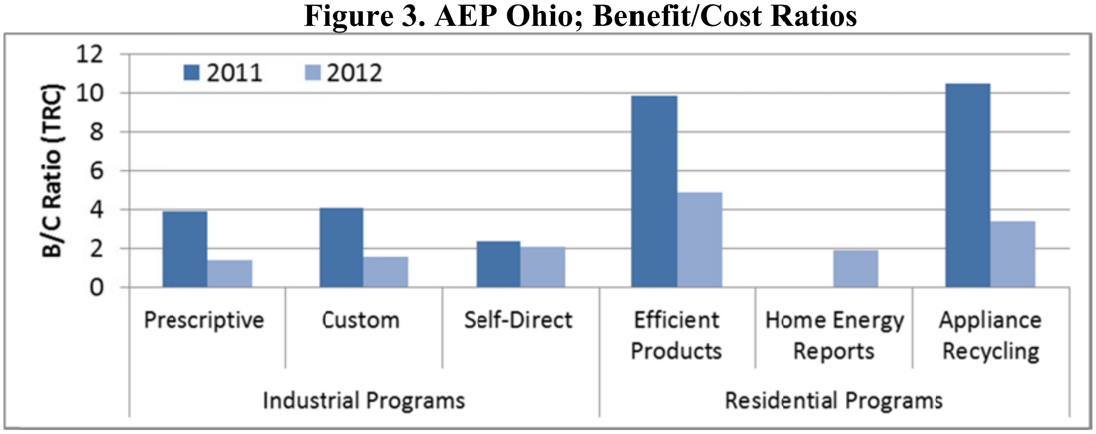
Figure 2. Xcel Energy (CO), 2011 Program Period



Source: Xcel CO, 2011.
Notes: these B/C ratios reflect a TRC test

Figure 3 shows similar data collected by American Electric Power in Ohio, indicating that fairly consistent performance among industrial programs, with residential lighting and appliance recycling significantly out-performing all other programs in 2011 (though much less so in 2012). Note that AEP's self-direct program is explicitly a "look-back" program, providing incentives for projects that already occurred; this type of program is potentially subject to "free-rider" effects whereby previously planned efficiency investments are rewarded by utility programs. The expectation is that customers will take their new rebates and invest in new EE projects, but there is no requirement to do so.

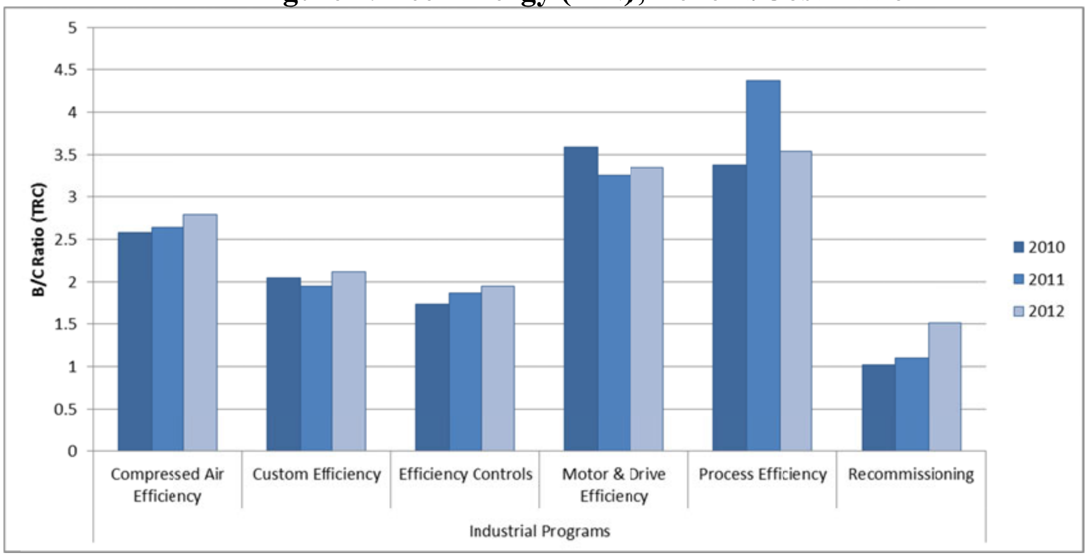
Figure 3. AEP Ohio; Benefit/Cost Ratios



Sources: AEP Ohio (2011, 2012)

Figure 4 shows benefit to cost ratios for several industrial EE programs offered by Xcel Energy Minnesota. Several years of experience with these programs shows that commercial and industrial programs are generally as cost-effective as residential programs; meanwhile, certain industrial EE program types – such as process efficiency, motor drive efficiency – reliably out-perform other programs.

Figure 4. Xcel Energy (MN); Benefit/Cost Ratio

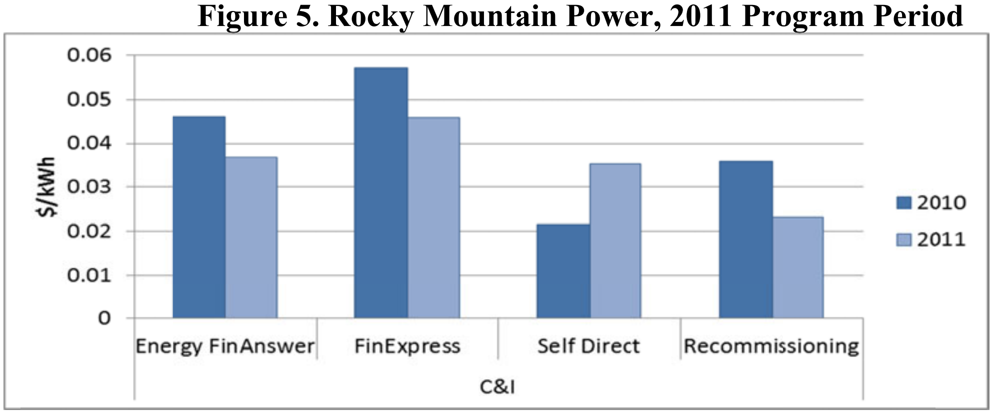


Sources: Xcel MN (2010, 2011, 2012)

Cost of Saved Energy

In Utah, Rocky Mountain Power (RMP)'s self-direct program is used by its largest business customers, who completed 33 projects within the program in 2011. The self-direct program is administered very closely with RMP's Energy FinAnswer programs, which are used by commercial and industrial customers[3]. Figure 5 shows the levelized cost of saved for its commercial and industrial targeted programs during the 2011 program period. The Energy FinAnswer program has been more cost-effective than the self-direct program in recent years.

Figure 5. Rocky Mountain Power, 2011 Program Period



Source: Rocky Mountain Power, 2011

[3] FinAnswer is a process efficiency program while FinAnswer Express is a prescriptive program.

The Wisconsin Focus on Energy program was founded in 1999 when the state established a public benefits fee with the passage of Act 9. Table 3 shows that non-residential programs had a higher measured benefit-cost ratio than residential programs in 2010 although the total program cost was nearly double.

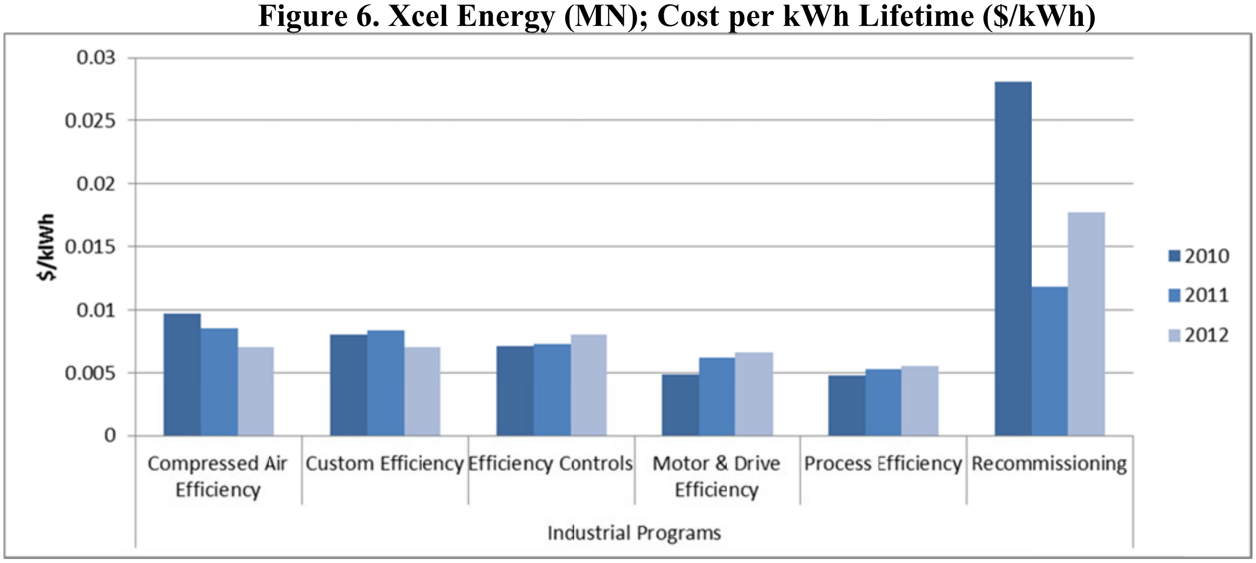
Table 3. Wisconsin Focus on Energy, 2010

	Non-Residential (mostly industrial)	Residential
Total Costs	$81 million	$42 million
Benefit-cost ratio	2.7	1.5

Source: Focus on Energy 2011

Figure 6 shows one metric of the cost of saved energy for Xcel Energy (MN). Here, with the exception of recommissioning, industrial and commercial sector programs have significantly lower costs for saved energy, compared to average residential programs. Note that recommissioning programs can have very different levelized costs, suggesting that program design and implementation may be particularly important for this program type. For example, while Xcel Energy found low customer follow-through on recommended savings; meanwhile, RMP had higher implementation rates because customers who do not implement the operational efficiencies identified through the collaborative process are required to repay direct program costs.

Figure 6. Xcel Energy (MN); Cost per kWh Lifetime ($/kWh)



Source: Xcel MN, 2010 – 2012
Notes: Costs are calculated by Xcel, "Utility Program Cost per kWh Lifetime."

Participation Rates

Preliminary data show that industrial programs have participation rates that are lower than residential or commercial programs, but higher than agricultural programs. As illustrated in Table 4 below, less than 1 percent of eligible PG&E industrial customers participated in EE programs in 2011. Given the high benefit ratios of industrial EE programs shown above, higher industrial participation could help to reduce rates and overall energy use.

Table 4. PG&E Energy Efficiency Program Participation Summary, 2011

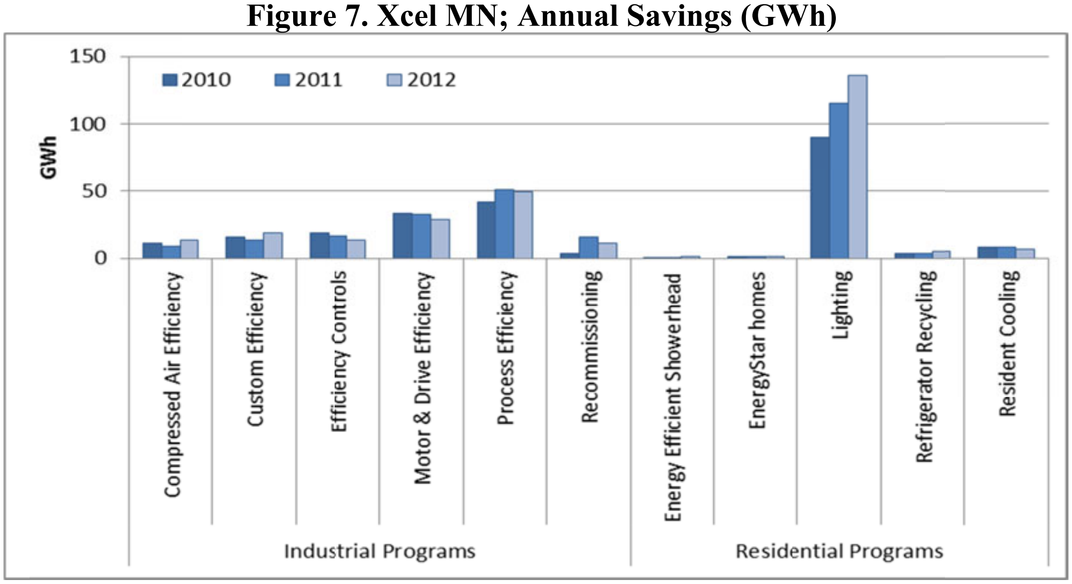
	Total Eligible	Total Participating	% of Eligible
Commercial	827,655	10570	1.28%
Industrial	74,267	600	0.81%
Agricultural	107,085	757	0.71%
Total	**1,009,007**	**11,927**	**1.18%**

Source: PG&E 2012.

Saved Energy

Data presented in the remaining tables illustrate that when EE programs are effectively targeted toward large customers, industrial (and commercial) programs can result in as much or more energy savings than residential programs. Data collected from multiple annual reports (e.g., Figures 7 and 8) supports this conclusion based on several years of available data.

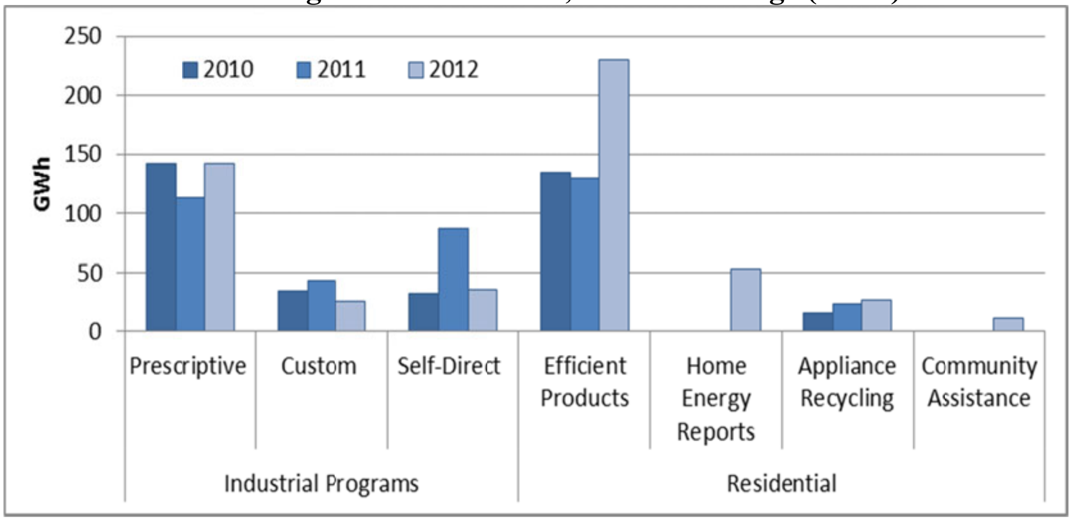
Figure 7. Xcel MN; Annual Savings (GWh)



Source: Xcel MN, 2010 - 2012

Notes: Net savings are calculated by Xcel, "Net Annual kWh Saved at Generator."

Figure 81. AEP Ohio; Annual Savings (GWh)



Source: AEP Ohio 2010 - 2012.

Conclusions

Industrial EE programs are generally as cost-effective – or more cost effective – than programs in other sectors, while also yielding relatively low costs of saved energy. This likely reflects the significant deep energy savings opportunities available in the industrial sector, and the fact that seemingly minor changes can yield significant savings over the lifetime of a measure.

Within industrial programs prescriptive programs, like motor and drive efficiency programs are popular and cost effective, therefore yielding high levels of total energy savings. Process efficiency programs can be similarly impressive results. Custom efficiency programs also show promising results in many cases, however, like recommissioning and self-direct approaches, program design is likely critical to program success and cost-effectiveness. Where results are inconsistent or program experience limited, more research will be needed to understand which program types are lowest cost and the greatest total energy savings potential.

Ultimately, policy makers and EE program designers that have not previously considered the industrial sector for major EE efforts might be well served by understanding the degree to which industrial EE is inexpensive, cost-effective and yield significant savings over time. Industrial EE programs can keep the overall EE portfolio low cost and affordable, conferring greater economic benefit to all ratepayers.

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