

One Small Step for Energy Efficiency: Targeting Small and Medium-Sized Manufacturers

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Executive Summary

The manufacturing sector accounts for about a third of primary energy consumed in the United States. This sector is increasingly relied on to generate energy savings to meet efficiency targets set by states and energy utilities. While most of that effort has sought savings from large manufacturers (the 10% of establishments that account for close to 50% of energy use), more energy efficiency programs are beginning to address the needs facing small to medium-sized manufacturers (SMM). This report discusses barriers, opportunities, and solutions to designing energy efficiency programs that result in significant savings from smaller manufacturers.

The term “small and medium-sized manufacturers” should not be confused with “small and medium businesses,” a group that includes many non-manufacturing establishments. This report is focused on the manufacturing sector. It is also generally applicable to industries such as agriculture and mining.

For energy efficiency programs, onsite energy consumption—or sometimes electrical demand—is generally the best metric for judging industry size. This figure is commonly between a few hundred and several thousand megawatt hours (MWh) per year, or a half to several million therms of natural gas. In practice the industry composition in a given service territory drives the size threshold. For example, an area with large petrochemical facilities may have a different definition of “small” than an area with mostly auto parts suppliers.

SMM make up about 90% of manufacturing establishments and use about 50% of the energy consumed by industry. Despite using less energy at a given facility than their larger counterparts, SMM are good targets for energy efficiency programs for a number of reasons. Not only do they pay higher prices for their energy and are less likely to have dedicated onsite energy managers, but smaller energy savings projects tend to save a higher percentage of total consumption. Still, barriers exist: a lack of staff resources, capital constraints, and a dearth of expert information on energy efficiency opportunities.

To overcome some of these barriers, energy efficiency programs have offered manufacturers, including SMM, a suite of program models. These include energy audits to identify opportunities, prescriptive rebates that provide low-hassle incentives for common measures, custom rebates to provide incentives for more complex or unique measures, and workshops and informational materials to help manufacturers build internal capacity for identifying energy efficiency opportunities. Even the successful models can be improved upon. Some programs have changed their interactions with SMM, developed new offerings, or redesigned their existing offerings in the face of particular barriers.

Energy efficiency programs targeting SMM have opportunities in the areas of outreach, energy management, financing, and leveraging existing resources.

A key to successful energy efficiency programs is reaching out to and developing relationships with customers. This is true for all manufacturing, but it is a particular challenge when trying to reach a large number of smaller facilities. One way to reach out is through trade allies. In many cases, trade allies already have relationships with SMM based on goods and services they have provided in the past. In addition to trade allies, programs

can partner with other existing organizations such as local manufacturing trade associations, Industrial Assessment Centers, manufacturing extension partnerships, and state energy or economic development offices. Another way to increase participation among SMM is to streamline processes to reduce transaction costs.

Several successful energy management programs have learned from their experiences with larger energy users and applied those lessons to the SMM market. One way of doing this is to use a cohort approach, which involves recruiting companies and treating them as a group to reduce interaction costs for training and education events. This approach allows program staff to address several customers at once, and also provides a peer network for the manufacturers to share best practices and benchmark against. Another promising energy management strategy for SMM is to share energy managers. This approach is attractive because SMM typically do not have the staff capacity to hire a full-time energy manager. In one example, a manufacturer hired a consulting firm to provide the equivalent of one full-time staffer to manage the energy use of six of their plants.

A third opportunity for energy efficiency programs targeting SMM is to help secure financing for projects. Promising strategies include on-bill financing, in which the utility provides financing and customers pay for it through their energy bills, and property-assessed clean-energy (PACE) programs, in which energy efficiency projects are supported through a property tax assessment. These tools reduce the upfront cost of energy efficiency improvements, a crucial barrier to SMM.

Finally, efficiency programs can leverage existing resources such as state and federal tax credits. One often overlooked group of resources are the programs run through the United States Department of Agriculture (USDA), including the Rural Energy for America Program (REAP), the Business and Industry Guaranteed Loan Program, and the Rural Business Enterprise Grant Program.

Five lessons emerge from successful programs:

- Build relationships with industrial customers.
- Think about how to streamline administrative processes to reduce transaction costs.
- Help customers build energy efficiency expertise on their staff.
- Identify a particular barrier to the SMM being served and design the program around it.
- Build on past successes.

Introduction

The demand for energy efficiency has been increasing over the past decade as consumers and businesses realize its benefits and energy utilities increasingly view it as a resource to be planned and managed. Initially, energy efficiency programs focused on the residential and commercial sectors. The manufacturing sector, which accounts for about a third of primary energy consumed in the United States (EIA 2013a), has been harder to reach for a number of reasons. These include the technical complexity of manufacturing processes, aligning programs goals with how decisions are made in industry, and in some cases the desire of large industries to be exempt from efficiency programs. As energy efficiency targets set by state governments spread across the country and continue to increase in magnitude, programs delivering energy efficiency must seek new and better ways to achieve savings.

Given this background, governments, utilities, and other program administrators see it as increasingly important that the manufacturing sector acquire energy efficiency resources. Over the last decade, energy efficiency programs have developed a host of offerings responsive to the needs of the manufacturing sector, particularly large or energy-intensive facilities. However, small and medium-sized manufacturers (SMM) have not always reaped the benefits of these programs, largely because the programs were not designed with them in mind. Currently, SMM are usually offered a generic suite of programs that apply broadly to commercial and industrial customers. Only a handful of innovative programs address particular barriers to energy efficiency faced by SMM.

In order to understand why energy efficiency programs are not sufficiently serving smaller manufacturers, it is necessary to look into the demographics of this sector and the barriers to energy efficiency that exist there. Examining both the generic energy efficiency offerings available to SMM and the more innovative approaches will shed light on new ways to increase energy efficiency and achieve savings goals among SMM.

WHAT IS A SMALL AND MEDIUM-SIZED MANUFACTURER?

The most fundamental question is definitional: what constitutes small and medium-sized manufacturing? This question has not gone unanswered, but it depends on who is asking it and why. For reasons discussed below, we use the term SMM in this paper but there are many variations on the term. This market segment is often referred to as “small business,” “small or medium-sized business,” “small or medium-sized enterprise,” “small or medium industry,” or “small manufacturing.” The following table gives the definitions of such terms both from common resources and from the programs highlighted in this report.

Table 1. Select Definitions of Terms Similar to SMM

Organization	Term	Definition
U.S. Small Business Administration	Small business (manufacturing)	<500 employees ¹ (including all affiliates)
National Association of Manufacturers	Small and medium manufacturer	<500 employees (small manufacturing) <2,500 employees (medium manufacturing)
U.S. DOE Industrial Assessment Center Program	Small- and medium-sized manufacturer	<500 employees <\$100 million in sales Annual energy costs between \$100,000 and \$2.5 million No in-house energy management staff Applies to industrial site only, not entire company
Energy Trust of Oregon	Small industrial energy user	<500 MWh per year
Energy Trust of Oregon	Small to medium industrial customers	Annual energy costs between \$50,000 and \$500,000 750 MWh – 7,500 MWh 5,000 – 100,000 decatherms
NEEA/Northwestern Energy	Small-to-medium business / smaller industrial customers	At least 150 kW monthly demand
ACEEE (Shipley et al.)	Small and medium-sized industry	<500 employees No corporate energy management staff
Energize Connecticut	Small commercial and industrial customers	Peak demand between 10 and 200 kW

Sources: SBA 2013, NAM 2006, IAC 2013, Prause & Warila 2009, Wilson & Macklin 2013, Gilles, Brown & Boston 2013, Shipley, Elliott & Hinge 2002, Energize CT 2013b.

These terms raise several issues. First, it is useful to clarify the terms “industry” and “manufacturing.” As defined by the U.S. Energy Information Administration,² the industrial sector includes agriculture, mining, construction and manufacturing, although manufacturing accounts for the great majority of industrial energy consumption (EIA 2013a). Since this report focuses on the barriers to energy efficiency in manufacturing, we use the term “small and medium-sized manufacturer” throughout. However, several of the programs we describe serve both manufacturing and non-manufacturing industries, and many of the recommendations will apply to the entire manufacturing sector.

¹ The actual definition varies by subsector (down to the 6 digit NAICS code level). For the vast majority of manufacturers, it is 500 employees, but in some cases it can be up to 1,500 or depend on other factors such as annual revenue.

² <http://www.eia.gov/tools/glossary/index.cfm?id=1>

It is also important to note that the distinction between manufacturing and non-manufacturing is not always clear. For example, some large dairy operations more closely resemble a food processing manufacturing facility in terms of energy-using equipment (e.g., pumps, conveyors, process heating, and refrigeration) than what we might think of as a farm. Additionally, some facilities involve both manufacturing and non-manufacturing; for example, a dairy may raise cattle and process the milk. For these reasons it is not unusual for programs to cover some agriculture or mining operations along with manufacturing.³

Another issue is that in common usage, “small business” (and often “small and medium business” or “small and medium enterprises”) extends far beyond small and medium manufacturing firms and includes, for example, retail, food service, and small service companies. Therefore energy efficiency programs targeting SMM should not be confused with programs targeting small business or small and medium business (SMB). Due to inconsistent usage of these terms, one must pay careful attention to how they are defined; a program may say it is reaching out to SMB but may in fact be using a definition more closely aligned with what this paper refers to as SMM.

Perhaps most critically, there are two basic ways to define the “small and medium” part of SMM: by the amount of energy consumed or by number of employees. For many small business applications, employment size is the more common metric. This is largely due to its use by the Small Business Administration (SBA), making it a de facto government standard. The SBA definition uses the broader definition of “business” discussed above and then varies it by economic sector and industrial subsector. For most manufacturing industries, the SBA definition of “small business” is a firm with fewer than 500 employees (SBA 2013). The National Association of Manufacturers (NAM) uses this SBA definition for small business and adds “medium business” as a manufacturer with fewer than 2,500 employees.

Another reason employment data are a more common metric than the amount of energy used is that employment data are more commonly reported than energy consumption. The latter is often either not tracked as thoroughly as employment or seen as confidential.

For energy efficiency, however, employment size is not a useful metric, as energy use does not correlate with number of employees. For our purposes, SMM is best defined by its energy consumption and energy demand. Energy is, after all, the target of efficiency programs. This is why the organizations in Table 1 above that deal directly with manufacturers use annual energy consumption (Energy Trust of Oregon), peak electricity demand (Energize Connecticut), or total annual energy costs (the Industrial Assessment Center program).

Ultimately, the amount of energy consumption used as the cutoff should depend on the market the program is targeting. Programs typically target the largest users first (for reasons discussed later in this report), and an SMM program should target those users who are not

³ For more information on energy efficiency programs serving agricultural sites, see <http://aceee.org/research-report/ie051>

being reached by the large user programs or more general offerings. Of course it is important to note that what constitutes a "small" manufacturer is relative to the general population. Someone looking at all industry in California may have a different idea of "small" than someone dealing with the customers of a small municipal utility.

Finally, we must address the difference between an establishment, facility, or site on the one hand and a firm, company, or organization on the other. The U.S. Census Bureau defines an establishment as "a single physical location where business is conducted or where services or industrial operations are performed" (Census 2011). This is a discrete site as opposed to a "firm," which is "a business organization consisting of one or more domestic establishments in the same state and industry that were specified under common ownership or control." The SBA and NAM definitions consider employment by the firm, as shown in Table 1. When considering what constitutes a SMM, energy efficiency programs should choose establishments, not firms. Programs are more interested in the energy use at the establishment or facility level. This makes sense, because most programs (particularly those administered by energy utilities) interact only with individual establishments, not with entire companies.

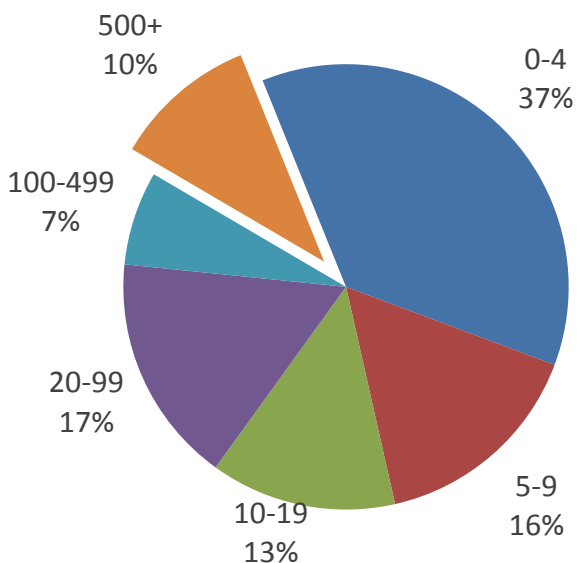
Ultimately, since there is no common definition of SMM or similar terms, it is important to understand the definition being used in a given context. This report uses "small and medium-sized manufacturers" loosely: manufacturing is the primary target, but our analysis is also generally applicable to other industrial sectors, and perhaps even large commercial sector entities. Although we do not specify a particular size threshold, we recommend that the determination of size be based on (1) energy consumption (2) only the energy used at that establishment.

This report will also sometimes refer to "small businesses" when presenting data that is not focused on the manufacturing sector. Due to the wealth of data on small businesses in general and the lack of data targeting smaller manufacturers, we will sometimes discuss information pertaining to the former.

ENERGY USE AND EMPLOYMENT IN SMM

Understanding the distribution of energy and employment size across the manufacturing sector helps identify the SMM market. Small and medium establishments make up the vast majority of companies both in manufacturing and the economy at large. Figure 1 below shows manufacturing establishments (facilities) in the U.S. by employment size. As we discussed, employment size is not the best metric for examining the SMM market, but it is one of the few measurements widely available.

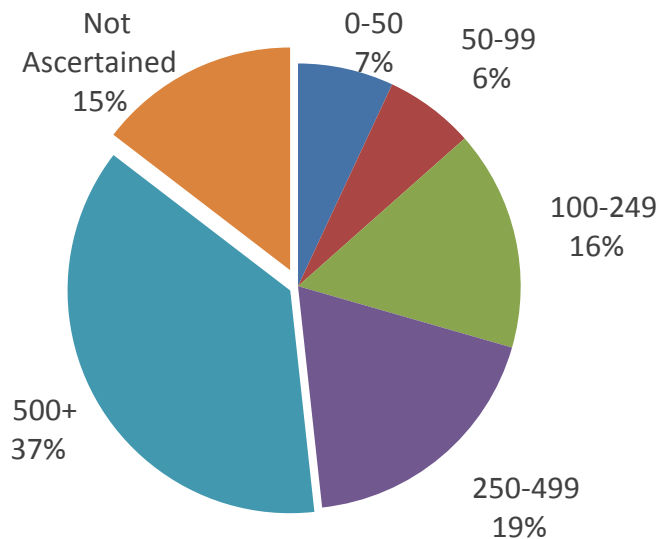
Figure 1. Percent of Manufacturing Establishments by Employment Size



Source: U.S. Census Bureau 2011

If we use the SBA convention of small business as having fewer than 500 employees, SMM accounts for nearly 90% of manufacturing facilities. 66% of facilities have fewer than 20 employees, and 83% have fewer than 100. Figure 2 shows the energy consumed by manufacturers based on the number of employees.

Figure 2. Percent of Manufacturing Energy Consumption by Employment Size



Source: EIA 2013b

These two charts show that the SMM market accounts for nearly 90% of all facilities but only about half of the total manufacturing energy consumed.⁴ Although most industrial energy efficiency programs target the largest users, these data show that in order to acquire energy savings from the entire manufacturing sector, programs must also find a way to address the needs of SMM.

While on average SMM account for about 48% of U.S. manufacturing energy use, this percentage varies across states and regions. Table 2 shows the SMM share of manufacturing energy consumption for the four main census regions.

Table 2. Energy Consumed by Manufacturers with Fewer Than 500 Employees

Census region	Percent of manufacturing energy use
Northeast	52.8%
Midwest	55.4%
South	43.5%
West	55.1%
U.S. average	48.3%

Source: EIA 2013b

This variation is partly a factor of the industries prevalent in the various regions. For example, large petrochemical and wood products companies common along the Gulf coast are the drivers for the South's low SMM energy share of 43.5%, while several industries that tend to be made up of relatively smaller companies – such as the steel casting and auto part supplier industries – drive the Midwest's SMM energy share up to 55.4%.

SMM AND ENERGY COSTS

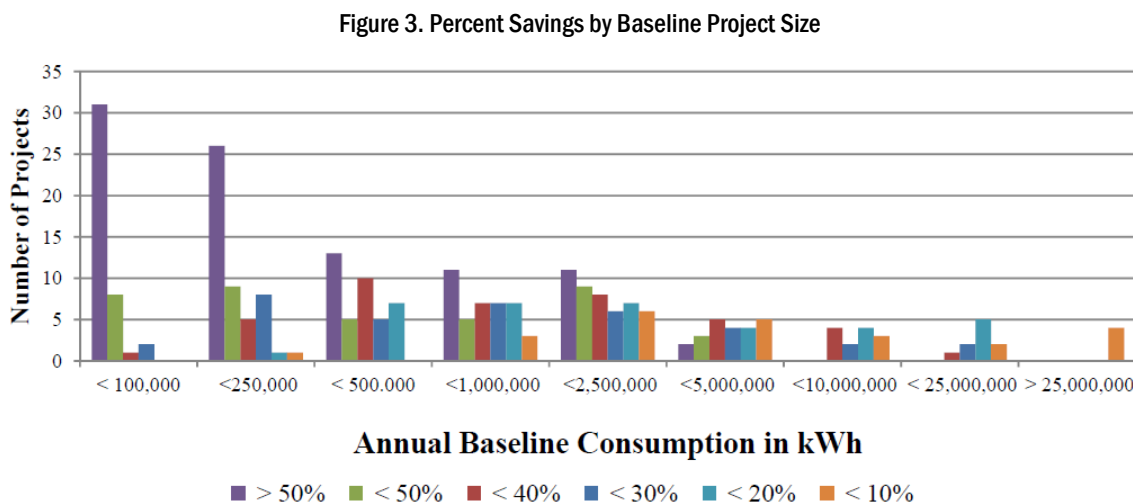
How significant are energy costs to small businesses? A 2013 Gallup poll placed the price of energy third on a list of concerns by U.S. small businesses, behind only health-care costs and taxes (Jacobe 2013). This concern is supported by data: smaller establishments (particularly those with fewer than 250 employees) pay significantly higher prices for electricity and natural gas compared to larger facilities. For example, establishments with 50-99 employees pay an average cost of 7.5 c/kWh, while establishments with 500-999 employees pay only 5.6 c/kWh (EIA 2013b). On average, manufacturing facilities with fewer than 250 employees pay 30% more per kWh of electricity and 8% more per MMBtu of natural gas compared to larger facilities.

⁴ The Manufacturing Energy Consumption Survey (EIA 2013b) puts 15% of manufacturing energy use in the “not ascertained” size category. It is not clear which size category this energy would fit under, but it accounts for consumption at petroleum refineries, which are less likely to be considered small and medium-sized industry.

In addition to paying higher energy prices, smaller firms tend to have tighter cash flow, so they do not have the buying power or access to purchasing options of large firms. Fortunately, several program options discussed later in this report help address these issues.

ENERGY EFFICIENCY PROJECTS AND SMM

There are many reasons to pursue energy efficiency at SMMs, but often overlooked is the relative impact that efficiency projects can have at smaller sites. Figure 3 below shows the results of a review of over 250 industrial energy efficiency projects by Southern California Edison.



In this figure, “baseline consumption” refers to the energy consumption of the system before an energy efficiency measure was installed. Smaller systems, which intuitively are more common at smaller sites, offer much higher savings relative to the baseline. The takeaway is that while energy efficiency programs may have a harder time achieving these savings (for reasons discussed below), they have a bigger impact at the site. In other words, even though the manufacturer’s absolute energy savings are smaller compared to other projects, smaller manufacturers are more likely to see a higher percentage reduction in their energy costs due to energy efficiency.

Barriers to SMM Energy Efficiency

SMM face the same barriers to energy efficiency as all manufacturers do, but they also have a few unique issues that make implementing energy efficiency offerings even more challenging. The problem is that SMM do not fit neatly into either of the two more common program types: small business programs and large industrial programs.

First, SMM are set apart from other small businesses in the same way that the industrial sector on a whole is set apart from the commercial sector: the way manufacturing uses energy is more complex. In medium to large commercial and institutional buildings (which may use as much or more energy as many small manufacturers), the vast majority of energy use is for lighting and space conditioning. By contrast, those end uses account for only about

15% of manufacturing energy use (EIA 2013b). The rest of the energy is consumed by the manufacturing process, the specifics of which vary greatly across subsectors (and even from plant to plant within a subsector). Each subsector or plant can require specific technical expertise to deliver energy efficiency. On top of that, manufacturers are wary of changing their process lines for purposes of energy savings. Safety, production throughput, and product quality are paramount; anything that might interfere with those is viewed with suspicion.

So while energy efficiency programs providing technology solutions for lighting and space conditioning can impact the majority of commercial buildings' energy use, the manufacturing sector needs solutions specific to each subsector or even facility. This need for technical expertise and one-on-one attention creates a higher transaction cost for industrial programs than for residential and commercial buildings. And while it is worth the high transaction cost to get savings from larger plants, lower savings per plant and limited program resources make it harder to justify one-on-one technical assistance for smaller manufacturing firms.

Second, SMM have different needs than their larger counterparts. A 2009 fact sheet by the American Council for an Energy-Efficient Economy (ACEEE) laid out four potential barriers to industrial energy efficiency (Elliott and Kaufman 2009):

- Access to industry-specific technical expertise, assessments, and training for workers
- Access to capital to make needed investments
- Need for new technologies, products, and processes
- Availability of a trained and capable workforce

Many energy efficiency programs targeting larger manufacturers tend to focus on the first barrier by providing technical expertise to identify and develop energy efficiency solutions in manufacturing processes. To a lesser degree they also focus on the second barrier through incentives or financing options. The other two barriers are more appropriately addressed by private companies, federal or state governments, or programs with a market transformation focus.

Another study by the Alliance to Save Energy identifies slightly different barriers when looking specifically at SMM (Bostrom, Harris & Lung 2010):

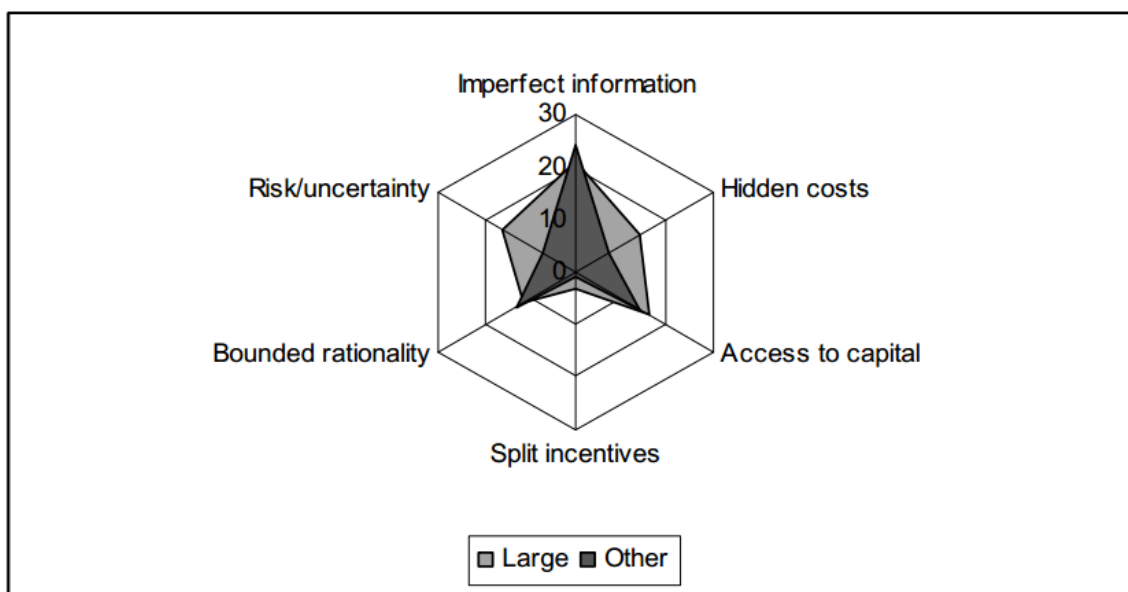
- Capital constraints, which lead to lower-cost initial measures
- The fact that energy is not the company's business, and hence a lack of dedicated staff
- Purchasing decisions, which should be made more strategically, not at the point of equipment failure
- Lack of access to industry associations and best-practice sharing

While the first three of these barriers apply to most industrial consumers, they are more pronounced for smaller facilities. Access to capital for energy efficiency is a barrier for large industries not because they lack access to capital in general, but because energy efficiency projects have to compete against many other priorities for that capital. SMM are less likely

to have access to capital in general. Likewise, manufacturing staff are generally unlikely to have the expertise to identify and design energy efficiency solutions. In SMM, this deficiency is compounded by a limited workforce and a lack of staff redundancy, making it more difficult to identify staff who could possibly take on the role of energy use management.

The United Nations Industrial Development Organization (UNIDO) further illuminates the differences between the needs of smaller and larger manufacturers in a literature review on barriers to industrial energy efficiency around the globe (Sorrell, Mallett & Nye 2011). The paper identifies 147 mentions of barriers from 64 studies. Figure 4 below shows the barriers to industrial energy efficiency for small and medium enterprises (SME) and larger manufacturers.⁵

Figure 4. Barriers to Energy Efficiency for Large Companies and SMEs



(Source: Sorrell, Mallett & Nye 2011)

This figure shows that while larger manufacturers are moderately affected by most of the barriers, three barriers are most commonly cited for SMM: imperfect information, access to capital, and bounded rationality.⁶ This finding speaks to the need among SMM for (1) more access to technical information on identifying and implementing energy efficiency solutions, (2) innovative ways to pay for it, and (3) a better understanding of business decision making. Successful energy efficiency programs targeting SMM must address all of these barriers.

⁵ Note that in this figure, the darker shade ("Other") represents SME industrial companies, which roughly correlates with SMM as used in this report.

⁶ "Bounded rationality" refers to deviations from the classical market theory that all economic actors are fully rational and act to maximize their own self-interest. It includes constraints on time and resources, use of rules of thumb, status quo bias, and risk aversion, among other issues.

Overview of Program Types

Energy efficiency programs typically provide some services to SMM, but these services are not always designed with this particular group in mind. This section will briefly examine the most common offerings to SMM before detailing several novel approaches that have potential to increase energy savings and participation rates among SMM customers.

GENERAL OFFERINGS TO SMALL AND MEDIUM-SIZED INDUSTRY

The SMM market has traditionally been served by generic program offerings. While many SMM are able to take advantage of these traditional programs, they are not being strategically targeted, so significant energy savings are left uncaptured. This is not to say that some of these programs have not been successful; in fact they are the base on which more successful and unique programs are built. Many of the programs highlighted in the later sections of this report still make use of generic offerings, but they go one step further to overcome barriers specific to SMM. The traditional offerings themselves fall into several main groups.

Audits. Identifying savings opportunities is the first step toward acquiring energy efficiency resources. Energy efficiency programs will often encourage energy audits or assessments at industrial plants. They may provide the technical service directly (using in-house staff or third party contractors), or they may reimburse the industrial facility for all or part of an audit by a contractor who is often preapproved or recommended. Audits result in a list of potential projects with estimated energy savings and a simple financial analysis. Once possible projects are identified, programs usually offer rebates or other financial incentives to increase the likelihood of implementation.

Prescriptive rebates. For common, relatively simple measures, energy efficiency programs will often offer rebates of a fixed amount for each piece of technology installed. When associated with common opportunities like lighting, motors, or boilers, the energy savings can be easily and accurately estimated, so there is no need to go through detailed calculations every time. This “deemed savings” approach allows programs to achieve reliable energy savings with minimum transaction costs. Products with energy performance labels indicating efficiency levels higher than are federally mandated or commonly available (i.e., levels that are industry standard) are generally used as the basis for prescriptive rebates. One example is the National Electrical Manufacturers Association (NEMA) Premium® label, which covers certain lighting, transformers, and electric motors.⁷ Prescriptive rebates are currently limited to individual pieces of equipment as opposed to systems. The text box on the following page describes possible new developments in this area.

Custom rebates. Many energy efficiency opportunities, especially in manufacturing, are too complex for a deemed savings approach. Therefore efficiency programs also offer custom rebates, where the amount of the rebate is based on estimates of how much energy is to be

⁷ <http://www.nema.org/technical/pages/nema-premium.aspx>

saved. This is sometimes called a “standard offer.” Custom rebates can achieve deeper savings in industrial processes and systems, but require more analysis and reporting. They rely on detailed engineering analysis and proof of implementation, which must be verified either by the program or by a third party.

Workshop and informational materials. In addition to directly implementing energy savings projects, efficiency programs often involve outreach activities such as workshops, webinars, informal technical materials, and best practice sharing. These elements help companies learn to identify energy savings best practices and to reach out to a wider audience. They can also help to make or strengthen contacts with the industrial site, thereby overcoming a key barrier: trust between the industrial customer and the utility.

REACHING SMM CUSTOMERS

While the general offerings described above are a good first step to reaching SMM, several complementary activities can help increase program participation and energy efficiency project implementation. The first is outreach. While the program models above include some outreach activities, opportunities exist for reaching out to SMM customers that go well beyond these elements.

As discussed earlier, reaching SMM customers is no simple task. Larger manufacturers warrant more personalized involvement by key account managers, both because of the size of the opportunity at each facility and because there are relatively few of them. Small manufacturers are more numerous and offer smaller savings per plant, but not so numerous as to warrant the mass marketing tactics used to reach residential and commercial buildings (Gillies, Brown & Boston 2013). Nevertheless, we can point to some effective strategies for improving outreach to SMM.

Trade Allies

In 2007, Energy Trust of Oregon (ETO) realized that while they were running effective industrial programs targeting their larger users, they were not reaching SMM (Prause & Warila 2009). Seeing SMM as the largest untapped market, they set out to develop a new approach to implementing energy efficiency projects at SMM facilities. The ETO Small Industrial Initiative program featured two innovations: outreach through a network of trade ally vendors, and streamlined administration and analysis.

Opportunity: System Labeling

While current labeling (and prescriptive rebate) programs focus on individual equipment, a new labeling process under development would label the energy performance of what is known as "extended products." An extended product group might include an electric motor, drive, controls, and the driven equipment, such as pumps, fans, or compressors. Because the efficiency of equipment is often highly dependent on the system in which it operates, extended product labeling will allow energy efficiency programs to more easily tap into the deeper savings available through whole system design without requiring the detailed engineering analysis used for custom rebates. System labeling initiatives are currently in the early stages of development, but they represent a unique opportunity for future energy efficiency programs.

ETO served so many SMM customers that program staff could not reach out to them directly. After analyzing common participant barriers, they realized that their program should not complicate a plant's day-to-day activities. Therefore they decided to make use of a network of trade allies made up of equipment vendors. Vendors already have expertise in the equipment they sell and install, and in many cases they have preexisting relationships with SMM customers. (If not, they have an incentive to develop those relationships.) Furthermore, when equipment at a plant breaks, plant managers often call those same vendors to get an immediate solution. Once the vendors are involved in the efficiency program, they can influence purchasing decisions which otherwise would not prioritize energy efficiency.

The ETO program was designed to be beneficial to the trade allies, too. ETO identifies the following benefits for vendors (Prause & Warila 2009):

- Vendors can be the hero. Energy Trust does not need to take all the credit with participants; it just wants sites to participate. Vendors can use the incentive from Energy Trust to make their customers happy.
- Vendors can realize increased sales of higher cost equipment by leveraging program funds.
- The program has very quick turnaround time, often reviewing, approving, and returning applications within two working days, and sometimes much faster.
- Vendors can add the Energy Trust logo to their promotional materials including ads and trade show posters.
- Energy Trust does not get in the middle between the vendor and the customer. Vendors continue to own the relationship.

Despite its success, the ETO experience offers some lessons learned. ETO found that some vendors were less interested or less technically capable than others, a troubling fact for a program staking its savings on outside organizations. Of the eight vendors used by ETO in the pilot program in 2008, one accounted for half the compressed air projects. Of the compressed air measures implemented, more tended to be larger equipment installations than lower cost operational fixes, even though both were often identified. ETO suspects that some vendors were not promoting the smaller measures as much because they could make more money selling large capital equipment than lower cost operational measures. ETO also found that they needed to maintain ongoing communication with vendors to keep pushing the program; otherwise they completed fewer projects (Heredos & Light 2011).

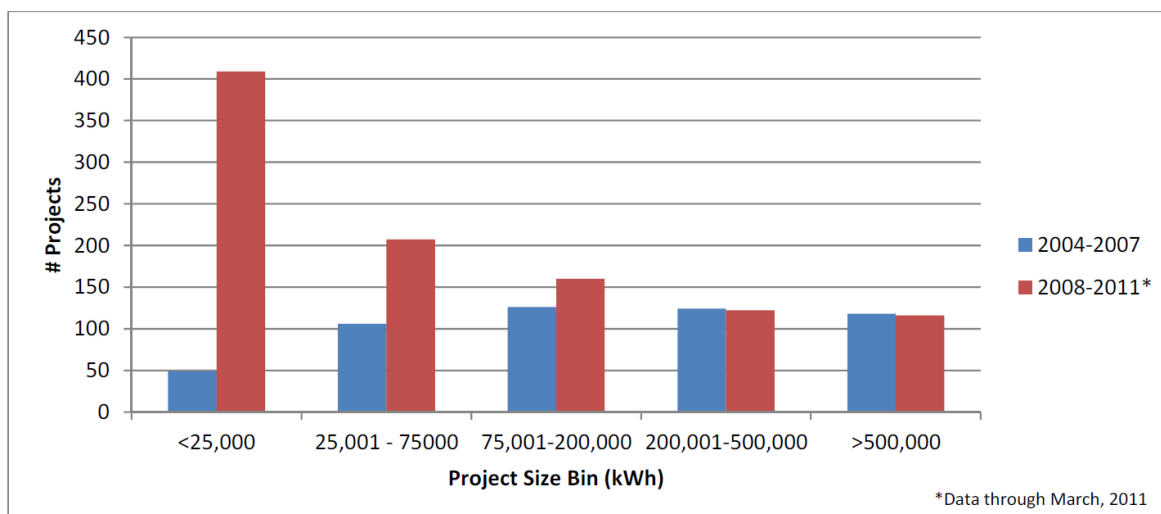
Streamlining Processes

Having developed a cost-effective method to reach SMM and identify savings, the ETO Small Industrial Energy Users program sought to remove another typical barrier to energy efficiency programs: an overly bureaucratic application process and burdensome reporting requirements. To do this they set about streamlining their process from the customer side. The use of trade allies already involved less interaction costs between the customer, the vendor, and the efficiency program. ETO decided to add a new class of incentives to further streamline the interaction.

This new class of “calculated savings” incentives fell between prescriptive, which offer a set amount based on installing certain equipment, and custom, which require detailed engineering to identify the technical solution, the cost, and the projected energy savings. ETO staff identified common measures (such as variable speed drives or air compressors) and made templates of the analyses they could apply to many future projects by using site-specific data. This method improved the confidence of savings estimates over prescriptive measures with deemed savings; at the same time, it avoided the detailed analysis and one-on-one assistance common to custom measures.

ETO's use of trade allies and streamlining led to a successful program. The results can be seen in Figure 5, which shows the number of projects completed sorted by the size of the project, both before and after the program was launched in 2008. The data not only show that ETO greatly increased the implementation of smaller projects, but they confirm the ETO hypothesis that there was untapped potential in the SMM market. ETO estimates that the program has been responsible for over 16 million kWh in savings.

Figure 5. Industrial Energy Efficiency Project Sizes for ETO Before and After SMM Program



Source: Heredos & Light 2011

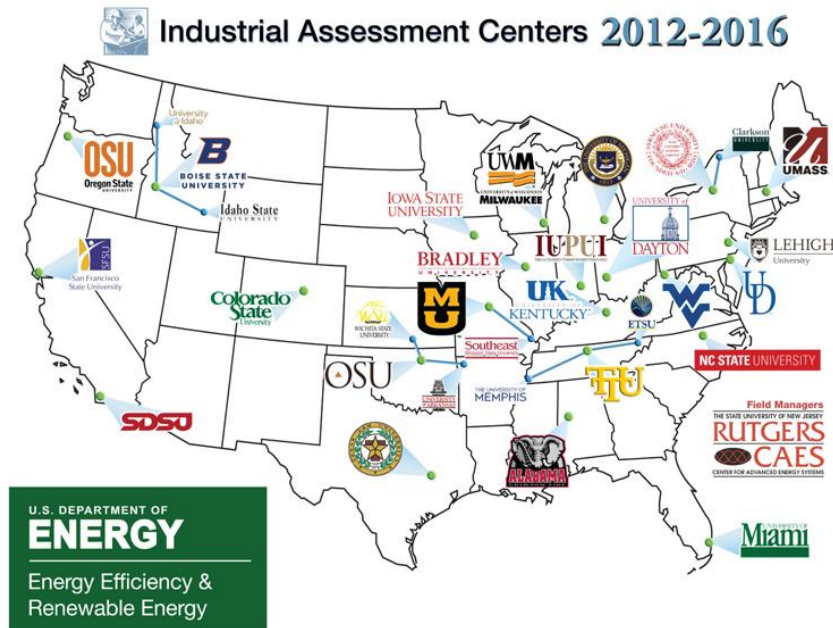
Outreach Methods

Energy efficiency programs targeting the SMM market have tried a number of strategies to identify and engage their smaller customers. Partnering with organizations such as the ones described below helps to identify possible participants, increase services, and lend credibility to the programs if the partner is well respected by local manufacturers.

Trade associations. Many manufacturers belong to trade associations which ideally deliver useful information to their clients in addition to representing them in larger matters. However this group has not always proven effective in recruiting companies for energy efficiency programs, because energy efficiency is not a focus of most trade associations. ETO noted that while they reached out to trade associations, they had more luck when they contacted companies that already had relationships with the ETO program or had participated in other programs (Wilson & Macklin 2013).

Industrial Assessment Centers (IACs). The Department of Energy funds 24 IACs at engineering universities across the country, as shown in Figure 6 below.⁸ The IACs provide free energy assessments to SMM. Several utilities partner with IACs as a way to offer SMM audit services, and then they offer incentives for implementation.

Figure 6. Locations of Industrial Assessment Centers



Source: <http://iac.rutgers.edu/database/centers/>

State energy and economic development offices. These offices have ties to the local manufacturing base as well as their own programs or incentives that can be leveraged.⁹

Manufacturing Extension Partnerships (MEPs). MEPs are organizations across all 50 states that are co-funded by the Department of Commerce, state governments, and private industry to help manufacturers address business needs.¹⁰ While they do not focus on energy issues, several have run pilots that include efficiency, and some have partnered with the local IAC. MEPs are familiar with the local manufacturing base and typically partner with the state economic development office.

Cohorts. Dealing with several companies as a single group reduces interaction costs for training and education events. This strategy has proven successful in some of energy management programs discussed below.

⁸ http://www1.eere.energy.gov/manufacturing/tech_assistance/iacs.html

⁹ <http://www.naseo.org/members-states>

¹⁰ <http://www.nist.gov/mep/>

ENERGY MANAGEMENT MODELS

Energy management programs have represented a growing trend in industrial energy efficiency programs for some time (Chittum, Elliott & Kaufman 2009). Large manufacturers often have an energy manager on staff to identify energy supply and efficiency issues and opportunities. In an effort to institutionalize energy management, many firms have been implementing energy management standards like the international ISO 50001, the ANSI/MSE 2000:2008, or the SEM model developed in the Pacific Northwest by the Northwest Energy Efficiency Alliance (NEEA). Unfortunately, smaller firms rarely have the resources to hire a full-time energy manager or comply with the reporting requirements of energy management standards like ISO 50001. However several energy efficiency program strategies can successfully bring energy management to the SMM market.

Shared Energy Managers

While a number of programs have helped larger manufacturers bring on on-site energy managers (Russell 2013), it is typically too costly for smaller firms to hire one. In 2006, Cook Composites & Polymers, a chemicals manufacturer with 11 small- to medium-sized plants, looked for an energy manager for its facilities (Imel, Gromacki & Morgan 2009). When they could not find a suitable candidate, they turned to Burns & McDonald, a large engineering and consulting firm with whom they had a prior relationship. Under the agreement they developed, a team of engineers from Burns & McDonald put in the effort of one full-time equivalent (FTE) to serve the energy management needs of six Cook Composites plants. The Burns & McDonald team were tasked with three primary activities as energy managers:

- Implementing an energy information system to monitor plant utilities
- Identifying and evaluating energy efficiency measures
- Coordinating engineering documents with the existing document management system

Once an efficiency projects was identified and scoped, Cook Composites added a task order to the Burns & McDonald contract for implementation. The Burns & McDonald team also worked on implementing the ANSI/MSE 2000:2008 energy management standard at the Cook Composites sites, eventually leading to ISO 50001 certification.

Strategic Energy Management for SMM (Cohort Approach)

No region has done more to advance the practice of energy management and continuous energy improvement than the Pacific Northwest. This area has deployed several SEM programs based on the NEEA Continuous Energy Improvement initiative. SEM programs tend to focus on larger manufacturers and typically embed an energy management system within the company (Kolwey 2013). In 2008 ETO added a new component to SEM dissemination: cohorts. The cohort approach provides a peer support group for companies just learning about SEM (Jones et al. 2011). It benefits the companies because they can talk to and measure themselves against others in the same position; it benefits the program administrator since dealing with a group of companies entails a lower interaction cost than assisting each company individually. This program innovation helped open up SEM to manufacturers smaller than those originally targeted by SEM programs. Two pilot programs are discussed below.

Montana. In 2011, NEEA and NorthWestern Energy (an electric and natural gas utility) developed an SEM pilot for smaller manufacturers in Montana (Gilles, Brown & Boston 2013). In addition to the barriers to SMM discussed earlier, the businesses targeted in this study were geographically distant from each other. The Montana pilot took advantage of the cohort approach to reach these customers. The project found companies willing to go through the SEM program and grouped them into two cohorts, each with five companies. The companies were selected through outreach activities by NorthWestern Energy and the Montana Manufacturing Extension Center, the local MEP.¹¹ While previous SEM cohort programs had lasted 18 months, the timeline for this initiative was shortened to 12 months to lessen the burden on the companies involved. Along with the shorter timeframe, each cohort met in person only quarterly; program staff largely relied on monthly webinars and phone-based support as they worked with the companies. Although results for both cohorts have not been released, they are close to being on track to meet the program's goals, namely:

- 80% of companies complete the SEM process.
- Companies realize a total of 8,760 MWh in savings
- Two employees from each company in the second cohort use the NEEA online *Continuous Energy Improvement* curriculum¹²

The Montana program administrators attribute success to a number of factors, including the leveraging of existing resources, recruiting the right companies (those with other management systems or ISO systems already in place), and using engagement strategies that accommodate the schedule and resources of the companies.

Oregon. In 2012, program administrators at ETO realized that many smaller industrial customers were trying to boost their savings and that some were eager to implement SEM. Therefore ETO started developing a pilot program to test SEM on SMM (Wilson & Macklin 2013). The pilot included 12 companies grouped in two cohorts. ETO used recruiting methods similar to those used in their earlier programs targeting SMM discussed in the previous section: they relied on key organizations that had relationships with smaller industry, used technical account managers with knowledge of local industry, and worked with companies that previously took part in ETO's small industrial program. As in the Montana pilot, each SEM cohort was together for one year; they met four times to share their experiences with their peers. ETO staff also met with each company monthly. ETO provided workbooks and tools to help establish ongoing energy management activities, and worked with the companies to fill them out. The workbooks included information about company energy team meetings, key personnel, basic facility information, and an energy model.

The energy model was seen as critical, both as a way to track energy consumption and savings and as a milestone: once company staff were able to use the model and explain it to

¹¹ See <http://www.nist.gov/mep/> for more information on the MEP program.

¹² See <http://www.online-sem.com>

others in the company without assistance from ETO staff, it was an indication that the energy management system was being internalized. The program also offered a toolkit containing data loggers, current transducers, load meters, and light meters. Providing the measurement tools upfront helped get the companies started. ETO staff also helped the companies identify energy savings opportunities through energy scans. In addition to the tools and technical assistance from SEM coaches, ETO provided the companies with two types of incentives. The first was based on energy savings achieved (2 cents per kWh and 20 cents per therm); the second was a flat incentive for reaching certain milestones in SEM adoption.

The ETO program showed that cultural differences in smaller industries are not necessarily a barrier to SEM programs. These differences include less staff capacity and expertise for monitoring energy use and identifying energy savings opportunities. As it turns out, smaller companies can be more nimble and their top managers more involved in day-to-day operations, allowing a quicker uptake of energy management systems. It can also be easier to raise awareness and engage employees in a small firm compared to a larger company. In terms of the recruiting process, having a longer time to inform companies about the program and noting those with interest make the actual recruitment go more smoothly. ETO observed that in addition to the 12 companies that took part in the program, another 17 said they were interested but the timing was not right.

FINANCING PROGRAMS

Another potential barrier to energy efficiency among SMM is access to capital or the allocation of capital to energy efficiency. As programs seek to address this barrier by offering new approaches to financing, two program types show potential for increased activity in the SMM market: on-bill financing/on-bill repayment (OBF/OBR) and property-assessed clean energy (PACE).¹³ OBF allows utility customers to invest in energy efficiency improvements and repay the funds through an additional charge on their utility bill. PACE programs, which are in many cases initiated by local governments, extend upfront capital for energy efficiency investments which is then repaid as a property tax assessment.

On-Bill Financing

OBF allows customers to pay for energy efficiency upgrades when high upfront costs are a significant barrier. In many cases, customers can take advantage of existing utility rebates and incentives to lower the first cost of a project, and then use the OBF option to spread that cost over the life of the measure. For most utility-administered OBF programs, ratepayer funds directly fund loans for energy efficiency projects. In some cases, on-bill obligations can be structured in a revenue-neutral manner, so that the estimated savings from the efficiency measure offset the monthly cost of paying off the obligation. Some programs offer zero interest as a further incentive. Other benefits include:

¹³ Another common financing option is energy service agreements (ESAs), which are popular in commercial and institutional settings but have not gained traction in the industrial sector. For more information on ESAs, see <http://aceee.org/research-report/e13e>

- Leveraging existing billing relationships, making it more simple for the customer
- Low risk of default
- The ability to tie the obligation to the property through the meter (also known as an on-bill tariff) or through a lien so it can be transferred to new owners, making the transaction more flexible for resale
- Scalability

On-bill repayment (OBR) programs capitalized through third-party financial institutions have also started to emerge recently and are making efforts to grow in scale. NYSERDA has been able to create a value stream by bundling residential on-bill loans for sale on the secondary market. While still an open question, this approach could be applied to energy efficiency loans to SMM.

Despite the advantages of OBF/OBR, several barriers do exist:

- Utilities may not have the staff capacity or expertise to lend money, although many partner with financial institutions, particularly community development financial institutions (CDFIs) to administer programs.
- Although exemptions may be available, programs may subject utilities to state and federal lending laws and regulations.
- Programs funded through ratepayers must be equitable, but not everyone qualifies for on-bill financing.
- Given the current size of on-bill programs, they may not offer sufficient capital for large commercial or industrial projects; they are better suited to small commercial business. This limitation may change as more investors become engaged.

Another barrier to widespread adoption is that in some jurisdictions, low-cost financing options are reserved for customers who have limited access to capital. Many industrial customers – particularly larger plants and mid-sized plants that are part of larger companies – have capital but are sometimes unwilling to allocate it to energy efficiency investments (Dodenhoff 2011). SMM firms are more likely to have problems obtaining capital than larger firms (Sorrell, Mallett & Nye 2011).¹⁴ Despite this and other barriers, on-bill financing has been successful in several states.

Connecticut. The Connecticut Small Business Energy Advantage program is run through Energize Connecticut, the statewide energy efficiency and renewable energy initiative. The program offers a comprehensive solution for energy efficiency in small businesses including SMM. It includes a free energy assessment, recommendations with detailed cost and savings estimates, incentives (up to 50% of installed cost), and zero-interest financing. Eligibility is

¹⁴ For more information on the benefits, barriers, and implementation of on-bill financing tools, see <http://aceee.org/sector/state-policy/toolkit/on-bill-financing>

limited to small commercial and industrial customers with 12-month peak demand between 10 and 200 kW (Energize CT 2013b). As of the third quarter of 2013, the program had 112 projects in the pipeline representing \$70 million in project costs (Sherman 2013). Of these projects, 64% included energy efficiency upgrades, the rest being renewable energy systems.

California. In 2009, the California Public Utilities Commission directed the investor-owned utilities (IOUs) in the state to develop on-bill financing programs targeting small business. Currently at least four IOUs offer on-bill financing on the same basic terms.¹⁵ The programs are available to any business (i.e., non-residential) customer in good standing; customers must have had an active account with the utility for at least two years. While customers who receive government funds or are government agencies have different terms, general business customers may receive a loan of between \$5,000 and \$100,000 for projects with a three- to five-year simple payback. The loan period cannot be more than five years, and loans must be coupled with rebates, which help shorten the payback period (Bell, Nadel & Hayes 2011).

While these programs do not target the SMM market specifically, at least one utility has run a successful pilot program targeting other small business customers. In 2008 and 2009, Southern California Edison (SCE) ran an on-bill financing pilot which targeted grocery and convenience stores with a monthly peak demand of less than 500 kW (Dodenhoff 2011). SCE made over \$700,000 worth of loans to 73 customers. While it is difficult to compare default rates with other programs due to different loan terms and conditions, the pilot was successful. From March 2008 through February 2011, less than 1.5% per year of the loan portfolio value was written off compared to a 14% annual small business write-off rate for Bank of America, 4.7% for JP Morgan/Chase, and 6.8% for SBA “7a” loans in 2010.

Property Assessed Clean Energy (PACE)

Like on-bill financing, PACE programs allow customers to reduce the up-front costs associated with energy efficiency investments. The investments are then repaid through a property tax assessment. Unlike on-bill financing, PACE financing is generally overseen by a local government or municipality rather than by an energy utility, and it is often run through a statewide administrator. Like OBF, PACE has a number of advantages and disadvantages. Advantages include:

- Immediate positive cash flow with no upfront costs to the consumer
- Low interest rates
- Transferability (although this is less likely to be applicable in the industrial sector)

¹⁵ More mature OBF programs run by the two Sempra Utilities (San Diego Gas & Electric and Southern California Gas) influenced the development of the OBF programs run by Pacific Gas & Electric and Southern California Edison. For details on the California IOUs OBF programs, see: <http://www.pge.com/en/mybusiness/save/rebates/onbill/index.page>, <http://www.sdge.com/bill-financing>, <https://www.sce.com/wps/portal/home/business/tools/on-bill-financing/>, and <http://www.socalgas.com/for-your-business/rebates/zero-interest.shtml>.

- Absence of obligation on the owner's balance sheet

PACE has three main disadvantages:

- It requires a great deal of support from local government.
- It can be complex and challenging to implement.
- The financial performance of PACE obligations is still untested in the marketplace, an uncertainty that can make PACE programs slow to scale.¹⁶

Energize Connecticut runs a PACE program called C-PACE in addition to its on-bill financing initiative (Energize CT 2013a). It is available to commercial and multifamily property owners as well as to industrial sites. Eligible measures funded through C-PACE include lighting, HVAC, chillers, boilers, furnaces, water heating, building envelope, building automation systems, and small renewable energy systems. In addition to capital implementation costs, C-PACE funding may also be used for audits and project measurement and verification, a provision that eliminates almost all up-front costs for the user. Energize Connecticut notes that the program generally works better for projects over \$150,000.

The Energize Connecticut database of successful projects lists five industrial sites. Three of them received financing for installing solar arrays, one for a combined heat and power project,¹⁷ and one for a suite of energy efficiency upgrades and ENERGY STAR equipment.¹⁸ This last example is particularly relevant to the SMM market because it demonstrates that PACE financing can be applied to a bundle of measures.

LEVERAGING EXISTING RESOURCES

Another opportunity for energy efficiency programs targeting SMM involves leveraging existing resources. Energy efficiency programs can use a number of federal and state energy efficiency initiatives and tax credits to increase their offerings and cost effectiveness. Many industrial customers may not be aware of these opportunities on their own. They include the MEPs and IACs described earlier, as well as another set of opportunities in the United States Department of Agriculture (USDA). A recent ACEEE white paper outlined a number of USDA energy efficiency programs (Farley 2013). A common misconception is that these programs are only for agriculture or food processing businesses. In reality, they apply to any rural business, rural being defined as any area that is not urban or suburban. Many manufacturing sites fit this definition. Some of the USDA programs are described below.

¹⁶ For more information on the benefits, barriers, and implementation of on-bill financing tools, see <http://aceee.org/sector/state-policy/toolkit/pace>

¹⁷ <http://www.c-pace.com/projects/72662/view>

¹⁸ <http://www.c-pace.com/projects/41619/view>

Rural Energy for America Program

The largest and most well-known USDA energy efficiency program is the Rural Energy for America Program (REAP). REAP provides financial assistance through grants and loans to promote energy efficiency and renewable energy development in the following areas:

- Energy audits
- Energy efficiency improvements to farm equipment
- Renewable energy projects
- Feasibility studies for other REAP-eligible projects

REAP is sometimes criticized for having an overly burdensome application process. In the past, most of the grants and loans went to only a few locations where staff at local county extensions or Rural Development offices knew the application process and helped their clients apply. Energy efficiency programs can help broaden this base by assisting smaller manufacturers to apply for these types of grants and loans.

Business Loans and Grants

Several other USDA programs provide grants and loans to rural businesses to promote economic development. Energy efficiency is not a primary goal, but it does fit under the economic development banner. The Business and Industry (B&I) Guaranteed Loan Program is intended for projects that reduce reliance on nonrenewable energy sources, although only a small amount has traditionally been given to energy efficiency projects. The Rural Business Enterprise Grant Program (RBEG) is designed to support job creation in small businesses with fewer than 50 employees. Utilities use RBEG grants to establish revolving loan funds for their customers.

Recommendations

The programs and opportunities described above offer an insight into how energy efficiency programs targeting SMM can reach out to smaller manufacturers and achieve greater energy savings. Several lessons emerge from this survey.

Building Relationships

Building trust and credibility is critical in dealing with manufacturing companies. Owners and managers have many priorities, and energy efficiency is not usually one of them. Nevertheless, an energy efficiency program can serve as a trusted source of information if it shows an understanding of the manufacturer's priorities and decision making processes. Sustained, long-term programs are crucial to building trust, and contractors, vendors, and other outside agents must contribute to that effort. If the people on the ground representing the program are not knowledgeable or trustworthy, neither is the efficiency program.

A corollary of this recommendation is to leverage the use of groups with existing relationships to manufacturers, including trade associations, municipalities, state energy and development offices, and other groups such as MEPs and IACs. Not only can this strategy increase the credibility of the program, but it can be a means to reach out to more energy users.

Simplify Processes

Recognizing the resource constraints of SMM can be an opportunity for efficiency programs. If programs reduce administrative requirements, SMM will be more responsive to their offerings. This streamlining can involve simplifying internal requirements as ETO did in their Small Industrial Initiative, or serving as an intermediary between a federal program and the end user by helping with paperwork and other requirements. (The ETO program is changing its name to the Streamlined Industrial Initiative to highlight this advantage.) Simplifying processes can also help the programs themselves become more effective and allow them to identify and address further barriers.

Building Staff Energy Efficiency Expertise

A key to the success of many energy management programs is building energy efficiency expertise among staff at manufacturing sites, both by getting dedicated staff onsite and by increasing their operational skills in energy efficiency. Building this expertise is particularly difficult in SMM, as these manufacturers are generally leaner on staff, and employees already tend to serve several roles. But if successful, this strategy ensures that savings from ongoing programs persist and new savings are identified without the need for continuous program intervention. The SEM programs in the Northwest are good examples of this approach.

Target Specific Barriers

Another way to achieve greater energy savings in SMM is to identify and target specific barriers. Financing programs are a good example. Low- or zero-interest financing through on-bill financing or property-assessed clean energy programs can offer attractive investment opportunities when capital budgets are tight or internal hurdle rates are high. Another way to target barriers is to adapt programs that are already successful at reaching larger manufacturers, making them more responsive to the needs of SMM. SEM programs accomplish this adaptation by shortening timetables, reducing in-person meetings, and providing a suite of hardware and software tools to get the companies started.

Build on Success

Finally, it is important for programs to continue to grow their offerings and build on their successes. Programs new to the industrial sector tend to first offer incentives for measures like lights and motors before expanding their offerings to more process-specific opportunities with greater savings potential (Chittum 2009). In the same way, programs targeting SMM should see what works, including learning from programs targeting larger users, and adapt to meet the specific needs of SMM. As an example, ETO had previous relationships with manufacturers based on their more mature programs, as well as experience with the cohort approach from the large users SEM program. They were able to successfully adapt the cohort model to the SMM market and identify leading companies to help pilot the program. Now they host periodic breakfast meetings of all the SEM program alumni (both small and large customers) to continue developing relationships with manufacturers and to reinforce learning.

Conclusions

A variety of energy efficiency programs are available to SMM. Many offer only generic incentives and support, but some seek to address SMM-specific barriers to implementing energy efficiency. These barriers differ in small but not insignificant ways from the barriers to energy efficiency for larger manufacturers. Targeting these differences is the key to developing cost-effective programs responsive to the needs of SMM.

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