Expanding the Energy Efficiency Pie: Serving More Customers, Saving More Energy Through High Program Participation

Dan York, Max Neubauer, Seth Nowak, and Maggie Molina

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529 14th Street NW, Suite 600, Washington, DC 20045

Phone: (202) 507-4000 • Twitter: @ACEEEDC

Facebook.com/myACEEE • www.aceee.org

Contents

About the Authors

Dan York has more than 20 years of experience in researching, analyzing, and implementing energy efficiency policies and programs. He is widely recognized for his work tracking and analyzing trends and emerging issues in utility-sector energy efficiency programs. All his educational and professional experiences have focused on energy efficiency and conservation as the foundations for a sustainable economy. He joined ACEEE in 2001.

Max Neubauer joined ACEEE in 2007 and was a member of the State Policy team through 2014. Max was a project manager for ACEEE's state-level energy efficiency potential studies and contributed to the annual State Energy Efficiency Scorecard. He also provided technical research and management support to ACEEE's sister organization, the Appliance Standards Awareness Project.

Seth Nowak conducts analysis and writes reports on energy efficiency programs and policies in the electric and natural gas utility sector. The focus areas of his research include exemplary programs/best practices and program evaluation, measurement, and verification. He joined ACEEE in 2010.

Maggie Molina oversees ACEEE's Utilities, State and Local Policy Program. She conducts research and analysis, and provides technical assistance on energy efficiency policy and programs. Since joining ACEEE in 2005, she has authored numerous reports on state policy and utility-sector energy efficiency topics, including the first editions of the State Energy Efficiency Scorecard, state-level energy efficiency potential studies, utility business models, the cost of saved energy, and next-generation efficiency programs.

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Executive Summary

Energy efficiency programs offered by utilities and related organizations have been serving utility customers for over three decades in many states. Today, there is growing need for these programs to increase energy savings as a way to save money for all utility customers, to reduce emissions, and to improve reliability. Achieving higher energy savings through energy efficiency programs generally requires higher customer participation. New approaches to programs as well as new types of programs are also creating wider opportunities for all customers to participate in programs. Achieving high participation across this wider program portfolio will also address regulators' concern about customer equity, because a greater number of customers will receive direct benefits from energy efficiency programs.

Program participation is an important metric for many aspects of efficiency programs, including planning, development, implementation, evaluation, and efficiency potential studies. Despite the importance of participation data in many aspects efficiency planning, this metric often does not get as much attention as energy savings and cost-effectiveness metrics. As a result, the data often are not transparent or consistent. There are no industry standards or conventions for defining and measuring participation. While some types of participation data are common across all types of programs, the nature of these data varies across program types. Within a given type of program, there tends to be greater consistency in metrics and data reporting.

The lack of common nomenclature and metrics creates numerous challenges in collecting and reporting participation data. As a result, there is a growing need to improve participant definitions and metrics. Many programs do not report participation data. Aggregate data on program participation at the national and state levels are limited. Existing energy efficiency program databases, such as the U.S. Energy Information Administration (EIA) Form 861, do not include any metric on program participation, either as absolute numbers or rates. There are some emerging efforts in this area, however, from E Source and the Consortium for Energy Efficiency. The gaps we identify in common nomenclature and metrics highlight the need for better participation data.

Despite the data challenges we encountered, we used the available data to identify programs within several program types that have achieved high participation. Our program selections are based on expert input and a variety of reference documents and data sets. These programs illustrate what is possible for specific types of programs, such as residential lighting and custom programs for large customers. The available data are insufficient to characterize selected programs as those that have achieved the highest participation among all similar programs. We also identify and discuss important factors within each type of program that contribute to their achieving high participation.

FINDINGS BY PROGRAM TYPE

We found that high participation is a relative metric within each type of program. While some types of programs may be considered high participation with single-digit percentages of customers in a program year, other types of programs may only be considered high participation if they serve as many as half the eligible population or more in a program year.

It all depends on the markets and types of customers targeted. Below are our summary findings by type of program.

Residential Products and Appliances

Residential products and appliance programs target a number of market actors. These are predominantly downstream consumers, but many programs also target midstream retailers and upstream manufacturers. Residential products and appliances programs typically track participation in terms of the number of units sold by type. These programs are capable of achieving high market shares and moving tens of thousands of targeted products in a program year. To achieve high participation, such programs leverage a mix of incentives, effective marketing, and retail/manufacturer relationships. A more useful metric of participation is the market share of energy efficiency products; those meeting ENERGY STAR® requirements are typically included. For example, programs have lifted market shares for ENERGY STAR products from about 65% to nearly 90%.

Residential Lighting

Residential lighting programs have been responsible for large shares of total energy savings for many residential program portfolios. Achieving such impacts has required programs to affect millions of individual light bulb sales. The primary metric used by programs is the number of light bulbs sold that are incentivized or otherwise attributed to the program. Long-standing, successful programs have achieved annual sales of three light bulbs per household. Socket saturation surveys are used to assess building stock characteristics and long-term program impacts. Surveys conducted in states and regions with long-running programs show that energy-efficient lighting (primarily compact fluorescent light bulbs) comprises 30–50% of all household lighting.

Residential Whole-Home Retrofits

Residential whole-home retrofit programs have commonly been offered in utility energy efficiency portfolios for decades, but the depth of these programs has improved in recent years under efforts such as Home Performance with ENERGY STAR. The number of customers that can be served by programs is much more limited than residential programs serving mass markets, such as those for lighting and appliances. Participation in whole-retrofit programs requires relatively large commitments from homeowners in terms of costs and time. Annual participation rates of 1–3% of all residential customers are possible. Some leading programs estimate that they have served about 12% of residential customers over 4 years and 25% of residential customers over 20+ years. And in a couple of small, geographically focused programs conducted in the late 1980s and early 1990s, participation rates as high as 80% have been achieved due to high incentives and saturation marketing.

Residential New Construction

New construction programs generally provide financial incentives for homes that are built to meet either prescriptive energy efficiency standards or performance targets in terms of energy use. Such requirements clearly reward construction that is above applicable energy codes for new construction. Many programs follow the ENERGY STAR New Homes guidelines because it is an established brand. Several programs and states we reviewed have achieved a 20–40% market share (i.e., participation) of new homes built to a higher energy

efficiency standard like the current ENERGY STAR (participation rates of over 50% were achieved before the ENERGY STAR specification was tightened).

Multifamily Housing

Multifamily programs primarily track program participation by the number of housing units receiving services. Multifamily markets generally have been underserved by programs due to a number of difficulties faced in these markets, but leading programs are improving outreach to this segment. The types of services can vary significantly. Typically, they fall into three primary categories (leading programs may offer all these options):

1. Direct installation and related low-cost services to occupants
2. Rebates for common measures such as new heating, ventilation, and air-conditioning (HVAC) systems and building envelope improvements
3. Comprehensive whole-building retrofits

For direct installation, annual participation rates of up to 16% (of multifamily units) have been achieved. For leading rebate programs, annual participation rates reach about 10%. And for comprehensive whole-building retrofits, some programs are reaching 1–2% of units per year. On a cumulative basis, one rebate program has achieved 93% participation, although it is backed by a municipal ordinance that requires owners to upgrade their buildings. Another rebate program without such an ordinance has achieved a 49% cumulative participation rate. We do not have good cumulative participation data on the other program types.

Small Business

Small business programs must be structured to serve a customer segment that is highly diverse. Individual customers typically have limited time, money, and expertise to address energy efficiency improvements that would benefit their businesses. Small business programs historically have relied heavily on lighting improvements, as these offer quick paybacks and are relatively simple to implement. Most programs are budget constrained—a budget is selected and the program is marketed until the budget is spent. In focused pilots where budget caps do not limit participation, maximum participation rates of 60-80% have been reached. Effective program design, particularly reliance on a one-stop shop model, appears to be especially important for achieving high participation in this customer segment.

Commercial Retrocommissioning

While the potential market for retrocommissioning is large, the practice is still not widely used. Retrocommissioning programs are not as widespread as other types of commercial programs due to a number of challenges in program design and implementation, as well as difficulty gaining sufficient program participation. The key metrics used by retrocommisioning programs are numbers of participants and numbers of projects. Retrocommissioning programs, even those serving large customer populations, typically reach a small number of customers each year, generally in the 10s and low 100s. Some programs have achieved up to 10% cumulative participation among large buildings over several years.

Commercial New Construction

The primary metrics for tracking participation in commercial new construction programs are floor area of participating buildings and number of projects. New construction programs in many areas have successfully influenced large shares of new construction markets—typically in the 50-60% range of new construction floor area for leading programs. These programs provide a variety of services and incentives to achieve high performance, energy-efficient buildings. Targeting new construction is a priority within program portfolios because this market typically offers relatively large energy savings potential and such savings tend to be highly cost effective. It also helps transform design and construction practices, and can lay a foundation for code upgrades.

Commercial Prescriptive Incentives

Prescriptive incentive programs target high-efficiency versions of equipment and systems that are fairly standard and widely used, such as lighting. Historically, commercial lighting has been a major source of overall portfolio savings. As with some residential programs serving mass markets, some programs serving commercial technologies such as lighting are moving upstream. Rather than providing incentives directly to customers, retailers and distributors receive incentives, which they then can pass along to their customers in the form of lower purchase prices. Prescriptive lighting incentives generally comprise the bulk of program participation. Large programs can serve from 1–3% of total business customers annually, with an emphasis on lighting measures. Participation for customers receiving HVAC incentives generally is much smaller. The limited data we found suggest less than 1%, although these must be evaluated in the context that only a fraction of HVAC equipment turns over annually (e.g., if average equipment lasts 20 years, about 5% turns over each year). From a market share perspective, it appears that some programs have contributed to market shares of about 25–35% for high-efficiency equipment.

Commercial and Industrial Custom Incentives

Because custom programs typically target the largest customers, the scale and focus of custom incentive programs are relatively small compared to the entire market of commercial and industrial customers. The numbers of customers served in a given program year typically measure in the 100s even for programs serving large numbers of customers. However these typically are among the largest customers, with correspondingly high energy use and often high savings potential. Targeting and serving these large customers with programs can yield high savings. Custom incentive programs targeting large industrial customers have achieved up to nearly 90% participation over the span of about three to four years in at least one case. Other program results demonstrate that achieving 50-70% participation among large industrial customers is possible. Medium and small customers, however, have been much harder to reach due to higher transaction costs and the absence of direct, ongoing relationships. These segments offer untapped potential, and leading programs are developing strategies to improve relationships with these segments.

CONCLUSIONS

Program participation is simple in principle, but complex in practice. The variety of program types and markets served has demonstrated that metrics of success are relative to the program type. Achieving higher participation, though, is key to achieving higher energy savings goals for most types of programs. As programs increasingly seek high savings in

response to such policy drivers as energy efficiency resource standards and environmental compliance with air regulations, achieving high participation across programs and portfolios is a key program strategy.

Participation also needs to be seen through the lenses of overall portfolios and applicable markets over long periods. In leading regions with longstanding programs, for example, a majority of customers have benefited directly from participating in available programs. Traditional program silos are being broken down so that customers access a full menu of available programs and services through a single point of contact with a utility or other program administrator. This helps address equity concerns by regulators and key stakeholders.

Data on program participation have a number of gaps and needs. There is a need for consistency in terminology and conventions for participation metrics and routine data tracking on program participation. Better data on efficiency program participation can provide several benefits to program administrators, regulators, and other stakeholders. For example, it can help them

- Develop and improve efficiency potential studies
- Achieve energy savings goals
- Design programs to be more effective, potentially reducing the cost of saved energy
- Assess the extent of customer equity concerns, or rate impact concerns
- Identify and serve hard-to-reach customers
- Achieve the goal of implementing all cost-effective energy efficiency, which requires reaching all customers

Achieving high participation in programs comes down to fundamentals of program design and marketing. Regardless of the type of program, program designs that are attractive to customers are needed to attract high participation. Customers must value the services and incentives provided. Programs also need to be designed to make participation easy. In addition to well-designed programs, effective marketing and outreach are also important to achieve high participation. Programs need to be sold to customers. All aspects of program design, marketing and delivery must be specifically tailored to the target customer type.

Marketing of energy efficiency programs is showing increasing sophistication, which is especially important as consumers face an ever expanding and often dizzying array of messages in all aspects of their lives. Big data is emerging as fertile ground for more sophisticated, tailored marketing of programs. Smart technologies and metering can yield highly detailed customer data on energy use. Through the use of rich data sets and advanced analytics, programs can identify customer segments most receptive to particular programs and services. Marketing is more focused.

Available budgets for programs are another indicator of participation rates. This may seem apparent, but it is nonetheless important to recognize. Our research highlighted numerous examples of programs constrained by budget limitations. Creative program design and marketing can help, but without sufficient funding, programs are inherently constrained in their reach.

Measuring and tracking program participation are important to quantify energy savings and evaluate progress towards capturing energy efficiency's potential. Many programs successfully achieve high participation. We can learn from these examples to increase participation across portfolios. In doing so, we will be spreading the wealth that increased energy efficiency provides to customers, the economy, and the environment.

Introduction

Energy efficiency programs offered by utilities and related organizations have been serving utility customers for over three decades in many states. In the past decade, the number of such programs has increased greatly as many additional states have enacted legislation or regulations that established or expanded such programs. Today there is growing need for these programs to increase energy savings as a way to save money for ratepayers, reduce risk, reduce emissions, and improve reliability. Such need stems from a number of policy drivers, including energy savings targets as set by state energy efficiency resource standards (EERS), which are now in place in 24 states. Many of these are ramped up from initial introductions so that the targets seek annual savings of 1–2% of utilities' total electricity sales. Another opportunity for energy efficiency savings is impending environmental regulations governing greenhouse gas emissions (e.g., Clean Air Act section 111[d]); such regulations will enable energy efficiency programs to be used for compliance with these regulations.

Achieving higher energy savings through energy efficiency programs generally requires higher customer participation. Utilities and related organizations that administer programs in most states and regions have relatively full portfolios of programs available to all types of customers. Program administrators have two main strategies to use in increasing overall program savings, including (1) increasing participation in programs, and (2) increasing savings per participant.

In this report we examine this first strategy, gaining high participation in energy efficiency programs. One objective is to identify programs that have achieved high participation rates, i.e., the number of participants relative to eligible populations. A second objective is to identify and discuss key program elements that lead to high participation. As programs and corresponding budgets for customer energy efficiency programs have grown, there is increased interest in the benefits of energy efficiency that accrue to all customers, both participants and nonparticipants in these programs. New approaches to programs as well as new types of programs also are creating wider opportunities for all customers to participate in some program or programs offered by their utilities.

Program participation is an important metric for many aspects of efficiency programs, including planning, development, implementation, evaluation, and efficiency potential studies. The accuracy of energy efficiency potential studies, for example, is directly related to the accuracy of the estimates of program participation (Neubauer 2014). Program participation data also are important to track and assess the delivery of program services and overall program performance. Achieving high participation can help improve program cost effectiveness, as program fixed costs are distributed among a larger customer population.

Regulators should also have access to better data on program participation. This is important not only for tracking and assessing program performance, but also for alleviating concerns about customer equity by fully assessing customer participation across entire program portfolios (Woolf 2013). These data are essential to track, assess, and address such equity concerns. They also are vital in identifying and serving hard-to-reach customers.

Finally, in those states striving to implement all cost-effective energy efficiency, high program participation is necessary to achieve this goal.

Despite the importance of participation data within many aspects of efficiency planning, this metric often does not get as much attention as energy savings and cost-effectiveness metrics and as a result the data are often not transparent or consistent. There are no industry standards and conventions on defining and measuring participation. Definitions and nomenclature used to report participation metrics vary significantly. The complexity of data and associated metrics reflect the diversity of program types. While some type of participation data is common across all types of programs, the nature of different programs and services offered necessitates different metrics for measuring participation. For example, programs may track number of efficient products sold, numbers of customers receiving services, or number of projects receiving customer incentives.

Despite the many challenges in collecting and reporting participation data that we discovered in the course of our research, there is a growing need to improve participant definitions and metrics. Some program administrators are at the forefront of this effort. They recognize that improved measurement and analysis of customer participation can yield the improved program performance that is necessary to meet their energy savings targets.

While program participation is a key energy efficiency program variable, there are limited studies to date that have comprehensively examined and assessed program participation. ACEEE completed one such study 20 years ago (Nadel et al. 1994), but clearly the state of practice for energy efficiency programs and the size of the industry have changed dramatically in the interim. This report updates and expands upon ACEEE's earlier work. In addition to dramatic changes in the design and delivery of energy efficiency programs over the past 20-plus years, there also have been dramatic changes in technologies and markets. Public perceptions, attitudes, and preferences concerning energy choices also have changed, especially in the face of such looming environmental problems as global warming.

Methodology

RESEARCH OBJECTIVES

We had several objectives for this research. First, we aimed to identify programs that are achieving high participation rates in certain program categories and analyze the factors linked to their success. In this objective, we encountered a number of challenges, as will be discussed in more depth in the next section. For example, data were not consistently available across program types, definitions differed, and often the programs did not self-identify participation rates as being among the most important indicators of success. Still, our core objective was to parse these issues, make some assessments of what "high participation" means, and identify programs with high participation. We also sought to identify whether upper boundaries of participation have emerged thus far for different types of programs. In conducting this research, we identified and discussed program approaches to tracking and reporting participation. A final objective was to raise the visibility of participation data as an important metric in energy efficiency planning by identifying and discussing research gaps and the need to improve reporting and understanding of participation.

We sought to answer a number of questions related to high participation in customer energy efficiency programs. These include:

- What metrics are used by different types of programs to track and record participation?
- What data are available on program participation?
- What are the upper bounds on participation rates that have been achieved by energy efficiency programs serving utility customers, whether they are administered by utilities or non-utility organizations?
- What is considered "high participation" by different types of programs?
- What are the key factors and program design elements for achieving high participation?

RESEARCH METHODS

Our research involved networking, literature review, and accessing available program data. We first conducted phone surveys with individuals who are industry experts with broad knowledge of leading programs and best practices on a regional or national scale. We asked these individuals for leads on which programs were achieving the highest levels of participation. Next, we conducted phone interviews with program experts directly involved in the programs identified as having high participation. We gathered data on program participation and other key metrics from a variety of sources, including personal communications, program reports, program evaluations, presentation slides, and published papers. We also gathered program data from DSM Insights, a proprietary database available from E Source that includes data from over 3,700 programs offered by 134 program administrators covering 44 states and provinces (E Source 2014). This database includes data on participation in terms of absolute counts of appropriate program units, such as numbers of products incentivized or number of retrofit projects completed. We sorted programs based on these counts to determine which of those programs had high participation. The database does not include participation rates, as such data are not commonly reported.

In order to gather and compare data on participation, we identified a set of common program categories. These are:

- Residential products and appliances
- Residential lighting
- Residential whole-home retrofit
- Residential new construction
- Multifamily housing
- Small business
- Commercial retrocommissioning
- Commercial new construction
- Commercial prescriptive incentives
- Commercial and industrial custom incentives

These categories capture the major types of programs that are offered by utilities and related organizations to utility customers and that capture the bulk of total portfolio savings. Later in the report, we explore each of these categories in detail. Traditionally, programs have

tended to fit neatly into such categories, which are sometimes referred to as silos. As we discuss later in this report, these silos are breaking down as program administrators restructure their offerings so that a given customer may access the full array of applicable services and incentives through a single program contact or portal. Nevertheless, there are benefits to developing and using a common categorization of program types along with common definitions of the metrics that define program performance, such as participation. Researchers at Lawrence Berkeley National Laboratory (LBNL) developed a typology of standardized program categories as part of their research on the cost of energy saved through energy efficiency programs (Hoffman et al. 2013). This research and analysis yielded 27 simplified program categories for efficiency programs and 62 more detailed program categories. For our purposes of looking strictly at program participation, the small set of broad program categories we chose is sufficient. We did not do a comprehensive review of all program types or all programs within each type.

There are other types of programs we did not include. One such category is commercial retrofit programs.[1] ACEEE 's research shows that these offerings have relatively low participation rates due to the complexity and costs of typical comprehensive retrofits, as well as the fact that major renovation projects are often included in new construction programs (Kwatra 2014). Another category we did not include is behavior change programs. Such programs typically take an entirely different approach to participation, as they reach large customer populations through such means as home billing reports. ACEEE recently completed research to classify behavior programs into discrete categories and to identify needs for tracking, collecting, and analyzing behavior program data (Mazur-Stommen and Farley 2013). We also did not include programs serving low-income customers, as participation in these is primarily limited by available budgets. Finally, we found limited data specific to both residential and commercial heating, ventilation, and air-conditioning (HVAC) technologies targeted in prescriptive rebate programs and therefore included these in the chapters on residential and commercial equipment programs rather than in their own chapters.

Research Challenges

DEFINITIONS AND METRICS

A difficulty we faced is that such fundamental terms as "participation" and "participation rate" are not well defined. We found that the definitions in use are inconsistent and there is no standard practice for reporting these metrics. A primary reason for this is that participation is not a metric for many programs because it has not been a primary program objective. In many types of programs, the primary objective is to reach energy savings targets within set program budgets and cost-effectiveness criteria. According to experts and managers we interviewed, the actual number of participants is of secondary importance.

[1] By "commercial retrofit programs" we mean programs that promote and provide incentives for comprehensive retrofits of commercial buildings—major changes and upgrades to building systems and envelope. Other commercial programs, notably commercial prescriptive and custom programs, generally target single equipment or system upgrades, not the entire building and all key end-use energy systems. Also, some new construction programs may include major building renovations as eligible for services.

Defining a Participant

First, defining "participant" is not straightforward. While many, if not most, of the programs we reviewed tracked participants in some fashion, the criteria used to identify participants varied among programs within a utility and between utilities (or other program administrators). This can be especially difficult for large customers. Some utilities track projects (where one customer can implement multiple projects), while others track customers. For some types of customers, especially large customers with multiple accounts and facilities, defining exactly who the participant is can be difficult, with program administrators tracking program data at the customer level, account level, site level, and/or meter level. In these cases, there may be distinctions between "sites served" or "projects completed" and "participants."

Another reason for the differences in definitions and reporting practices is that for some types of programs there is no practical way of counting and tracking individual participants. In these cases, such as upstream lighting rebate programs,[2] the program incentives are targeted and paid to retailers and distributors of lighting products, not individual consumers. The key metric used in these types of programs is the number of units sold.

Defining Participation Rate

Defining "participation rate" is more complex because it requires defining a consistent eligible population as the denominator. In many cases the broadest eligible population is the entire rate class, such as all residential or all commercial customers. For many programs, that clearly is too large a population to be a meaningful metric. For example, a residential retrofit program typically targets single-family homeowners, not all residential customers, which would include owners and renters of multifamily units. Most business program portfolios have a range of offerings, with some for all customers and others for niche customer classes or market segments. Examples of size eligibility thresholds in business program offerings include the following:

- *Small business*. Demand of less than 200–300 kilowatts (kW).
- *Retrocommissioning*. Buildings of 50,000–100,000 or more square feet.
- *Process efficiency*. Annual consumption of more than 20 gigawatt-hours (GWh).
- *Self-direct*. Parameters vary, e.g., an approximate demand of at least 2 megawatts (MW) and annual consumption of at least 10 GWh.
- *Prescriptive/custom*. Typically, any business customer can participate, but custom programs cater to larger customers.

Even programs with well-defined eligibility thresholds may not have a good handle on the total number of potential customers that fall within the size categories. This is especially true for commercial customer programs, because program administrators may lack the

[2] National Grid–Rhode Island is one exception; its upstream lighting program does track customer names and addresses (Murphy 2014).

detailed building data for individual customers that are used to determine eligibility, such as number of square feet.

Residential program portfolios, similarly, are typically divided into programs that target subsegments of the entire population and then apply corresponding criteria to further refine eligibility. For example, a utility program for high-efficiency natural gas furnaces would not target all homeowners, but only those with existing natural gas furnaces, particularly customers with old or failing furnaces that will need replacement soon. Determining such numbers is difficult and requires market research that can be expensive and time-consuming.

Annual Versus Cumulative Data

Participation ideally is assessed on both an annual (program year) and cumulative basis. Cumulative participation is the most relevant in terms of highlighting the success of a program because it takes several years to build participation in a program. However measuring and tracking cumulative participation can be difficult. Customer turnover in both households and businesses is one problem cited. Another issue is that program designs change and evolve over time. Our research sought to capture both annual and cumulative data when they were available from our program contacts and documentation such as evaluations or annual reports.

Other Indicators of Successful Participation

The number of customers participating in a program is not always the appropriate metric. Many types of programs, for example, focus on and measure market share, such as residential ENERGY STAR® product programs. Market share generally is defined as the number of targeted products (such as ENERGY STAR) as a percentage of total annual sales. Such a metric is especially applicable and useful for programs such as new construction (e.g., percentage of new homes that are ENERGY STAR) and equipment (e.g., percentage of residential central air conditioners that are ENERGY STAR).

Other metrics used by programs are sales of energy-efficient products per customer or surveys of energy-efficient products in place. For example, many residential lighting programs estimate and track the number of energy-efficient lighting products purchased annually per customer. Such programs also may conduct periodic socket saturation surveys, which involve market research by household to count the number of energy-efficient products in place compared to the total number of lighting sockets in a house.

One of the other metrics related to participation used in some types of programs, especially retrofits, is conversion rate. This is defined as the percentage of customers that actually implement a recommended project or improvement following an initial audit or other type of engagement with a program. We found that for some types of programs, the conversion rate is the primary metric tracked and used to determine relative program success in gaining participation.

Finally, participation rates for large customer programs, such as custom commercial and industrial (C&I) programs, may not be an appropriate standalone indicator of a successful program. For example, while other programs such as residential appliances offer fairly consistent levels of energy savings per participant, C&I custom programs have very wide

disparities between the largest and the smallest customers. This means that a C&I custom program could be very successful in terms of cost effectiveness and energy savings despite serving only a handful of large customers. In this case, other important indicators of success are the size of the customer and the size of its delivered energy savings.

LACK OF PROGRAM DATA

The lack of common, consistent definitions and of participation data in annual reporting were the primary difficulties we encountered in searching for data on program participation. For reasons discussed above, many programs do not report participation data, particularly any metric such as participation rate that would require determination of an eligible population base. Moreover, for certain types of programs, overall participation rate would not be a meaningful program metric. The population of eligible participants may be so large relative to the number of participants that can be served by a program that it is of limited value to determine and track a participation rate. This is especially true for program areas that have achieved very small market penetration. In these cases it may be more useful to identify subsets of the eligible customers that are best suited for the programs and track participation rates accordingly. For example, where the eligible or targeted population is very small and limited, such as for programs serving very large customers with specialized services, participation rates can be a useful way to track progress, complementing data on total energy savings achieved.

Aggregate data on program participation at the national and state levels are limited. Existing energy efficiency program databases, such as the Energy Information Agency (EIA) Form 861, do not include any metric on program participation, either absolute numbers or rates. There are some emerging efforts in this area, however. For example, the Consortium for Energy Efficiency (CEE) has begun to include requests for participation data in their research. Also, we did find and use one relatively new database, DSM Insights (E Source 2014), that includes data on the numbers of participants for a large set of individual energy efficiency programs. In addition to the absolute numbers of participants, DSM Insights also includes data on actual participation as a percentage of planned participation—that is, how many customers actually participated in a program compared to how many were targeted or expected to participate in program plans. This metric did allow us to identify programs that achieved high absolute numbers of participants and programs that achieved high participation relative to the targeted participation level.

Our research identifies several reasons for improved program participation data. Better data on efficiency program participation can provide several benefits to program administrators, regulators, and other stakeholders. For example, it can help them

- Develop and improve efficiency potential studies
- Achieve energy savings goals
- Design programs to be more effective, potentially reducing the cost of saved energy
- Assess the extent of customer equity concerns, or rate impact concerns
- Identify and serve hard-to-reach customers
- Achieve the goal of implementing all cost-effective energy efficiency, which requires reaching all customers

ONE-STOP SHOPS

An emerging trend in program design is that administrators are breaking down traditional silos that have divided programs and services into very distinct services. This trend is in response to the growing recognition among administrators that customers do not really seek programs per se; they seek the services and incentives available to them to address energy efficiency improvements in order to reduce their energy costs and gain other attendant benefits. As discussed earlier, recent research and analysis by LBNL identifies and creates a taxonomy of customer energy efficiency programs (Hoffman et al. 2013). While this expansive set of program types may suggest that such program silos persist, at least from the program administrator's perspective, leading program administrators are functionally combining and merging services for their customers from these traditional silos into more comprehensive packages of available services, sometimes referred to colloquially as "one-stop shops." This is evident in many programs offered to multifamily customers, small business customers, commercial retrofit programs, and home performance programs. The program model is simple: provide customers with a single point of contact to access a full array of services and incentives available. While program administrators may maintain individual program leads, the customer does not need to see that structure. On the program administrator side, improved customer segmentation and improved communication among program leads can enable better data for participation leads.

OVERCOMING RESEARCH CHALLENGES

Despite these numerous research challenges, we did identify programs that have achieved high participation and were able to gather relevant program data on participation for these programs. Despite the lack of consistent definitions and or common metrics across all program types, within a selected program type there tend to be conventions that allow direct comparisons. Our research also reveals important factors within each type of program that contribute to achieving high participation. The gaps we identify in common nomenclature and metrics highlight the need for better participation data.

Based on all of these considerations, table 1 summarizes the leading participation metrics for each of the ten program types we examined.

Table 1. Participation metrics by program type

Program	Metric
Residential lighting	Participation = number of units sold/number of residential customers, or socket saturation survey results
Residential products and appliances	Participation = number of units sold/number of customers, or market share of efficient equipment (e.g., ENERGY STAR)
Residential whole-home retrofit	Participation rate = units served/all single-family residential customers
Residential new construction	Participation rate = units participated/new homes (and major renovations), or market share of efficient homes (e.g., ENERGY STAR)
Multifamily housing	Participation = units served/number of multifamily units

Program	Metric
Commercial retrocommissioning	Participation = buildings or floor area served/buildings or floor area above a building size threshold
Commercial prescriptive	Participation rate = customers served/all commercial customers, or market share of efficient equipment
Commercial and industrial custom incentives	Participation rate = customers served/eligible commercial and industrial customers (often segmented by customer size class)
Commercial new construction	Participation rate = floor area of buildings served/floor area of all new buildings (and major renovations)
Small business	Participation rate = customers served/number of customers eligible

The next sections of the report present our findings and discussion on participation by each of the selected program types. In each section we examine the target market, technologies, and program designs. We then present research results for selected programs we identify as having achieved high participation. We also identify and discuss key factors that contribute to high participation. Our intent is to characterize and quantify what "high participation" means by these different program categories. In this way, other programs can assess their performance relative to these benchmarks. Following these sections on different program types, we present our overall findings, conclusions, and recommendations.

Residential Products and Appliances

MARKET

Residential products and appliances programs focus on incentives, marketing, and education to increase the saturation of energy-efficient products and appliances in retail stores and, ultimately, in homes. Efforts are targeted at a number of market actors—predominantly downstream consumers—but many programs also target midstream retailers and upstream manufacturers. The vast majority of product and appliance purchases are at the retail level, so targeting retailers and manufacturers with incentives and/or outreach can catalyze market transformation by increasing the flow of energy-efficient products into the marketplace. Programs tend to target ENERGY STAR products and appliances, as it is an established brand that often represents the most energy-efficient products on the market, though products with higher (or lower) efficiency gains exist and are often eligible in addition to qualified ENERGY STAR products. The new ENERGY STAR Most Efficient designation, for example, is an extension of the ENERGY STAR brand designed to identify and advance highly efficient products in the marketplace.

Residential products and appliances programs track participation in terms of the number of units sold by type. These programs are capable of achieving high market shares and moving tens of thousands of targeted products in a program year. To achieve high participation, such programs leverage a mix of incentives, effective marketing, and retail/manufacturer relationships. The primary metric of participation is the market share of energy efficiency products. For example, Pacific Gas and Electric's Plug Load and Appliances Program has achieved market shares for various ENERGY STAR products, including electronics,

appliances, and water-saving measures, of 68–86%. The New York Products Program from the New York State Energy Research and Development Authority (NYSERDA) has been extremely successful at increasing the annual market share of new ENERGY STAR appliances sold since 2001. The market share of ENERGY STAR refrigerators has increased from approximately 20% to 72%; of clothes washers, from approximately 20% to 75%; of dishwashers, from approximately 40% to 88%; and for room air conditioners, the ENERGY STAR market share grew from approximately 30% to 67%.

These programs address end uses and measures that typically are not covered by residential new construction, retrofit, or HVAC programs. "Products" is an all-encompassing term that can include lighting, consumer electronics, and other plug loads, although residential lighting is often an autonomous program, which we discuss in its own chapter in this report. Appliances are typically limited to white goods, but some programs also include water heaters and other non-appliance water-saving measures.

The market for energy-efficient products and appliances is driven by awareness and education about energy efficiency, the availability of energy-efficient products in the marketplace, and incentives that reduce purchase costs for consumers. Increasing awareness—not just program awareness, but also awareness about energy efficiency and its benefits—is critical and a primary driver. When consumers shop for electronics or appliances, energy efficiency often is not a priority. Consumers are usually concerned more with the price and features of these types of products than they are energy savings.

PROGRAM DESIGNS AND TECHNOLOGIES

Residential products and appliances programs are designed to motivate product purchases by improving awareness and knowledge of energy efficiency and reducing purchasing costs. Eligible measures vary significantly, but programs usually include at least 3 products and sometimes upwards of 8–10 (Peters et al. 2012). Eligible consumer electronics typically include televisions, set-top boxes, computers, monitors, and advanced power strips (APSs). Computers, TVs, and set-top boxes alone account for almost two-thirds of end-use electricity consumption for plug loads (Urban, Tiefenbeck, and Roth 2011). Eligible appliances typically include clothes washers, dishwashers, refrigerators, freezers, dehumidifiers, pool pumps, room air conditioners, and, particularly in the case of natural gas programs, water heaters and heating equipment. HVAC incentive programs target central air-conditioning units, furnaces, and heat pumps. Programs providing incentives for high-efficiency natural gas furnaces have a long history and in many regions have helped transform the market to make these types of units the norm.

Regardless of the target market for programs—downstream, midstream, or upstream—efforts to educate and raise awareness about programs specifically and energy efficiency generally are a primary component of any program. Program administrators have found it more cost effective to focus on market transformation through education and awareness building as a means of driving demand and participation in these types of programs. Retailers and manufacturers are well positioned to influence consumer choice, as they already commit a great deal of resources toward marketing. Marketing typically occurs through such vehicles as point-of-purchase materials, retail placement opportunities, advertising with traditional media (print, radio, online), and articles and educational

material in community and association newsletters (print and online). Program administrators have also found that cooperative opportunities with retailers and manufacturers can be leveraged to create awareness of the ENERGY STAR brand as well as to generate sales and extend the energy efficiency message to communities. They also point out cross-marketing opportunities with other energy efficiency programs, such as residential new construction and home retrofit programs.

Financial incentives are a motivating tool for participation on the part of consumers, retailers, and, to a lesser degree, manufacturers. From the perspective of the consumer, the cost of energy-efficient products is a primary barrier, so program administrators will help reduce purchase costs either through consumer rebates (mail-in, in-store, online) or through retailer and manufacturer buydowns, where program administrators provide financial incentives on every unit sold to encourage retailers and manufacturers to reduce the price of a product. Consumers often balk at redeeming mail-in rebates, however, because they perceive the redemption cost (time) to be prohibitive, particularly when the rebate is small. Program administrators have also found that when rebates dry up, demand for energy-efficient products dries up as well.

Hence a greater focus by program administrators is warranted on market transformation targeted at retailers and manufacturers, either through education and awareness or with financial incentives. For example, a small per-unit incentive applied to thousands of sales transactions can mean a lot of money to retailers, which helps to drive the market toward energy-efficient products. For retailers, incentives are usually structured to reward them for increasing the sales of efficient consumer electronics over some predetermined sales baseline. Incentives targeted at manufacturers are less common (lighting is an exception), as manufacturers generally react to consumer demand by increasing supply and not vice versa. When they are, it is typically done in the form of buydowns that lower the ticket price of products in retail stores.

Rebates are often structured differently depending on the focus of the program. Rebates for consumer electronics, for example, are typically targeted at midstream retailers and upstream manufacturers. In part this is because consumers' purchasing decisions for electronics are not heavily influenced by energy efficiency. Instead, consumers are more concerned about price, performance, and features. But the per-unit incentives for consumer electronics are typically very small relative to their incremental cost and, as such, are not intended to influence consumers' purchasing decisions. Consumer electronics programs, therefore, tend to focus more on sales incentives to retailers and manufacturer buydowns in order to drive down consumer purchasing costs.

Rebates for appliances, on the other hand, are typically targeted at downstream consumers. Rebates for appliances tend to be considerably higher than for consumer electronics because of their relatively high incremental cost, in the range of $25–500 (Efficiency Maine 2013), though the high end of that range is due to the inclusion of water heaters: rebates for appliances are infrequently set above $50. However programs also focus on retailers and manufacturers through training and education in order to increase the sales of efficient appliances as well as the supply of eligible appliances.

Rebates for high-efficiency residential HVAC equipment, particularly central air conditioners and natural gas furnaces, also need to be higher because of the high incremental costs. For example, CenterPoint Energy in Minnesota offers rebates from $150–$400 for furnaces that range from 92–96% AFUE (annual fuel use efficiency). Xcel Energy in Minnesota offers incentives for high-efficiency central air conditioners (rated at 14.5 seasonal energy efficiency ratio [SEER] and higher) of $225–$400. Such ranges and amounts are typical for the incentives for residential HVAC equipment, which are relatively expensive purchases for homeowners.

The per-unit savings of products and appliances vary widely, as does the saturation of efficient products, so programs often focus on incentivizing products with the least saturation and/or the highest savings potential. For example, some program administrators have discontinued rebating certain appliances because the saturation of ENERGY STAR appliances has grown significantly in many states. Still, the incremental cost of energy-efficient equipment is enough of a barrier that significant annual improvements to market share are difficult to deliver without successful intervention (Peters et al. 2012). Federal appliance standards have improved over the years as well, decreasing the incremental savings generated by efficient products compared to the federal baseline.

PROGRAM RESULTS

Defining and Measuring Program Participation

Residential products and appliances programs track participation in terms of the number of units sold by type. Statewide data on the total sales of products are difficult to acquire, because retailers and manufacturers consider sales data to be competitively sensitive and may be disinclined to provide these data to new programs. Measuring participation based on the number of households is not useful since one household may participate several times, taking advantage of rebates for more than one product. So these programs do not measure consumer participation in terms of percentages.

Program administrators collect other types of information in order to establish indicators of success for their products and appliances programs:

- Number of participating retailers and manufacturers
- Market share of ENERGY STAR products and appliances
- Energy savings
- Peak-demand savings

In our discussion below, we focus on achieved market share as the best metric for participation.

Since retailer and manufacturer participation is key, program administrators often track the number of new and existing participating retailers and manufacturers over time, though this is usually reported in absolute terms (number of retailers and retail stores) instead of a percentage. Programs also promote ENERGY STAR products and appliances almost exclusively, so tracking the market share of ENERGY STAR products over time is an important indicator of program success. ENERGY STAR product market share is difficult to estimate and infrequently provided in program evaluations, however, and attribution is an

issue in order to parse the impact on market share from program efforts versus exogenous market changes. ENERGY STAR product specifications also change every few years, so participation has to be tracked relative to a particular baseline or the estimates can be misleading. Similarly, since consumer awareness about energy-efficient products is crucial, programs often track consumer awareness about the ENERGY STAR label through market surveys. The introduction of ENERGY STAR Most Efficient products has changed this focus slightly, however, because ENERGY STAR is considered a mature market in many states, so tracking changes in market share and awareness over time might not be a relevant indicator in some states.

Efficiency Vermont's Efficient Products Program includes lighting products as eligible measures. In 2013, 79% of program savings came from lighting. Appliances still focus on downstream rebates, upstream for APSs, computers, and TVs.

PG&E's Plug Load and Appliances program, formerly known as the Home Energy Efficiency Rebate, is part of a statewide effort to promote energy-efficient electronics and appliances, including water-savings measures. The program offers incentives directly to consumers, but also develops and builds upon existing retailer relationships to spur demand for and supply of energy-efficient products that are not limited to ENERGY STAR. Between 2010 and 2011, the market share of energy-efficient televisions increased from 20% to 59% for version 4 of the ENERGY STAR television specification and from 5% to 27% for version 5. This quick change in market share led the program to raise qualification standards shortly thereafter. The market share of ENERGY STAR monitors, version 5 + 10%[3], increased from 22% to 68% over the same period.

NYSERDA's Energy $mart Efficient Products program, now known as the New York Products Program, began in 1999 and works with retailers, manufacturers, and distributors to increase the demand for and sales of energy-efficient appliances, lighting, and home electronics. The program, implemented by Lockheed Martin, does not provide financial incentives to consumers. Instead, the program provides incentives partners for cooperative advertising and special promotions, as well as marketing campaigns on both the supply and demand sides of the appliance and lighting markets. The program also develops and distributes special point-of-purchase materials, markets through NYSERDA's website, develops educational materials, and coordinates with retailers to "obtain donations of ENERGY STAR appliances and lighting in support of the Program's outreach at trade shows, home shows, and county and State fairs, as well as training sessions for retail staff and managers." According to the most recent evaluation, in 2012, the ENERGY STAR market share of appliances was 75% for clothes washers, 88% for dishwashers, 72% for refrigerators, and 67% for room air conditioners. There were 823 participating partners, representing 99 appliance-only retail stores, 177 appliance and consumer electronics retail stores, and 574 active lighting retail stores. There were also 52 manufacturer partners in 2012. The evaluation also shows that the program has been extremely successful at increasing the annual market share of new ENERGY STAR appliances sold since 2001. The market share of ENERGY STAR refrigerators has increased from approximately 20% to 72%,

[3] Meaning 10% better performance than version 5.

from approximately 20% to 75% for clothes washers, from approximately 40% to 88% for dishwashers, and from approximately 30% to 67% for room air conditioners (Dimetrosky et al. 2014).

For another perspective on participation rates across programs, in addition to market share, table 2 presents participation in terms of number of units relative to the number of residential customers. Higher percentages do not necessarily mean a more effective program, as they may reflect other factors such as the number and type of products included. Note that the highest rate, 9% in Vermont, is a program that includes lighting products, for example.

Table 2. Participation rates for selected residential efficient products programs

Program	Year launched	Annual participation (units in the most recent year)	Number of residential customers*	Annual participation as % of residential customers
Efficiency Vermont: efficient products		29,077	309,019	9%
Energy Trust of Oregon: high-efficiency products		19,542	1,642,444	1%
DTE Energy: ENERGY STAR appliances	2009	16,679	1,925,908	1%
Efficiency Maine: residential appliance program	2011	20,646	703,770	3%

* EIA 2013a

We were unable to find market share data on high-efficiency HVAC equipment. Instead, we relied on participation data from DSM Insights (E Source 2014), similar to the table above on high-efficiency appliances. As shown by these selected programs, initiatives of this type can provide incentives to thousands of customers and reach single-digit percentages of residential customers annually—1–6% in this selected set. Since the typical residential HVAC system lasts about 15–20 years, the number of customers in the market for HVAC equipment each year is about 1/18 of the total number of customers, and therefore these numbers can be multiplied by about 18 to estimate the percentage of annual equipment sales that participate. Using this guideline, participation rates of these programs range from about 14–60% (not counting the one outlier at the high end). By way of comparison, EPA (2014) estimates that the market share of ENERGY STAR residential central heat pumps, air conditioners, and furnaces were 37%, 18%, and 9%, respectively, in 2013. EPA does not collect regional data, but we estimate that air conditioner market share will be higher in the south and furnace market share higher in the north.

Table 3. Participation rates for selected residential HVAC programs

Program	Year	Annual participation (highest achieved in period 2010–2013)	Number of residential customers*	Annual participation as % of residential customers
Potomac Edison Company: HVAC and water heaters	2013	4,654	205,880	2.3%
Sacramento Municipal Utility District: HVAC residential cooling	2011	18,108	533,393	3.4%
NSTAR: residential cooling and heating equipment	2013	5,919	781,310	0.8%
Xcel Energy, Minnesota: residential cooling	2013	11,493	1,098,341	1.0%
National Grid, Massachusetts: residential heating & water heating	2012	25, 942	1,012,559	2.6%
Baltimore Gas & Electric: HVAC rebates	2010	15,498	833,783	1.9%
CenterPoint Energy, Minnesota: heating system rebates	2013	42,009	748,740	5.6%

*EIA 2013a; EIA Form 176 for natural gas utilities.

Programs that leverage a mix of incentives, education, and awareness, and retail/manufacturer relationships are capable of achieving very high rates of market saturation in a short period. The programs identified above are achieving market shares close to 90% for certain products, though there is a wide range. Well-designed programs can also increase market share significantly over a short period of time. PG&E, for example, increased the market share of ENERGY STAR version 5 televisions or greater by 500% within one year, although the specification was relatively new. The market share of ENERGY STAR version 4 televisions increased by 300% in the same time period. While the market share of efficient appliances increased more slowly for NYSERDA's program, these are also market shares of an entire type of product, which includes many energy efficiency levels, not just relative to a certain specification.

Keys to Achieving High Participation

Successfully increasing participation in residential products and appliances programs is dependent upon various efforts focused on consumers, retailers, and manufacturers.

With respect to consumers, efforts to educate and raise awareness about the benefits of energy efficiency are paramount. Energy efficiency is not as high a priority for consumers as are price, performance, and features. Demand for energy-efficient products can diminish as rebates dry up, so rebates generally are not the means to achieve and sustain high market shares. Programs must therefore create opportunities to educate and raise awareness with consumers as frequently as possible. The majority of product purchases occur in retail stores, where consumers are influenced by sales representatives, marketing materials, and

stocking practices. Sales representatives need to be engaged and well trained in order to deliver messages about energy efficiency to consumers. Point-of-sale (POS) marketing materials, promotions, and rebates are important for raising awareness independently of efforts by sales representatives because they prime interested consumers to prioritize some factors over others (Research Into Action and DeHoratius 2014). Shrewd stocking practices are also effective in ensuring the consumer is aware of which products are the most efficient and eligible for rebates.

An increasing number of product sales are occurring online, although this is less common for appliances than for consumer electronics. Consumers are also turning to the Internet more regularly for information about products and appliances than they are to retail sales representatives. Program administrators have taken notice and are directing more marketing and promotional efforts toward the Internet through utility and retailer websites and in partnership with other organizations like ENERGY STAR, TopTen USA, and Consumer Reports, as well as utilizing social media. Connecticut Light & Power, for example, partners with TopTen USA in order to utilize a web-based system that helps consumers identify the most efficient products by product category and allows them to search for product availability at local participating retailers.

Consumer incentives are important to driving participation, so minimizing purchase costs as well as simplifying the process through which rebates are redeemed will spur consumers to purchase energy-efficient products independent of their demand for features and performance. If rebates are small, consumers will be disinclined to spend time redeeming them. Even relatively large rebates for appliances can go unclaimed if the process is too difficult or takes too long. POS rebates, for example, expedite the process of redeeming rebates: the availability of an accessible in-store or online rebate could make the difference in a consumer's purchasing decision. Alternatively, product buydowns are an efficient way of addressing the cost issue that requires no effort on the part of the consumer. Coupled with savvy marketing and education efforts, programs that work with midstream and upstream entities to reduce purchase costs have proven to be very effective at both short- and long-term participation gains. In fact, some program administrators are either shifting toward or focusing strictly on midstream and upstream program designs because of the larger potential for sustained participation and market transformation. As we noted earlier, demand for energy-efficient products tends to disappear when rebates do. NYSERDA, for example, favors upstream programs aimed at long-term market transformation over traditional rebate programs; it has never operated a per-unit incentive program on a regular basis (Peters et al. 2012).

Retailers and manufacturers influence participation in residential product and appliance programs by acting as resources for information about energy-efficient products and, primarily, by doing what they do best: supplying, marketing, and selling electronics and appliances. Programs that leverage retailers' and manufacturers' competitive advantage in marketing and sales are usually more successful in reaching consumers. Program administrators report that sharing marketing costs with retailers and manufacturers provides a good deal of value to them, for example. Ultimately, establishing and maintaining relationships with retailers and manufacturers is crucial.

A primary factor in ensuring participation on the part of retailers is scale, both geographic and financial. Residential products and appliances programs are more attractive to retailers if program administrators can convey to them how scale will be guaranteed. In turn, they will dedicate more resources, such as staff and shelf space, to programs if those investments will generate a significant return. Several states, such as California, Connecticut, Massachusetts, and New York coordinate statewide programs as a means of creating scale, though these statewide efforts also ensure consistent program design and messaging. The Northwest Energy Efficiency Alliance coordinates a region-wide program that addresses issues like utilities' desire for independence, which can make developing training packages for retailers difficult, for example. Creating scale for retailers is also integral to getting manufacturers on board. A focus on national retailers is important because they have the greatest leverage over manufacturers.

Given the importance of relationships and scale, program administrators noted that retaining the services of an effective vendor is invaluable. Vendors that manage similar programs in other states or utility service territories have the ability to leverage existing relationships as well as their experience in working with other utilities. Vendors also have the staff and resources needed to communicate regularly and effectively with retailers and manufacturers in order to coordinate program planning and design, such as incentives and marketing as well as in-store and community events. These relationships extend beyond retailers and manufacturers, of course, leveraging other state and community organizations that can promote the education and awareness. California's statewide program, for example, works with state and local water agencies to promote its program relative to eligible measures that save water.

SUMMING UP AND RECOMMENDATIONS

Several program administrators noted that residential products and appliance programs are generally moving more toward midstream and upstream programs focused on retailers and manufacturers rather than downstream programs focused on consumers. Program administrators believe that participation on the part of the consumer is predicated upon education and awareness, cost (in time and money), and product availability. While education and awareness efforts are usually incorporated into programs regardless of the type (e.g., downstream versus midstream), program administrators believe that addressing the issues of product cost and availability are best addressed by incentives directed at retailers and manufacturers. These entities are experts at marketing their products to consumers and, as awareness of and demand for energy-efficient products increases, they have the most influence over the types and volume of products that are made available on the market. Consumers' purchasing decisions are mainly influenced by a product's price and features (both function and energy related), and they are dependent on retailers and manufacturers to provide that information. Incentivizing and enabling retailers and manufacturers to lower product costs, educate consumers on the benefits of energy efficiency, and stock and market eligible products accordingly are the most effective ways to motivate consumers to purchase energy-efficient products.

Program administrators that incorporate these elements into their programs will have greater success in moving the market toward energy-efficient products and appliances, particularly in comparison to programs that focus marketing and incentives on downstream

consumers. Leading programs that we identified above are achieving market shares of 30-90%; there is a considerable range in the market shares we found. Market shares can also change as technology improves and these products become more efficient: ENERGY STAR specifications, for instance, change every few years, depending on the product, which requires program administrators to update eligibility requirements accordingly.

Residential Lighting

MARKET

The residential lighting market is highly diffuse. It clearly is a mass market with products available in a wide range of retail stores, from corner convenience stores to big-box home improvement stores. Historically, the market was characterized and dominated by a limited array of technologies, primarily incandescent lamps (light bulbs). So prevalent were these technologies that consumers learned to equate the power demand (in watts) with the amount of light given off by a given bulb.

What once was a fairly simple market has changed significantly over the past couple of decades. The introduction of compact fluorescent lamps (CFLs) in the 1980s marked the beginning of a much more complex market, with a vastly expanded set of products available. In more recent years the introduction of light-emitting diode (LED) lamps has added even more choices for customers and greatly accelerated change in this market. Established in the Energy Independence and Security Act of 2007 (EISA), federal standards for residential lighting products that are now in effect have essentially removed traditional, inefficient incandescent light bulbs from the market, as these technologies do not meet the standards.[4] More efficient incandescent technologies have been introduced and provide customers yet more options for household lighting.

Barriers for consumers to purchase and use energy-efficient lighting technologies such as CFLs and LEDs primarily are higher purchase costs, lack of awareness and understanding, and concerns about the quality and performance of the technology. Many early CFLs suffered from a number of performance problems, including a lagged start to full brightness, poor lighting color (cold, not warm like traditional incandescents), and flickering. The bulbs themselves were also often bulky and failed to fit certain lamps without modification. Such problems are largely resolved through advances in the technologies and products. Modern CFLs have proven to perform well in a full array of household applications. The legacy of the early performance problems still cast a shadow on markets for new residential lighting products. The industry has learned from its CFL experience by ensuring that LED lighting products do not suffer through a similar period of poor performance. Instead, the industry has been careful to make sure that the initial LED lighting products entering consumer markets are high-quality products that perform well. The success of CFLs can be seen by their widespread availability and low prices.

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[4] The Energy Independence and Security Act of 2007 (Pub. L. 110-140) established efficiency standards for appliances and lighting among its many provisions. Conventional incandescent lamps (bulbs) do not meet the lighting standard. To meet the new standard requires new, higher-efficiency incandescent technology or such alternatives as compact fluorescent and LED lamps.

The greatly expanded set of choices for lighting products itself can be a barrier for consumers. Many consumers may be resistant to purchase new, unfamiliar technologies. They also may purchase products that do not suit their desired performance or lighting application. If such a mismatch is made and the consumer is not pleased with the result, the experience may taint future purchases of the technology. With all the new lighting choices, consumers are being forced to relearn how make what once was a very simple purchase decision.

The residential lighting market has long been primarily driven by purchase price. Consumers have mostly sought low-priced products; the baseline for cost and performance historically were cheap incandescent bulbs. Other products, such as CFLs, have had to compete against that baseline technology and get consumers to look beyond purchase price to lifetime costs and savings.

PROGRAM DESIGNS AND TECHNOLOGIES

The CFL has long been an icon of energy-efficient technologies. Over the past 10 to even 20 years or more, programs to increase the purchase and use of CFLs in households have typically been a primary part of customer programs provided by utilities or related public benefits organizations. The primary program approach has been to reduce the purchase cost of CFLs to consumers via rebates. Even with such effective price reductions, the higher-efficiency products, such as CFLs and now LEDs, still carry a price premium. Consumers still need to be convinced of the value of making such a purchase, which is done through marketing and education based on the benefits of the more efficient product, which include lower life-cycle costs, longer product life, and reduced environmental impacts.

Residential lighting programs have achieved high participation and associated market impact. Such programs typically have yielded the highest energy savings within program portfolios, often 50% of all savings.[5] Successful programs serving large customer populations measure units sold in the millions. Such widespread market penetration has led to significant price decreases for CFLs over the years and has made the CFL a ubiquitous product that is widely available and accepted by consumers. This transformation has taken 10–20 years. Early indications on the next great residential lighting technology, LEDs, are that this transformation may happen much faster.

The common strategy among the leading programs that we identified in this study is an upstream buydown retail program. In this way, the incentives are paid to the manufacturers, distributors, and retailers for stocking and selling energy-efficient products. All that consumers realize when they purchase the products is a lower cost; there are no rebates paid to consumers.

In a recent review of residential lighting programs in the Northeast and Mid-Atlantic states, the Northeast Energy Efficiency Partnerships (NEEP) identified a comprehensive set of

[5] In Massachusetts, lighting from all programs represents 59% of the program administrators' 2013 residential annual savings goals and 63% of low-income goals. In Rhode Island, such savings account for 59% of 2013 non-income-eligible residential lighting savings and 60% of income-eligible savings.

program elements typically found in the portfolios of utilities and other program administrators (NEEP 2013). These include direct installation, special retail events, consumer education, marketing, web-based tools, smartphone applications, and behavioral change.

While utilities and program administrators typically will have a specific residential lighting program, it is common that energy-efficient lighting is targeted and included as part of other programs serving residential customers, such as direct installation with energy audits performed for low-income and other home-weatherization programs.

PROGRAM RESULTS

Defining and Measuring Program Participation

The primary metric and program objective for residential lighting programs is simply the number of lighting products (lamps or bulbs) that are incentivized or otherwise attributed to the program. This could be direct rebates to customers or it could be incentives paid to upstream distributors and retailers. Participation rate is a metric that generally is not recorded, tracked, and evaluated, according to the leading-program contacts we interviewed. Essentially, the target and eligible populations are the same: all residential customers along with some fraction of certain commercial markets, principally small businesses that purchase lighting products from retailers. To determine market impacts and household rates of adoption requires looking at different metrics, such as market penetration and saturation. This typically involves socket saturation surveys of households to reveal how many energy-efficient lamps are in place. Program evaluations also may estimate the number of efficient products bought by a typical household in a year or how many households in total purchased at least one efficient product. Such market research studies and evaluations, however, are generally not performed annually or even routinely by program administrators.

NEEP (2013) found in its most recent survey of residential lighting programs in the Northeast that program lamp sales range from 0.6 to 2.6 efficient lamps per household per program year. Looking ahead, NEEP reports that 2013 efficiency program plans average 1.5 efficient bulbs per household. Below is a breakdown by state annual averages in the Northeast.

- New Hampshire: 0.6 units per household
- Vermont: 2.6 units per household
- Massachusetts: 2.3 units per household
- Connecticut: 2.3 units per household
- Rhode Island: 1.9 units per household

Our interviews with managers from leading programs affirmed the prevalence of using the number of bulbs that are incentivized or otherwise promoted as the primary metric for participation. As was observed by the program manager at Puget Sound Energy (PSE), "It's all about the number of bulbs" (J. Smith, Puget Sound Energy, pers. comm., May 19, 2014). We heard the same message from Arizona Public Service (APS), PG&E, and Efficiency Vermont.

Residential lighting programs can reach thousands of customers quickly due to their structure around mass markets for such ubiquitous products as light bulbs. For example, APS has achieved high sales volumes relatively quickly, increasing from initial program year sales of about 362,000 units in 2005 to 3.3 million units by 2010 (D. Kelliher, regional director, Ecova, pers. comm., April 17, 2014). APS program managers expect this sales mark of about 3 million to be possibly the high point in the program's history; they expect the total numbers to go down as LEDs start to pick up share and require higher incentives per unit (D. Osterman, program manager, APS, pers. comm., May 21, 2014). PSE has provided incentives for 15 million CFLs through its Residential Lighting Program along with other outlets for efficient products, such as through energy audit/direct install programs (J. Smith, PSE, pers. comm., May 19, 2014). Long-standing programs serving large populations, such as PG&E, have affected the purchase of millions of bulbs over many years.

These types of programs can achieve high participation even in states with small and largely rural populations. For example, over the six-year period of 2007–2012, Vermonters purchased 4.5 million CFLs through Efficiency Vermont's program, an average of three per customer (Bonn 2013).

Table 4. Selected residential lighting program results

Program	Year launched	Annual participation (units in the most recent year)	Number of residential customers	Bulbs per customer (average annual)
Arizona Public Service	2005	3.3 million, annual in 2010	1.0 million	3.3
Efficiency Vermont	2001	4.5 million, cumulative, 2007–12	0.3 million	3.0
PG&E, SCE, SDG&E (California statewide investor-owned utilities programs)		95 million, cumulative 2006–08	10.1 million	3.1

The results shown in the table above show that achieving annual sales per customer of about 3+ bulbs per customer is typical of well-established programs.

The eligible population for residential lighting programs generally is anyone buying light bulbs. Efficiency Vermont's Residential Lighting Program is typical; the program is open to all customers and ratepayers throughout the state. As a result, "The program has a wide and vast reach across the state," according to the program manager (L. Bonn, program manager, Efficiency Vermont, pers. comm., May 23, 2014). Since most of these programs work upstream with retailers and distributors, there really is no way to limit purchases of qualified products to specific customer populations, such as those only served by the utility program. PG&E's program experience is typical. PG&E really cannot tell who is participating due to the nature of program and has not conducted research to address this question. The majority of sales have been through large retailers, big-box stores, and smaller chains (W. Han and D. Thayer, PG&E, pers. comm., May 27, 2014). PSE, similarly, does not count specific numbers of customers. PSE does define which stores are eligible to participate in its programs based on zip codes. While there is some effort to limit sales to customers outside its service area, this is difficult to do. It targets its marketing to its customers via

local and regional newspapers and radio. Also, generally there are no comparable programs serving customers in surrounding areas, so any spillover impacts are minimal.[6]

Long-Term Program Results on Markets

Residential lighting programs have achieved high participation and associated success via numerous strategies. Partnering with manufacturers, distributors, and retailers has been critical for success. Such partnerships have led to improved technologies, widespread availability of products, and effective retail campaigns to promote the products and boost sales.

While programs mostly focus on annual sales volume of residential lighting products as the means to reach annual energy savings targets, some programs do conduct periodic market research on the saturation of efficient lighting products within households. The metric for this type of research is socket saturation. Such surveys determine how many of the total screw-in light sockets within a household are filled with an energy-efficient lamp such as a CFL or LED. Some program administrators also conduct related market research to estimate the number of households that participate in their lighting programs, which would also yield the average number of qualified products purchased by each participating household.

In the Northwest, the Northwest Energy Efficiency Alliance (NEEA) completed a building stock assessment (Baylon et al. 2012) that included counting the number of light sockets in homes and assessing how many energy-efficient products are in an average home. The study found that there are on average 63.2 lamps and 39.9 fixtures per home. CFLs comprise 25% of the total lamps per home. The regional average for the number of CFLs installed per home is 15.5. The state breakdown of CFLs per home is:

- Idaho: 15.1
- Montana: 12.0
- Oregon: 13.6
- Washington: 17.3

Residential lighting programs have been in place in many states in the Northeast for many years. This region has been a leader in transforming residential lighting markets. While much of that change has occurred relatively slowly over 10–20 years or more, NEEP has found dramatic, rapid changes over the past few years.

Despite the rapid changes underway in the Northeast and other regions, NEEP's research on residential lighting (NEEP 2013) finds that socket saturation in the Northeast and Mid-Atlantic region appears to have stagnated at about 30%. Evidence from California, however, suggests that socket saturation continues to increase, reaching 40% in some areas (NEEP 2013). NEEP concludes, "We have found that the residential lighting market has a long way to go towards being transformed, and efficiency programs continue to have a very meaningful role to play in accelerating the uptake of efficient residential lighting."

[6] "Spillover effects" refers to increased sales of products targeted by a program that occur in the market beyond sales from direct participants due to indirect program effects, such as marketing and increased product availability.

Massachusetts reports a 40% socket saturation of CFLs, unchanged from 2010 to 2013. New York research by NSERDA shows this at 25%, unchanged from 2011 to 2013. The apparent stagnation of socket saturation is thought to be largely the result of a dominance of CFLs replacing CFLs (burned out) rather than CFLs replacing inefficient incandescent lamps. Regionwide, the goal for sales of energy-efficient lighting units is 19.3 million, or 1.5 units per household sold on average.

Thus, the most successful programs are reporting up to 40% socket penetrations. Multiple studies (NEEP 2013; Baylon et al. 2013) find that CFLs are used for more hours than non-CFL products, and thus the best programs are affecting the majority of residential lighting energy use. With LED products, there is an excellent chance that even higher socket penetrations can be achieved since LED products are smaller, instant-on, generally dimmable, and do not suffer from the negative connotations of fluorescent lighting. Table 5 summarizes penetration by state or region.

Table 5. Residential lighting program penetration

State or region	Efficient units/household	Socket saturation (percentage efficient units)
Idaho	15.1	
Montana	12.0	
Oregon	13.6	
Washington	17.3	
Northwest average	15.5	25%
Northeast Mid-Atlantic		30%
Massachusetts		25%
Vermont		33%
California	10.3	40%

Efficiency Vermont's research shows that socket saturation in Vermont homes was 33% in 2011; in 2008 the socket saturation was 19%, indicating that the program has continued to penetrate and increase the share of efficient lighting products in Vermont households. A typical Vermont home has 44 light sockets (Bonn 2013). Efficiency Vermont performs household inventories of energy efficiency about every three years, which help estimate the uptake of energy-efficient lighting products in households. Such results in the past have relied on a lot of assumptions; the program manager interviewed reported that the results were not very accurate (L. Bonn, Efficiency Vermont, pers. comm., May 23, 2014). As a result, Efficiency Vermont and the Public Service Department are working on getting more accurate estimates of household purchases and participation in programs such as residential lighting.

California's investor-owned utilities (PG&E, SDG&E, and SCE) have had some of the longest-running residential lighting programs in the United States, now well over 20 years and continuing. Over that time, these programs have had a large impact on residential

lighting markets in California and promoted millions of efficient lighting products. In 2006–08 the utilities paid incentives on over 95 million CFLs through the Upstream Lighting Program. A market effects study of efficient lighting products in California (Cadmus Group, Inc. 2010) concluded, "California IOU consumer awareness increased dramatically in the past decade and remains higher than awareness in the Comparison area." This study found that CFL saturation was significantly higher in California than the comparison area, with 79% of households in California reporting that they use at least one CFL inside or outside their home; the comparison area value was 66%. The study found that the average California home had 10.3 CFLs compared to 8.4 CFLs in the comparison area. Sales of CFLs averaged 1.1 units per household.

Changing Program Participation

Participation in residential lighting programs is largely a function of budgets and the corresponding amount of incentives available for qualified products, according to program managers we interviewed. As one manager commented, "Incentives drive sales." For example, APS program contacts commented that APS's residential lighting program is viewed as a dial or lever than can be readily moved up as needed to make up any differences between overall program portfolio targets and actual savings achieved (D. Osterman, program manager, APS, and J. Gidley, program manager, Ecova, pers. comm., May 21, 2014). This is especially applicable because residential lighting program savings make up such a large share of total portfolio savings, as is typical.

PG&E contacts expressed a similar perspective on PG&E's residential lighting program. They noted that the primary constraint to participation is the program budget, adding that it is relatively easy to scale program targets up or down based on the budget available for incentives. This is especially true since it does not really take an increase in administrative dollars to increase the amount paid out in incentives for more products. Any increases to established budgets can almost all go toward the incentives for higher numbers of products (W. Han and D. Thayer, PG&E, pers. comm., May 27, 2014). A PSE program contact noted that the company generally has had to throttle back its residential lighting program as it hit budget limits. In these cases, it hit its savings targets before reaching its budget limits and therefore could not provide incentives for sales of additional qualified products (J. Smith, program manager, PSE, pers. comm., May 19, 2014).

Changes in product markets, technologies, and standards are changing this strong historical relationship between program budgets and participation. Such changes are affecting program cost effectiveness as baseline efficiencies have increased due to federal lighting standards (EISA). Shifting to LED lamps, which are higher cost, generally means that higher incentive costs per unit are required. This means that fewer products overall can receive incentives than would if they were all based on CFLs. An APS program contact noted that they do not have as much wiggle room in their budgets, as incremental costs have been going down for more efficient technologies (D. Osterman, program manager, APS, pers. comm., May 21, 2014). The program has had to reduce incentive amounts accordingly. The program cannot boost incentive amounts to boost sales and associated energy savings to meet targets, as it had done in the past.

Efficiency Vermont has found that customers are especially price sensitive. For example, when the program changed incentives for specialty lamps that effectively increased the purchase price from about $1 to $4, program staff expected to see a 45% drop in sales. Instead, the drop was much greater—about 70% (L. Bonn. Efficiency Vermont, pers. comm., May 23, 2014).

In our research, we asked program contacts about changes made in programs to increase participation. Key changes cited include:

- Special promotional events, such as limited-time buy-one, get-one-free campaigns or product giveaways
- Moving upstream in market channels to work with manufacturers and distributors to ensure product availability and to leverage their marketing and sales expertise
- Working with other utilities to create a bigger, regional presence for marketing and allied programs, as well as to provide greater consistency in program services across a state or region
- Working to partner with nonprofit organizations and community groups, especially for certain hard-to-reach customer segments, such as senior citizens and low-income households; program partners might include senior centers or food banks
- Targeting ethnic grocery stores

While there seems to be a strong relationship between budgets and sales of qualified products, programs do experience fluctuations in sales from year to year. For example, Efficiency Vermont has seen sales of efficient lighting products promoted through its program jump from one year to the next.

Keys to Achieving High Participation

Common program elements for high participation emerged from our interviews and related research. The fundamental elements of successful programs are

- pricing
- marketing
- product placement

These three elements drive sales of energy-efficient lighting products as promoted in residential lighting programs. Additional attributes of successful programs include continuity in messaging and funding. This maintains program momentum and ensures that customer expectations can be met. Simplicity in serving customers helps achieve high participation by making it easy for them to access services and receive incentives. Working upstream has been a key to achieving simplicity from a customer perspective. There is no paperwork or even rebate to process; customers simply receive a discounted price.

Effective marketing drives high participation. As one program manager opined, “Stop educating and start marketing.” He added that programs should take a traditional marketing approach: offer a good price on targeted products at a convenient place that provides confidence to customers. Other guidelines and approaches mentioned by other program managers for successful marketing include the following:

- Big promotions can be effective.
- Messaging needs to consistent and highly visible.
- Both traditional and new media, such as social media, can be used to increase visibility and expand program reach.
- Targeted marketing can increase participation among certain customer segments.
- Getting qualified products in high traffic areas can boost sales.

Partnerships with retailers, distributors, and manufacturers are central to the design of residential lighting programs that have achieved high participation. Such partnerships serve a variety of key roles for programs; for example, they

- Ensure sufficient availability of targeted products
- Improve program marketing by leveraging retailer experience and resources
- Provide incentives to organizations whose objective already is to sell products
- Make the customer purchase seamless through upstream buydowns (no paperwork for the customer to receive discounted products)
- Ensure product quality and performance, such as that provided by relying on ENERGY STAR–rated products
- Extend markets and availability of products across program areas

SUMMING UP AND RECOMMENDATIONS

Residential lighting remains a primary target of customer energy efficiency programs. EISA and related developments have resulted in dramatic changes in residential lighting markets in recent years. Despite these changes, residential lighting programs will continue to be a significant part of energy efficiency program portfolios. There remains a large potential for continued penetration of residential energy-efficient lighting technologies even in states and regions where successful programs have been in place for 10–20 years or more.

As an example of the continued push for increasing the share of energy-efficient lighting technologies, NEEP, serving the Northeast, has a regional goal of achieving 90% socket saturation by 2020 and notes, "We believe this remains a prudent, albeit ambitious, goal." NEEP adds that according to its most recent lighting market survey, "Progress towards higher socket saturation has stalled." Despite this, NEEP argues that implementation of effective lighting program strategies can overcome such apparent stagnation and that the 90% goal is indeed achievable (NEEP 2013). Leading programs are achieving annual sales of up to three bulbs per household and cumulative socket penetration of 40%.

Residential lighting markets are undergoing rapid, fundamental changes. LED lamps are emerging rapidly. Programs can continue to influence the purchasing of these and other energy-efficient lighting technologies through incentives, marketing, and education. LEDs are poised to achieve higher market saturation than CFLs, according to several of the experts interviewed in our research. The LED market is dynamic and the technology behind the products is judged to be superior to CFLs in terms of certain key performance features. With such rapid changes underway, programs must be responsive and adapt to the market. A program contact from PSE noted that customer adoption of LEDs is occurring far faster than it did for CFLs (J. Smith, PSE, pers. comm., May 19, 2014). His experience has been that the program needs to double its initial forecasts for adoption of LEDs, and even with that

adjustment, such forecasts have still been about 50% low. Because so many new products such as LEDs are rapidly entering the market, residential lighting programs will need to do a lot of education in order to increase customer understanding of these products and engage customers to try them.

Residential Whole-Home Retrofit

MARKET

Residential whole-home retrofit programs have been a common offering among utility energy efficiency portfolios for decades, but the depth of these programs has improved in recent years under efforts such as Home Performance with ENERGY STAR. These programs focus on whole-home retrofits for single-family homes and homes with up to four units. Programs often utilize the ENERGY STAR brand, offering services that follow the Home Performance with ENERGY STAR[7] (HPwES) standards, albeit to varying degrees. At a minimum, whole-home retrofit programs usually provide audits and weatherization services focusing on insulation of the building envelope and air and duct sealing. Some also include direct installation (DI) measures, such as faucet aerators and pipe wraps. However most whole-home retrofit programs, including HPwES, provide rebates for additional measures beyond weatherization and DI in order to drive homeowners toward more comprehensive whole-home retrofits with deeper savings.

Given that a variety of measures and end uses can be covered by whole-home retrofit programs, there are a number of market actors involved. Auditors, raters, and contractors (who often are qualified to perform services for only one equipment type) are required to assess opportunities for savings, perform the installations, and measure and verify the results. Financial institutions are often engaged by administrators to provide additional financial support, particularly for projects intended to achieve deeper savings. State and local media are key to raising awareness about both programs and the merits of energy-efficient home improvements generally. Retailers and manufacturers are also key players, as the demand for energy-efficient measures and equipment drives their availability, particularly for programs with more aggressive eligibility requirements.

The whole-home retrofit market is driven predominantly by the presence of utility, state, and local programs as opposed to macroeconomic forces. While there are savvy homeowners out there that will invest in retrofit measures in the absence of a utility program, they are rare and projects can be limited to one-off installations (such as furnace or air conditioner replacements) as opposed to comprehensive retrofits. Homeowners are largely unaware of the benefits of energy efficiency, but even if they are, they can be put off by the costs of whole-home retrofit projects. Without available utility programs that educate and provide incentives to homeowners, the idea that whole-home retrofits can save money and add comfort or economic value to a home is mostly lost, no matter how green a homeowner would like to become.[8] The availability of low-cost options (audits, DI) made

[7] https://www.energystar.gov/index.cfm?c=home_improvement.hpwes_about_energy_efficiency

[8] This assumes there are no equivalent, effective, state-funded programs to educate, raise awareness, or incentivize these types of retrofit projects.

possible by utility programs are a powerful introduction to the potential of energy efficiency improvements and can lead to deeper, more comprehensive home retrofit projects.

Barriers in the home retrofit market vary depending on the focus of the program and the types of measures eligible for rebates. Homeowners are fairly open to investing in low-cost weatherization or DI measures, such that homeowners' participation is predicated upon program awareness more so than economics. Homeowners require much more convincing to invest in comprehensive whole-home retrofits, however, because of the additional costs. HVAC equipment or appliances, particularly in early-replacement applications, can be expensive. Homeowners also tend to be unconcerned with the functionality of air conditioners, clothes washers, or water heaters until they break down. As a result, program administrators have learned to highlight other, nonenergy benefits (not related directly to saving money) in order to spur interest in the market, such as greater comfort and increased home values.

PROGRAM DESIGNS AND TECHNOLOGIES

Whole-home retrofit programs are designed to address a variety of end uses within the home, though they primarily focus on improving the tightness of the home envelope through insulation and air- and duct-sealing measures. A home audit is usually the first step, and even audits can vary in their comprehensiveness (e.g., online versus comprehensive). Many programs will include DI measures in addition to insulation and air sealing, as they are low cost and relatively straightforward to install. Together, these types of measures can achieve savings of 10–15%. Programs that focus on direct installation or weatherization measures can offer the best opportunity for high rates of participation, given the relatively low costs and the fact that smaller projects are less intrusive to homeowners. In new markets, these types of programs offer a lot of value with respect to raising awareness about the benefits of whole-home retrofit projects, which can be a boon to programs in the future as they shift toward more comprehensive retrofit services.

Comprehensive whole-home retrofit programs offer the best opportunities for significant, cost-effective energy savings in residential program portfolios. Comprehensive programs add other types of measures or equipment on top of home envelope and DI measures in order to achieve energy savings of 20–45%, depending on the eligible measures.[9] Windows, HVAC equipment, water heating equipment, appliances, and lighting measures are commonly included, though it is infrequent to find programs that provide rebates for all of these within the same program.[10] Often these additional measures are rebated through other individual programs, either in lieu of or in addition to a traditional whole-home retrofit program. These programs are also typically allocated larger budgets given the higher

[9] PG&E's Energy Upgrade California Home Upgrade targets comprehensive retrofits that can achieve 45% energy reductions (PG&E 2014).

[10] Rocky Mountain Power's Home Energy Savings program in Utah provides rebates for a comprehensive list of measures for both electric- and natural gas–heated homes, including insulation, air and duct sealing, HVAC, water heating, windows, and lighting.

incremental cost of the measures and, therefore, the higher the incentives needed to move the market, at least during the early years of a program.

PROGRAM RESULTS

Defining and Measuring Program Participation

Program administrators generally concern themselves with two primary measures of participation with respect to residential retrofit programs: the number of audits completed and the number of projects completed. The latter is often referred to as "conversion," i.e., the number of audits converted into retrofit projects. To estimate participation rates for home retrofit programs, these metrics are usually measured against the total number of residential customers within the utility service territory. Many utilities will segment their residential market in order to identify and target high-usage homes or communities with a relatively older building stock (and likely high usage), but it is rare to report participation rates at a level more granular than a utility's entire residential customer base.

Program administrators often report other participation metrics for home retrofit programs, focusing on the number of measures installed by type (e.g., CFLs, furnaces) or end use (e.g., HVAC, DI, although that is not an end use). These metrics can be misleading, as one customer usually has a number of measures installed, particularly if the program either focuses on DI measures or includes them as part of a larger suite of measures. Sometimes it is unclear what the participation data are capturing.[11] The number of audits can also be misleading because not every audit participant takes the next step to install energy efficiency measures. The number of conversions is the most informative metric from a participation perspective, but it is important for program administrators to keep track of participation across the various measures installed.

Mass Save's Home Energy Services (HES) program is a whole-home approach that targets all non-low-income residential customers living in single-family houses or one- to four-unit buildings. It is administered by Massachusetts' gas and electric utilities and energy efficiency service providers. In terms of the number of assessments completed, since 2010, NSTAR's implementation of HES has yielded almost 2% participation annually, although this is relative to all residential customers, not just single-family homes. NSTAR's conversion rate—i.e., the conversion of assessments into retrofit projects—was 35% in 2012, which was the median for all ten participating utilities in the state, with a range of 26–64%.

Efficiency Vermont's HPwES program started in 2005 and offers up to $2,000 in incentives per household for a variety of energy efficiency home improvements, with a focus on whole-home projects. Typical projects start with an audit, followed by a report with suggested home improvements and associated energy savings. From 2008 to 2010, 878 projects were completed, where a project consists of at least one measure installed in a residence. Approximately another 600 were completed in 2011. In September 2012, the program completed its 3,000th project since the program began. In 2012 alone, the HPwES program completed 1,035 projects, the first year in which the program surpassed 1,000

[11] Xcel Energy's demand-side management status reports for Minnesota and Colorado, for example, do not elaborate on what their participation data represent.

projects. With approximately 300,000 residential customers in the state, this amounts to at least 1% cumulative participation through 2012, although the program is directed at single-family homeowners, so this rate is likely higher.

Table 6. Participation rates for selected programs

	Year launched (data year range)	Participation unit type	Annual participation (units in the most recent year)	Annual participation rate (% of eligible customers)	Cumulative participation (units)	Cumulative participation rate (% of all residential customers)
MidAmerican Energy (Iowa)	1990s	Audits	4,875	0.9%	143,175	25.9%
National Grid Rhode Island: EnergyWise	2010–13	Unique accounts	14,830	~3%	52,381	12%
Xcel Energy Minnesota: Home Energy Squad	2010	NA	5,663	0.5%	20,232	1.8%
Austin Energy Home Performance with ENERGY STAR	1982–2012	Single-family housing units	2,236	1.2%*	50,487	25%*
Manitoba Hydro: Power Smart Residential Loan	2001–12	% of consumers in targeted sector**	6,202	1.32% (2012)	70,358	15%
NSTAR: Mass Save, Home Energy Solutions	2008	Unique accounts	12,983	1.7%	NA	NA
American Electric Power (Ohio): In-Home Energy	2010	Residences	10,678	1.0%	27,414	2.5%
Entergy Arkansas: Home Energy Solutions	2008	Accounts	6,431	1.1%	18,847	3.2%
Efficiency Vermont: HPwES	2005	Residences	1,035	0.3%	~3,000	~1.0%
NYSERDA: HPwES	2006	Residences			40,457	1.0%

Most cumulative participation rates are based on a percentage of all residential customers (single family and multifamily), whereas the programs focus on single-family homes. In reality, the programs are achieving much higher penetrations of single-family homes only. NYSERDA's cumulative participation is through December 31, 2011, defined as number of homes treated. * Participation rate is relative to eligible customers only (multifamily buildings with four or more units are not eligible); some of these are repeat customers. ** Assumes one residential retrofit per loan, per customer (from LBNL).

Many whole-home retrofit programs are fairly immature, so understanding the upper bounds of participation is difficult. Data on cumulative participation is also difficult to acquire, as program evaluation or demand-side management (DSM) reports tend not to include participation data beyond annual achievements. From the sample above, however, it appears as though cumulative participation in the double digits is achievable. Long-running programs such as MidAmerican in Iowa and Austin Energy in Texas demonstrate cumulative participation above 20%. Manitoba Hydro has approached this level of cumulative participation, with a rate over 11 years of 15%. Part of this impact may be the

sheer size of the budget: the Power Smart Residential Loan program has lent almost $300 million for efficiency improvements in single-family residences. Annual participation rates of 1–2% are common, although this is relative to all residential customers as opposed to just single-family households, so these figures are likely conservative. On the other hand, many programs report participants in terms of the number of audits or assessments, as opposed to completed projects with the installation of at least one measure, which would push overall participation rates downward. National Grid Rhode Island's EnergyWise demonstrates among the highest annual participation rates, in the 3% range.

While not a direct apples-to-apples comparison, since the loans support the spectrum of residential programs, not only whole-home retrofits, the Sacramento Municipal Utility District Residential Loan Program has the highest participation rate and the largest number of loans of any residential financing program we have found. Operating under its current business model since 1991, SMUD's residential lending program is a contractor-driven, point-of-sale financing program for residents. From 1990 to 2010, over 84,000 loans have closed under the program, a participation rate of approximately 16% among all the utility's residential customers.

Long-Term Program Results on Markets

Since participation in home retrofit programs is usually defined as the number of participating homes relative to a utility's total number of residential customers, annual and cumulative participation rates are generally quite small, as table 6 shows. Expressing participation in these programs as a percentage of total residential customers is important for tracking performance over time, but the metric belies the overall impact of these programs. From an energy consumption perspective, savings can be quite high despite seemingly low participation rates, especially when participants are investing in comprehensive whole-home retrofits. Measuring participation against all residential customers also confounds the issue, because this typically includes multifamily and manufactured housing customers that are not serviced by these programs. Data on residential customers by housing type, however, is not readily available by utility service territory, let alone at the state level.

Still, there is an expectation on the part of utilities that whole-home retrofit programs cannot reach high annual rates of participation, in the double digits. Xcel Energy Minnesota, for example, opined in its 2013 DSM report that "Despite increased marketing spend and efforts and multiple years of program operation, we believe this program is trending towards its maximum annual participant potential" (Xcel Energy 2013). Although Xcel does not elaborate upon this quantitatively, in 2013 participation in its Home Energy Squad program reached 0.5% of all residential customers, the lowest rate of the programs included in table 6.

Useful insight on maximum participation rates is also provided by several projects that intensively market residential retrofits in small geographic areas. The "granddaddy" of these programs is the Hood River Conservation Project, which intensively marketed retrofits in the town of Hood River, Oregon, during the 1980s. Hood River is a town with about 3,500 eligible homes about an hour from Portland. The program paid most of the cost of retrofits, contributing up to the avoided cost of a new coal power plant. The retrofits on

average reduced electricity use by 9%, generally at no cost to the homeowner. Ultimately, 91% of eligible customers received energy audits and 85% of eligible homes were retrofitted (Results Center 1992a).

Another somewhat similar project was conducted in 1990 in the town of Espanola in Ontario, Canada. The Espanola Hydro Electric Commission served about 2,000 residential customers, and they sought to maximize participation as part of a community-based research and demonstration project. Incentives covered the lower of full measure cost or the value of utility-avoided costs. Ultimately, 87% of eligible customers received energy audits; 72% installed recommended energy-saving measures and 70% installed recommended measures to reduce electric demand (Results Center 1992b).

Not all geographically targeted programs achieve such high market shares. For example, NStar Electric & Gas ran a two-year program targeted at the town of Marshfield, Massachusetts, in 2008–09. The program targeted demand reductions in a transmission-constrained area. Ultimately, 8% of residential customers participated, which, while much higher than participation in adjoining towns that were not targeted, was far lower than the programs discussed in the paragraphs above. A survey of nonparticipants found that 80% had not heard of the effort, implying that the marketing efforts were not as extensive as the intensive programs discussed above (Opinion Dynamics 2010).

Keys to Achieving High Participation

Successful whole-home retrofit programs must rely on shrewd marketing and outreach in order to garner high rates of participation. Incentives and the availability of financing are also vital, because the costs of comprehensive retrofit projects are a primary barrier to participation. However even with generous incentives, participant costs for comprehensive retrofits can be prohibitively expensive, so program administrators must appeal to homeowners from a number of different perspectives other than their wallets, such as health, comfort, and safety.

All home retrofit programs rely on basic corporate marketing strategies to raise awareness, such as telemarketing, bill inserts, and radio or television advertising. Messaging tends to focus on the energy bill savings and comfort-improving aspects of the program, which are two primary reasons for homeowners to invest in home retrofits. But these types of marketing and messaging alone will not sustain participation year after year: They are great for raising awareness, but they do not truly inspire homeowners, particularly to commit to comprehensive retrofits. In order to achieve and sustain high rates of participation, program administrators should utilize a variety of marketing strategies that are focused at the community level and ensure that these strategies are dynamic throughout the year and into the future.

In Minnesota, Xcel Energy, CenterPoint Energy, the Center for Energy and Environment (CEE), and the Neighborhood Energy Connection (NEC) teamed up in 2010 to deliver the Home Energy Squad, an audit and DI program that focuses on installing low-cost measures. The four entities decided to partner together because of the potential for scale given the proximity and overlap of the two utilities' service territories. Xcel and CenterPoint understood that consistent messaging (and pricing) across the two markets could improve participation and that partnering with local, community-focused organizations, as well as

local government agencies, would allow them to successfully reach more customers beyond those they reached through more traditional, mass-media strategies. These entities noted the following key factors in increasing participation:

- Coordinated program design efforts, such as marketing and pricing, and regular communication are critical in areas with multiple utilities
- Promoting the program through social media or through special deals with online marketing services such as LivingSocial can also be effective
- Working with cities to provide marketing, messaging, and financing requires significant effort, but ensures skin in the game. Customers are generally responsive to information provided by city government agencies
- Engaging communities through workshops and other local events is a low-cost method to reach new customers
- Engaging communities can build program loyalty, which can lead to increased referrals through word of mouth. Leveraging the common interests and efforts of community organizations can help support these efforts.

Reaching out to and interacting with communities is an extremely cost-effective approach to bolstering participation in home retrofit programs. The level of engagement can vary, as there are a seemingly limitless number of ways in which program administrators can engage communities, in terms of both the events or venues used to engage potential participants and the partners that program administrators team with in order to cast a wider and tighter net. Program administrators that utilize this approach have organized or participated in events such as community workshops and at places of worship, farmers' markets, state and local fairs, block parties, and others. Partnering with the right local organizations is also important, such as neighborhood organizations, city and neighborhood councils, housing and redevelopment authorities, and other municipal agencies. Ultimately, there is no single approach to community-based marketing; because the characteristics of communities differ so widely, successful marketing has to be tailored to each one.

Efficiency Vermont (EVT) engages its communities regularly as a means of increasing participation. In 2013, for example, EVT partnered with the Vermont Energy and Climate Action Network (VECAN)—a network of town energy coordinators and committees—to launch the statewide Vermont Home Energy Challenge. EVT also partnered with VECAN to institute the state's first Button Up Vermont Day of Action, which provided education to enable individuals in 30 towns to provide fellow community members with weatherization and energy efficiency information and assistance. EVT also conducted regional forums for more than 50 communities and worked in partnership with businesses to motivate employees to save energy at home through the Employee Energy Challenge.

Contractors and crew members can also be important to bolstering participation for a variety of reasons. Contractors that are friendly, knowledgeable (about energy efficiency benefits generally as well as programs), and provide quality installation services can have significant impacts on participation through word of mouth. Home retrofit programs usually target a number of different end uses, so partnering with a variety of qualified contractors is important; it is rare for contractors to provide both HVAC and insulation services, for example. However programs that retain one contractor to perform all aspects of

a project can reduce customer uncertainty, increase convenience, and, ultimately, ensure trust. Programs must also provide value to contractors: Rebates on these services give participating contractors a competitive edge, but additional carrots are crucial to keeping them in the program. These can be financial, such as referral programs where contractors are rewarded for generating leads, as well as qualitative, such as regular engagement with the contractor community to encourage feedback about the program, contractor awards, and so on.

Easy access to financing is a major driver of participation, particularly for deep comprehensive retrofits, and successful programs will often offer a variety of financing options to ensure customer access (Zimring et al. 2014). For example, in Oregon Clean Energy Works has retained local lending companies such as credit unions and community development banks to provide preferential lending to program participants. In some states, such as Oregon, on-bill financing programs can be made available so that customers can pay for services through their energy bills.

The SMUD residential loan program noted above has multiple attributes contributing to its 16% cumulative participation rate (Hayes et al. 2011). SMUD offers a customer-friendly evaluation and application process. Marketing includes informing targeted customers that contractors have been vetted by SMUD and trained to assess home energy performance at the subsidized rate of $99 per inspection. Via whole-house energy inspections, customers are informed of possible upgrades and presented with options for both implementation and financing right in their homes. Contractors sit down with customers and help them fill out all necessary paperwork. Once the loan application is complete, loan approval takes only a day or two.

Columbia Gas of Ohio's Home Performance Solutions program has been around since 2008 and has found similar success engaging communities with the help of its third-party implementer, Conservation Services Group. Program administrators identified the following factors as key to their success.

- Initially providing generous rebates to customers—including "kickers," customer bonuses given for conducting an audit and installing all measures advised—were key to getting customers interested. Eventually, cost effectiveness became an issue, however.
- Engaging with cities, such as mayors and city councils, attending trade shows, and similar efforts were crucial to marketing and messaging efforts.
- Moving to a whole-home performance package (air sealing, insulation, HVAC, and so on) is important, although only a handful of contractors are able to provide the suite of services.
- Maintaining an open forum for contractor engagement is crucial to their participation and effectiveness.

SUMMING UP AND RECOMMENDATIONS

Whole-home retrofit programs come in a variety of shapes and sizes, so no single approach to program design will fit everywhere. At the very least, programs can focus simply on audits and DI measures, although more comprehensive programs will also include rebates

for equipment installations, windows, and appliances. Regardless of the focus, there are many common characteristics that lead to successful programs with high participation, and these should be emulated, but tailored to the unique characteristics of the jurisdiction or utility service territory.

Community-based marketing, engagement with local government agencies, accessibility to financing (for comprehensive projects), and an active contractor market are key traits that can lead to high rates of participation in addition to traditional methods (radio, bill inserts, and so on). Over time, these factors can catalyze consistent increases in participation that would be unattainable simply through rebates and media advertising. Above all, however, engaging communities to some degree is crucial for reaching new customers.

Truly understanding the upper bounds of participation in whole-home retrofit programs is difficult, in part because most programs have not been around long enough to assess long-term potential. In part, this also depends on the metric in question. Convincing homeowners to complete an audit or assessment is relatively straightforward. Convincing homeowners to complete installations of at least one measure is slightly more difficult, although rebates are usually generous enough for homeowners to insulate or address air infiltration issues. Convincing homeowners to complete a whole-home retrofit is considerably more daunting for a number of reasons, most commonly because of the cost, although easy access to financing can help address this issue.

Ultimately, cumulative participation rates in the double digits are achievable, but this assumes programs that are mature, have an established brand, have an effective and extensive contractor network, and have effective marketing and outreach campaigns. With such elements in place, some targeted programs have achieved more than 50% participation, and some serving broader areas have achieved about 20%. Much lower values are more typical. Annual participation rates of 1–2% appear common, though better data are needed to assess this. Our analysis estimated participation rates relative to all residential customers, as opposed to just single-family homeowners, for example.

Residential New Construction

MARKET

Residential new construction programs take a whole-home approach to energy efficiency improvements, focusing on the design and construction of new homes (site-built, manufactured, custom versus spec homes), as well as major renovations to existing homes. Incentives are directed primarily at builders and trade allies for installing energy efficiency measures and equipment, but demand for custom homes requires programs to target homeowners as well. A growing number of residential new construction programs also focus efforts on constructing zero net energy homes as well as on incorporating sustainable building practices. In the case of zero net energy homes, building science plays a major role in the design/build process, where the orientation of a home and other physical features are tinkered with in order to leverage or minimize the impact of natural elements, such as solar heat gain and airflow. For programs with conservation or sustainability goals, the types of materials and methods used are also important.

As a result of the numerous potential features of an energy-efficient, sustainably constructed home, residential new construction programs require the efforts of a number of service providers. Beyond contractors and trade allies, architects and engineers are key players, as are auditors, raters, and financial institutions. Experienced vendors and third-party administrators are also important, as they can often leverage existing relationships with contractors, trade allies, and so on, in order to quickly develop the necessary infrastructure to effectively deliver program services. Ultimately, a diverse network of service providers is key to the successful implementation of any residential new construction program.

The construction of new homes must comply with a variety of building codes, including building energy codes, which vary by state and levels of government, such as counties and municipalities. For residential buildings, the applicable codes are usually the International Energy Conservation Code (IECC) and the International Residential Code (IRC). A new home can comply with the codes through either a prescriptive path, which is based on a predefined package of improvements, or a performance path, which is based on a customized package of upgrades. Codes set minimum requirements for the energy intensity of various types of equipment (HVAC) and non-equipment (insulation) measures. Code requirements become more stringent over time, generally raising the performance requirements of key building components and systems with each new edition of the code.

The market for residential new construction services is driven predominantly by the strength of the housing market. The recent economic recession caused a precipitous drop in residential new construction, with certain markets experiencing a 75% decline in the number of new homes built. However the market has recovered and programs are seeing improvements in participation on an annual basis. In any given state, there are usually hundreds of homebuilders that account for varying portions of the housing market. Generally, there are a large number of home builders that construct only one to a handful of homes per year. In contrast, there are a usually only a small number of home builders that construct large volumes of homes per year. In Oregon, for example, 95% of the housing market is comprised of home builders that construct anywhere from one to nine units annually (Evergreen Economics 2014).

Since residential new construction programs focus incentives toward home builders, barriers to participation are usually considered from the builder perspective. Barriers differ depending on the market share of the builder. They include:

- Lack of awareness of the program on the part of the builder
- Expenses (materials and labor costs) and fees (verification, rating) that outweigh earned incentives (particularly salient for smaller businesses and/or in instances of low-cost, entry-level homes)
- Paperwork
- A perceived lack of market demand for energy-efficient new homes

PROGRAM DESIGNS AND TECHNOLOGIES

Residential new construction programs are often measure based and prescriptive, but a number are also performance based, using performance ratings such as the Residential Energy Services Network (RESNET) Home Energy Rating System (HERS) as a benchmark.

Many programs follow the ENERGY STAR New Homes[12] (ESNH) guidelines because it is an established brand, so builders are familiar with the standards. The ESNH program focuses on implementing comprehensive upgrades to the HVAC system and home envelope, including energy-efficient windows and appliances. Version 3 of the ESNH program is designed to achieve at least 15% savings above the 2009 IECC.

In addition to ENERGY STAR, programs also tend to feature more than one tier of services in order to provide choice and, thereby, to maximize participation. For example, a residential new construction program may provide an above-code tier, which incorporates measures that surpass a state's mandated building energy code. A second tier may require compliance with ENERGY STAR standards. As with the IECC or IRC codes, new homes can qualify for ENERGY STAR certification by following either a prescriptive path or a performance path. Programs can also go beyond the ENERGY STAR standards, which usually entails setting a minimum performance threshold based on HERS. It is also common for programs to offer standalone incentives for energy efficiency measures, to increase the opportunities for beyond-code energy savings in new homes when builders or homeowners are not prepared to make investments in whole-home energy efficiency improvements.

PROGRAM RESULTS

Defining and Measuring Program Participation

Participation in residential new construction programs is measured against the number of new homes constructed in a state in a given year, but there are several interpretations as to what constitutes new construction. Often participation is based on the number of building permits issued, but in instances where homes are being constructed with multiple units (up to four), participation can be based on the number of new meters installed or the number of applications for electric and/or gas service. Program success is gauged more by annual participation than by cumulative participation, so it is rare to find cumulative data for residential new construction programs. This is in part because housing markets are always fluctuating, so participation does not reflect just the effectiveness of the design of a program. For example, the number of participating homes may increase from one year to the next, but a program's participation rate may drop because a greater number of total homes were constructed due to a relatively strong housing market. Conversely, if participation is steady across years but the number of new homes constructed drops, a program's participation rate will appear inflated.

The New Homes program from Energy Trust of Oregon (ETO) began in 2004. In 2005, ETO estimated almost 20,000 single-family building permits were issued in its territory. By 2010, that number had fallen to around 4,400. Roughly the same number of homes qualified for ENERGY STAR certification through ETO's program in 2008 as in 2011, but the relative activity in the housing market across those years made for entirely different participation rates. In 2008, 899 homes qualified for ENERGY STAR certification, representing 14% of the new homes market (Research Into Action and Stellar Processes 2010). In 2011, 812 homes qualified for ENERGY STAR certification, representing 25.7% of the new homes market

[12] http://www.energystar.gov/index.cfm?c=next_generation.ng_qualified_new_homes

(Evergreen Economics 2012). In fact, the disparity in participation rates is considerable in the years surrounding the economic recession. In 2008, 2009, and 2010, participation reached 12%, 16%, and 14%. In 2011, 2012, and 2013, participation "surged" to 26%, 23%, and 22%.

The ENERGY STAR Homes program implemented by Efficiency Vermont (EVT) began in 1995 and focused solely on building homes to the ENERGY STAR standards (NMR 2009). In 2012 it began offering an additional, lower tier of service, Energy Code Plus, which focuses on building homes that exceed Vermont's statewide mandated building energy code. In 2013 EVT added yet another tier, dubbed High-Performance Homes, which are defined by a level of energy efficiency that makes them well suited to achieving net zero energy use with the incorporation of renewables. Vermont is a small state, so EVT focuses a lot of its efforts at the local level, working closely with jurisdictions to identify potential participants as early in the building process as possible. In the last two years, 28% and 31% of new homes have received services from EVT, either through the Energy Code Plus or ENERGY STAR tiers. In 2012 participation in the two tiers was 8% and 20%, respectively. In 2013 participation in the two tiers was 15% and 16%, respectively (NMR 2014).

The Northwest Energy Efficiency Alliance's ENERGY STAR Homes program has been active since 2004. NEEA's territory covers four states—Washington, Oregon, Idaho, and Montana—each with a varying level of activity in the residential new construction market. As a result, participation in the program varies considerably by state. In 2010 the most recent year for which participation data are available, NEEA's program relied heavily on the housing market in Washington, where the number of ENERGY STAR homes certified through the program reached almost 1,800, or 14.6% of the state's market for new homes. Idaho certified the second-highest number of ENERGY STAR new homes, with around 760, representing 24.3% of the state's market for new homes. Overall, in 2010, NEEA's program certified about 3,200 ENERGY STAR new homes, 15.1% of the regional market for new homes.

The Arizona Public Service (APS) Residential New Home Construction program began in 2006, and was enhanced in 2010. The program offers two tiers of rebates. The first focuses on building new homes to the ENERGY STAR Version 3 standards. The second tier focuses on even higher standards, providing rebates for new homes that achieve a HERS rating of 60 or lower. In 2012, the program reached 16% of the new homes market: 12% were built to ENERGY STAR Version 2.5 and Version 3 standards, while the remaining 4% were built to HERS standards. In 2013 the program reached 21% of the new homes market: 18% were built to the ENERGY STAR Version 3 standards, while the remaining 3% were built to achieve a HERS rating of 60 or lower.

Table 7. Participation rates for selected programs: residential new construction

Program	Year launched	Annual participation (units in the most recent year)	Annual participation rate (% of eligible customers)
Connecticut Light & Power	2009	833	24%
Efficiency Vermont	1995		31%
Northeast Energy Efficiency Alliance: ENERGY STAR Homes	2004	3,202	15%
CenterPoint Energy, Minnesota: Whole-Home New Construction		1,110	10%
Energy Trust of Oregon: New Homes Program	2004	1,616	22%
Arizona Public Service: Residential	2006	3,870	21%

Where participation rates were not explicitly reported, we use building permit data by state, by year, from the Census to estimate participation rates (http://www.census.gov/construction/bps/stateannual.html). Building permits include permits for 1–4-unit buildings.

As table 7 shows, achieving a 20–30% market share (participation) of new homes built to a higher energy efficiency standard like ENERGY STAR is common. Some of these programs had achieved higher rates in previous years than the most recent results, presented above. Since 2008, the programs that we reviewed have achieved a range of savings, 12–31%, with values toward the lower end of that range having been realized during program years falling within the recent recession. Several of these programs have consistently achieved participation of 20–25% or greater over the last several years, in part due to the recovery of the housing market. Connecticut Light & Power (CL&P), for example, has achieved 25% participation consecutively for the past several years.

States with the highest market share of ENERGY STAR New Homes in 2012 were Maryland and Delaware, both at 40%, closely followed by Iowa (36%) and Nevada (34%). In previous years, quite a few states had ENERGY STAR Home market shares above 50%, but with the tighter criteria required by new ENERGY STAR standards, even states in the top tier are in the 25–40% range (ENERGY STAR).

Long-Term Program Results on Markets

The long-term focus of program administrators is the maximum annual participation rate that a program can achieve. Still, leading programs are constantly striving to achieve higher annual rates of participation. CL&P, for example, is taking a holistic approach in determining what can be done to reach 50% annual participation (CL&P et al. 2012). As noted above, such levels were achieved in several states under the ENERGY STAR program before the qualifying criteria were increased. Achieving annual rates above 25% for more stringent specifications appears to be achievable in theory, but is predicated on a number of factors endogenous and exogenous to program design.

Keys to Achieving High Participation

Engaging the builder and/or homeowner early in the building process is critical. There are various points during the permitting process when the program can be marketed, such as during the planning stages of a project, when a builder or homeowner applies for the original building permit, and during the permit application process for electricity, gas, and water service. Permitting processes vary by state and happen at the local level, so program administrators need help in determining the most opportune moments to engage with potential participants, which should be as early in the process as possible.

Providing various services to builders is key to ensuring their engagement, especially considering that builders are often the primary vehicle for marketing to homeowners. The housing market is cyclical, so builders must be convinced a program provides value to their business regardless of the state of the economy. When housing markets are weak, for example, builders can diversify their businesses and focus more on home renovations. The value proposition to builders varies, however, depending on their size. High-volume builders may not prioritize energy efficiency unless it is demanded by their clients, so other benefits are needed to ensure their participation, such as programs providing an extra set of eyes on building crews or reduced warranty issues. Low-volume builders that focus on energy efficiency, on the other hand, will derive more value from assistance with the marketing of the program (funding or cost sharing) and their services, and training, such as instruction on code compliance and ENERGY STAR standards. HERS raters, for example, can be utilized as energy efficiency consultants to help builders grow, providing them with technical assistance on how to maximize energy savings and minimize costs (time, materials) during the construction process. Some program administrators have found that these low-volume boutique builders are often the major drivers of participation in residential new construction programs because of their focus on building energy-efficient homes. Lastly, participation by builders in these programs can also help to market their businesses, allowing participating builders to differentiate their product from the rest, whether or not homeowners are interested in investing in energy efficiency improvements.

Most residential new construction programs focus their efforts on marketing to builders, but reaching out to homeowners remains an important means of growing participation. While builders can be effective ambassadors for a program, reaching out directly to homeowners is crucial to building awareness. When builders approach homeowners about opportunities for potential energy-efficient improvements, homeowners will already be aware of a program and about the benefits of energy efficiency generally. Program administrators noted that builders immensely value marketing efforts conducted on their behalf, as it can be a major driver of homeowners to the program and, ultimately, to the contractors themselves. NEEA, for example, engages in large marketing campaigns with awards and drawings for potential participants. NEEA also supports builder-driven projects by highlighting building practices or stories about homes completed through the program, which increases recognition for builders.

For many residential new construction programs, identifying the right vendor with experience in delivering these types of programs can be invaluable, particularly when it comes to developing and maintaining relationships, such as with builders and trade allies. Successful programs tend to have engagement from at least a small majority of the home-

building market: each program administrator that we spoke with noted that the majority of builders in their state participate in their program, even if that means they only build one home per year to the program's standards. Vendors help to market programs to builders and trade allies and through those relationships, they can help to improve program design and delivery. CenterPoint Energy Minnesota, for example, retained the services of a vendor that it treats as an extension of its team. The vendor had already been working with other utilities to deliver their new construction programs, which allowed CenterPoint to leverage the vendor's existing relationships with trade allies and builders.

Regardless of a vendor's direct involvement, establishing and maintaining relationships in a program's network is vital to participation. In addition to builders and trade allies, engaging the state Home Builders Association (HBA) is important for a program to reach as many potential home builders as possible. Working with realtors to increase the visibility of energy-efficient homes in local real estate listings is also important to raising awareness about the benefits of energy-efficient homes and about new construction programs generally. In order to help participating builders grow and maximize their effectiveness, it is also important to have good relationships with auditors and raters. Various resources are available to provide technical assistance to home builders, contractors, and other building professionals, such as auditors and raters. One such resource is RESNET.[13] Having strong partnerships with local jurisdictions and relevant agencies, such as boards and planning commissions, helps a program gain traction locally and facilitates marketing and outreach during the permitting process. Most successful programs communicate regularly with their partners to discuss program issues, share information, and so on, in order to maintain their interest and engagement.

Residential new construction programs that provide multiple tiers of services can be influential in driving the market toward more energy-efficient home construction. Tiered services give builders and homeowners greater choice, which can be important for homeowners with relatively limited financial resources. Programs that offer an above-code tier, for example, provide relatively low-cost options for improving the performance of a new home that can also be used to educate new and existing participating builders about energy-efficient home construction. A tier dedicated to ENERGY STAR certification provides builders with a well-established, national brand that they can leverage and market accordingly. Offering a tier of services above ENERGY STAR provides interested builders with experience in constructing advanced, energy-efficient homes, the requirements of which may be incorporated into future building energy code iterations, depending on the state.

SUMMING UP AND RECOMMENDATIONS

While residential new construction program participation levels are, in part, correlated with and dependent upon the cyclic nature of housing markets, there certainly are facets of

[13] RESNET is a nonprofit organization committed to helping homeowners reduce the cost of their utility bills by making their homes more energy efficient. RESNET is responsible for creating the national training and certification standards for home energy ratings (HERS) and Home Energy Survey Professionals (http://www.resnet.us/about).

program design that can be targeted in order to maximize participation. Key barriers to participation for both builders and homeowners are the associated costs of building energy-efficient homes (materials, labor, and administrative) as well as inadequate awareness and knowledge of the program and energy efficiency generally. In that respect, focusing on the value proposition to builders is a major component of maximizing participation, particularly when housing markets are weak.

Independent of the influence of broader economic forces, program administrators noted that outreach to and partnerships with an assortment of market actors is critical to program success. Engaging builders, architects, and contractors is clearly important, but coordination with home builder associations, realtors, and local government agencies are also invaluable. Successful partnerships are helpful in identifying potential program participants early on in the building process, during the permitting application process, for example.

Programs that take a holistic approach to program deployment are able to sustain participation even when confronted with a weak housing market. Although, as we noted earlier, it is possible that participation rates for residential new construction can increase if the number of permits issued falls more dramatically than actual participation. Table 7 above shows that leading programs are able to consistently achieve annual participation rates of 20–25% with stringent efficiency specifications, and a few states have reached 40% of new homes with their ENERGY STAR New Homes programs (participation rates above 50% were achieved when specifications were less stringent). However leading program administrators are also seeking ways to double their annual participation rates, so it is likely that higher rates are attainable.

Multifamily Housing

MARKET

Multifamily housing markets are highly diverse. Building types vary from small four- or five-unit buildings to large complexes with hundreds of units. Owners may be private individuals, corporations, or public organizations, such as housing authorities. Residents may be renters or owners of their units.

Multifamily housing markets generally have been underserved by energy efficiency programs due to numerous barriers faced in serving these customers, including split incentives, limited financial and technical resources, uncertainty surrounding potential benefits, and the time and complexity of participating and receiving services and incentives (Johnson 2013).

Defining the customer can itself be a challenge. In some cases this is the owner of a property. In others it may be a property manager or management company. It may be an individual owner or it could be a corporation or other organization. It may be individual occupants of units, whether owners or renters.

PROGRAM DESIGNS AND TECHNOLOGIES

Multifamily markets are best served by programs designed specifically to address the unique characteristics and needs of multifamily customers, typically both building owners and occupants. Program services typically include:

- Direct installation of low-cost measures, such as CFLs, faucet aerators, and low-flow showerheads in individual units and common areas
- Technical assistance to evaluate and plan for major equipment and system upgrades
- Financial incentives for energy-efficient appliances, equipment, and systems

ACEEE reviewed leading multifamily programs and identified ten best practices for these programs (Johnson 2013). They are:

1. Provide a one-stop shop for program services.
2. Incorporate on-bill repayment or low-cost financing.
3. Integrate direct installation and rebate programs.
4. Streamline rebates and incentivize in-unit measures to overcome split incentives.
5. Coordinate programs across electric, natural gas, and water utilities.
6. Provide escalating incentives for achieving greater savings levels.
7. Serve both low-income and market-rate multifamily households.
8. Align utility and housing finance programs.
9. Partner with the local multifamily housing industry.
10. Offer multiple pathways for participation to reach more buildings.

While these best practices may not be part of all leading programs, what is common among leading programs are services tailored to meet the specific needs identified for multifamily customers. ACEEE's report provides numerous examples that illustrate these practices. While a growing number of energy efficiency program administrators, whether utilities or non-utility organizations, have specific multifamily housing programs included in their program portfolios, such programs still are not commonplace, particularly full-featured programs that address both direct installation of low-cost measures and comprehensive retrofits of major building equipment and systems.

PROGRAM RESULTS

Defining and Measuring Program Participation

Multifamily programs primarily track program participation by the number of housing units receiving services. A complexity of this metric is that the types of services provided to units by programs can vary significantly. Typically, they fall into three categories:

1. Direct installation and related low-cost services to occupants
2. Prescriptive incentives for purchase and installation of major common equipment, such as lighting and HVAC
3. Comprehensive retrofitting of common building equipment and systems, such as HVAC and building envelope

The costs and energy savings that result from these different types of services will vary significantly. Participation rates, therefore, do not necessarily correlate closely with energy savings. It would be possible to achieve high participation, but low savings per participant and overall energy savings. Alternatively, there could be programs with low participation but high per-unit and overall project and program savings.

Table 8 shows the results we found for selected programs in our review of best practices.

Table 8. Multifamily program results

Program	Year launched	Annual participation (units in the most recent year)	Annual participation rate (% of eligible customers)	Cumulative participation (units)	Cumulative participation rate (% of eligible customers)
Austin Energy PowerSaver Multifamily Rebates	1989	18,213	9%	191,309	93%
Puget Sound Energy Existing Multifamily Retrofit Program	2006	39,489	16%	120,000	49%
Energy Trust of Oregon Existing Multifamily Program	2011	21,765	10%	35,718	16%
Sacramento Municipal Utility District (SMUD) Multifamily Home Performance Program	2012	1,200	1%	12,100	10%
NYSERDA Multifamily Performance Program	2007	28,429	1%	180,352	7%
CNT Energy Energy Savers	2007	4,126	1%	14,422	4%
Efficiency Vermont Multifamily Program	1998	450 (comprehensive projects only)	1%	NA	NA
Public Service Electric & Gas Residential Multi-family	2010	2,295	.5%	10,322	2%
LEAN Massachusetts Low-Income Multi-family Energy Retrofits	2010	6,715 gas, 14,535 electric	NA	10,715 gas, 28,524 electric	NA

For these leading programs, annual participation rates range from about 1–16%, depending largely on the primary type of services provided. Most programs provide a range of services so that total program data may be combined. For direct installation, participation rates of up to 16% have been achieved. For leading rebate programs, annual participation rates reach about 10%. And for comprehensive whole-building retrofits, some programs are reaching 1–2% of units per year. The number of units served in the most recent year range from 450 (comprehensive projects only) to almost 40,000 (primarily direct installation).

Participation in programs is largely a function of available budgets and resources. Leading programs may hit enrollment limits early in the program year; if more resources were

available the programs would be able to serve more customers. One leading program hit such a limit early in a recent program year and essentially stopped its marketing and outreach efforts since it could not accept more projects into its queue due to the existing commitments to those customers and projects already enrolled.

Long-Term Program Results on Markets

Leading multifamily programs seek to reach high numbers of eligible customers each program year and over many years. The cumulative number of customers served is an important program metric used by programs to establish program goals and measure progress toward them. The number of multifamily units in most utility service territories is large and program budgets are limited.

In the set of leading programs given in table 8, the cumulative participation rates range from 2% to 93%. This suggests that it is possible to achieve high cumulative participation. However the particular program that achieved 93% participation, Austin Energy's PowerSaver™ Multifamily Rebates, is somewhat unique. This program is tied to a city ordinance that requires all multifamily buildings to have energy audits performed on them and for the owners to meet certain energy efficiency criteria. The program also has been in place for over 20 years, giving it a long time to achieve such a high cumulative rate.

Aside from the Austin example, other programs have achieved high participation rates. Puget Sound Energy's Existing Multifamily Retrofit Program has achieved a cumulative participation rate of 49%. The Energy Trust of Oregon's Existing Multifamily Program has achieved a cumulative rate of 16% and SMUD's Multifamily Home Performance Program has reached 10%. The key variables driving long-term impacts are the duration of the program, annual budgets, and the types of services provided. Other than Austin Energy, there remain large numbers of multifamily units to be reached by the leading programs.

Keys to Achieving High Participation

Outreach and networking are the primary means to help achieve high participation in multifamily programs. Owners need to see the value of making energy efficiency improvements to their properties in order to make the commitments necessary to enroll in and participate in programs. Contractors and related businesses in building retrofit and renovation markets need to be aware of the services available through programs and see benefits to them to steer customers to such programs. Gaining contractors as valued allies and even partners in programs can greatly boost participation. The contractors can become part of program marketing and outreach. They also can gain business by participating and partnering with programs to provide services.

Effective marketing, outreach, and networking all can increase awareness, generate interest, and bring potential participants to programs. To gain their participation, however, programs need the kinds of best practices in place that make participation customer friendly and tailored to meet the needs of multifamily building owners and occupants. Program features such as one-stop shopping, a streamlined process for receiving services and incentives, integration of electric, natural gas, and water utilities, and partnering with community development and housing finance organizations all work to make effective, successful programs.

A final observation on the leading programs we examined is that they all have had strong, long-term commitments from the program administrators. While all programs benefit from longevity and consistent commitments, multifamily programs especially need time to develop and demonstrate success. Strong networks and relationships among contractors and other allies are critical in developing new projects and achieving high participation.

SUMMING UP AND RECOMMENDATIONS

Multifamily programs are growing rapidly due to a variety of factors. Historically, this customer segment has been underserved because of a variety of barriers. There are leading multifamily programs that provide clear models of how to overcome these barriers and serve multifamily customers successfully. Such programs are demonstrating that it is possible to serve large numbers of multifamily building owners and their occupants. Among the programs we reviewed, those providing comprehensive services, including major retrofits, can achieve annual participation rates of about 1% of eligible customers. Programs that focus primarily on direct installation of simple, low-cost measures can achieve annual participation of about 15%. Programs providing primarily prescriptive incentives for purchase and installation of more costly end-use technologies such as common area lighting and HVAC equipment can reach annual participation of about 10%. On a cumulative basis, one rebate program has achieved 93% participation, although it is backed by a municipal ordinance that requires owners to upgrade their buildings. Another rebate program without such an ordinance has achieved a 49% cumulative participation rate. We do not have good cumulative participation data on the other program types.

Gaining high participation in multifamily programs takes the commitment of program administrators to build and sustain the services and associated funding required. Multifamily programs need strong marketing, outreach, and networking among the key parties involved in projects, including owners, contractors, housing finance institutions, community development organizations, and trade allies. Such partnerships and collaborations are fundamental to successful programs serving multifamily markets.

Small Business Programs

MARKET

The small business market is a diverse one, spanning firms as different as hair salons are from convenience stores or dentists' offices. There are also, however, common characteristics within the small commercial sector, such as their low energy use due to their small size and the constraints of limited time and money. Partially as a result of these attributes, current and traditional small business programs primarily rely on lighting measures that offer quick payback for most if not all of their energy savings. Programs generally define eligible businesses by average electric demand or use, commonly with a demand threshold of 100 or 200 kW. Nonresidential customers under 500 kW of average demand are more likely to be classified as small and medium-sized businesses. This section focuses on small business programs only.

Energy efficiency program managers have historically considered small businesses to be hard-to-reach customers. Single-site, single-facility enterprises are among the least cost effective for programs to work with, as the administrative and marketing costs per unit of

energy saved are higher. Most small businesses do not have building managers or operators to address energy use in their buildings, and owners are sometimes not available. Small business owners, perhaps more than other utility customers in other market segments, need to be actively sold to before they will buy into energy efficiency, or in some cases, even accept installation of efficient equipment for free. These attributes have made program participation particularly relevant and of interest to program designers and managers.

PROGRAM DESIGNS AND TECHNOLOGIES

Utilities often use direct-install programs for the relatively hard-to-reach small business sector. Contractors qualified and selected by the program do the energy audit and equipment installation, while the customers simply have to enroll in the program and approve specific measures. This makes participation simple and easy for the small business owner. Typical measures installed in small business programs today include high-efficiency linear fluorescents, screw-in LED lamps and ballasts, LED display case lighting and open/closed signs, window film, occupancy sensors, and vending misers.[14] Historically, small business program participation rates have been modest, as many programs are budget constrained and have sought to gradually penetrate the small building stock at the rate of a few thousand customers per year.

The small business sector comes with built-in barriers to high program participation: the businesses are small, diverse, and short on time and capital. The barriers also tend to reinforce each other, so that overcoming one or two for a given customer or type of customer may not close the deal to result in a new program participant yielding cost-effective savings to the program.

Barriers include the following.

- *Size*. Efforts that result in small energy savings per location increase the administrative cost per unit of energy saved. This is compounded by the siloed nature of DSM, which occurs through programs, regulations, and trade allies, each segmented by mass distribution of individual products and with efficiency program activities separated from demand response activities. This dynamic does not optimize energy savings per dollar of program delivery expense, and it requires more time and effort on the part of the customer to access multiple services.
- *Time and money constraints*. Businesses require short payback times achieved with minimal time commitment from the business owners, who are busy running their operations. Also, from the program administrator perspective, small business

[14] Window film is a transparent film that adheres directly to the glass surface of windows and saves energy by reducing solar heat gain in summer and retaining heat indoors during the winter. Vending misers are energy-saving control systems that shut off the refrigeration on soft drink machines when beverages do not need to be kept as cold, usually nights and weekends. They are not timers, but rather contain a combination of infrared sensors and temperature sensors that detect if anyone is within a set distance from the machine.

programs are not as cost effective as most other energy efficiency programs; as a result, many small business programs are budget constrained.[15]

- *Diversity*. There are a wide variety of industry subsectors and types of businesses. Diverse in energy uses, savings opportunities, financial needs, languages spoken, and culture, the small business sector represents a unique set of challenges for program management and design.
- *Lack of awareness*. This diversity makes it difficult for utility customers to develop familiarity with the programs and an understanding of what the benefits may be, and how they work. Consequently, trust in the utility-sector programs is low. Many small business owners are not aware of the benefits of energy efficiency or lack sufficient knowledge of program benefits.
- *Remote decision makers*. Many small businesses are owned and operated by large franchises or chain stores. In these cases, the corporate offices may be responsible for buildings and operations decisions, not the local managers.

Other barriers impact some small commercial firms, such as the inability of some business contacts to make decisions on energy efficiency investments (e.g., franchises or chain stores where those decisions are made by corporate partners). Utility-sector energy efficiency programs that design program services, marketing, and financial incentives to overcome all these barriers win higher program participation rates.

PROGRAM RESULTS

Defining and Measuring Program Participation

With these constraints often at play, utility small business program objectives are not necessarily to maximize participation rates within the sector overall, but rather to increase cost-effective participation, or to maximize energy savings overall within the program budget. One strategy for keeping administrative costs down—and participation high, per dollar spent—is to target subsegments with common characteristics. For example, a program might focus on certain types of businesses, such as convenience stores, that have similar energy end uses and technologies in place, or focus on neighborhoods, where marketing expenses can be minimized by reaching out to geographically clustered businesses.

Participation rate could theoretically be measured by the ratio of program participants to all businesses that are potentially eligible as defined by the program, such as those with average electric demand use under the threshold level of 100 kW or 200 kW per month. In practice, what is more likely to be measured and tracked is more along the lines of a conversion rate, which compares targeted businesses to participants, or a "take rate." This term refers to the percentage of small businesses receiving an energy audit directly or indirectly through the program that become participants with energy efficiency measures installed.

[15] Sacramento Municipal Utility District's Complete Energy Solutions program concluded that small business owners have so little time or resources to focus on anything other than their core business that "turnkey and hassle free" was adopted as their "overarching program design principle."

There are practical issues to tracking participation rates in small business programs. The unit of measure makes a difference. A business customer may have multiple billing accounts. Billing accounts are a clear and definitive measure, but not necessarily consistent from one year to the next or directly matched to individual businesses or facilities. A small business may expand to acquire an adjacent retail storefront, yet have two billing accounts. This could be the case if the gas or electric meters are not changed when the business expands. There are also possible accounting issues. National Grid, for example, altered its classification of some small grocery stores that are parts of larger national chains, including what were once multiple small businesses in tallies of medium and large commercial energy efficiency program participants. In Massachusetts, National Grid had 98,000 eligible customers, but those small business electric customers had over 150,000 eligible accounts.

Table 9. Long-term program results on markets

Program	Launch year	Particip'n unit type	Annual number of audits or surveys	Annual particip'n (units in most recent year)	Annual particip'n rate (% of eligible customers)	Annual conversion rate or take rate	Cumulative particip'n (units)	Cumulative particip'n rate (% of eligible customers)
One-Stop Efficiency Shop[1]	2000	Business		1,447			10,456	
National Grid Rhode Island Small Business Direct Install (electric)[2]		Eligible electric billing accounts		1,285	2.1%		5,966	9.8% (over 6 years, 2008–13)
National Grid Massachusetts Small Business Direct Install (electric)[2]	1989[3]	Eligible electric billing accounts		1,574	1.0%		7,537	4.8% (over 6 years, 2008–13)
Consolidated Edison and Orange and Rockland		Business customer	5,096	(through Aug. 2010) 3,726	1.2%	73%		
SMUD Complete Energy Solutions[4]			2,346	617		26%		
Commonwealth Edison Smart Ideas for Your Business SBES[5]	2011	Business customer participants (with full retrofits)		7,400	4.9%		9,497	6.3% (2011–13)

[1] CEE 2014. [2] B. Rivers, National Grid, pers. comm., Sept. 2, 2014. [3] Mougne and Fife 2013. [4] Davis 2014. [5] S. Baab, Commonwealth Edison, pers. comm., Sept. 25, 2014.

Changing Program Participation

Experience from each of the following programs demonstrates that when they took specific actions to expand participation, they succeeded.

In 2007, Connecticut Light & Power's Small Business Energy Advantage (SBEA) program saw a big increase in participation after extending loan terms to small business customers so they could achieve positive cash flow immediately. Previously, SBEA had provided fixed loan terms. Making terms variable yielded a 5% increase in program participation in one year. (D. O'Connor, United Illuminating, pers. comm. April 24, 2014)

Minnesota's One-Stop Efficiency Shop® began as a very small program in terms of participation. By consistently enhancing the sales skills of those on the front line with customers, participation increased annually for a decade (Funk 2012).

Efficiency Vermont increased participation by making participation simpler and easier for customers. With participation down during the first half of 2013, Efficiency Vermont made some aggressive program adjustments that increased participation during the second half of the year. For convenience stores, one of the targeted eligible market subsegments, they created standard rebate forms through which all project rebates could be processed. Benefits of this change were simplification, speed, and clarity about the process. This was paired with a project completion bonus for chains of convenience stores owning between 30 and 50 stores (Efficiency Vermont 2014).

The Southern California Edison small business program created a surge in participation through the Green Job Skills Training component of the program. In a pilot initiative of the increased outreach and communication effort, the take rate increased from 36% to more than 55%. More than 10,000 customers participated, saving 45 GWh and reducing demand by 9.6 MW. Later, the program was able to double the take rate compared to the historical rate. It also created over 30 skilled job positions in installation, energy auditing, and clerical areas. Important to program success in expanding participation is that it has generated not only energy savings, but also jobs (Rodriguez and Goforth 2012). Community-based organizations and faith groups work closely with the small business direct install program to create community partnerships that result in employment in the communities where they operate (K. Rodriguez, SCE, pers. comm., August 28, 2012).

Maximum Participation Rates Achieved

Maximum participation rates achieved have been above 50%, and some beyond 60%, for small business programs focused on a narrow area that have a sufficient budget to serve all interested customers. SCE reported a take rate of 55% for the pilot initiative described above. The highest participation rate for a targeted direct install lighting program we found in our research was with the New England Electric System Enterprise Zone program[16] in 1991–93, which exceeded 85% of targeted customers (Nadel et al. 1994).

[16] The successor company is National Grid Massachusetts.

For a full-scale program, it can take decades to achieve cumulative participation rates at that level, particularly since most programs have limited annual budgets and market the program only until the budget is depleted. This is the case with National Grid's small business programs. National Grid has served about 10% of eligible customers in Rhode Island over the past six years. Further complicating matters is the fact that small businesses are also eligible for incentives and measures made available to larger commercial enterprises.

For high annual participation rates, a clear leader is the Commonwealth Edison (ComEd) Smart Ideas for Your Business® Small Business Energy Savings program for businesses using less than 100 kW. In 2013, the program served 7,400 customers with actual retrofits. With an estimated 250,000 small business accounts, the program's annual participation rate approaches 3%; if only small business customers in the 10–100 kW range are considered, the ratio is almost 5%. SBES has also geo-targeted savings for small business in a small town, paying 100% of the measure costs, with 33% of all small businesses participating in a single program year. This reduced the total commercial and industrial load by 8% that year.

Keys to Achieving High Participation

The established programs that have achieved high program participation and raised their take rates are those that combine a compelling business case—paying high incentives and providing financing—with enhanced and highly targeted marketing strategies.

On the financial side, utilities and other program administrators that have budgeted for and invested heavily in generous incentives and loan financing have succeeded in increasing participation. Sometimes trade allies can be involved in providing the financing. Historically, many small business energy efficiency programs, particularly direct install programs, have provided many if not all services for free: free energy audits or lighting consultations, free products and equipment, and free installation. Leading programs combine free and very low-cost options with low- or even zero-interest rate financing. To make the selling proposition even better, many offer on-bill financing. Combining these elements together in a package often results in an offering to the small business owner that gets them new, high-efficiency products and equipment with neutral, or even positive, impacts on their cash flow. For types of businesses where cash flow management is critical to their success, such as retail stores, this can be compelling.

On the marketing side, they increase their outreach, use multiple marketing communications channels, and, most important, gear their promotional messages and advertising to the unique perspectives of each business owner. They explicitly take a sales approach and customize how the message is delivered to the small business owner's industry sector, community, culture, and even the owner's neighborhood. Partnering an energy advisor with a trade ally while performing energy assessments can help build trust and participation.

Some outreach and marketing strategies program managers have found success with include:

- Increasingly targeted and even personalized communications efforts using software and data analytics. Program managers use customer relationship management (CRM) software combined with internal program data for market segmentation, profiling, and modeling. This enables them to target communications and outreach to the best candidates for participation, and to match measures and incentives to various types of businesses.
- Hiring auditors primarily based on sales ability, even above outstanding technical skills
- Partnering with community-based organizations to offer job training. This offers the additional benefit of hiring a diverse workforce that is a match for community small businesses in language, culture, and ethnicity.
- Developing and maintaining an extensive network of qualified local vendors and contractors. Trade allies play a vital role in managing community strategy, and they provide additional community intelligence to assist with business district targeting.
- Conducting door-to-door outreach, neighborhood by neighborhood, and establishing communication with businesses before energy service representatives visit. This builds further awareness and trust.
- Providing educational seminars in multiple languages in conjunction with local nonprofit organizations (including local business associations and faith-based groups) about energy efficiency and the programs offered

SUMMING UP AND RECOMMENDATIONS

The common element underlying successful efforts to achieve and sustain high program participation and participation rates in the small commercial market is a program design that conforms to the perceptions and needs of the business owner. While higher financial incentives and more promotion and advertising may have some impact on participation, it is the targeting and tailoring of specific messages and measures to targeted markets that work best. Also, to serve many customers, budgets need to be sufficient to meet demand. The highest participation rates have been about 5% per year for a large program and as much as 85% in a constrained geographic area.

Commercial Retrocommissioning

MARKET

Retrocommissioning (RCx) is a systematic process for optimizing existing building performance according to occupant needs. Through the RCx process, improvements to building systems and operations are identified and implemented. "Retrocommissioning is a collaborative process that looks at how and why a building's systems are operated and maintained as they are, and then identifies ways to improve overall building performance," according to one manual on the practice of retrocommissioning (EPA 2007). While some new equipment and materials may be purchased and installed, retrocommissioning is primarily focused on getting the optimal performance out of existing building equipment and systems, including lighting, HVAC, building automation and controls, and water heating (BCA 2014).

The majority of existing buildings do not perform as designed or intended due to a variety of factors. The equipment systems may never have been commissioned and optimized when

newly constructed and installed. It is common for even properly commissioned systems to fall out of adjustment or otherwise not be operated as they should be for optimal performance. Buildings also typically undergo changes in occupancy and use, leading to changes that affect building operations and performance.

Extensive experience in the United States and other nations has demonstrated that RCx can result in significant energy savings and improved building performance. In doing so, RCx plays important role in reducing energy use and associated costs for building owners, as well as reducing peak demand. Field results have shown that proper RCx can yield cost-effective energy savings of an average of 5–15% with payback times from 0.2 to 2.1 years; in some cases, annual savings of as much as 30% are possible (PECI 2007).

The primary market is essentially all large (more than 50,000 square feet) commercial buildings with building energy management systems. For a building to be retrocommissioned, its owners must support and invest in the process, and building managers and operators typically must buy in and cooperate.

PROGRAM DESIGNS AND TECHNOLOGIES

While the potential market for RCx is large, the practice is still not widely in place. There are some market drivers helping to increase RCx, mostly increased recognition by building owners of its multiple benefits and value. Building labeling and certification programs such as LEED also are helping to increase the practice both of new building commissioning and RCx. A survey of building commissioning professionals ranked the following drivers of demand for both new and existing building commissioning:

- Voluntary green building certification (68%)
- The building owner's corporate environmental goals (64%)
- Codes or other mandates (45%)

Utility incentives (32%) (PECI and BCA 2013)[17]As shown by these results, utility and related programs are helping to drive demand for commissioning. Such programs have been created and offered in many areas to increase RCx and help grow this market.

RCx programs typically take a multiprong approach in the services provided. While details of RCx program designs vary, they generally are built on the following foundations.

- Marketing and outreach, particularly targeted at building owners, operators, and building tradespeople
- Training for building professionals and trade allies, including architects, engineers, building operators, contractors, and equipment suppliers
- Financial incentives for building owners to identify, analyze, and implement RCx in their buildings, generally using commissioning contractors or other building professionals

[17] Question asked: "What is motivating the commissioning work in your business? (Multiple answers allowed)."

- Technical assistance to building owners, such as engineering input, analysis, and review of proposed projects as well as follow-up on completed projects

The greatest RCx program costs are incurred for financial incentives paid to owners for implementing cost-effective projects. Such incentives may be a combination of both prescriptive and custom incentives, depending on how the program is structured and linked to other customer programs.

PROGRAM RESULTS

Defining and Measuring Program Participation

The key metrics used by RCx programs for participation are the number of participants and number of projects. Defining a participation rate would be difficult and not very meaningful for program managers and administrators. As noted earlier, the market is essentially all commercial buildings, but even the largest RCx programs reach a very small number of buildings in a given program year. For example, statewide in California from 2006 to 2008, there were a total of 28 utility and related retrocommissioning programs that collectively completed 260 RCx projects (Tso, Baker, and Willems 2010).[18] Given the large markets served by California's investor-owned utilities, this number is relatively small.

Our interviews with program managers confirmed that RCx programs are characterized by relatively low numbers of total participants, with annual values in the 10s and low 100s at best. Participation in RCx is generally measured against program targets established at the beginning of each program cycle. This yields a percentage value for actual participants versus plan participants—the realization rate. For our research we defined high participation according to two dimensions, total number of actual participants and the percentage of actual to plan participants (realization rate). Screening a database of energy efficiency programs on these metrics yielded four programs demonstrating both high participation compared to other RCx programs and high realization rates (E Source's DSM Insights). Table 10 presents the programs and participation data.

Table 10. Retrocommissioning programs with high participation

Program administrator	Program year	Total actual participants	Actual participation/plan
Pepco	2013	207	145%
	2012	245	278%
Baltimore Gas and Electric	2012	43	96%
	2011	72	118%
Xcel Energy Minnesota	2012	113	103%

[18] "Programs" in this context included a variety of utility programs and initiatives that address achieving higher energy efficiency in existing buildings, including partnerships with municipal governments, schools, and universities, along with programs addressing specific market segments, such as data centers, lodging, hospitals, retail stores, and office buildings.

Program administrator	Program year	Total actual participants	Actual participation/plan
Delmarva Power	2013	55	262%

Source: DSM Insights 2014

Long-Term Program Results on Markets

With the relatively low annual number of participants in even the largest RCx programs we reviewed, it is clear that the long-term direct impacts relative to the total market of existing buildings is low. A manager for CenterPoint Energy's RCx program reported that since the 2004–05 program year, they have completed a total of 65 RCx projects and that this has "barely scratched the surface" of the potential. ComEd's retrocommissioning program has had a total of 125 participants out of about 1,300 eligible customers (over 150,000 square feet) from June 2008 through October 2014, a period that includes program initiation and ramping up to full operation. This yields a cumulative participation rate of about 10%.

RCx programs' primary objectives are to achieve cost-effective energy savings toward overall program and portfolio targets. A secondary objective of many programs is also to help support the development of the building commissioning market for both new and existing buildings. Regions in which programs have been in place for many years do appear to have helped achieve such an objective, such as in the Northwest, Northeast, and California.

Best practices view retrocommissioning a building as an ongoing process throughout the life and operation of a building rather than as a one-time project. The same forces that led to the need for retrocommissioning in the first place will remain in place. Certain approaches to existing buildings, such as monitoring-based commissioning, are expressly established for continuous commissioning (Meiman et al. 2012). Building performance is continually monitored and adjusted to optimize performance. Utility RCx programs can catalyze processes to maintain high performance over the life of the building, not only as a one-time project.

RCx programs also can expose building owners, operators, and tenants to a broader spectrum of energy efficiency programs and opportunities. One program manager mentioned that the company views establishing RCx program customer relationships as a way to market other energy efficiency programs and services. Programs can also help to instill an energy efficiency ethic in building owners and operators, so that the RCx process becomes an ingrained standard procedure that continues beyond the initial boost given by a utility program.

Changing Program Participation

Participation in RCx programs is largely a function of budgets. The larger the budget available, the greater the number of customers able to participate in a program. Program contacts we interviewed for this project all noted this relationship. Given the large potential market, no programs reported any sort of diminished participation from hitting or nearing market saturation. Limits to participation are largely budgets and availability of funds to support projects and customer participation in programs.

Keys to Achieving High Participation

Despite the large opportunities for cost-effective application of RCx, utility programs face numerous barriers to gaining customer participation. It can be harder to sell a process than a one-time upgrade. It takes commitment, time, and resources to implement RCx successfully. As noted earlier, even relatively large, well-established RCx programs are characterized by relatively small numbers of participants, especially relative to the number of customers who likely would benefit from RCx.

We found that the following strategies are used to achieve high participation in RCx programs.

Focus marketing and outreach on the most promising market segments and building types. Generally, RCx programs have various eligibility criteria, one of which is the size of the building. For example, ComEd uses 50,000 square feet as the threshold, and CenterPoint Energy now uses 100,000 square feet, after initially having set this much higher, at 400,000 square feet. In addition, certain types of buildings and building owners, such as nonprofit organizations, educational institutions and governments, may be more likely to participate. They tend to have long tenures with their buildings, in contrast with many commercial buildings with leased spaces. Additional targeting can be based on analysis of energy use. CenterPoint Energy also uses guidelines for eligibility based on high energy-use intensity (kWh per square foot), significant baseline energy use (kWh per year), and significant baseline peak power (kW) demand.

Rely on account management to gain participation. This includes allowing sufficient time (at least one to two years) to bring customers into the program, since establishing an effective RCx process takes more time than many simpler building equipment upgrades or other energy efficiency measures. Effective account management also is critical to get customers to move from identification of opportunities to implementation of such measures. Experience shows that follow-up from program and account managers is critical for customers to take recommended actions.

Rely on well-qualified RCx contractors. Within the industry, these contractors typically are referred to as agents or authorities; they play a third-party role by working with building owners and leading the RCx process from initiation to postcompletion follow-up. One approach, as exemplified by CenterPoint Energy, is for programs to select contractors and post lists of the ones that have been approved.

Offer streamlined, customer-friendly services. RCx is inherently a more complex undertaking than many other types of energy efficiency improvements. A comprehensive evaluation of California's RCx programs noted several improvements that would help increase both the realization rates and the resulting program savings, including the following:

- Reduce the data and analytical burdens on customers and the commissioning provider.
- Provide RCx providers with simple, straightforward tools to quantify costs and savings.
- Give program staff primary responsibility for collecting baseline data.

Promote and include partnership opportunities. Working with partners such as university systems and municipal governments can yield strong results given the large number of buildings and associated energy use that can be affected.

Gaining commitment to follow projects through completion is another key to successful programs. CenterPoint Energy requires participants in its RCx program to commit to implement all measures with a simple payback of up to 1.5 years. The company also imposes a financial penalty of an amount based on a sliding scale according to building size and potential project savings for failure to meet this implementation commitment (Nexant 2014).

SUMMING UP AND RECOMMENDATIONS

RCx is a foundation for achieving optimal building performance in accordance with the operational requirements of building owners. The RCx process ensures that all systems and components are designed, tested, operated, and maintained in order to achieve such performance. The legacy and norm for the large majority of commercial buildings are that they perform suboptimally. RCx is a proven means of achieving and maintaining high performance, with significant energy savings being one of its many well-documented benefits.

Despite the vast potential and clear need to expand RCx so that it is ingrained as a standard operating procedure for commercial buildings, it is still not common practice. Utility RCx programs have successfully helped individual program participants achieve significant energy and cost savings. Such efforts also have helped grow the RCx markets in the regions served by these programs.

Participation in utility RCx programs is largely a function of budgets; leading programs typically are able to achieve high realization rates for their programs. They likely could serve many more customers if the funds and resources were available. Nowhere did we find any reports of programs reaching saturation points in targeted markets. Leading programs we identified are able to serve 100–250 participants per year. One program, Commonwealth Edison's, achieved an estimated cumulative participation rate of about 10% over a six-year period in the large buildings targeted by the program.

As with other programs serving large customers, RCx programs offer large savings potential. While the total number of participating customers in even the largest RCx programs may only be in the 10s for a given year, the amount of energy saved by each customer typically is large due to the size and nature of the involved buildings and systems.

Commercial New Construction

MARKET

The commercial new construction market includes the design and construction of new buildings and major renovation of existing buildings. This market is highly diverse in terms of building sizes, types, designs, and ownership. It includes small businesses, office buildings, big-box retail stores, apartments, condominiums, shopping malls, hospitals, warehouses, places of worship, schools, restaurants, and hotels. Owners may be public or private.

The types of businesses involved in this market are also expansive. They include architects, engineers, contractors, financial institutions, suppliers, and skilled tradespeople. Such businesses may consist of a handful of employees or they may be large multinational corporations with thousands of employees.

The market must adhere to a variety of building codes, including codes addressing energy efficiency. Building codes vary by state and even small units of government, such as counties and municipalities. Codes set minimum requirements. Those codes addressing energy efficiency have become more stringent over time, generally raising performance requirements of key building components and systems with each new edition of the codes.

The market for buildings that are more energy efficient than required by codes is driven by a number of factors. More and more building owners are interested in green buildings, as illustrated by the rapid growth of LEED and other programs that promote and recognize energy-efficient buildings.[19] Such buildings offer lower energy costs and a variety of additional benefits, which can include reduced operations and maintenance costs, high-quality indoor environments, increased occupant comfort, and improved productivity. Increasingly, building tenants are seeking green, energy-efficient premises when in the market for commercial building spaces, as is evident from the rapid market growth of green buildings (USGBC 2014).

While there is a growing market for energy-efficient commercial buildings, there remains a large potential for such buildings, even as energy codes continue to raise baseline performance. This potential exists because of a variety of market barriers faced by building owners and developers in going beyond code requirements. The primary barrier has been higher first costs, which typically have involved additional design time and higher costs for certain high-performance equipment, such as HVAC and the building's shell, windows, and lighting. However as this market has matured, such differential first costs have been reduced and even eliminated in some cases. A related barrier is the extra time it can require to design high-performance buildings, as more-specific modeling and engineering are typically required. Such extra time can be a luxury in fast-paced, fragmented commercial building markets.

Market activity is highly correlated to overall economic activity and growth. Construction activity itself is a key variable that factors into measurements of economic growth because of its large role in the economy. This was quite apparent in the severe economic recession from about 2009 to 2012, when the construction industry was especially hard hit; in many areas it is still struggling to return to prerecession levels.

PROGRAM DESIGNS AND TECHNOLOGIES

The primary objective of new construction programs is to affect the design and construction of new buildings and major retrofits so that superior energy performance is achieved relative to applicable building energy codes. The main strategy taken is to provide design

[19] Leadership in Energy and Environmental Design, LEED, is a green building certification program that recognizes best-in-class strategies and practices.

assistance and incentives to building owners. Programs typically bring energy experts into the conventional design process in order to do more detailed energy modeling of building performance during the design phase. The extra modeling allows designers to test performance of a greater number of alternative building designs in order to yield a design that best meets the objectives of high performance and high energy efficiency. Without this approach, designers miss the synergies and larger energy savings that are possible with integrated building systems compared to one-by-one project savings focusing on upgrading single pieces of equipment or other building components.

New construction programs often include financial incentives for the purchase and installation of energy-efficient equipment and systems, such as lighting and HVAC. Financial incentives also can be structured based on meeting certain performance standards and certifications, such as ENERGY STAR or LEED.

PROGRAM RESULTS

Defining and Measuring Program Participation

The primary metric used for tracking new construction activity is the floor space (square footage) of new buildings. There are a number of industry indices and market data reporting services in common use, such as CMD (formerly Reed Construction Data) and the McGraw Hill Construction Dodge. New commercial construction programs similarly track their performance by the same metric, the total floor space of projects affected by their services. In this way, programs can determine what percentage of the total new construction market they are reaching.

Another key metric used by new construction programs is the number of projects served by the programs. This metric is important since most programs seek to influence and serve a large share of customers that are involved with new construction and major renovations. It is valuable for programs to serve customers and projects of all sizes. Historically, new construction programs have tended to serve large projects (50,000 square feet or more), but an increasing effort is being made by many such programs to serve smaller projects through a variety of program innovations, such as simplified modeling and model guidelines for selected types of common buildings (e.g., small retail buildings, restaurants, small office buildings, and schools) (York et al. 2013).

The NYSERDA New Construction Program provides technical assistance and capital-cost incentives for electric energy efficiency improvements in new construction and major renovations for commercial and industrial customers in New York. A program evaluation (Navigant 2014a) found that for the period 2008–12, the cumulative market penetration statewide for the New Construction Program was 37%, as measured by the percentage of square footage of participating projects. This was an increase from the 2000–07 period, when the market penetration was 32% statewide. The evaluation also revealed significant differences by geographic region within the state and the types of buildings participating in the program. The program achieved 49% participation in the upstate region, but only 29% in the downstate region. The program achieved the highest penetration for government services buildings (77%), and industrial/manufacturing buildings (73%), whereas that figure was only 9% for apartment buildings. Overall for the period 2008–12, the program

engaged 836 new construction projects comprising 91 million square feet of nonresidential building space.

Savings by Design is a statewide program in California that has been in place for over a decade and is implemented by the state's four largest investor-owned utilities—Pacific Gas & Electric, Southern California Edison, San Diego Gas & Electric, and Southern California Gas Company—along with two large municipal utilities: Los Angeles Department of Water and Power, and Sacramento Public Utility District. The program promotes energy-efficient design and construction by offering design and financial assistance to nonresidential building projects that go above the minimum standard set by California's Title 24 Code.

Savings by Design has been very successful in reaching and influencing new construction markets to yield high-efficiency buildings. A recently completed comprehensive evaluation of the program (Navigant 2014a) shows, however, that participation is highly variable from one year to the next. Of the three participating utilities that we reviewed, PG&E participation varied from 3–34%; SDG&E varied from 5–41%, and SCE varied from 9–16%.

Participation in Savings by Design also varies widely according to building type. Table 11 gives the historical participation rates by building type for each of the three IOUs included in the evaluation. There is not much consistency in participation rates by building types across these three utilities.

Table 11. Savings by Design percentage participation rates by utility and building types

Building type	PG&E	SDG&E	SCE
Amusement, social, and recreational buildings	1	10	1
Dormitories	0	65	0
Government service buildings	37	12	1
Hospitals and other health treatment	15	12	10
Hotels and motels	1	1	7
Manufacturing plans, warehouses, labs	83	19	37
Miscellaneous nonresidential buildings	36	31	34
Office and bank buildings	7	16	17
Parking garages and automotive services	0	40	0
Religious buildings	3	6	0
Schools, libraries, and labs (non-manufacturing)	14	17	12
Stores and restaurants	15	6	12
Warehouses	14	3	25
Total percentage participation (all building types)	14	17	13

Commonwealth Edison and Nicor Gas jointly provide the New Construction Service, which offers a high level of technical and analytical support for new construction projects. The

program provides energy modeling and technical consulting as a free service to program participants. The New Construction Service has achieved the following market share, as measured by square footage of projects divided by total square footage of all new construction (and major renovation)(C. Cowan, director of program design and delivery, Energy Center of Wisconsin, pers. comm., April 4, 2014).

Table 12. New Construction Service market share

End year	Market share (%)
2010	3
2011	23
2012	41
2013	58
2014	29
2015	63*

*Projection based on projects in process

The Energy Trust of Oregon's New Buildings Program provides financial incentives and technical assistance to owners who install energy efficiency measures in new commercial construction and major renovation projects. An evaluation of the program (PWP 2010) estimated that the program had achieved a market penetration of 65%, with free ridership estimated to be 35% based on Energy Trust algorithms and results from 43 respondents. The Energy Trust defines market penetration as the total square footage of projects participating in the New Buildings Program compared to the overall new construction market in the area. The market penetration value of 65% represents adjustments made for the effects of projects started in earlier years that were completed in 2009; without these adjustments the market penetration is 89%, clearly a very high value. During the 2009 program year, the program paid incentives for about 1,350 measures at 211 sites.

Participation in new construction programs is closely correlated with budgets. Program managers interviewed all reported that the primary goal of their programs is to reach set energy savings targets. Budgets, in turn, determine the size and types of marketing and outreach, which can include professional networking, training, and education. Budgets also determine the amount of financial incentives that can be paid to projects. The primary limiting factor for participation in the programs we examined is budgets. These programs all reported readily meeting savings targets. If larger budgets were available to pay for additional technical services and incentives, the program managers we interviewed agreed that higher participation could be achieved.

The wide variation in market share by building type shown in the evaluation data from Savings by Design clearly show that there remains high potential across most types of building projects. More importantly, some programs have been able to achieve very high participation rates—well above 50% in several cases and even above 75% in a few cases for a single program year and/or building type. Savings by Design has tried boosting participation by paying incentive kickers or bonuses for meeting certain criteria, such as

gaining LEED certification. This worked to a degree, but the program ended such bonuses because this market (for LEED-certified buildings) was moving on its own (M. Basarkar, manager of emerging technologies and portfolio optimizations, PG&E, pers. comm., May 23, 2014).

National Grid has a long-standing new commercial construction program in Rhode Island. The company estimates that its programs have reached as much as 60% of new construction projects, but that includes programs such as upstream lighting and major replacements. After adjusting for other such programs, the company estimates that it is reaching about 50% of new construction and major renovation projects (B. Rivers, National Grid, pers. comm., Oct. 7, 2014). This is a good example of how difficult it can be to isolate single-program participation rates when portfolios of programs and services are available.

Table 13 shows participation results as measured by market share for selected programs that have high participation.

Table 13. Market share for selected high-participation programs

Program	Projects and area	Annual market share	Cumulative market share
NYSERDA New Construction Program	836 projects, 91 million square feet (2008–12)		37% (2008–12) 32% (2000–07)
Savings by Design (California) Highest shares achieved*			
PG&E		34% (2009)	
SDG&E		41% (2010)	
SCE		16% (2010)	
Commonwealth Edison and Nicor Gas: New Construction Service		58% (2013)	
Energy Trust of Oregon	211 sites, 1,350 measures (2009)	65% (89% if unadjusted for projects started in earlier years)	
National Grid		~50%	

* A program evaluation of Savings by Design gives annual total market shares for the years 2006–12. These fluctuate a great deal: PG&E's ranges from 3% to 34%, SDG&E ranges from 5% to 41%, and SCE ranges from 9% to 16%. To show the highest participation, we give the highest values achieved by these programs.

Long-Term Program Results on Markets

The nature of new construction programs means that participation rates are most meaningful on an annual basis. Program administrators seek to affect current markets for new construction. A primary determinant of program success is the share of such building projects that receive program services and incentives. It is conceivable that a program administrator could determine fractions of buildings participating in programs over a multiyear period. In our research we did not find any program tracking such long-term data. Rather, the clear emphasis is on annual participation rates—how much of the current

construction market a program is affecting. This, in turn, leads to determination of program savings and cost effectiveness, which are key metrics used to evaluate programs overall.

While we did not find estimates of long-term program results, we did find estimates of energy efficiency potential within new nonresidential construction markets. In its evaluation of Savings by Design, Navigant (2014b) estimates that PG&E could achieve about four times the current program savings through expanded participation targeted at buildings with the highest cost-effective savings potential. For SDG&E this estimate is 1.6 times current savings; for SCE, this estimate is 5 times. Reaching and serving more customers through Savings by Design would take more time and money.

A few commercial new construction programs try to increase market share of efficient technologies and practices so that these efficiency measures can ultimately be included in building codes that will have participation rates approaching 100% (assuming codes are well implemented). The California utilities in particular follow this philosophy and have succeeded in having many efficiency measures incorporated into California's building code. In California, utilities receive credit for savings from code improvements to the extent that they helped to influence them (Misuriello et al. 2012).

Keys to Achieving High Participation

Timing, trust, and ease of participation seem to be keys to achieving high participation in commercial new construction programs. A specific goal of the most recently completed evaluation of California's Savings by Design program was to provide "enhanced analysis of best practice approaches to increasing program participation (Navigant 2014b). The keys to high participation are effective marketing and outreach, incentives and recognition, and program design. Specific recommendations made in this evaluation include:

- Marketing and outreach
    - Focus efforts on design teams.
    - Develop strong relationships with professional communities, such as ASHRAE and the American Institute of Architects.
    - Actively train architects and engineers.
    - Target top design firms and the largest electric customers.
    - Leverage nonenergy benefits of participation to both design teams and building owners.
- Incentives and public recognition
    - Encourage early enrollment by providing increased early design support.
    - Offer incentives for energy modeling.
    - Offer awards program by building type for innovative designs and building practices.
    - Support LEED building recognition.
- Program design
    - Offer a variety of program tracks to suit the needs of a wide range of participants, from large and complex projects to small and simple projects.
    - Determine design team's goals and needs early in the process and respond accordingly with appropriate technical assistance and incentives.

Savings by Design also benefits from being a well-known, long-established program. This kind of awareness and trust have helped bring projects into the program.

Early involvement of programs with design teams is critical to achieving maximum benefits and makes for a smoother overall process. Effective communication among program staff and project teams also is cited as a key to successful outcomes. Program staff also need to respond quickly for requests for information, design assistance, and other program services. Key program contacts need to be involved throughout the entire process.

A process evaluation of the Energy Trust of Oregon's New Buildings Program echoes the findings and recommendations of the evaluation of Savings by Design. Key recommendations include:

- Reach out to small design firms.
- Emphasize ease of participation in marketing materials and ensure processes in place achieve this end.
- Provide data on costs and benefits for the most popular measures.
- Provide public recognition for participating projects.
- Link building codes to program outcomes—what measures are needed for compliance and what can be used to exceed codes and qualify for incentives.

A program manager of the New Construction Service program offered by Commonwealth Edison and Nicor Gas cited keys to this program's success:

- Provides rigorous technical and analytical support at no cost to participants at appropriate times in the design and construction process
- Minimizes paperwork and simplifies the participation process
- Offers a high degree of flexibility in how to incorporate energy efficiency into the building design by using performance-based incentives (dollars per kWh or dollars per therm saved)
- Establishes trust and strong relationships with owners, design team, and contractors involved in construction projects. (C. Cowan, Energy Center of Wisconsin, pers. comm., April 22, 2014)

SUMMING UP AND RECOMMENDATIONS

New construction programs in many areas have successfully influenced large shares of new construction markets—up to about 60% or somewhat more of new construction activity—by providing a variety of services and incentives to achieve high-performance, energy-efficient buildings. Targeting new construction is a priority within program portfolios because this market typically offers relatively large energy savings potential, and such savings tend to be highly cost effective. It also helps transform design and construction practices, and can lay a foundation for code upgrades.

Despite the importance and attractiveness of the new commercial construction market for achieving high-performance, energy-efficient buildings, this market poses a variety of challenges for programs. Leading programs share common approaches centered on

providing timely, high-quality technical assistance to building owners and design teams along with financial incentives for selected energy efficiency measures.

Keys to achieving high participation are:

- Targeted education, training, and outreach to owners, architects, engineers, contractors, and suppliers
- Demonstrated success and credibility
- Development of trusted, strong relationships with key constituents in new construction markets
- Streamlined, user-friendly processes to enroll and receive services and incentives.
- Flexible program services able to meet the needs of a variety of building types and sizes.

Participation in commercial new construction programs is a largely a function of available budgets and is driven by program savings goals. Participation is primarily measured by the percentage of new construction as given in square feet of new space that is included in receiving program services and incentives. Some leading programs have readily reached over half the market in some years. There can be wide variation in participation depending on the types of building and types of ownership.

Commercial Prescriptive Incentive Programs

MARKET

Commercial markets for the lighting and HVAC energy efficiency measures included in prescriptive rebate programs are evolving. This evolution may be accelerating in recent years as a result of the increasing proliferation of new technologies and wider availability of existing technologies, both of the equipment itself and of the systems and controls by which they are organized and managed.

Commercial and industrial prescriptive programs occupy one end of the C&I program spectrum. At the other end are custom programs, which we cover in the Commercial and Industrial Custom Incentive Programs section. More generally, the market for energy-efficient improvements for commercial buildings and industrial plants is broad and heterogeneous. It encompasses the full range of technologies and systems used by commercial and industrial customers, including lighting, motors, mechanical drives, compressed air, process heating, and manufacturing machinery.

While this market is both large and complex, utility energy efficiency programs segment it according to how best to serve the needs of different types of customers. Certain types of customers and buildings can be well served by prescriptive rebates for energy-efficient equipment and systems. In these cases, the equipment and systems are fairly standard and in widespread use among large numbers of customers. This section discusses commercial lighting and HVAC prescriptive programs and prescriptive rebate offerings housed within other types of programs. Commercial custom programs are often geared toward the largest customers, such as manufacturing businesses, which may have the most varied and complex energy use.

We define prescriptive programs here, in contrast to custom programs, as those in which a given standard of fixture or piece of equipment that is replaced with a prescribed, higher-efficiency one has a standard financial incentive in place. No extensive calculations or customizations for the customer's facility are required. The defining aspects are the existence of set financial incentives, a corresponding list of approved measures or energy-saving improvements, and a simple process for customers to use in obtaining funding for the most common efficiency projects.

PROGRAM DESIGNS AND TECHNOLOGIES

Program designs are evolving along with the changing markets, and both influence and interact with each other. Understanding this development process is relevant to our discussion of the role and status of program participation and participation rates.

Drivers of the evolution of commercial prescriptive program designs include federal lighting efficiency standards, the proliferation and availability of high-efficiency products and technologies, and changes to the structure and composition of energy efficiency portfolios. The focus of this section is on prescriptive lighting programs, as lighting is often the area of largest savings within energy efficiency portfolios and among the end uses with the highest program participation.

Federal Lighting Standards

In 2009, the U.S. Department of Energy set new fluorescent lamp standards that effectively prohibited the manufacturing or importing of most of the T12 fluorescent lamps that were on the market as of July 2012.[20] At that time, commercial lighting programs were simpler than they are today. Utilities could capture cost-effective energy savings credit for offering financial incentives to their business customers to replace T12 lamps with T8 lamps and to replace magnetic ballasts with more-efficient electronic ones. Compared to today, program implementation contractors and program administrators needed less technical, marketing, and management expertise to garner substantial savings. Linear fluorescents were the low-hanging fruit of commercial lighting programs.

With higher-efficiency standards being put in place for such a large chunk of the commercial lighting efficiency market, the resulting higher savings baseline reduced the amount of energy savings utilities could claim per unit. At the same time, state energy efficiency resource standards were ramping up across the country. Utilities faced greater energy-savings requirements as a result. Their response was to move toward more comprehensive lighting program design to acquire deeper savings. More programs worked with lighting designers and provided or supported contractor and trade ally training

[20]T12, T5, and T8 refer to the lamp diameter in eighths of an inch. Thus, a T8 lamp is one inch in diameter, and a T12 lamp is 1.5 inches. Smaller-diameter lamps are generally more efficient, as the smaller diameter means less internal losses. While the standard exceeds the efficiency of a majority of the T12 lamp types, the three largest lamp manufacturers responded to the standards by developing lamps that are either compliant (i.e., they meet the efficacy requirements of the standard) or are exempt (i.e., they have a high color-rendering index that exempts them from meeting the efficacy requirements of the standard).

programs to equip them better for providing comprehensive lighting program implementation services. For those lighting contractors with less expertise in lighting design, systems, and controls—the elements that distinguish comprehensive lighting programs—there was a rush to seize as many of the traditional linear fluorescent replacement opportunities as possible.

Technology

As energy-efficient technologies advance and successive generations of products proliferate in the marketplace, programs gain the data and implementation experience to more accurately prescribe incentive levels for more products. Consider that it was not too long ago that LEDs were not a common measure in commercial prescriptive programs. With a greater selection of incentivized products included, the potential for participation expands.

Some typical measures featured in commercial prescriptive lighting programs today include reduced-wattage T8 and T5, reduced-wattage ceramic metal halide, CFLs, and screw-in LEDs. For HVAC, typical measures are water- and air-cooled chillers, variable-speed drives installed on existing HVAC equipment, rooftop unit optimization, demand-controlled ventilation, and air-side economizers. Prescribed incentives are available for lighting products in the categories of fluorescent lamps and ballasts (including hardwired CFLs), fluorescent fixtures (high efficiency, high bay, low glare, and others), LEDs (especially exit sign lights, refrigerator, and outdoor lighting), and lighting controls such as occupancy controls and daylight dimming.

Place Within Portfolio

Traditional approaches that provide financial incentives for higher-efficiency technologies within a distinct category, e.g., commercial lighting or commercial HVAC are giving way to more holistic, multisystem, design-oriented approaches toward saving energy. Commercial energy efficiency program portfolios are increasingly organized around customer size and custom versus prescriptive structure. Commercial prescriptive lighting programs as such have not gone away. There are still well over 100 utility energy efficiency programs counted as "prescriptive lighting" (Baldacci and Schaefer 2012). What is new is how the prescriptive lighting and HVAC incentive offerings are integrated with and relate to other offerings within the full energy efficiency portfolio, as discussed below in the section Keys to Achieving High Participation.

PROGRAM RESULTS

Defining and Measuring Program Participation

Participation may be assessed in terms of percentage of eligible businesses participating or by quantity of efficient products sold through distributors. While market-saturation survey results may reflect either the growth of specific product unit sales or the market share of efficient technology, how much of that share is directly attributable to energy efficiency programs is difficult to estimate.

In contrast to many other program areas, it could potentially be relatively straightforward to measure participation rate in those cases for which all businesses are eligible. Where

available, the total number of business customers or total commercial utility accounts could be used as the denominator to calculate the participation rate.

It is common for programs to define eligible businesses relatively broadly. For the Mass Save Bright Opportunities Commercial and Industrial Upstream Lighting Program, for example, there are only two requirements. First, only facilities that receive electrical service under a nonresidential rate class from an electric utility in Massachusetts are eligible. Second, the equipment must be installed and operated at the customer's facility within the boundaries of the state. Effectively, that includes almost the entire business sector, including both commercial and industrial firms of a range of sizes and levels of energy use. New York State Electric and Gas (NYSEG) has similarly broad eligibility for all its C&I programs, offering rebates to any nonresidential commercial, industrial, or institutional customer that pays an electricity and/or natural gas System Benefits Charge on their utility bills. Xcel Energy is open to any of its customers with a valid Xcel Energy business account in its Minnesota electric service territory.

Participation rate may also be measured by growth in sales or market share of high-efficiency products attributed to program activities.

Program Results

To identify prescriptive C&I lighting and HVAC programs with the highest participant counts in terms of business customers, we searched E Source's DSM Insights. Results are shown in table 14.

Table 14. C&I lighting and HVAC programs with highest business customer participation

Program	Annual participation (customer count in the most recent year) *	Total business customers **	Annual participation rate
Efficiency Vermont SMARTLIGHT and all commercial lighting	1,849	51,437	3.6%
Xcel Minnesota Lighting Efficiency	1,741	134,948	1.3%
CenterPoint Energy Minnesota Heating and Water Heating	2,794	NA	
Xcel Energy Colorado Cooling Efficiency	223	209,212	0.1%
SMUD HVAC Nonresidential Cooling	468	68,713	0.7%

* E Source DSM Insights ** EIA 2013a

As discussed above in several of the residential program sections, market share can also be a useful participation variable for some commercial efficiency measures. Unfortunately, such data are rarely collected, although there are some useful cases in which they are available. For example, the Consortium for Energy Efficiency and Northeast Energy Efficiency Partnerships (NEEP), a regional organization, worked closely with program administrators on common incentive programs for high-efficiency motors and commercial HVAC systems in the 2000s. During this period, they compiled the available market penetration data,

working with manufacturers and distributors. In 2002 and 2003 the market share of premium efficiency motors ranged from about 10% for small motors (1–5 horsepower) to about 65% for large motors (100–200 horsepower), with a market share of about 25% for the median size category in terms of horsepower shipped (5–20 horsepower) (Elliott 2007). Likewise, about the same time, high-efficiency commercial rooftop air conditioners had a market share of at least 15% (Nadel et al. 2004). These market shares are much higher than participation in rebate programs of the period (Elliott 2007), indicating that many purchasers of eligible equipment do not participate in rebate programs, although rebate programs may well influence the stocking and specification of these high-efficiency products, even if purchasers do not apply for rebates.

At a broader national level, ENERGY STAR reports that 35% of light commercial air conditioners met the ENERGY STAR specification in 2013 (EPA 2014). This market share is much greater than participation in the best rebate programs as discussed above (e.g., 0.7% per year times a 15-year life implies the best rebate programs are achieving around 10% participation among annual light commercial air conditioner purchases).

Many commercial rebate programs emphasize lighting. We could not locate any recent market share data for fluorescent lighting systems (currently the most common commercial lighting system), but many programs are beginning to promote LED lighting systems. According to an August 2014 DOE report, the market share for LED lighting in the commercial sector was about 2% in 2013, although they project the market share to rise to 42% in 2020 and 82% in 2030 (Navigant 2014c). These findings indicate a large potential for LED lighting going forward.

Keys to Achieving High Participation

It may be more accurate to describe these as characteristics of high-participation programs, so as not to imply a direct cause-effect relationship. Nonetheless, among those prescriptive commercial lighting and HVAC programs that have relatively high participation levels, and those that have generated participation above the amount called for in their program plans, we have observed three program design elements.

1. Going midstream: paying incentives to the product distributor rather than, or in addition to, the end user
2. Pairing up: having prescriptive efforts paired with custom, or a hybrid, to align incentive and service offerings with each subsegment of the market so all customers get routed into an avenue for participation that matches their needs
3. Including prescriptive lighting and HVAC measure incentives as part of a suite of elements within a comprehensive business efficiency program, e.g., “commercial comprehensive” or “commercial whole-building retrofit”

MIDSTREAM Higher participation is being achieved by going to midstream and upstream incentives, which has a major benefit in leveraging program and portfolio budget dollars. Paying incentives at midstream to distributors and upstream to manufacturers rather than

to customers has been well established in residential product programs. Now some leading commercial lighting and HVAC programs have also used this program approach.

In the Mass Save Bright Opportunities program, for example, "Mass Save works with electrical distributors to provide discount prices on the most-efficient LED directional lamps and reduced-wattage linear fluorescent lamps to customers including the lighting design community, architects and other contractors. Mass Save effectively buys down the cost to the point where the best high efficiency replacement lights end up priced close to or at the same as the level as conventional lights" (York et al. 2013). In the first full year of operation, the NSTAR 2012 annual report claimed its program had 21,000 participants (NSTAR 2013).

Another example of a midstream program is the Business Instant Lighting Discounts (BILD) program at ComEd. BILD quadrupled participation since 2011 by making fundamental changes to its design. At the start, the retail program implementer had been inherited from the consumer side of the portfolio. That implementer did not have experience working with lighting distributors. Another barrier at that time to increasing participation was that the program was based on CFLs. CFLs are generally not proactively sold by distributors; they are a reactive sale in the distribution channel.

Three changes to the BILD program were made:

- The program put marketing literature into the hands of distributors to promote the program to their customers (who are also ComEd's customers).
- They incentivized more products, including reduced-wattage T8 and T5 linear fluorescents, reduced-wattage ceramic metal halides, and screw-in LEDs. These were in line with what distributors were already making available to the marketplace, enabling them to proactively drive sales volume, rather than act as rebate delivery services.
- BILD added a bonus program for distributors to compensate them based on program volume, thereby offsetting their marketing costs. The program interacted with the distributor in parallel with the way manufacturers do, supporting increased sales.

PAIRED Another program approach that potentially may expand overall participation is the pairing of prescriptive programs with additive and/or complementary programs or program services. For ComEd's commercial lighting programs, the BILD program operates in conjunction with a more traditional prescriptive program in which the incentive payment goes to the end user. If a given business customer removes a two-lamp T12 strip fixture and installs a two-lamp T8, they receive $5 per lamp; the BILD program adds another $1 per lamp through the distributor.

The Vermont SMARTLIGHT program, which provides replacement lighting for contractors and business customers offered through distributors, achieved an increase in participation in 2013. This is attributed in part to changes in a sister business lighting program, RELIGHT. Through RELIGHT, commercial customers contract for their lighting retrofits with professional lighting designers who advise them on lighting design and equipment for maximizing energy savings. Efficiency Vermont pays the customer to reduce the upfront costs of engaging the lighting designer. Efficiency Vermont claims that the program

averages savings of 40% greater than the commercial lighting programs that put efficient lamps and fixtures into the existing arrangements, brightness, color temperature, and so on.

Xcel Energy Colorado's Cooling Efficiency product is part of its overall business energy efficiency program portfolio. The description below is typical of how prescriptive C&I rebate offerings are presented.

> The Cooling Efficiency Product offers incentives to customers who purchase and install high efficiency cooling equipment. Rebate dollars and study funding are offered to assist in "buying down" the incremental cost associated with purchasing high efficiency equipment, and to shorten the associated payback period. Customers may qualify for a mix of prescriptive rebates for common high efficiency equipment and custom rebates for newer and more system-based high efficiency solutions (Public Service Co. of Colorado 2014).

INCLUSION IN LARGER PROGRAM OFFERING While standalone prescriptive energy efficiency programs organized by end use are no longer the leading edge, straightforward prescriptive rebates for a predetermined set of measures are now commonly seen as elements within larger programs. Xcel sometimes refers to Cooling Efficiency as a program, and other times as a product. ComEd's Smart Ideas for Your Business brand encompasses multiple programs; a visit to the Business Savings tab on the ComEd website has separate sections for small business, commercial and industrial, and programs and incentives. The programs and incentives section includes pages for lighting and for HVAC, among other end-use categories, and these are mixed in among industry groups such as commercial real estate and multifamily housing—both of which clearly include prescriptive lighting rebates.

SUMMING UP AND RECOMMENDATIONS

Overall, our analysis found some programs achieving 3% participation per year among all C&I customers, with an emphasis on lighting measures. The highest annual participation rate was 0.7%, although HVAC equipment has an average 20-year life, which implies that only about 5% of customers are replacing their HVAC systems each year. In terms of market share, high-efficiency motor and HVAC equipment market shares are reaching 25–35% of product sales each year, not all of which directly participate in utility-sector energy efficiency programs.

Both external factors and program approaches contribute to increased participation in prescriptive commercial lighting and HVAC programs. Providing incentives for more products and technologies increases the potential for participation. Recruiting lighting distributors and HVAC companies to participate in midstream programs by offering that wider range of efficient measure options and providing marketing support can multiply the effect. Although we do not have quantitative data, channeling customers toward preapproved qualified measures with prescribed rebates from comprehensive retrofit, new construction, and other points of engagement within the efficiency portfolio adds to participation.

Commercial and Industrial Custom Incentive Programs

In this section, we first provide an overview of the C&I custom market and highlight typical program designs and technologies, including a discussion of the unique nature of industrial programs. We then provide results from our research on participation rates and discuss a couple of specific program examples.

MARKET

The market for energy-efficient improvements for commercial buildings and industrial facilities is broad and heterogeneous. It encompasses the full range of technologies and systems used by commercial and industrial customers, including lighting, motors, mechanical drives, compressed air, process heating, and manufacturing machinery. Utility energy efficiency programs segment this market according to how to best serve the needs of different types of customers. While many customers can be well served by prescriptive rebates for energy-efficient equipment (we covered prescriptive C&I programs in the previous section), many of the technologies and systems used to serve building functions or run industrial processes are unique to customers' specific applications. Making changes to such equipment and systems generally requires customized solutions, not off-the-shelf technologies and simple replacements of an existing technology with a more energy-efficient one. Prescriptive approaches therefore need to be complemented by custom solutions and corresponding incentives.

C&I custom programs usually have broad eligibility. Programs may allow any commercial or industrial customer of any size to participate. Due to the broad and heterogeneous nature of the market, however, program managers may use different lenses to categorize potential participants and fine-tune their program offerings for those customers. Here we list three typical ways that program managers can categorize program offerings for their C&I segment.

1. *By customer class (commercial versus industrial).* While C&I custom programs often allow both commercial and industrial customers to participate, industrial customers may have separate program offerings that better cater to manufacturing, for example. Later in this section, we examine the industrial sector in more detail.
2. *By customer type (e.g., health care, schools).* Similar to categorizing by customer class, using a framework of customer types enables program managers to cater offerings to specific types of buildings and facilities. As utilities improve their understanding of customer segmentation, they are better positioned to offer these niche programs to targeted sectors.
3. *By customer size.* Another lens that helps cater program offerings to unique needs is customer size. Small business programs, for example, are often a separate category because they are good targets for direct install projects (we covered these programs in a previous chapter). Large customers are also a unique category and are good targets for efficiency programs because they offer large energy savings opportunities. Process efficiency programs, for example, are targeted to the largest customers that use energy-intensive processes. In some states the largest customers (e.g., demand of at least 2 MW) may use a self-direct option, which means that customers use their own capacity for efficiency improvements (i.e., self-direct the funds outside of a dedicated program). This structure of small versus large is a

helpful framework, but often leads to the medium-sized enterprises being overlooked.

There is no one-size-fits-all approach. Program managers may use more than one of these strategies—for example, designating an industrial program track, and further designating within that track small, medium, and large customers. Also, program strategies may evolve over time to test out new approaches.

Our research indicates that basic C&I custom programs tend to cater to the largest energy users. Importantly, these customers offer large energy savings opportunities, which can reduce transaction costs for customer engagement, and offer good cost effectiveness. Even within the largest customers, there is a wide disparity of usage. For example, a rule of thumb is the 90/10 rule: 90% of energy in the large commercial and industrial sector is consumed by 10% of customers. For smaller customers, program managers can rely on trade allies and other marketing efforts to bring prescriptive and small business to them. There are additional custom needs for the medium customers, especially, and we discuss that later in the section.

PROGRAM DESIGNS AND TECHNOLOGIES

Custom programs allow customers to develop specific projects that may be a mix of technologies and practices. For building systems, programs typically structure rebates based on the amount of energy savings achieved, typically in terms of $/kWh saved. To receive custom rebates, participants are first required to complete an engineering and cost analysis of a proposed project. Sometimes program staff or contractors will perform this assessment. In other cases, customers may be responsible for performing such analyses and applying to programs to receive assistance.

Custom programs also are used to serve industrial customers to make improvements to their manufacturing processes. In these cases, programs may structure financial incentives based on a per-unit-of-production method. These programs emphasize achieving savings from the manufacturing process itself, i.e., process efficiency programs.

Large customers have very different levels of interest in energy efficiency compared to small and mid-size customers. Energy efficiency program staff need to understand customer readiness and be ready to facilitate program participation when a given customer is ready to become engaged. Key questions for program managers are “Who should be participating?” and “How can we target them?” Often these large customers already are served by utility key account managers, which means that utilities likely have extensive energy-use data and are very familiar with the customer’s operations and associated needs. Large customers also may have dedicated energy managers.

With high energy use and often correspondingly high potential for energy savings, large customers pose especially attractive targets for utility programs seeking to achieve high overall portfolio energy savings at low cost. While attractive as program participants, large customers may also be high risk for programs, as they can lead to large sunk costs in terms of project development if such efforts do not lead to completed, successful projects.

Another risk in the design and delivery of custom rebate programs for large customers is that of free ridership—customers who would have made improvements even absent program incentives and services. If customers are deemed free riders, the savings may not be counted by evaluators toward program targets. This risk is mitigated through the types of customer relationships developed and maintained with key account management.

INDUSTRIAL PROGRAMS

As discussed previously, industrial customers have unique needs and deserve further discussion. Custom projects represent the biggest share of program participants from industrial customers because of their customized needs. Some industrial customers can benefit from and do participate in other programs, such as prescriptive rebates for technologies such as lighting, motors, and HVAC equipment. Anything to do with industrial processes, however, almost always involves customized solutions and associated custom rebates. While prescriptive offerings for measures such as lighting help open the door to further savings, by themselves they offer limited savings. For example, lighting and space conditioning account for only about 15% of manufacturing energy use (EIA 2013b). The best approach is to offer an umbrella of offerings for industrial customers.

Industrial customers also face unique challenges. They are particularly focused on productivity and quality, and as a result, anything that is done that can affect production, whether due to shutdowns or the nature and quality of products, is viewed as risky and potentially costly. Changes to production equipment and processes take a large commitment from companies. The timelines for such changes also tend to be lengthy—measured in years, not months. Another challenge for industrial customers is that from their perspective, efficiency investments compete with core business investments. Financial incentives and other program approaches do help to overcome some of these challenges by reducing the costs, and therefore the risk, associated with efficiency upgrades and ensuring that multiyear projects can work with program incentives.

Next, we discuss some key distinctions between large and medium-to-small industrial manufacturing programs in the context of program eligibility and participation.

Large Manufacturing

Program options for this segment include standard prescriptive and custom offerings, as well as more specialized process efficiency, as well as self-direct options. Eligible participants for these large customers are typically well defined and understood. Utility key account managers are the primary avenue for customer relations. In some cases of utility-led program administration, program managers may not interact with participants at all, leaving all communications to the key account managers. In cases of statewide third-party program implementers, the program administrator works closely with utility key account managers.

Small and Medium-Sized Manufacturers

Small and medium-sized manufacturers (SMMs) make up a large portion of industrial customers and energy use, accounting for 90% of industrial establishments and 50% of energy use, but they are often underserved by program offerings (Trombley 2014). This has happened for several reasons, but new trends highlight the growing importance and

opportunity for energy efficiency in this sector. Program administrators face higher transaction costs in helping SMMs save energy and much lower savings per participant than from large industrial customers. Also, they face greater challenges in marketing to and building relationships with smaller industrial customers because small customers generally have very limited time and capacity to pay attention to energy efficiency issues. These barriers highlight the opportunities for improving marketing, program design, and participation rates, as discussed next.

Strategies to Improve Participation

The successful strategies of industrial programs are well documented. We set out below the ten best-practice strategies identified in *Industrial Energy Efficiency: Designing Effective State Programs for the Industrial Sector* (Goldberg 2014). Many of these strategies directly relate to attracting and retaining participants.

1. Clearly demonstrate the value proposition of efficiency by documenting and communicating cost savings and other benefits; use case studies of companies within the area.
2. Develop long-term relationships; stability in program personnel can help build trust between program administrator and customers.
3. Maintain industrial sector credibility and technical expertise on the program team; employ staff and contractor experts that understand the industrial segment and have the technical expertise to provide high-quality technical advice and to support issues specific to that industry.
4. Address diverse industrial customer needs with a diverse set of program types, such as prescriptive, custom, self-direct, process efficiency, and strategic energy management.
5. Consider operational and capital cycles in project scheduling. Multiyear operational planning can best accommodate company scheduling requirements.
6. Streamline and expedite the application process, and provide a one-stop shop.
7. Conduct continual and targeted program outreach.
8. Leverage key partnerships.
9. Set medium- to long-term goals as an investment signal.
10. Undertake proper project measurement and verification and complete program evaluations.

The same report also identified four key areas of interest for further program evolution (Goldberg, Taylor, and Hedman 2014), listed below. These strategies will be important means of attracting and retaining new participants.

1. Increase support for strategic energy management and energy manager programs.
2. Develop approaches for providing energy efficiency incentives for whole-facility performance.
3. Capture more energy efficiency projects by expanding quantification and recognition of project nonenergy benefits.
4. Continue efforts to expand industrial natural gas efficiency programs.

PROGRAM RESULTS

Next, we define program participation metrics, provide results from our research, and then describe several programs and their strategies for achieving high participation rates.

Defining and Measuring Program Participation

Many program managers of custom C&I programs noted that participation data generally are not of primary importance due to the unique nature of each participating customer and the broad, heterogeneous market. As discussed previously, custom programs typically serve a small number of large customers. This is especially true for custom programs targeting industrial processes. These programs are focused on achieving high levels of cost-effective energy savings, and the number of participants may be of secondary importance. For example a custom program could be very successful in terms of cost effectiveness and energy savings by serving just a handful of customers. Program plans generally include a target number of customers, but the primary objective of programs is to reach energy savings targets. Predetermined program budgets also limit participation. But as program managers scale up to reach higher savings targets, and as utilities do more sophisticated customer segmentation, there will be a need to improve tracking of C&I custom program participation in order to increase participation.

Defining and tracking participants can be complex for this sector because there are several levels that could be used to define a participant. From the typical utility perspective, these could include (from lowest to highest level): (1) meter, (2) premise, (3) account, and (4) customer. For example, an entire city may be a customer, with several separate accounts and several hundred premises. Each of the premises may also have several meters. Tracking participation rates may be further complicated for statewide third-party implementers because they are one step removed from these utility data on customer accounts.

Another difficulty in trying to determine and track participation on an annual basis is that the sales cycle for many large customer projects are longer than one year; they may take two or more years to develop and implement. And relationships with large customers tend to be ongoing in nature. For that reason, long-term relationships may be the best indicator of successful participation rather than unique projects implemented.

Because custom programs typically target the largest customers, the scale and focus of custom incentive programs are relatively small compared to the entire market of commercial and industrial customers. The number of customers served in a given program year typically measure in the hundreds even for programs serving large numbers of customers. We examined two subsets of the entire market for commercial and industrial custom programs: C&I custom programs, which generally are those programs open to all C&I customers; and industrial efficiency improvement programs, which offer customer incentives which are tailored specifically to serve industrial customers with process loads.

Tables 15 and 16 list the custom incentive programs having the highest numbers of participants among customers fitting under the broad umbrella of C&I customers (DSM Insights 2014). For these programs, the total eligible base of customers is unclear, and therefore we cannot measure participation rates. So instead of providing participation rates, in these tables we express the actual number of participants as a percentage of the number

of expected participants per the original utility program filings. In all cases in the two following tables, the total number of participants met or exceeded the planned number of participants. Also, the actual number of participants does not reflect the size of the energy savings value because it does not indicate the overall size of the participant or the size of the energy savings delivered.

Table 15. Custom rebate programs with high participation

Program administrator	Program year	Total actual participants	Actual participation/plan
Georgia Power	2013	1,751	412%
	2012	1,022	303%
NSTAR	2012	1,214	107%
	2011	914	103%
Pepco	2013	136	234%
	2012	128	272%
BGE	2012	222	173%
	2011	130	153%
Alliant Energy, Iowa	2013	322	100%
	2011	295	107%

Source: DSM Insights 2014

Table 16 lists industrial process improvement programs with the highest number of participants that we found.

Table 16. Industrial process programs with high participation

Program administrator	Program year	Total actual participants	Actual participation/plan
Xcel Energy, Minnesota	2012	182	246%
	2013	516	478%
NYSERDA	2013	175	N/A
	2012	85	N/A

Source: DSM Insights 2014

Participation data for four industrial efficiency programs are shown in table 17. We selected these programs because they have data on participation as a percentage of total eligible customers. This was not based on an exhaustive review of all industrial programs, but instead on discussions with industrial efficiency experts, which led to outreach to several program administrators. Several other programs were reviewed, but they did not have the necessary data to estimate participation rates.

Table 17. Select industrial program participation rates

Program administrator	Program years	Total participants	Total eligible customers	Cumulative participation rate
Enbridge Gas				
Large industrial	2010–13	160	179	89%
Medium industrial		92	325	28%
Small industrial		60	462	13%
Micro industrial		32	1922	2%
Wisconsin Focus on Energy: Large Energy Users Program*	2012–14	555	751	74%
Xcel Colorado: Industrial Process	2014	35	~80–120	~35%
Efficiency Nova Scotia Custom Program				
Large industrial	2011–13	12	30	40%
Medium industrial		47	192	24%
Small industrial		35	2,234	2%

* This program also targets commercial and institutional customers, but the majority (76%) of participants are industrial customers.
Source: P. Goldman, Enbridge Gas, pers. comm., May 2014. C. Schepp, Leidos Engineering, pers. comm., Oct. 2, 2014. J. Vincent, Efficiency Nova Scotia, pers. comm., May 2014. D. Kennedy, Xcel Energy, pers. comm., Oct. 2014.

These results show that successful custom industrial programs targeted to the largest customers can effectively reach the majority of the targeted market. For example, Enbridge Gas has reached nearly 90% of its largest industrial customers, and Wisconsin Focus on Energy has reached nearly 70% of large energy users. While the data shown represent only a few years, both of these programs have long track records of success, which has helped to build relationships and drive continuous participation. Newer programs can also reach large shares of the largest customers. Efficiency Nova Scotia has reached 40% of its largest industrial customers with its custom offering over the span of only 2011–13 (J. Vincent, Efficiency Nova Scotia, pers. comm., May 2014). In addition to custom programs, program offerings such as efficiency products and direct installation programs can also be targeted to industrial customers and offer additional savings opportunities. The long track records of success with these large customers can offer continuous energy savings opportunities going forward, i.e., the low-hanging fruit grows back with new technology and operations measures. For this reason, these programs are most successful when they focus on long-term relationships with customers rather than one-off projects.

The medium and small customers have been much harder to reach because there are many more of them, and therefore higher transaction costs and lack of direct, ongoing relationships. The custom programs we reviewed served about 2–3% of small industrial customers and 24–28% of medium-sized customers. (Note, however, that the definitions of "small" and "medium" may vary by jurisdiction.) Other program offerings, such as direct install and efficient products, are available to these customers, but custom projects also offer significant additional potential. The most important takeaway is that in general, the small and medium-sized industrial segment offers untapped potential for custom-based energy

savings. Many strategies can be used to improve participation from this segment (see Trombley 2014 and Goldberg, Taylor, and Hedman 2014).

Program Examples

ENBRIDGE GAS Enbridge Gas has offered a custom rebate program for its industrial customers for 15 years. The company serves 179 large industrial customers, which represent 71% of all industrial consumption and 20% of industrial customers. It has reached 160 of these customers from 2010 to 2013, which is a cumulative participation rate of 89%. The program is mature, but it has evolved over time to become more focused on providing hands-on technical resources. The program provides a full circle of education: workshops, web-based technical information, analysis of potential efficiency improvements, and quantification of project incentives. It connects interested customers with service providers who can follow through and implement selected projects (P. Goldman, Enbridge Gas, pers. comm., May 2014).

While this program has been very successful in gaining the participation of large customers, like other programs it has struggled to achieve high participation among smaller customers. The smaller savings and associated smaller incentives mean fewer program resources are available to pursue projects with these customers. But new strategies are being deployed and have been successful in driving participation, e.g., use of a web portal and calculators designed specifically for smaller customer sectors, and a partnership with a local university to have graduate students complete assessments for small customers.

The participation rates in its programs are important, but the overall policy drivers are the savings targets and budgets established by the Ontario Energy Board. A performance incentive in place for Enbridge Gas is a powerful tool to encourage the company to maximize savings achieved through its programs. While Enbridge Gas supplies information on program participation, the Ontario Energy Board tends to focus on free riders and measure life in addition to overall energy savings. Participation is not a specific metric requested by the board.

FOCUS ON ENERGY: LARGE-ENERGY USERS PROGRAM In 2012, Wisconsin's Focus on Energy restructured its industrial program to target customers stratified by energy usage. With this change, Focus on Energy created the Large Energy Users (LEU) program. Currently, 76% of the program participants are industrial customers, and the remainder are hospitals, large office buildings, and universities. Since 2012, the program has successfully reached 74% of large energy users (C. Schepp, Leidos Engineering, pers. comm., Oct. 2, 2014). Key strategies for success have been face-to-face contact with customers, with utility key account managers working side by side with them. Each customer has an assigned energy manager from Focus on Energy, who contacts them at least once a year, and together they identify project ideas through energy assessments. In addition, Focus on Energy provides special offerings, such as large request-for-proposal (RFP) grants and performance-based staffing support incentives. The overall focus of the program is on relationship building, and working with the various trade associations of customer types has been successful. The program has also improved efforts to establish strategic energy management teams, targeting 50 over the next two years.

SUMMING UP AND RECOMMENDATIONS

Our research and interviews identified a number of common elements found in programs serving large customers, both commercial and industrial, that have achieved high participation rates. These elements include:

- Credibility and trust in the service provider. Using outreach contractors that are trusted in the field, such as former industrial plan managers, can improve customer receptiveness.
- Demonstrated results. For example, peer companies' stories help drive participation.
- Long-term relationships and face-to-face interaction between program providers and customers
- Ease of participating (e.g., a one-stop shop)
- Responsiveness

For the industrial and institutional sectors, Enbridge Gas and Wisconsin Focus on Energy are examples of programs that have successfully reached a vast majority (74–89%) of their very largest energy users through efficiency programs. The small and medium-sized manufacturers have been more difficult sectors to reach (13% is the highest participation rate we found for small industrial), and they offer significant untapped energy efficiency potential. Several strategies have been documented to improve participation in that market (see Trombley 2014). Similarly, the medium-sized commercial market is ripe for additional energy efficiency potential.

Findings

HIGH PARTICIPATION CHARACTERIZED BY MAJOR PROGRAM CATEGORIES

Different types of programs define and track participation by different metrics. While the specific metrics and degrees of emphasis on participation vary, what is common across programs is the objective of reaching energy savings targets within budgets and cost-effectiveness criteria. To do so requires customers to respond to and participate in programs in whatever way participation is defined, whether by purchasing an energy-efficient product or undertaking and completing a comprehensive building retrofit. While there are not common and consistent metrics across program types, we did identify some common metrics and methods used within specific types of programs. High participation is relative to the program type. Below are our characterizations of high participation according to major categories of programs.

- *Mass markets*. Programs serving mass markets, such as residential lighting, are increasingly based on upstream and midstream models. Incentives go to suppliers and retailers so discounted products rather than product rebates are offered directly to consumers. Such upstream programs focus on units sold and market share. Counting individual participants is not so relevant or practical.
- *Comprehensive building retrofits.* Retrofit programs for homes or commercial buildings serve large eligible populations compared to the number of customers that can be served. The focus of these programs remains on energy savings and cost effectiveness. Programs serve relatively few customers compared to total

populations in a given year, but over many years some programs have reached a significant share of the total market.

- *New construction programs.* Programs that promote the construction of highly energy-efficient homes and commercial buildings are capable of achieving high market shares. Effective program designs and the resulting high customer demand have yielded high participation rates in many areas and can lay the foundation for future building code upgrades.
- *Custom programs.* Programs that offer customized rebates and services remain important, especially for large customers with specialized systems and processes. These programs may serve few in absolute numbers, but due to the large savings possible with many of these individual customers, they are important to securing program success in meeting savings targets. Some programs targeting the small sets of the very largest industrial customers have achieved high participation rates.
- *Streamlined programs.* Programs that offer a single point of contact for a customer to access the full, comprehensive suite of incentives and services are especially important to achieve high participation in markets that are hard to reach, such as the small business and multifamily sectors.

KEYS TO HIGH PARTICIPATION

Achieving high participation in programs comes down to fundamentals of program design and marketing. This is perhaps an obvious point, but there clearly have been programs that have failed to achieve desired participation rates due to ineffective program designs and marketing. Regardless of the type of program, attracting high participation requires program designs that are attractive to customers. Programs need to offer services that meet customer needs and reduce barriers to taking the types of actions sought by programs, such as purchasing an energy-efficient product or undertaking a comprehensive retrofit. The services and incentives provided must be valued by customers. Programs also need to be designed to make participation easy. In addition to well-designed programs, effective marketing and outreach are also important to achieving high participation. Programs need to be sold to customers. The challenge for program administrators is to sell programs and services that customers want and value (Jewell 2014; LeBlanc 2014; Skumatz 2014).

Marketing of energy efficiency programs is showing increasing sophistication, which is especially important as consumers face an ever-expanding and often dizzying array of messages in all aspects of their lives. Gaining attention and interest in energy efficiency among so many other customer interests and concerns is challenging. There is a lot of competition for consumers. One way to achieve this is to target certain audiences with tailored messages. Research on PG&E's Whole House Retrofit program showed that leveraging a variety of data sources to discern participant savings patterns and underlying reasons for taking actions can be used for enhanced targeting and messaging, which can lead to higher participation (Avseikova et al. 2014).

Big data is emerging as fertile ground for more sophisticated, tailored marketing of programs. Smart technologies and metering can yield highly detailed customer data on energy use. By using rich data sets and advanced analytics, programs can identify the customer segments that will be most receptive to particular programs and services. Marketing is more focused. Smart meters are creating opportunities to improve customer

engagement with utility programs and services (Hartman and LeBlanc 2014; Donovan, Bleything, and Enterline 2014).

Customer incentives have been cornerstones of most energy efficiency programs. Clearly, there is a strong relationship between incentive levels and participation. Program administrators work to balance the mutual objectives of high participation and cost effectiveness. One strategy for boosting participation is to increase the incentive amounts, but there are limits to how high they can go and remain cost effective and within budget. The guiding principle of setting incentive levels is to partially offset the higher cost of purchasing a high-efficiency product or taking actions to improve energy efficiency. Program administrators draw on the experiences of other programs as well as their own in setting incentive amounts. These may be adjusted over time as needed to reach desired participation levels or reflect market changes. Incentives also may be offered for limited periods for special promotions.

For certain programs, especially those serving commercial and industrial customers, building trust in the marketplace can help achieve high participation. For example, the EnergySmart Grocer program in the Pacific Northwest has been one of the most successful commercial programs in the region. It has achieved a market penetration of over 90% in its target market and an average of over three retrofits per site in five years. This success is based on designing the program around a trust formula (Achilles 2014). Other programs echo the importance of trusted relationships. It is possible to approach trust and credibility from different perspectives. There are numerous examples of community-based approaches having been successfully used to reach customers and gain participation in programs (Moran 2014). There also are examples of state and regional networks that have formed partnerships or collaboratives, which can be used to exchange experiences and best practices (Vance and Perkins 2014).

Participation is dynamic and the result of the interplay of numerous variables. The same program offered in different areas may achieve markedly different results. For example, in Massachusetts the total number of electric customers participating in the same programs as administered by different distribution utilities varied significantly, from 2.7–5.1%—almost a factor of two (Bodman, Todd, and Stefanik 2014). Participation also can vary widely from year to year for certain programs. There also can be great variation within a customer segment according to the type of building or business served (Bodman, Todd, and Stefanik 2014).

Rethinking Participation

PARTICIPATION IN PORTFOLIOS, NOT JUST PROGRAMS

Program participation is generally viewed in relative isolation. Programs are planned, implemented, and evaluated individually. However many of the traditional program silos are breaking down, giving customers access to a full array of the services and incentives via a single point of contact. Program participation then becomes a more complex metric. As this transformation occurs, it becomes more meaningful to begin examining participation in portfolios, not just in individual, isolated programs.

Since participation is a key variable in determining program savings, program administrators naturally focus on gaining sufficient participation to meet program savings and other performance targets program by program. If we view participation from the perspective of entire program portfolios that have been in place for several years, analysis of certain portfolios in the Northeast has found that a majority of customers are participating. For example, a recent analysis of participation in National Grid Rhode Island's energy efficiency programs found that over the period of 1998–2007, the vast majority of residential customers, roughly 30% of small C&I customers, and the majority of large C&I customers had participated in the programs (Woolf and Kallay 2014). An analysis of energy efficiency programs in Vermont similarly found that over 2002–2012, a substantive portion of customers had participated (Woolf, Malone, and Kallay 2014). For example, the analysis found that the business existing facilities program had reached 31% of customers, the residential existing homes program had reached 13%, and the efficient products program had reached 100% of customers (note, however, that these figures include repeat participation and thus exaggerate the participation rate). Promoting customer participation is a way to address equity concerns among customers in terms of who pays and who benefits. There also can be significant program spillover effects that benefit all customers, not just those who participate directly in a given program. Just as with savings impacts, there are net and gross measures of participation. In addition to spillover effects, there may be free-rider effects.

A related issue is repeat participants. Many customers participate in certain types of programs multiple times during different program periods, especially for energy-efficient products, such as lighting or appliances. It can be especially challenging to track repeat participants, but such data can be valuable in assessing overall cumulative program and portfolio participation.

Equity among customers is a concern and an objective among program administrators and regulators. For example, ComEd conducts a detailed analysis at the end of every program year to determine where program savings come from by town, rate class, Standard Industrial Classification code, and county. If a certain program is underperforming in terms of the relevant participation metric, the administrators address this by making program changes to improve performance. ComEd's data on participation illustrate the range and reach of its C&I program, Smart Ideas for Your Business. Based on 374,000 business accounts, ComEd reports the following cumulative participation rates by size of customer (as measured by peak demand) for the period June 1, 2008, through October 1, 2014:

- Less than 100 kW: 4.5%
- Between 100 kW and 1,000 kW: 19.3%
- Over 1,000 kW: 46.0%[21]

In the Northeast, equity concerns have led regulators, energy efficiency stakeholders, and National Grid in Rhode Island to examine participation data in light of suggestions that

[21] These are preliminary estimates provided as a courtesy to ACEEE by ComEd (2014).

goals be established for participation. An analysis of cumulative residential participation data found that the majority of customers have participated in the programs (Murphy 2014).

An equity concern related to high participation is the trade-off in many types of programs between participation and savings per participant. For example, multifamily programs that offer only direct installation of low-cost measures may achieve high participation, but the savings per participant are low. By contrast, multifamily programs that provide comprehensive retrofits and thereby achieve high savings per participant generally will achieve much lower participation rates compared to direct installation programs.

LONG-TERM METRICS AND PROGRAM OBJECTIVES

Most energy efficiency programs seek long-term changes in markets related to customer energy use, such as new buildings, appliances, or lighting. While measuring annual program participation is important to assess performance, it also is important to measure long-term market impacts. In such studies the emphasis generally is on characterizing and analyzing overall market trends, which includes both the direct impacts of programs and the indirect impacts of broader market and technological changes. Lighting socket surveys and appliance saturation surveys are examples of these broader market research efforts that are vital to assessing long-term program impacts.

As we discovered in our research, for many types of programs, individual customer participation is not the only relevant metric. For programs seeking to achieve fundamental, lasting changes in markets, the most relevant metric is the market share or market penetration. We see this clearly in such mass consumer markets as residential lighting and appliances. For commercial customers, parallels are sales of energy-efficient HVAC equipment and lighting products. The focus increasingly for many types of products and services is on market share and products sold, not participants and rebates paid. As programs seek market transformation, in fact, the goal is to raise participation to a tipping point where stocking practices and the availability of products are fundamentally changed. For example, such a tipping point was reached when T8 commercial lamps became the standard, making T12 lamps obsolete or their use limited to custom applications. Reaching such tipping points can also trigger or otherwise signal a change to applicable codes and standards to ratchet them up to higher levels of energy efficiency.

More and more program administrators are designing and marketing programs to smaller, more focused market segments. For example, rather than offering a single lighting rebate program available to all commercial customers, a program administrator may offer a much more targeted lighting program to specific commercial market segments, such as large retail, small retail, schools, hospitals, and restaurants. Such changes will require corresponding changes in the metrics used to track and report participation, particularly to gather data on the size of each market—the denominator for a participation rate.

Gaining customer participation is essentially about program influence. Programs seek to gain participation by influencing customer decision making at some point in applicable markets. Customers need to be ready for change; readiness itself is a key indicator of participation. This is especially true for large customers considering large, comprehensive changes. Account managers working with large customers are often in the best position to

facilitate their participation in programs by having an ongoing relationship with them and being aware of when such customers are ready to initiate improvements that have been recommended.

Overall Conclusions and Recommendations

Program participation is simple in principle, but complex in practice. The variety of program types and markets served has made it difficult to develop and apply common participation metrics applicable to all programs. Participation may need to be measured in different ways for different types of programs. Achieving high participation, though, is key to achieving high energy savings goals for most types of programs.

Participation needs to be seen through the lenses of overall portfolios and applicable markets over long periods. Participation in programs across entire rate classes (e.g., residential, commercial) demonstrates that majorities of customers are participating in programs to varying degrees. This is important to address equity concerns of many regulators and other stakeholders. Over many years, most customers will have benefited directly from participating in available programs, whether purchasing energy-efficient lighting products at a discount or completing major retrofit projects that may have taken several years to plan and implement.

Traditional program silos are being broken down so that customers can access a full menu of available programs and services through a single point of contact with a utility or other program administrator. Measuring and tracking participation become more complex, but it remains an important metric by which to evaluate program performance.

Many factors affect program participation. To achieve high participation, programs must be designed to address these many factors successfully, attracting customers and gaining their participation. As programs increasingly seek high savings in response to such policy drivers as energy efficiency resource standards and environmental compliance with air regulations, achieving high participation across programs and portfolios is a key program strategy that is being implemented.

Based on our research, we identified a number of gaps and needs to improve data on program participation. There is a need for consistency in terminology and conventions for participation metrics. Without such consistency, it is difficult to track and compare program performance. Given the diversity of program types and target markets, the objective should be to gain such consistency in terminology, conventions, and metrics within a given type of program. There also is a need for more complete, routine data tracking on program participation. This should be done program by program as well as by state and region.

There are numerous actions that should be taken to improve data on program participation and address the gaps and needs we have identified with these data. Regulators, program administrators, and other stakeholders should work together at both the state and regional levels to establish standard definitions and protocols for documenting and categorizing program participation impacts. Such an initiative would fit well within existing regional collaborations, such as those in the Northwest and Northeast, that were formed to address a variety of program design, data, and evaluation issues. State regulators should require

program administrators to measure and report participation data after first establishing standard definitions and protocols for documenting and categorizing program participation impacts. These data should be tracked over time to give historical perspectives on participation in absolute terms, eligibility, and participation rates. Such long-term perspectives are especially important since most programs seek to achieve significant long-term impacts on targeted markets. These data should be routinely reported in annual reports along with other key program metrics. Regulators also should consider establishing participation targets by program and across entire portfolios. Achieving high participation is a strategy for achieving high energy savings and addressing equity concerns among utility customers. These data also are important for identifying customer populations who may be underserved.

Reducing energy use through improved efficiency is a unique and valuable energy resource for the multiple economic and environmental benefits it provides. This resource is acquired through countless individual customer actions. Measuring and tracking such actions are important to quantifying this resource and evaluating progress toward capturing its potential. Energy efficiency programs must go both deep and broad to achieve high energy savings. Going deep means gaining high savings per participating customer. Going broad means gaining higher participation in available programs. Numerous examples exist of programs successfully achieving high participation. We can learn from these examples in order to increase participation across portfolios. In doing so, we will be spreading the wealth that improved energy efficiency provides to customers, the economy, and the environment.

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