Big Savers: Experiences and Recent History of Program Administrators Achieving High Levels of Electric Savings

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Executive Summary

Utility-sector energy efficiency programs have grown substantially in the past decade. According to the most recent ACEEE *State Scorecard*, electric efficiency program investments have increased from approximately $1.5 billion in 2006 to over $5.9 billion in 2014. In 2006 only 12 states had adopted policies requiring electric utilities to meet energy efficiency savings targets. Today, 25 states have implemented such policies.

As savings levels have increased, national leaders in program administration have emerged. This report reviews annual program performance for 14 leading energy efficiency program administrators. We selected these 14 examples through a review of ACEEE internal data sources and discussions with industry experts. We sought diversity in the selection of program administrators, and therefore looked for differences in service territory size, total electricity sales, and geographic location. In total, our review covered 107 program years dating back to 2005.[1]

IMPRESSIVE ACHIEVEMENTS

The program administrators we profile are not only national leaders, they are noteworthy for the large improvements they have made over time. Among the 14 program administrators we reviewed, none achieved energy savings of 1.5% of retail electric sales in 2009.[2] By 2014, 8 of the 14 were higher than 1.5%, with 4 of the 8 higher than 2%. Figure ES1 below shows the results of our review of 107 total program years. The figure shows a clear trend of improving energy savings as a percentage of retail electric sales.

Average savings among the program administrators rose from 0.8% in 2007 to 1.8% in 2014. Program administrators were also able to increase savings from year to year at high levels. A review of the year-over-year savings increases for our sample showed an increase of 0.5% savings as a percentage of sales nearly 20% of the time. The average increase in savings as a percentage of sales is 0.2%. The data also show that high savings are sustainable over time. Of the 14 program administrators reviewed, 7 achieved savings levels higher than 1.5% for consecutive years. Three of the seven have sustained this level of savings for more than four years.

Finally, program administrators were able to produce high levels of energy savings even in low-electricity-price regions. When we consider average retail rates at a state level for the program administrators in this study, 8 of the 14 operate in states with an average retail electric rate lower than the national average.

[1] We discuss detailed criteria for the selection of the 14 program administrators in the methodology section.

[2] We calculate electric savings as a percentage of retail sales by dividing the incremental first-year, net energy efficiency savings by the total volume of retail electric sales in a year for a given utility.

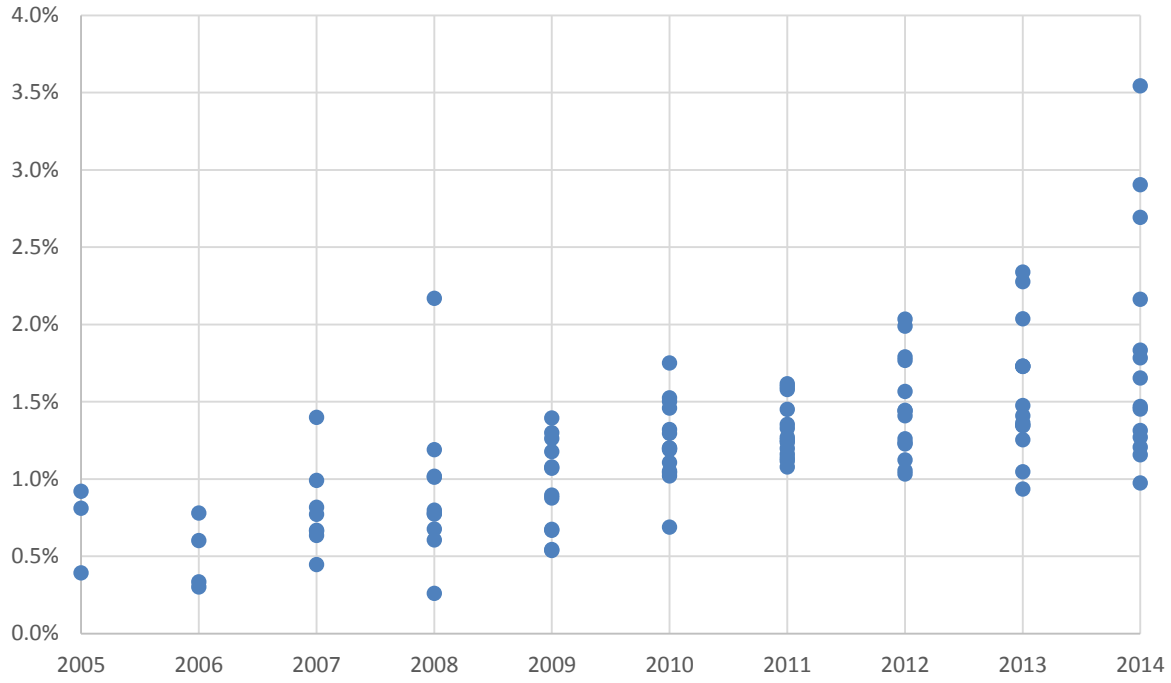

Figure ES1. Net electric savings as a percentage of retail electric sales for 107 program years, 2005–2014

STATE POLICIES MATTER

State or local policy requirements to meet specific energy efficiency savings goals guide all program administrators in this study. The design of the targets and goals varies, but these policies are critical in driving high levels of savings. Financial performance incentives for meeting energy savings targets or other policy goals also influence program administrators. They result in higher levels of savings because they increase the potential return on investment in energy efficiency. Additional revenues increase the visibility of energy efficiency programs to executives guiding utility decisions.

COST OF SAVED ENERGY

Our analysis of 107 program years indicated that the levelized cost of saved energy (LCSE) has remained relatively flat since 2010. The program portfolios are highly cost effective, with an average LCSE of 3.4 cents per kilowatt-hour (kWh). The LCSE was flat even while total program spending and average spending per customer increased for most observations in our study. Figure ES2 shows the average LCSE and savings as a percentage of sales between 2009 and 2014.

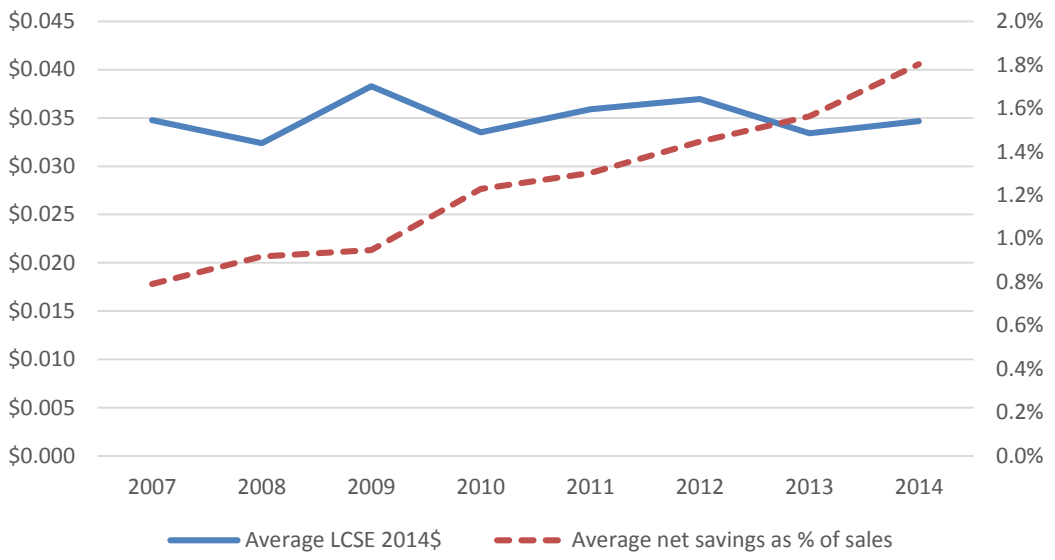

Figure ES2. Average LCSE and average net savings as a percentage of retail sales

PROGRAM TRENDS

We saw several trends when we reviewed the detailed program portfolio plans for program administrators in our study. For example, lighting program savings as a percentage of total savings have declined since 2009 for almost all the program administrators we reviewed. This is largely due to changes in lighting standards since 2007. However lighting still produces significant savings for many program administrators and will likely continue to do so in the near future. Light-emitting diode (LED) lighting, commercial controls, and other new lighting measures continue to become more cost effective as technology costs decline.

Several other new programs and measures will also contribute to program administrators' ability to sustain high levels of savings. ACEEE's 2015 report, *New Horizons for Energy Efficiency*, documented several programs and measures that will drive future electric energy savings. Most of the programs and measures reviewed in this study are cost effective, with an LCSE of under 7.5 cents/kWh. Many of these measures are already becoming more prevalent in the portfolios of our 14 program administrators.

INSIGHTS FROM PROGRAM MANAGERS

In addition to reviewing program results, we also interviewed program managers to determine the keys to high levels of savings. Many stressed the importance of building strong relationships with customers to maintain clear communication about the value of programs. Others emphasized the value of a diversified portfolio and cautioned against relying on a few programs or measures to achieve success. Program managers also highlighted the need for strong political support from state legislatures and public service commissions. Finally, they stressed the importance of financial mechanisms such as timely program cost recovery and performance incentives.

CONCLUSION

Our review of this group of 14 leading energy efficiency program administrators demonstrates that high levels of energy savings are not only achievable but also sustainable. Advances in technology, reductions in measure costs, and program innovation will continue to create new savings opportunities, allowing program administrators to sustain and grow high levels of savings. We have also documented instances of several program administrators achieving cost-effective and high levels of savings in regions with low electricity and energy prices.

We also found that the cost of saved energy has remained flat since 2010, while total spending and savings levels have increased. The weak correlation between LCSE and energy-savings levels demonstrates that LCSE does not necessarily increase as energy savings increase. The important conclusion is that utility programs have remained cost effective even as portfolios have matured and natural gas prices have declined to unprecedented lows. The evidence we reviewed also suggests that this is true in regions with lower electricity costs and avoided costs.

Finally, state and local policies are critical to driving and sustaining high levels of savings. Energy efficiency resource standards (EERS), cost recovery mechanisms, and performance incentives are all important policies to promote high levels of energy efficiency. Strong support from regulatory bodies such as state regulatory commissions is also essential to maintaining high levels of savings.

Introduction

Energy efficiency savings and spending levels have increased substantially since 2005. This trend comes as more states realize the value of energy efficiency as a low-cost resource with multiple benefits beyond electricity savings. As many states are now also considering increasing energy efficiency as a potential compliance option for the US Environmental Protection Agency's Clean Power Plan, among other reasons, we sought to discover if it is possible for a program administrator not only to achieve higher levels of savings but also to sustain high levels of savings over time. The aim of this report is to document and showcase program administrators achieving and sustaining high levels of electric savings. We intend for the trends, best practices, and challenges identified in this report to be instructive to utilities across the country as they develop and ramp up energy efficiency programs.

Our report begins with an overview of our methodology. The report is then broken up into two major sections. The first section analyzes the recent performance of 14 high-performing program administrators. This analysis focuses on several metrics including energy savings, spending, and cost effectiveness. The second section includes detailed profiles on each of the 14 program administrators. The profiles focus on several key aspects related to the background of each program administrator, program portfolio changes over time, spending and performance over time, and the challenges and opportunities faced by each program administrator.

Methodology

This study reviews program administrators achieving and sustaining high levels of electricity savings. We focus on a common metric: energy savings as a percentage of retail sales, which we calculate by dividing the incremental first-year energy efficiency savings by the total volume of retail electric sales in a year for a given utility. This metric is widely understood and is often used by state legislatures or public service commissions to establish energy efficiency resource standards (EERS). We sought to include program administrators that have achieved net electric savings levels higher than 1.5% of retail sales in the past decade. This threshold of 1.5% is in the top tier of electricity energy-savings results and goals according to ACEEE's *2015 State Scorecard* (Gilleo et al. 2015).

Net versus Gross Savings

Net savings are defined as the "changes in energy use attributable to a particular energy efficiency program; these changes may implicitly or explicitly include the effects of factors such as freeridership, participant and non-participant spillover, and induced market effects."[3] Gross energy-savings impacts are "changes in energy consumption that result directly from program-related actions taken by participants in an energy efficiency program, regardless of why they participated" (Jayaweera and Haeri 2013).[4] Both net and gross savings can serve useful purposes, and for this reason we collected data for both savings

[3] In practice net savings calculations typically account for freeridership, but only sometimes account for spillover and induced market effects.

[4] For more information on the difference between net and gross savings and various estimation methodologies, see Violette and Rathbun 2014 and Slote, Sherman, and Crossley 2014.

metrics if they were available. Most states use net energy-savings figures for setting energy-savings goals and tracking savings. Many states also track gross savings, and some use gross savings targets for statewide goals. We recognize that methodologies for calculating net savings can vary, making it difficult to directly compare results. However we chose to focus on net energy savings for this report because they are more broadly useful for setting energy-savings goals and tracking savings achievements.

DATA COLLECTION AND SELECTION OF SAMPLE

To determine which program administrators to include in this study, we first reviewed savings data for all states and program administrators reviewed in recent ACEEE research.[5] ACEEE knowledge and prior experience guided the potential list of program administrators for this study. Based on that selection we sent an initial survey to potential participants seeking data on energy savings, program spending, and several other energy efficiency metrics.

The data request solicited quantitative information on efficiency program spending and savings from 2005 to 2014. We requested information from this time frame because very few states achieved savings levels higher than 1.5% prior to 2005. While some respondents were able to provide data from 2005 onward, most were only able to provide a more recent time series. We also asked a series of qualitative questions to uncover details of program portfolios, cost recovery, challenges, and the energy efficiency policy structure under which program administrators operated. We used the results of this survey to select the final sample of program administrators for this study.

We collected additional information from program annual reports, evaluations, and plans. We also conducted interviews with program managers to discuss how programs have evolved over time and specific challenges they have faced. The interviews also provided background on major challenges and opportunities that have shaped efficiency portfolios, and areas that program administrators planned to target in future years.

The initial scope of this project was to focus on program administrators achieving net savings levels higher than 1.5% of retail sales in recent years. However we have included several program administrators who have not met this threshold. Four program administrators achieved savings levels of approximately 1.3%, and one achieved savings levels of only 1.2%. We included these five additional program administrators for several reasons. First, we wanted to highlight the performance of larger utilities such as Commonwealth Edison (ComEd), Pacific Gas and Electric (PG&E), and Southern California Edison (SCE). While these three utilities have not achieved net savings levels of 1.5% in recent years, they are considered leaders in program implementation and have much insight to offer on achieving high savings levels in large service territories. All have also dealt with unique constraints, including a spending cap in the case of ComEd and restrictions on

[5] This research includes the ACEEE *2015 State Scorecard* (Gilleo et al. 2015), the ACEEE *2015 City Scorecard* (Ribeiro et al. 2015), *Municipal Utility Energy Efficiency: Successful Examples Around the Nation* (Kushler et al. 2015), *The Best Value for America's Energy Dollar: A National Review of the Cost of Utility Energy Efficiency Programs* (Molina 2014), *Energy Efficiency Resource Standards: A New Progress Report on State Experience* (Downs and Cui 2014), and others.

counting energy savings for PG&E and SCE. Second, we wanted to include program administrators from several geographic regions to show the possibility of achieving high savings levels in different regions. Both Otter Tail Power Company (OTP) and Northern States Power Company (NSP) are located in Minnesota. Electric savings opportunities vary based on geographic factors including energy prices and weather. Third, all five of these utilities achieved gross savings of at least 1.5%. As discussed, gross savings can also serve a useful purpose, and therefore we took that into consideration. Finally, we wanted a large enough sample of program year data points from which to draw conclusions on spending and savings trends.

Our final group of program administrators is not an exhaustive list of all administrators with high energy efficiency savings, as we did not interview every program administrator, nor should it be considered a statistically representative sample. Rather we sought to include an illustrative range of geographic locations, regulatory structures, energy costs, state policies, and number of customers. The availability of data was also a contributing factor in the selection of the sample. Our sample includes both utilities that deliver energy efficiency services and electricity to customers, and non-utility program administrators that are contractually charged with delivering energy efficiency programs using ratepayer funds.

DATA ASSUMPTIONS, CAVEATS, AND CHALLENGES

We report savings at the customer meter, a data point consistent with what is reported by most of the program administrators in our sample. In some cases program administrators reported savings at the generator level. In these cases we requested a loss factor, or the electricity lost between the generator and the customer meter (referred to as line losses), to convert generator-level savings to meter-level savings. For our sample the line loss factor was generally between 6 and 10%.

As this report focuses on utilities achieving high levels of electric savings, we sought to include only costs and energy savings associated with energy efficiency programs. We did not include costs and savings associated with demand response programs or renewable energy, but we did include savings for combined heat and power (CHP).

We encountered several challenges, primarily data integrity issues. Program administrators report energy efficiency program data in slightly different ways. For example, some report only net savings while others report only gross savings. Some report energy savings at the meter while others report at the generator. Many also do not explicitly state how the data are reported. We mostly resolved these challenges through follow-up questions to program and regulatory affairs managers. On several occasions utility-provided data did not match publicly available data. This occurred with utility revenues, customer counts, and total retail electricity sales. In these cases we relied on utility-provided data over publicly available data.[6] When utilities reported only gross savings, we adjusted to net savings using a 90%

[6] Publicly available data in this context refers to utility-specific data from the US Energy Information Administration, Form 861.

net-to-gross ratio. This assumption is consistent with the adjustment used in the ACEEE *State Scorecard* (Gilleo et al. 2015).

We also relied on retail sales data provided by the program administrator. When these data were unavailable we used retail sales data from the US Energy Information Administration (EIA).[7] We applied both inputs to this metric on a consistent basis for the same year in each case.

DIFFERENCES IN REPORTED VALUES AND OUR METRICS

In some cases we used a different percentage savings calculation from the values program administrators reported to state regulators. For instance, in Minnesota utilities are required to achieve 1.5% gross savings as a percentage of sales. However the retail sales input used for this calculation is a weather-normalized three-year average for the most recent three-year period leading up to the filing of the program plan with the Minnesota Public Utilities Commission. Utilities report gross savings at the generator for state compliance purposes. For consistency purposes in this study we converted the utilities' gross savings at the generator to net savings at the meter. We also relied on retail sales for the program year in which the savings occurred, producing a different value from what the utilities report. These adjustments led to differences between the savings as a percentage of sales values, used in this report, and those reported to Minnesota regulators. In 2014 Northern States Power Company reported an achievement of 1.66% savings as a percentage of sales, using gross savings at the generator and 2009–2011 weather-normalized sales, excluding exempt customers. Using net savings at the meter and a 2014 retail sales figure, we estimated net savings as a percentage of sales to be 1.32% in 2014.

PROGRAM ADMINISTRATORS IN THE STUDY

Table 1 lists the 14 program administrators included in this study. Program administrators vary in terms of regulatory structure, services provided, cost of electricity, total retail sales and customers, customer demographics, and geographic location. The list includes investor-owned utilities offering only distribution service and those offering fully bundled service, which includes generation, transmission, and distribution. It includes two statewide, third-party program administrators responsible for delivering energy efficiency programs: Energy Trust of Oregon and Efficiency Vermont.[8] Two municipal utilities are also included: Seattle City Light and Fort Collins Utilities. Table 1 offers details on each utility profiled including retail sales and customer count data for 2014.

[7] We relied on sales and customer data from Form EIA-861, Sales to Ultimate Customers. www.eia.gov/electricity/data/eia861/.

[8] Efficiency Vermont is technically considered an energy efficiency utility (EEU) in Vermont.

Table 1. Program administrators included in study

Program administrator	State	Type	Retail sales (GWh 2014)	Customers (2014)	Years of data included in study
Pacific Gas & Electric	CA	IOU – Bundled	86,872	5,339,264	2006–2014
Southern California Edison	CA	IOU – Bundled	87,417	4,993,448	2007–2014
Commonwealth Edison	IL	IOU – Distribution	88,581	3,864,059	2008–2014
Energy Trust of Oregon[1]	OR	Third-party	32,404	1,403,201	2005–2014
Eversource[2]	MA	IOU – Distribution	24,871	1,393,499	2009–2014
National Grid[3]	MA	IOU – Distribution	21,040	1,304,183	2009–2014
Northern States Power[4]	MN	IOU – Bundled	30,753	1,250,135	2010–2014
Arizona Public Service	AZ	IOU – Bundled	27,013	1,163,079	2008–2014
Narragansett Electric[5]	RI	IOU – Distribution	7,576	492,576	2007–2014
Seattle City Light	WA	Municipal	9,341	415,056	2007–2014
Tucson Electric Power	AZ	IOU – Bundled	9,165	414,748	2010–2014
Efficiency Vermont[6]	VT	Third-party	5,568	364,375	2005–2014
Fort Collins Utilities	CO	Municipal	1,442	70,552	2005–2014
Otter Tail Power	MN	IOU – Bundled	2,328	60,809	2007–2014

[1] Energy Trust of Oregon serves the electric customers of Pacific Power and Portland General Electric. [2] Eversource Electric includes the Western Massachusetts Electric Company (WMECo) and NSTAR Electric. [3] National Grid Massachusetts includes the Nantucket Electric Company and Massachusetts Electric Company. [4] Northern States Power Company is a wholly owned subsidiary of Xcel Energy. [5] Narragansett Electric Company is a wholly owned subsidiary of National Grid. [6] Efficiency Vermont serves the entire state of Vermont, with the exception of the Burlington Electric Department service territory.

In total we collected 107 observations for program portfolio results, where each observation is a program year for one program administrator. Figure 1 shows the number of observations by year included in this study.

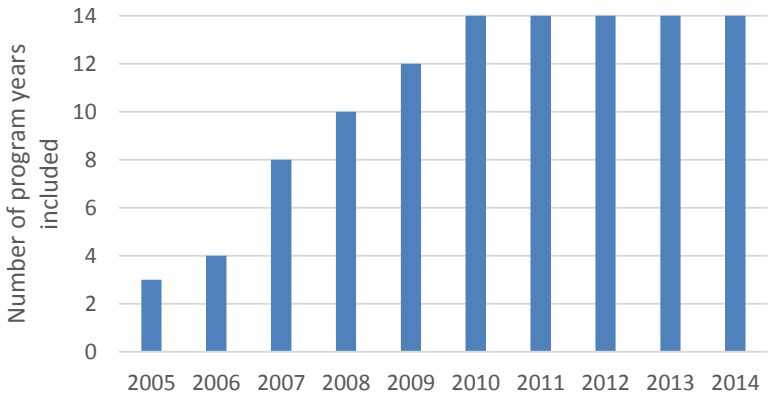

Figure 1. Number of program portfolio observations in sample, by year

Quantitative Results of Review

In the following sections we present high-level results of the data collected from the 14 program administrators included in this study. The results focus on energy savings, program spending, cost of saved energy, ramp rates, and cost effectiveness.

ENERGY SAVINGS

Figure 2 shows the net electric savings as a percentage of retail sales for each utility in our study. Each dot in this figure represents a program year for an individual program administrator.

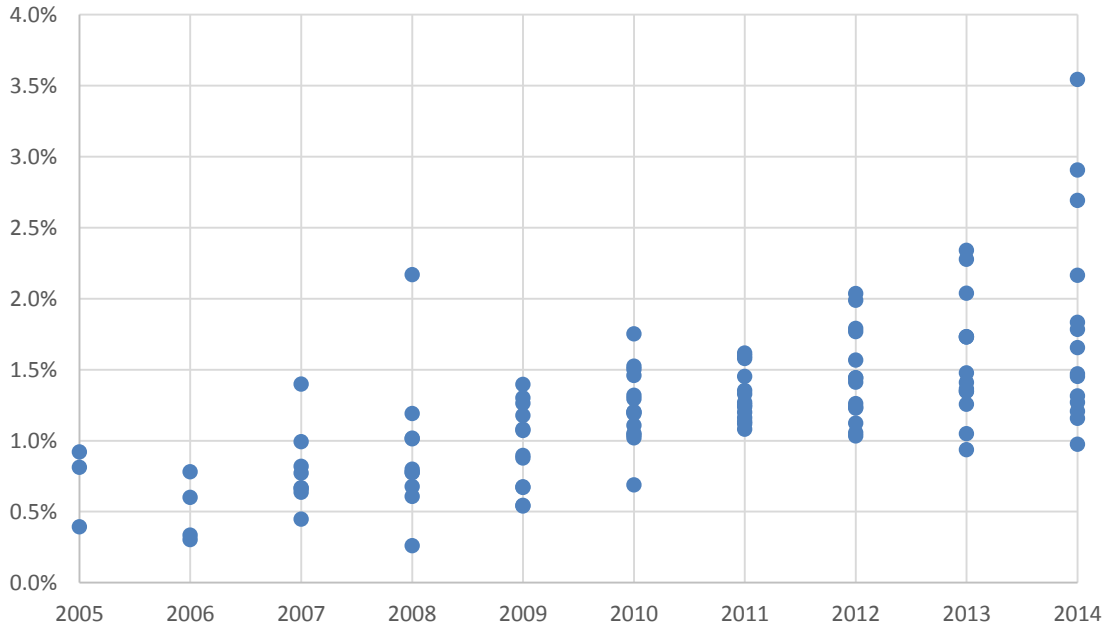

Figure 2. Net electric savings as a percentage of retail electric sales, by year

This figure demonstrates a clear trend of increased savings levels from year to year. Average savings among the program administrators rose from 0.8% in 2007 to 1.8% in 2014. During the period covered in our review, program administrators achieved savings levels over 1.5% in 25 instances, over 2% in 10 instances, and over 3% in 1 instance. The data also show that high savings are sustainable over time. Of the 14 program administrators reviewed, 7 achieved savings levels higher than 1.5% in consecutive years. Three of the seven sustained this level of savings for more than four years. Thus far three program administrators have been able to achieve savings levels higher than 2% in consecutive program years, with National Grid Massachusetts and Eversource Massachusetts doing so for three consecutive program years (2012–14).

Figure 3 shows the growth in savings as a percentage of sales for each utility in our sample from 2009 to 2014.

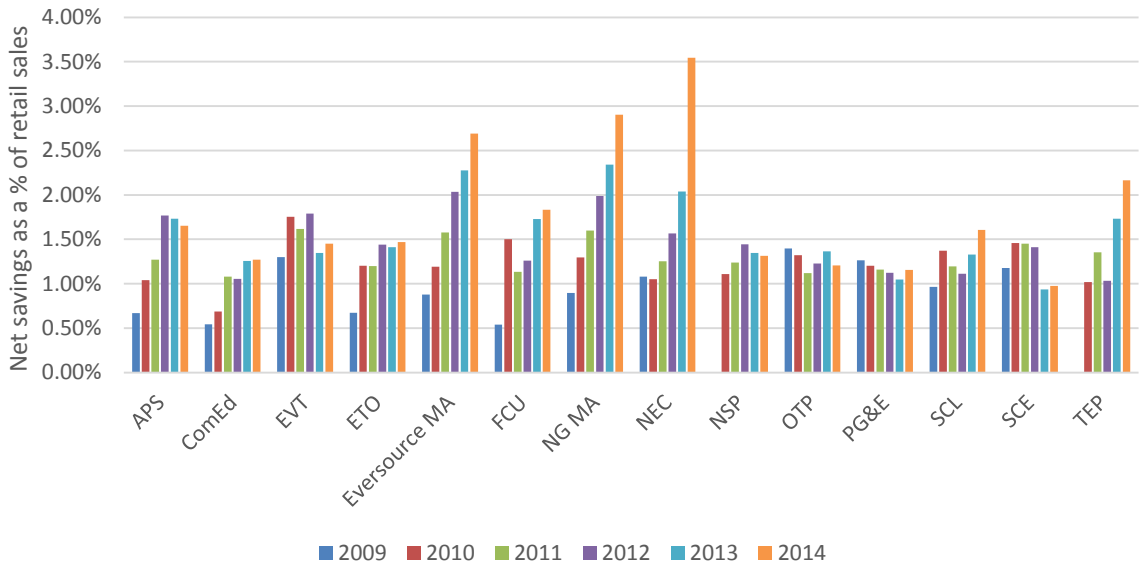

Figure 3. Net energy savings as a percentage of retail electric sales, 2009–2014. EVT = Efficiency Vermont. ETO = Energy Trust of Oregon. FCU = Fort Collins Utilities. SCL = Seattle City Light. Eversource MA = Eversource Massachusetts. APS = Arizona Public Service. NGMA = National Grid Massachusetts. NEC = Narragansett Electric Company. NSP = Northern States Power Company Minnesota. OTP = Otter Tail Power Company Minnesota. PG&E = Pacific Gas and Electric. ComEd = Commonwealth Edison. SCE = Southern California Edison. TEP = Tucson Electric Power.

In general most utilities in our study exhibit the overall trend of savings increasing from year to year. We identified several drivers for the annual increase in savings including specific state or local savings goals, increased levels of spending, and financial incentives such as revenue decoupling or performance incentives. However electric savings do decline from year to year in some instances. Declines in savings may be attributable to a number of factors including baselines, changes in program budgets, and lower-than-expected realization rates.[9]

RAMP RATES

As part of program planning and energy forecasting, regulators and program administrators routinely estimate how quickly energy efficiency programs can be expanded. In the context of this report, we use the term *ramp rate* to describe the actual change in savings as a percentage of retail sales from one year to another. For example, if a program administrator saved 1.5% of retail sales in one year and 2% in the next year, the ramp rate would be 0.5%. We examined ramp rates for each program administrator.

Our review includes 93 ramp rates at the portfolio level. The average ramp rate at the portfolio level for our sample was 0.19%. Of the 93 ramp rates, 44 were above 0.2%. Nearly 20% of the observations were above 0.5%. This means that in almost 20% of the program

[9] A realization rate is the ratio of evaluated savings to reported or planned savings. An energy efficiency baseline is a basis for measuring energy savings. Baselines are often based on what might have happened in the absence of the program.

years we reviewed, savings as a percentage of sales increased by 0.5% from one year to the next.

In general we saw savings rising from year to year for the utilities we surveyed. A 2009 ACEEE study reviewed the factors driving large increases in savings from one year to the next (Kushler, York, and Witte 2009). The most significant factors include increases in program budgets, a strong state legislative requirement, a supportive regulatory commission, and the implementation of performance incentive structures. These factors also drive performance for the program administrators in this study. We discuss the policy instruments driving higher savings later in this report.

This research also demonstrates several examples of utilities aggressively ramping up energy savings. For example, APS was able to increase savings as a percentage of sales from 0.67% in 2009 to 1.77% in 2012. Eversource Massachusetts was able to ramp up from 0.88% in 2009 to 2.69% in 2014. Finally, Otter Tail Power was able to ramp up from 0.45% in 2007 to 1.4% in 2009.

However there were also instances in which utilities achieved lower savings levels than in the year before. In many cases the declines were very small—less than 0.1%—and reflect natural variation in realized savings from year to year despite steady portfolio savings goals. However, in 19 instances we noted decreases in savings of more than 0.1%. We identified two major reasons for these declines.

First, several of these instances occurred immediately following the 2009 recession. In a 2009 report Efficiency Vermont noted that the "fiscal environment had an impact on the work of Efficiency Vermont in both the residential and business customer classes… many consumers chose to defer cost-effective investments, no matter how attractive the long-term economic benefits might be" (Efficiency Vermont 2009). Other program administrators were operating in similar economic conditions, which may explain savings declines in peak recession years.

Second, utility savings may fluctuate based on the program cycle. Many program administrators have three-year cycles, with incentives and goals based on performance over the entirety of the cycle. Program administrators invest in longer-term and perhaps riskier programs early in a cycle. In the final year of a cycle there is pressure to meet energy-savings targets, particularly for those program administrators whose progress is judged by the entire course of the program cycle rather than by each year. Utilities reported shifting funds into programs offering dependable energy savings—often lighting programs—in order to hit targets. When a new cycle begins the program administrator may see some backsliding in savings as it explores new approaches under less immediate pressure to meet savings targets.

Despite these occasional ebbs in savings, overall the data illustrate that steady and sometimes aggressive ramp rates and sustained high levels of savings are possible.

SPENDING

Program spending varied significantly among the utilities in our sample. To compare the spending trends of the utilities in this study, we examined spending per customer, spending

as a percentage of total revenue, and trends in overall spending. A customer is defined in this context as a utility billing customer, which includes residential, industrial, and commercial customers. Figure 4 highlights the average spending per customer and net energy savings as a percentage of retail sales for all 14 utilities from 2005 to 2014.[10] Each dot in this graph represents a different program year for a different program administrator, totaling 107 observations.[11]

Figure 4. Annual spending per customer and net savings as a percentage of total sales. The customer count includes all residential, commercial, and industrial customers.

From direct inspection of the data we can conclude that there is a direct relationship between total program spending and energy savings. To further evaluate the strength of this relationship, we calculated the Pearson correlation coefficient (r) for these two variables. A correlation coefficient is a statistical measure of correlation between two variables. An r-value of 1 indicates a perfect relationship while a value of 0 indicates no relationship between the two variables. The data show a strong correlation between spending per customer and energy savings as a percentage of sales, with an r-value of 0.79. The average spending per customer for our entire sample was $63.14. However, for observations in which savings are in excess of 1.5% of sales, the average spending per customer is $95.49. For observations of savings higher than 2%, program administrators spend an average of $131.37 per customer. Table 2 shows spending per customer for various savings level ranges.

[10] Data are as reported by utilities and do not include all program years for all utilities. See table 1 for a description of which program years were included in averaging.

[11] The absolute level of spending per customer is influenced by the relative number of customers of different sizes (e.g., residential versus large commercial and industrial) served by the utilities covered by the program administrators. We did not attempt to make an adjustment for that factor. This could make direct comparisons between two program administrators difficult if they had substantially different customer-sector profiles, but it is unlikely to substantially alter the overall patterns observed here.

Table 2. Spending per customer data for various savings levels for sample in study

Savings level	Average	Median	Minimum	Maximum
Over 2%	$ 131.37	$ 143.34	$ 31.53	$ 176.13
Between 1.75 and 1.99%	$ 87.54	$ 86.91	$ 54.53	$ 126.00
Between 1.5 and 1.74%	$ 69.42	$ 83.87	$ 29.54	$ 97.94
Between 1 and 1.49%	$ 63.82	$ 62.10	$ 18.61	$ 114.75

Another common metric used in the industry is energy efficiency program spending as a percentage of total utility revenue. For that metric the average value for our entire sample was 3.21%. The average was 5.07% for utilities achieving savings higher than 1.5%, 6.04% for those achieving savings higher than 1.75%, and 6.94% for those achieving savings higher than 2% of sales. The median value for all 107 program years is 2.8%, nearly three times the national median in the 2015 ACEEE *State Scorecard*.

Figure 5 shows the relationship between energy efficiency program spending as a percentage of total revenue and net energy savings as a percentage of total retail sales. These data show a strong correlation between these two variables for our sample, with a correlation coefficient of 0.74. Average spending as a percentage of total revenue for our entire sample is 3.26%. Average savings as a percentage of sales is 1.24%. These data suggest a ratio of approximately 0.40% savings for every 1% of spending as a percent of revenue.

Figure 5. Spending as a percentage of revenue and net savings as a percentage of sales

This research shows that higher spending levels are associated with higher energy-savings levels. While there are a few outliers in our sample, the general trend of these observations shows that average energy savings are highly correlated with spending per customer and as a percentage of total revenues. These data do not tell us about underlying trends in the cost

of energy efficiency *per unit of electricity saved*. Below we explore the levelized cost of saved energy (LCSE) for the program administrators in our sample. This research shows that while spending and savings levels have increased, the average cost of saved energy has remained relatively flat since 2006.

COST OF SAVED ENERGY

In this section we present results for the LCSE for the 14 program administrators in this study.[12] The LCSE is the average annual cost of saved energy for the lifetimes of the measures and programs saving energy. It is often used to compare various resource options for supply-side resources and can also be useful in comparing supply-side resources with demand-side resources, such as energy efficiency. The costs reviewed for this analysis include costs borne by the program administrators, such as incentives paid to participants and administration, marketing, and evaluation costs. The program costs also include performance incentives paid to program administrators for achieving specific savings goals, but do not include participant costs.[13] The exclusion of participant costs in the LCSE is a departure from the total resource cost test (TRC), which does include participant costs. The methodology for this analysis is consistent with prior ACEEE LCSE analyses, and with the utility or program administrator cost test (UCT/PACT) (Molina 2014).

Figure 6 shows the results of this analysis. The LCSE generally ranged between approximately 1 and 8 cents per kilowatt-hour (kWh) at the portfolio level. All costs have been converted to 2014 dollars. The median LCSE for our sample is $0.035 per kWh. This value is consistent with national trends presented in recent research (Molina 2014; Billingsley et al. 2014).

[12] The cost of saved energy is the total expenditure by a program administrator in a given year to achieve electric savings. These costs generally include administration, marketing, rebates, and evaluation. For a more detailed discussion of the cost of saved energy, see Molina et al. 2014.

[13] While performance incentives are often paid annually to program administrators, the incentive for Efficiency Vermont is paid at the conclusion of each three-year plan. For Efficiency Vermont we include the performance incentive in the year it was paid, the final year of each program cycle.

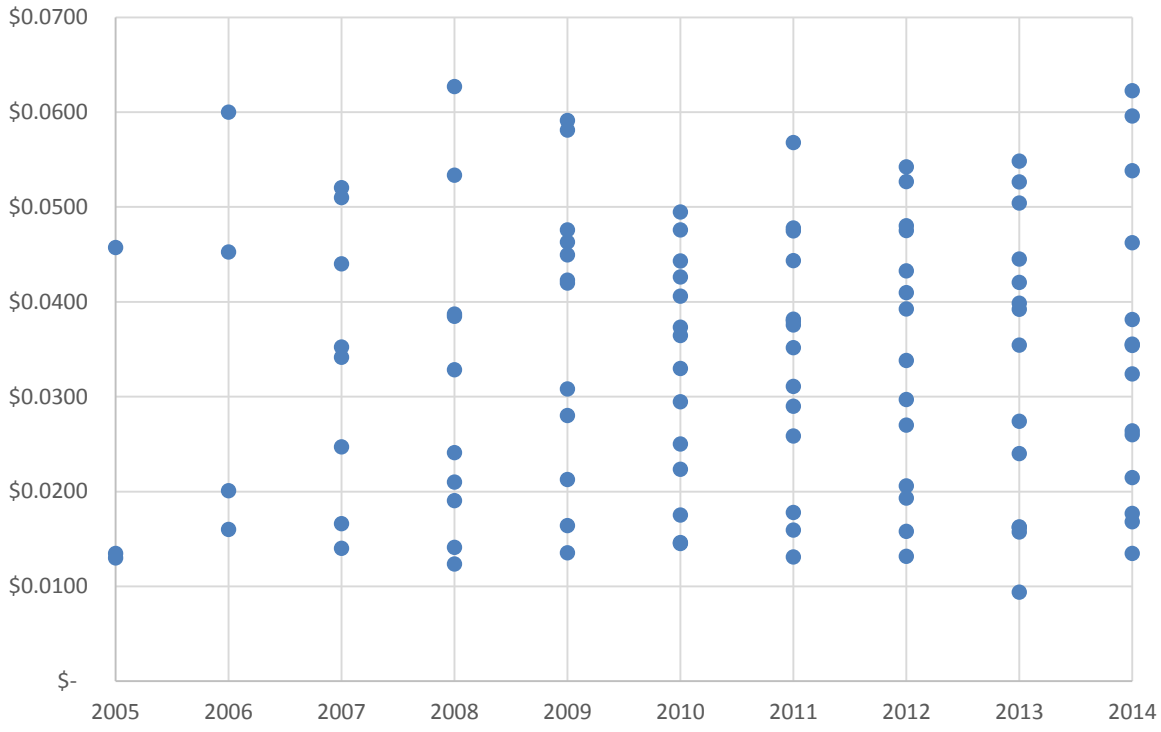

Figure 6. LCSE at portfolio level for 107 observations. Savings data are net at the meter. LCSE presented in 2014 real dollars.

Figure 7 shows average annual savings and cost values for our sample from 2007 to 2014. The LCSE deviated modestly from the median over the study period while average energy savings achieved by program administrators continued to rise.

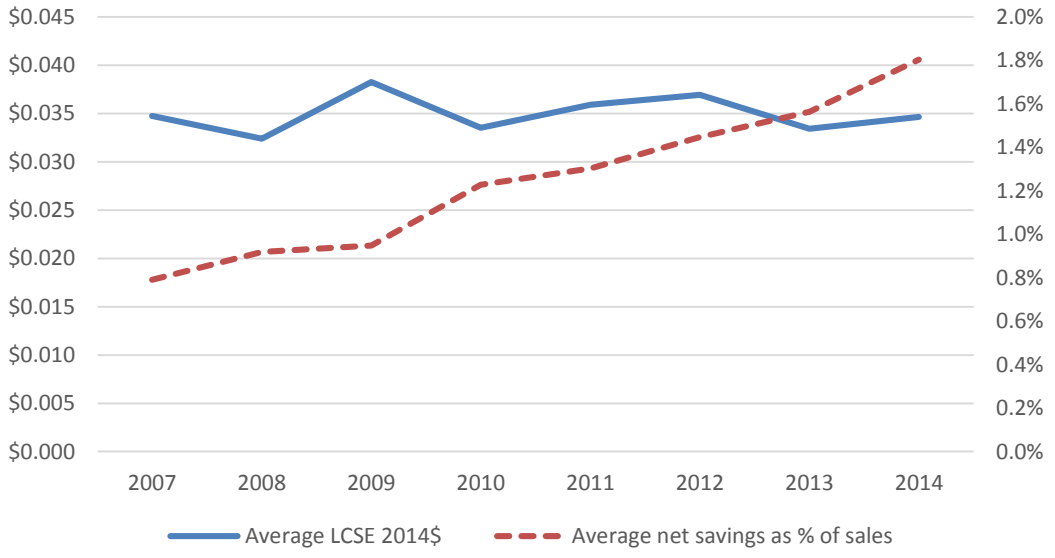

Figure 7. Annual average value of LCSE at portfolio level in 2014 dollars, and average net energy savings as percentage of sales

Ten of 14 program administrators collect performance incentives. Figures 6 and 7 include performance incentives in the determination of the LCSE. The inclusion of performance incentives has a minimal impact on the LCSE in our sample, with an average increase in cost of $0.003 per kWh associated with performance incentives.

Figure 8 presents the relationship between the LCSE and the corresponding net electric savings for those observations. The figure shows wide variation between these two variables, suggesting a weak relationship. A correlation coefficient of 0.2 also demonstrates a weak relationship between the two variables. This result indicates that as energy savings as a percentage of total sales increase, the LCSE does not necessarily increase.

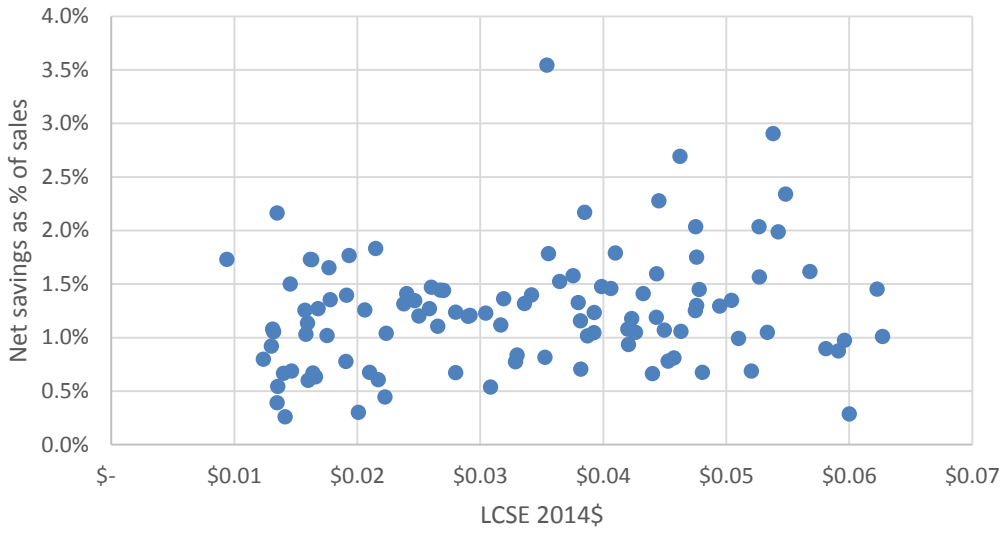

Figure 8. All sector LCSE values relative to electric savings as a percentage of sales

PORTFOLIO COST-EFFECTIVENESS METRICS

The program administrators featured in this study employ various tests to determine cost effectiveness. Assumptions and methodologies are generally consistent within a state but can vary widely between states. National Grid and Eversource in Massachusetts rely on the same tests and inputs to determine cost effectiveness. Program administrators within the states of California, Minnesota, and Arizona also have similar cost-effectiveness testing policies. However substantial differences exist between these states and those of the other program administrators in this study.

Most program administrators in this study rely on the California Standard Practice Manual cost-effectiveness tests.[14] The test most commonly used by program administrators in our sample is the TRC, with some program administrators using the UCT/PACT or the societal cost test (SCT). However, even if two jurisdictions use the same test, their assumptions may vary widely. For this reason the values presented in this section are not meant to be

[14] For more on these tests see CPUC 2001.

compared among utilities, but to demonstrate individual cost-effectiveness results for a segment of our sample.[15]

Figure 9 shows cost-effectiveness measures for 11 of the 14 program administrators in this study.[16] Note that the methodologies and assumptions vary widely for the 11 program administrators in figure 9.

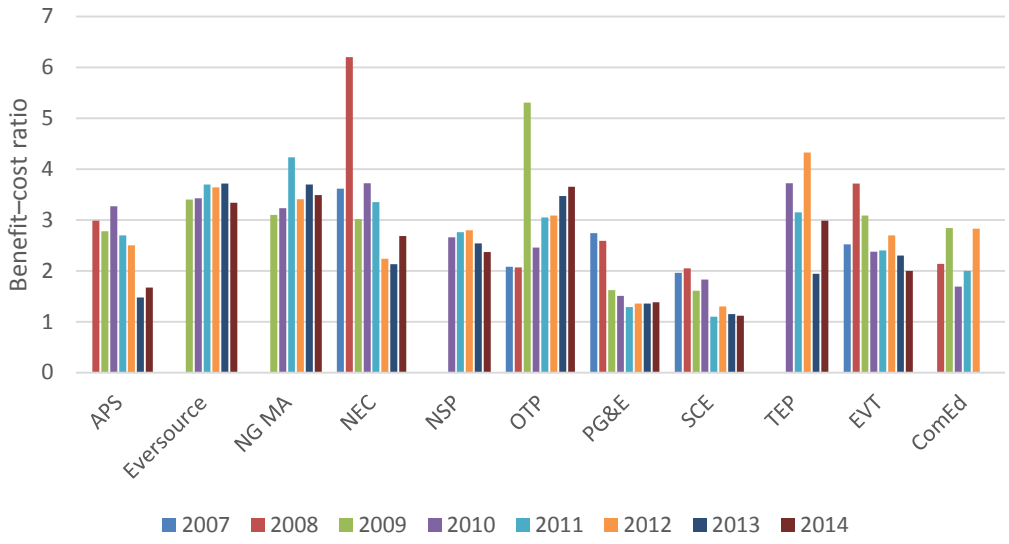

Figure 9. Cost–benefit ratios for 11 program administrators for select program years. Note: the results presented for each program administrator are not meant for comparison with others in the figure. EVT = Efficiency Vermont. Eversource = Eversource Massachusetts. APS = Arizona Public Service. NGMA = National Grid Massachusetts. NEC = Narragansett Electric Company. NSP = Northern States Power Company Minnesota. OTP = Otter Tail Power Company Minnesota. PG&E = Pacific Gas and Electric. ComEd = Commonwealth Edison. SCE = Southern California Edison. TEP = Tucson Electric Power.

All 11 of these program administrators have shown portfolio cost-effectiveness ratios above 1.0 and the majority have exceeded 2.0. There are several possible explanations for changes in cost–benefit ratios over time. One possible explanation for jurisdictions that have seen a decline in cost–benefit ratios is a decline in avoided costs. The price of natural gas, the largest component of avoided cost of energy, declined between 2007 and 2014. The average annual Henry Hub spot price for natural gas was nearly $7 per million British thermal units (MMBtus) in 2007. In 2014 this value declined to $2.62 (EIA 2016). More research is needed to fully understand these trends.

[15] Among those that do not rely on the California Standard Practice Manual, Seattle City Light conducts cost–benefit tests for programs internally but does not publish the results. Fort Collins Utilities relies on an LCSE calculation to measure cost effectiveness. If the program portfolio LCSE is below the blended wholesale rate for electricity, the portfolio is deemed to be cost effective.

[16] The other three program administrators (Seattle City Light, Fort Collins Utilities, and Efficiency Vermont) do not report cost effectiveness at the portfolio level as a cost–benefit ratio.

One challenge to program cost effectiveness that we often hear is low electricity or energy costs. Looking at average retail rates at a state level for the program administrators in this study, 8 of the 14 operate in states with an average retail electric rate lower than the national average. Table 3 shows the average retail electricity price for each state in our sample and demonstrates that only 6 of the 14 are in states with retail rates above the national average of 10.44 cents per kWh. The data illustrate that many program administrators in states with lower-than-average retail electric prices are achieving high levels of savings.

Table 3. Average retail rate of electricity for states in sample

State	2014 average retail rate (cents/kWh)	State rank (average $/kWh)
Rhode Island	15.41	5
Massachusetts	15.35	6
California	15.15	8
Vermont	14.57	9
National	10.44	NA
Arizona	10.18	19
Colorado	10.06	21
Minnesota	9.52	28
Illinois	9.36	30
Oregon	8.68	39
Washington	7.13	51

Actual retail rates for specific program administrators will vary from state average. State average includes residential, commercial, industrial, and transportation retail rates. The rank represents each state's national rank in average retail electric rates. *Source:* EIA 2016.

Drivers of High Savings

STATE AND LOCAL POLICY

While utilities deliver energy efficiency programs for a variety of reasons including cultivating positive customer relationships and relieving stress on the grid, they are also in large part driven by the policy directives of state and local regulators. A variety of mechanisms are available to regulators to encourage energy savings, including revenue decoupling, performance incentives, and energy-savings targets or EERS. Table 4 details the regulatory structures in place for each utility profiled in this report, and we discuss the importance of each policy framework below.

Table 4. Regulatory frameworks in place for program administrators

Program administrator	State	Type	Energy-savings target	Revenue decoupling or similar mechanism	Performance incentive	Penalty
Arizona Public Service	AZ	IOU	●	●	●	
Commonwealth Edison	IL	IOU	●			●
Eversource MA	MA	IOU	●	●	●	
Narragansett Electric	RI	IOU	●	●	●	
National Grid MA	MA	IOU	●	●	●	
Pacific Gas & Electric	CA	IOU	●	●	●	
Southern California Edison	CA	IOU	●	●	●	
Tucson Electric Power	AZ	IOU	●	●	●	
Northern States Power Co.	MN	IOU	●	●**	●	
Fort Collins Utilities	CO	Muni	●			
Otter Tail Power	MN	Muni	●		●	
Seattle City Light	WA	Muni	●			●
Efficiency Vermont	VT	3rd party	●	NA*	●	
Energy Trust of Oregon	OR	3rd party	●	NA*		

* Third-party administrators do not sell energy to customers. However Green Mountain Power in Vermont and Portland General Electric in Oregon are decoupled. ** The decoupling mechanism for Northern States Power Company was approved in a 2015 rate case and was not in place during the period outlined in this report.

In a white paper on regulatory frameworks that encourage energy efficiency, Molina and Kushler (2015) noted that the policy most strongly associated with higher energy savings is an EERS. Notably, all of the program administrators profiled in this paper are required to meet energy-savings targets. Fort Collins Utilities and Seattle City Light are subject to local targets while the other utilities are required to meet state-ordered savings targets. In California utility staff noted that hitting targets was a major motivator for efficiency-program staff, with progress reports distributed monthly.

Regulators have also taken steps to ensure that utilities and administrators are provided with incentives to meet these targets. With the exception of ComEd in Illinois, every investor-owned utility (IOU) profiled in this report has revenue decoupling or a lost-revenue recovery mechanism in place.[17] Decoupling eliminates the throughput incentive, the link between a utility's revenues and sales volume, essentially making the utility indifferent to the effect that energy efficiency programs might have on energy sales.

[17] APS and TEP in Arizona both have a lost-revenue adjustment mechanism in place rather than full revenue decoupling. For more information on lost-revenue adjustment, see Gilleo et al. (2015).

The majority of IOUs in our sample (all except ComEd) are also able to earn financial incentives for meeting performance goals. Molina and Kushler (2015) found that regulatory reforms like performance incentives and decoupling may influence utility management to cooperate with rather than oppose state policies that call for specific energy-savings targets. The specific structure of these incentives varies from state to state.[18] Penalties are another mechanism states may consider to encourage utilities to meet targets, but are far less common than incentives, with only a few states including Washington and Illinois setting penalties through legislation.[19] The utility staff interviewed in Washington and Illinois noted that while they were certainly wary of the penalty and were intentional in their efforts to avoid them, they did not feel that the penalty mechanisms were a major driver of success.

The high-achieving municipal utilities and third-party administrators that we profiled tended to have more-limited adjustments to their business models. Third-party administrators have no incentive to limit energy efficiency savings because they are not electric service providers. Municipal utilities, meanwhile, tend to respond to strong support from local regulators. Since municipal utilities are directly beholden to local governments and citizens rather than to investors, they may be incentivized to invest in energy efficiency for reasons beyond earnings. In a recent survey of municipal utilities, Kushler et al. (2015) found that the highest-ranked factors for providing energy efficiency services were customers' positive views of these programs, and the expectation or requirement by the utility's local governing boards for strong energy efficiency performance. None of the high-achieving municipal utilities we surveyed in this report earn an incentive, and none are decoupled.

TRENDS IN PROGRAMS

Most of the program administrators we surveyed have been delivering efficiency programs for many years—some for 20 or more years. These program administrators continue to rely heavily on traditional program offerings targeted at lighting, appliances, and equipment.

The contribution from lighting programs as a percentage of the total portfolio has declined in recent years, but lighting programs continue to make up a significant portion of savings for the program administrators we reviewed. This trend is well documented in case studies for specific program administrators in Appendix A. Several key factors drive changes to utility-sector lighting programs. First, changes to lighting standards in the 2007 Energy Independence and Security Act phased in more-efficient lighting standards for general-service screw-in lamps. Standards for fluorescent lamps and ballasts have also increased. The standards were phased in over the 2012 and 2014 period. While these changes did raise the baseline for many types of light bulbs (and corresponding energy savings), savings opportunities still exist in lighting. Second, light-emitting diodes (LEDs) have dramatically reduced in cost. Many program administrators, while recognizing the challenges associated with changing baselines, highlighted the promise of lower-cost LEDs to provide a new

[18] See Nowak et al. (2015) for a discussion of performance incentive structures.

[19] Pennsylvania also has a legislative penalty in place. Previous incentive structures in California also included a penalty, but the current model does not.

source of lighting savings for utility programs. These two factors have increased the energy savings from LED programs for most program administrators we reviewed.

In early years of efficiency delivery, program administrators tend to offer a simple and minimal selection of program types. However in recent years they have sought new ways to achieve energy-savings goals and maximize cost effectiveness. We asked program administrators to report on whether they claimed savings in any of the years reported for seven specific program types that we identified as emerging program practices (see York et al. 2015 for more on these program types). Table 5 shows the responses to this survey question.

Table 5. Innovative program types for which program administrators claim energy savings

	Program type						
Program administrator	Combined heat and power (CHP)	Building codes	Market transformation initiatives	Conservation voltage reduction (CVR)	Demand response	Rate design	Residential behavior
APS		●		Pending	●	Pending	●
ComEd	●	Pending		Pending			●
EVT							●
ETO	●	●	●				●
Eversource MA	●		●				●
FCU	Pending	●	●		Pending	Pending	●
NGMA	●		●				●
NEC	●	●	●	Pilot			●
OTP					●		●
PG&E		●	●				●
SCL	●		●				●
SCE		●	●				●
TEP	●	●		●	●		●
NSP					●		●

As reported by program administrator staff in data requests. EVT = Efficiency Vermont. ETO = Energy Trust of Oregon. FCU = Fort Collins Utilities. SCL = Seattle City Light. Eversource MA = Eversource Massachusetts. APS = Arizona Public Service. NGMA = National Grid Massachusetts. NEC = Narragansett Electric Company. NSP = Northern States Power Company Minnesota. OTP = Otter Tail Power Company Minnesota. PG&E = Pacific Gas and Electric. ComEd = Commonwealth Edison. SCE = Southern California Edison. TEP = Tucson Electric Power. Note: the residential behavior program offered by TEP was a pilot and is no longer offered.

As table 5 shows, only residential behavior programs are offered by all 14 program administrators in our study. These programs generally focus on residential customers and involve sending a customer a personalized report on energy use over a given time period. There are several other types of utility behavior programs, but the majority of behavior

programs in our review were based on home energy reports.[20] The report also usually includes information on how the recipient compares with similar customers on electric usage and offers tips on how to save energy.

Energy savings from building code adoption and compliance were also fairly common with the majority of program administrators currently offering or planning to offer this type of program. In California energy savings from building codes have been a growing source of very cost-effective energy savings, and in 2013 made up more than 15% of overall savings reported by PG&E. Green Building, the Fort Collins Utilities program that includes implementation of local amendments to building energy codes for residential and commercial buildings, accounted for approximately 9% of 2014 portfolio savings (growing from 2% in 2011).

The remaining programs on the list are less common. While not a new practice, conservation voltage reduction (CVR) is growing as an energy efficiency program. Traditionally distribution utilities have used CVR as an emergency measure or to reduce demand in specific areas for other reasons, such as delaying construction of new infrastructure. In general the utilities we surveyed use CVR, but only one claimed credit for CVR as an energy efficiency measure in its most recent portfolio. Two other utilities, APS and ComEd, are considering CVR but are not yet claiming savings. Narragansett Electric Company is currently piloting a CVR program but is not counting energy savings at this time.

CHP is a growing contributor to savings levels in the program portfolios we reviewed. Of our 14 program administrators, 7 included savings from CHP in program portfolios. CHP projects have the ability to produce a large amount of energy savings. Nearly 30% of Narragansett Electric Company's energy savings target in 2014 was attributable to one 12-megawatt (MW) CHP project at Toray Plastics. Narragansett provided 70% of the cost of this project, approximately $16 million. The project will save over 80,000 megawatt-hours (MWh) and 65,000 dekatherms annually (NEC 2015). Tucson Electric Power also installed two large CHP projects in 2014, accounting for 40,000 MWh or 18% of incremental savings for that year. The majority of these savings are from one 5.5-MW project at the University of Arizona Health Sciences Center (TEP 2015).

Only two companies we surveyed are considering counting energy savings from specific rate design programs. See York et al. (2015) for a discussion of research on the energy efficiency impacts of rate design programs.

SUSTAINING HIGH LEVELS OF SAVINGS

This report documents the ability of program administrators to achieve and sustain high levels of savings. Even as codes and standards have increased and avoided-energy supply costs have decreased, program administrators have been able to continue to achieve high levels of energy savings year to year. We asked program managers several questions related to how program administrators would continue to sustain high levels of energy savings, even while avoided costs decline, standards increase, and markets become saturated. The

[20] For more information on various utility-led behavior program types, see Mazur-Stommen and Farley 2013.

managers identified several areas and seemed optimistic about the ability to continue to achieve cost-effective and high levels of savings.

Program Focus in the Future

Our review of program portfolios between 2007 and 2014 revealed several trends. First, program portfolios have become more diverse as program administrators rely less on lighting programs to carry performance. This trend will continue in coming years. Future program portfolios will generally not rely as heavily on one program or measure, as many have in the past. Instead program portfolios will consist of many different sources of energy savings.

Lighting programs, both measures and control technologies, are expected to continue to play a large part in portfolios (York et al. 2013; York et al. 2015). Most of the utilities we surveyed had largely shifted program focus away from compact fluorescent lamps (CFLs) and toward LEDs. While available energy savings are reduced as incandescent lights are phased out of the market and no longer constitute the baseline from which savings are measured, most program administrators still see significant value in delivering lighting programs. Utility staffers indicated that customers appreciated the improved technology. LED programs are still relatively low in cost and generate significant energy savings, although they are not the silver bullet that CFLs once were for efficiency portfolios.

Program managers expect behavioral programs to continue to grow as a source of cost-effective savings. These programs typically have only a one-year measure life, but recent studies suggest that despite the decay curve, some portion of savings may persist for three or more years after initial treatment ends (Khawaja and Stewart 2014). While more needs to be learned about the impact of these programs, many program managers expressed hope that these programs will account for significant savings in future program portfolios.

In interviews, program managers cited CVR as a large potential source of savings in future years. Multiple program administrators had recently started program pilots or intended to in the near future. Interviewees also mentioned several other programs in our interviews including industrial processes, geothermal heat pumps, energy management systems for commercial buildings, and deep retrofits for commercial and residential buildings. Many also emphasized the importance of control measures and automation. For example, Energy Trust of Oregon, Fort Collins Utilities, and Otter Tail Power noted that lighting controls and smart thermostats were likely to play a larger role in future portfolios. This is consistent with ACEEE's research findings on intelligent efficiency, which refers to savings enabled by information and communication technology.

Regulatory Support

Many of our program administrators stressed the importance of strong regulatory support as a necessary aspect of sustaining high levels of energy savings. Financial assurances such as timely cost recovery, performance incentives, and mechanisms to allow the recovery of net lost revenues are critical to supporting high performance, according to the program

managers we interviewed.[21] Regulatory support also includes timely approval of program plans and requests to modify budgets or program strategies if changes are needed. Allowing program administrators flexibility in areas of budget-shifting or other changes can allow midcourse corrections for programs that are not performing as expected.

Partnerships

Partnerships with third parties, communities, local governments, and other outside entities were also highlighted as necessary to maintaining high levels of energy savings. Fort Collins Utilities, for example, works closely with the Larimer County Conservation Corps to deliver a low-income audit and direct-install program. Seattle City Light partners with the Northwest Energy Efficiency Alliance (NEEA) to deliver market transformation initiatives. This partnership generated 44,712 MWh of savings in 2014 at a cost of $0.005 per kWh (SCL 2015). Northern States Power Company is working with a local community in Plymouth, Minnesota, to deliver targeted energy efficiency savings to alleviate the need to construct a new high-voltage transmission line. Finally, Northern States Power has worked with the Center for Energy and Environment (CEE) to deliver energy efficiency savings from small businesses for several years. This partnership is very successful and provided Northern States Power with 10% of its total electric savings in 2014.

RAMPING UP TO HIGH SAVINGS: EXPERIENCE AND ADVICE

We also asked program administrators several questions related to how they were able to ramp up to 1.5% and what advice they might offer to program administrators intending to do the same. The answers to these questions were often very similar. The most common recommendation was to ensure that program delivery infrastructure is in place and ready to deliver the volume of services necessary to meet new program demands.

Delivery infrastructure can be both internal and external infrastructure, and the two often overlap. Internal infrastructure includes the labor and resources necessary for program design, reporting, implementation, and evaluation. External infrastructure relates to the contractors and program delivery network necessary for program implementation. Most program administrators we interviewed stressed the importance to program success of ensuring delivery infrastructure, as well as quality control of the work done by those delivering programs to ensure customer satisfaction and long-term success.

Other program administrators opined on the value of integrating evaluation with program planning and delivery. Using evaluation results to modify and improve program performance was critical to success for several program managers we interviewed. The use of public processes for engagement and education was cited as a source of public support and credibility. Program managers stressed the diversification of program offerings as a key to success in ramping up. Administrators should be open to new approaches in program delivery such as midstream and upstream efforts. Those we interviewed also suggested working closely with trade allies to leverage existing markets for products and services

[21] This list of important factors would be very consistent with prior ACEEE research on what we have referred to as the three-legged stool of key regulatory mechanisms for enabling strong utility-sector energy efficiency portfolios (Nowak et al. 2015; Gilleo et al. 2015; Molina and Kushler 2015).

instead of attempting to create new markets. Finally, those we interviewed often characterized customer engagement and marketing as essential pieces to ensure that customers understand the programs, products, and services, in order to fully capture customer savings.

Conclusion

Our review of this group of 14 leading energy efficiency program administrators demonstrates that high levels of energy savings are not only achievable but also sustainable. Even as program administrators face substantial challenges that may limit savings opportunities in traditional areas, energy savings have increased from year to year. Average net energy savings levels have doubled for the program administrators in this sample, from 0.9% in 2008 to 1.8% in 2014. Advances in technology, reductions in measure costs, and program innovation will continue to create new savings opportunities, allowing program administrators to sustain and grow high levels of savings.

We have also documented several program administrators' achievement of cost-effective and high levels of savings in regions with low electricity and energy prices. This demonstrates that program administrators are able to achieve high levels of savings while facing lower avoided energy costs than those in higher-electricity-price regions, such as the Northeast and California.

Our analysis documented several specific trends and results related to program costs over the study period. Based on several different metrics we found that energy savings and spending levels are highly correlated. Simply stated, more investments in energy efficiency resources achieve larger energy savings. What is more noteworthy however is our finding that the cost of saved energy has remained flat since 2010 while total spending and savings levels have increased. The weak correlation between the LCSE and energy-savings levels demonstrates that the LCSE does not necessarily increase as energy savings increase. The important conclusion is that utility programs have remained cost effective even as portfolios have matured and natural gas prices have declined to unprecedented lows. The evidence we reviewed suggests that this is also true in regions with lower electricity costs and avoided costs.

Finally, state and local policies are crucial for driving and sustaining high levels of savings. All of the program administrators profiled in this paper are required to meet energy-savings targets or EERS. Cost-recovery mechanisms for program costs and lost revenues are crucial for influencing utilities to increase savings (Molina and Kushler 2015). Many program managers stressed the importance of having appropriate financial policies in place in order to achieve program success. Notably we found that utility performance incentives have a minimal impact on the LCSE. The average increase from performance incentives is $0.003 per kWh for our sample. Strong support from regulatory bodies such as state regulatory commissions is also essential for maintaining high levels of savings.

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Appendix A. Program Administrator Profiles

ARIZONA PUBLIC SERVICE

Arizona Public Service (APS) is an investor-owned utility covering 11 of 15 counties in Arizona. APS serves over 1.1 million customers, with approximately 46% of its total sales to residential customers and 54% to business customers. APS is a wholly owned subsidiary of Pinnacle West Capital. APS owns over 7,500 MW of generating capacity (52% natural gas, 26% coal, 18% nuclear, 3% solar).

Policy Drivers

In 2010, the Arizona Corporation Commission (ACC) established an EERS requiring all investor-owned utilities to achieve cumulative annual electricity savings of 22% of retail electric sales in 2020. The target required 1.25% cumulative energy savings beginning in 2011 and increases annually until the 2020 goal is met.

APS is eligible to earn a performance incentive based on a share of net benefits generated that varies based on the percentage of the annual savings goal achieved. No penalties are in place, and the performance incentive is capped at $0.00125 per annual kWh saved. The current incentive mechanism structure started in 2014.

Trends over Time

ENERGY SAVINGS AND PORTFOLIO SPENDING

Figure A1 shows the spending and savings for APS since 2008. Savings have been over 1.5% since 2012.

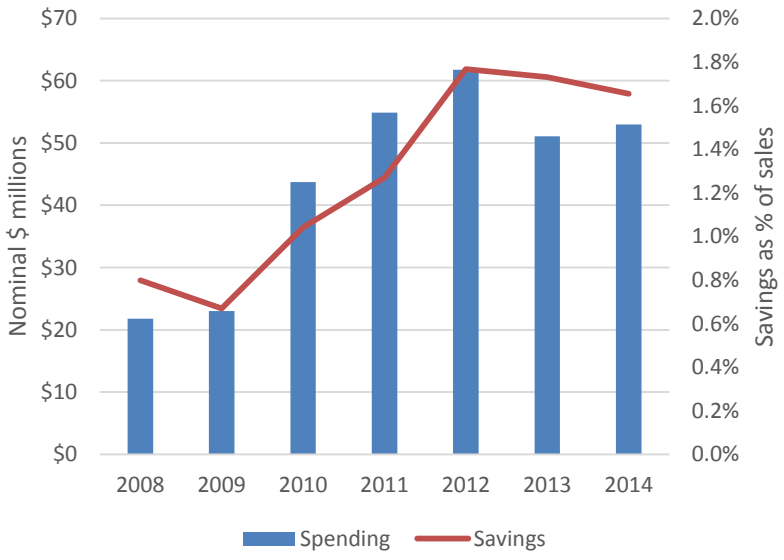

Figure A1. Annual electric energy efficiency program spending and annual savings as a percentage of retail sales. In Arizona net savings are equivalent to gross savings. *Sources:* APS 2009–2015.

COST EFFECTIVENESS

Arizona relies on the SCT to evaluate the cost effectiveness of programs and measures. The SCT in Arizona uses the utility-weighted average cost of capital instead of a societal discount rate (the common discount rate for the SCT). The cost–benefit tests are required for portfolio-level, total program-level, and individual measure-level screening, with the exceptions of low-income segments, pilots, and new technologies. Figure A2 shows APS's cost–benefit ratios for the SCT for 2008 to 2014.

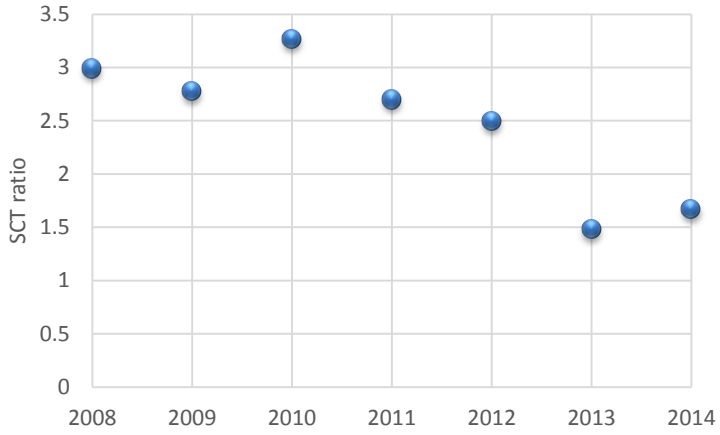

Figure A2. APS SCT ratio, 2008 to 2014

The benefits are quantified based on avoided-cost values from the current integrated resource planning (IRP) proceeding. Benefits include avoided energy, generating capacity, transmission and distribution capacity, and water. Utilities in Arizona currently assume a net-to-gross ratio of 1.0 for all programs. This is based on a 2011 market effects study which found that a combination of spillover, freeriders, and overall market effects resulted in gross savings equaling net savings.

PORTFOLIO DESIGN

Figure A3 shows the APS program portfolio in 2010 and 2014. As the figure demonstrates, the number of programs has grown, as have the total electric savings

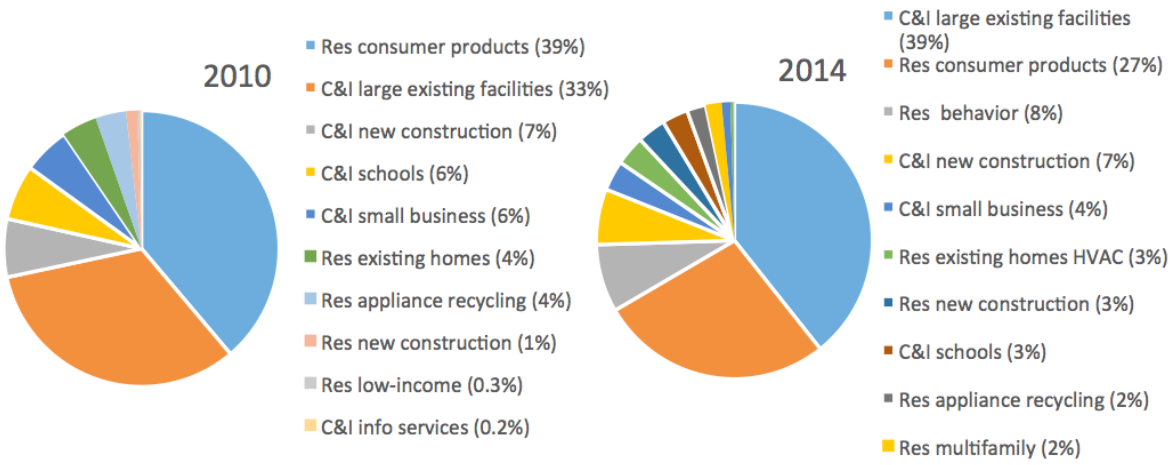

Figure A3. Portfolio annual energy savings for residential programs. Comparison 2010 and 2014. In 2010 multifamily and shade-tree programs generated zero savings. *Sources:* APS 2011; APS 2015.

Savings from large existing commercial and industrial facilities grew from 33% of the portfolio in 2010 to almost 40% in 2014. Lighting and variable-speed drives were the biggest contributors to this increase. Savings from residential lighting declined from nearly 40% of the total portfolio in 2010 to 27% in 2014.[22] Residential behavior, a program not offered in 2010, accounted for 8% of total savings in 2014. Sector savings did not vary much from 2010 to 2014, with a 52% commercial and industrial (C&I) and 48% residential savings mix.

Challenges and Opportunities

Over the next five years, APS plans to work with customers to achieve energy savings of over 2.8 million MWh. APS cited changing codes and standards as a primary challenge to achieving high levels of energy savings in the future.

In addition to the utility's established energy efficiency programs, APS will continue to expand conservation voltage reduction, LED street lighting, its prepaid electric services program, codes and standards, and behavioral programs. In the nonresidential segment APS will include commercial lighting controls and variable refrigerant flow HVAC systems in the portfolio.

[22] Residential lighting measures made up 90% of the savings in residential consumer products (80% from CFLs and 10% from LEDs).

COMMONWEALTH EDISON

Commonwealth Edison Company (ComEd) is a unit of Exelon Corporation. ComEd service territory covers 11,400 square miles in northern Illinois. Its 3.8 million customers make up about 70% of the state's population. ComEd is a delivery-only investor-owned electric utility. The company does not own generation.

Policy Drivers

In 2007 the Illinois General Assembly passed legislation that created a requirement for energy efficiency programs to be implemented throughout the state. Illinois Compiled Statutes Sec. 8-103 authorizes utilities to recover program costs and set incremental savings targets beginning at 0.2% of retail sales in 2008 and ramping up to 2% for 2015 and beyond. However legislation also limits total recoverable program costs based on a maximum tariff of 2% of retail rates. ComEd-operated programs were designed to hit legislative goals under the budget cap for program years 1–5, but beginning in program year 6 ComEd requested lower targets to account for budget constraints.

ComEd is subject to a penalty should it fail to meet targets as approved by the Illinois Commerce Commission (ICC) at the end of a three-year cycle. In such cases the utility must make a contribution of $665,000 to the Low Income Home Energy Assistance Program (LIHEAP). Furthermore program administration will be turned over to a state agency.

ComEd is not decoupled, although rates are adjusted automatically each year in response to changes in overall energy sales.

Trends over Time

ENERGY SAVINGS

ComEd energy savings have closely followed the requirements put in place by legislation, with a ramp-up beginning in 2008. Figure A4 shows spending and savings over time.

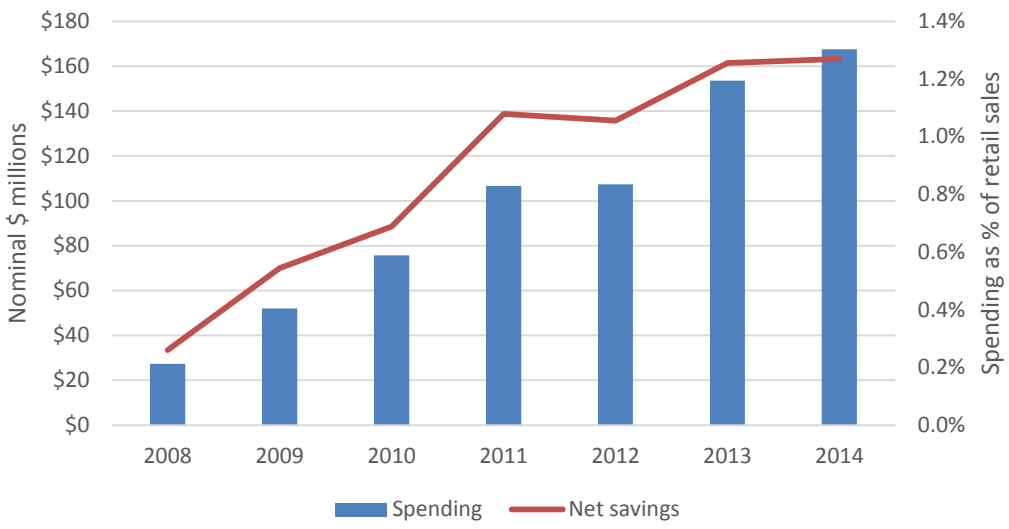

Figure A4. Net savings as a percentage of retail sales and total energy efficiency portfolio costs for ComEd for 2008 onward. This figure does not include the portion of spending and savings assigned to the state's Department of Commerce and Economic Opportunity (DCEO). *Source:* ComEd data request.

Legislative savings targets required a relatively swift and consistent ramp-up of programs over time. During plan year 1 ComEd budgeted about $25 million to achieve the required 0.2% incremental savings. By plan year 4, ComEd's budget was over $100 million (with a target of 0.8%) and for both plan years 6 and 7, ComEd's budget was around $160 million.

PORTFOLIO DESIGN

Illinois statute divides responsibility for program delivery between investor-owned utilities and the Illinois Department of Commerce and Economic Opportunity (DCEO). ComEd portfolios focus on commercial, industrial, and residential sectors, while DCEO uses 25% of the ratepayer funds that ComEd collects to deliver programs targeted at low-income communities and state and local government properties.[23] Therefore the sample portfolios shown in figure A5 do not include programs targeted at low-income communities and public buildings.

[23] Note that DCEO receives 25% of funds but is not required to achieve 25% of savings due to the customer classes served.

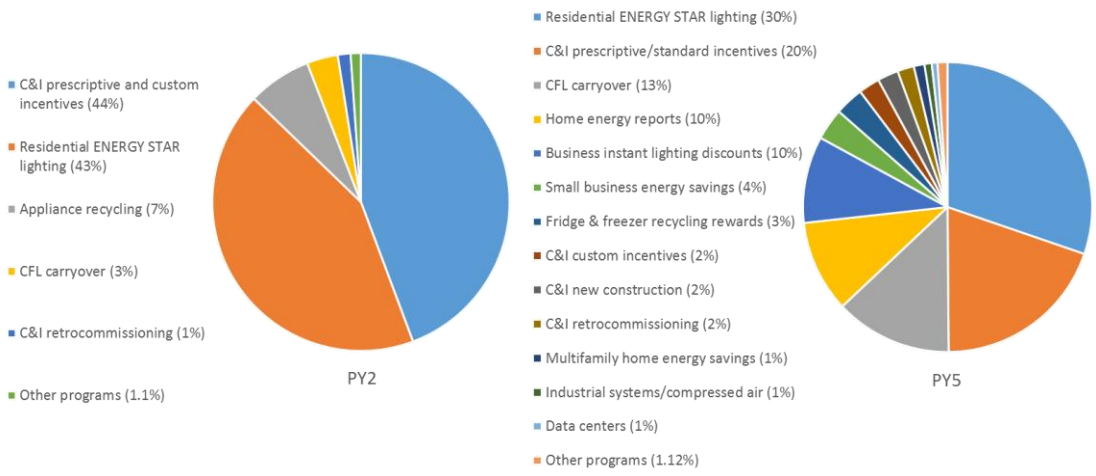

Figure A5. ComEd portfolios in plan year 2 (2009) and plan year 5 (2012) by program type. *Source:* ComEd annual reports.

ComEd's portfolio of programs has grown significantly since it initiated programs as directed by legislation. Programs have always targeted all ComEd customers, packaged under a Smart Ideas banner, but the utility has sought ways to expand program offerings over the years. In plan year 5, ComEd worked with gas utilities to deliver joint programs. Additionally, for the first time a small portion of savings came from third parties that proposed and implemented energy efficiency programs.[24] Although ComEd's portfolio has expanded in size and complexity, the utility still draws a large portion of savings from residential and commercial lighting and other standard incentives for businesses. ComEd also credits savings to what it calls CFL Carryover, or the calculated portion of savings associated with CFLs that are installed up to two years after initial investment.

COST EFFECTIVENESS

The primary test used to screen programs is the TRC. The TRC includes societal benefits for carbon dioxide emissions reductions. Figure A6 shows results for plan years 1–5.

[24] See ComEd's Annual Report for Plan Year 5 for more information on third-party programs.

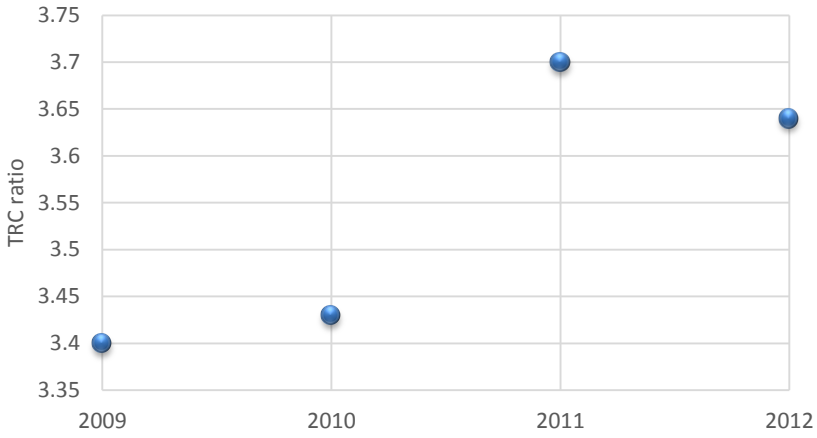

Figure A6. TRC results for ComEd portfolios, plan years 1–5. Note that plan years run from June to May and do not align with calendar years. *Source:* ComEd annual reports.

Development of a cost-effective portfolio is a multistage process. ComEd first conducts a measure analysis, then bundles cost-effective measures into programs, which are further analyzed for cost effectiveness and finally bundled into the portfolio as a whole.

Challenges and Opportunities

LEVERAGING VENDORS TO GROW PROGRAM INFRASTRUCTURE

Adding quality staff and thorough vetting of vendors was critical to delivering both the quality and quantity of programs required to meet savings targets. ComEd has one internal manager per program with external vendors responsible for running each program. While some utilities choose to keep program administration largely internal, ComEd has had success in partnering with vendors, leveraging expertise in the marketplace. Internally ComEd staffing numbers have grown modestly, reaching about 50 over the course of the ramp-up.

ADAPTING PORTFOLIO TO NEW FEDERAL STANDARDS

To date CFL lighting has made up a large portion of ComEd's portfolio. Utility staff reported that in years when program savings were lower than expected, shifting money and resources into the residential lighting program helped fill gaps. However, moving forward, federal standards will phase out traditional incandescent bulbs thereby shifting the baseline for ComEd's lighting programs. ComEd has already introduced new LED technologies into its portfolio, but will need to plan for lower energy savings from programs with a more stringent baseline.

COORDINATING TO SERVE HARD-TO-REACH CUSTOMERS

Due to legislative requirements, DCEO rather than ComEd delivers energy efficiency programs to low-income customers and state agencies. ComEd reported minimal coordination with the agency but did state that public-sector programs are similar to the programs ComEd offers its commercial and industrial customers. This has led to some confusion when ComEd redirects customers in the public sector to DCEO.

Within its own portfolio ComEd staff identified the small commercial market as the most challenging. Larger customers have individual account managers and advocates while smaller commercial customers do not. In response ComEd has significantly increased the amount of funding allocated to the direct install program for the small commercial market and has worked closely with trade allies to increase program participation.

EFFICIENCY VERMONT

Vermont pioneered the statewide program administrator model with the creation of Efficiency Vermont in 1999. Efficiency Vermont is an energy efficiency utility (EEU), developed as an agreement among Vermont's 22 electric utilities, the Vermont Department of Public Service (DPS), and other stakeholders. The EEU began delivering services in 2000. Efficiency Vermont's programs cover the entire state with the exception of the City of Burlington. Efficiency Vermont serves about 360,000 customers.[25]

Efficiency Vermont is operated by the Vermont Energy Investment Corporation (VEIC). Initially VEIC was engaged under a contract-based model in three-year increments. However in late 2010 the Vermont Public Service Board (PSB) issued an order of appointment, which engaged VEIC as an EEU for a period of 12 years. An independent financial audit reviews Efficiency Vermont's plans and programs, DPS oversees a third-party savings verification process, and a comprehensive triennial audit is ordered by legislation and overseen by the PSB. A separate energy efficiency charge on electric bills funds electric efficiency programs. Efficiency Vermont also offers programs targeted at reducing heating and process-fuel use. These programs are funded using Regional Greenhouse Gas Initiative (RGGI) revenues and revenues from the sale of energy efficiency into the regional forward capacity market.

Policy Drivers

Efficiency Vermont has received performance incentives since the program's inception in 1999. Performance incentives apply to a variety of quantifiable performance indicators (QPIs) and typically range between about 3 and 4% of program costs. A portion of this compensation, known as an operations fee, is guaranteed, while the remaining compensation is based on achievement of QPIs. The energy-savings requirements of the QPIs are linked to the state's requirement that EEUs "realize all reasonably available cost-effective energy efficiency savings."[26] This requirement essentially functions as the framework for an EERS. The PSB approves three-year budgets based on a modeled maximum-achievable scenario for energy efficiency. In turn Efficiency Vermont proposes energy-savings targets over a three-year period, which are ultimately adjusted upward as part of a negotiation process with DPS. These include a stretch goal, at which the EEU receives 100% of its performance incentive associated with energy savings, as well as a "super stretch" target. Among targets related to energy savings for the 2015–2017 period, for example, stretch goals represent a goal set 20% above the expected savings, and super stretch goals are set 5% beyond the stretch level.

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[25] Efficiency Vermont calculates number of customers based on meters served. The City of Burlington does not receive efficiency services from Efficiency Vermont. Instead it offers energy efficiency programs through the Burlington Electric Department, which is also a designated EEU. However Efficiency Vermont and Burlington Electric coordinate their program offerings.

[26] See 30 V.S.A. §209.

Trends over Time

ENERGY SAVINGS

Since beginning program delivery Efficiency Vermont has significantly increased the size of its energy efficiency programs. Figure A7 shows incremental energy savings achieved each year for the past decade.

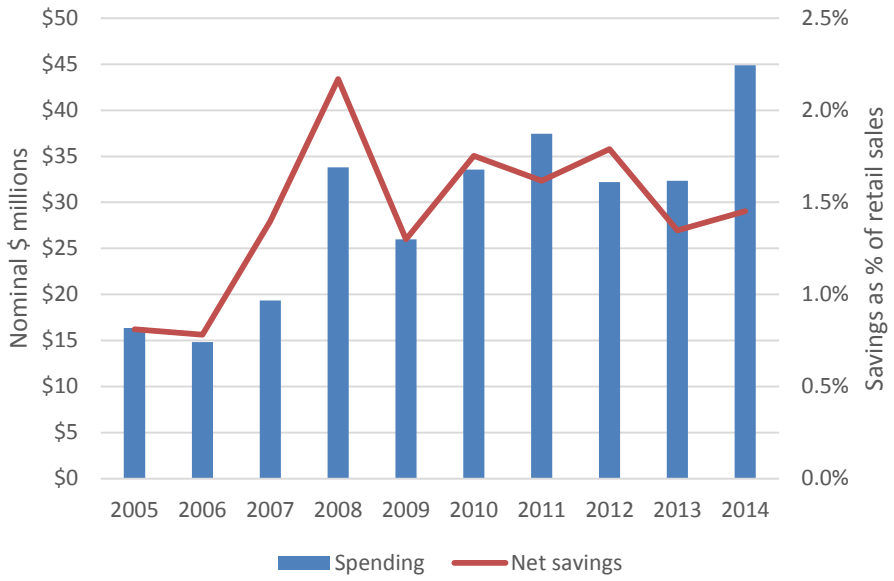

Figure A7. Net savings and total costs from Efficiency Vermont portfolios, 2005–2014. Savings are metered savings as reported by Efficiency Vermont. Program costs include performance incentives.

The steep ramp-up in savings from 2006 to 2007 corresponded to the removal of a legislative cost cap and a related increase in program funding. Since the lifting of the cost cap Efficiency Vermont has typically achieved electricity savings of at least 1.5% each year. These incremental savings have had major impacts on statewide energy demand. Figure A8 shows how energy efficiency has been used to effectively meet growing demand within the state.

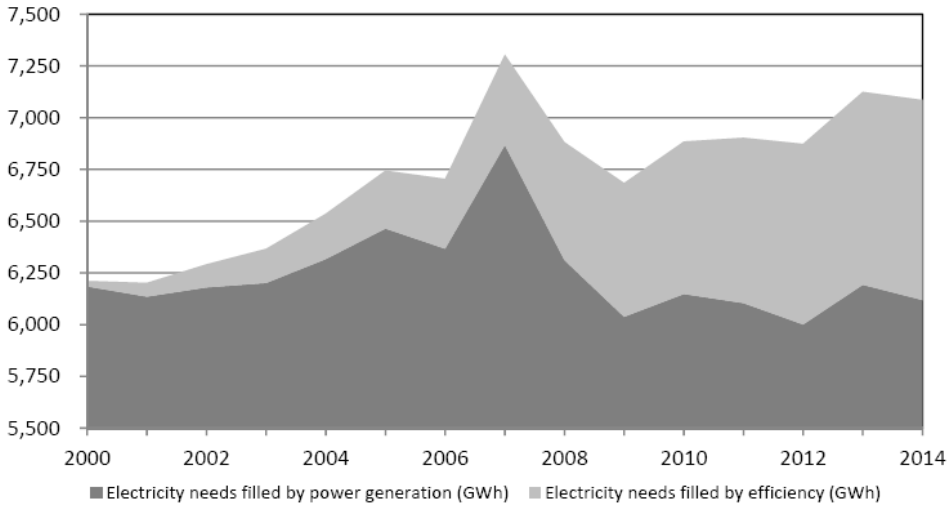

Figure A8. Cumulative effects of energy efficiency in Vermont.
Source: Efficiency Vermont 2014 Annual Report.

PORTFOLIO DESIGN

Figure A9 illustrates Efficiency Vermont portfolios in two sample years, 2010 and 2014. This figure shows the proportion of savings attributed to general program types.

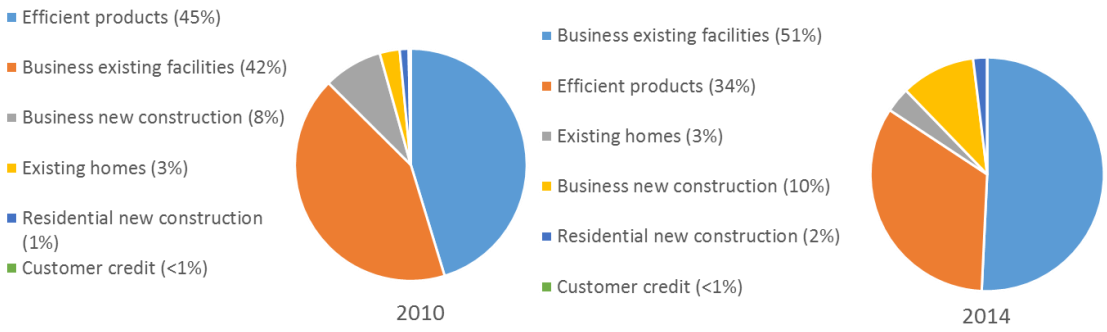

Figure A9. Portfolio savings by program type, 2010 and 2014. *Source:* Efficiency Vermont annual reports.

Activities have been fairly evenly split between the commercial and residential sectors, with the majority of programs focused on prescriptive and upstream rebates in existing facilities. Efficiency Vermont also attributes a small portion of savings to its customer credit program, a self-direct program that allows qualified large businesses to self-implement efficiency measures and receive reimbursement for projects that pass the Vermont societal cost-effectiveness test.

Figure A10 shows savings by major end-use category. It does not show categories responsible for smaller amounts of savings.

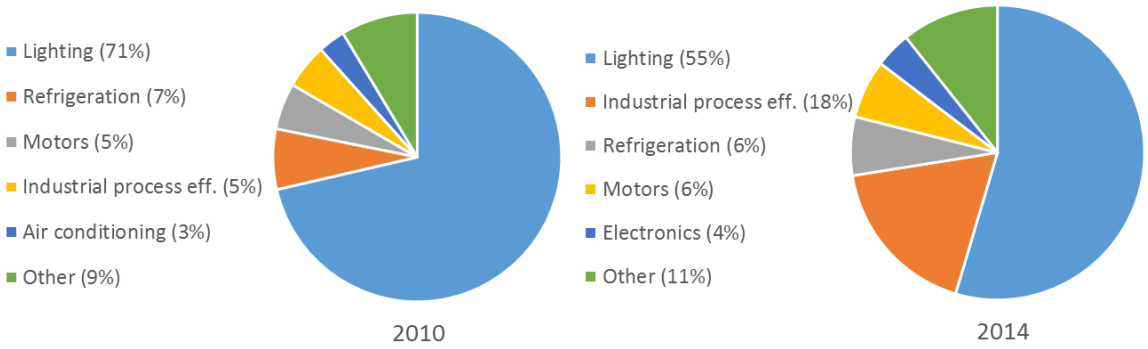

Figure A10. Portfolio savings by end use, 2010 and 2014. Only the end uses to which the greatest savings are attributed are shown. All others are included in the "other" category. *Source:* Efficiency Vermont annual reports.

To date portfolios have leaned heavily on lighting. In 2010 Efficiency Vermont attributed about 70% of total electricity savings to lighting programs. In 2014 that number was somewhat lower, although still well over half of total portfolio savings at about 55%.

COST EFFECTIVENESS

Efficiency Vermont uses the SCT as its primary test for decision making at the overall portfolio level as well for total program– and customer project–level screening. Some programs are excepted including low-income programs and pilots.

Efficiency Vermont assesses cost effectiveness over the entire course of its three-year portfolio plan. In order for it to receive an incentive, the ratio of total electric benefits to total costs must be greater than 1.2. Over each three-year planning horizon, Efficiency Vermont has far exceeded this minimum requirement, as table A1 shows.

Table A1. Ratio of total electric benefits to Efficiency Vermont costs

Performance period	CE ratio
2003–2005	1.96
2006–2008	2.81
2009–2011	2.40
2012–2014	1.96

Source: **Efficiency Vermont annual reports**

Efficiency Vermont credits early improvements in cost effectiveness to scaling up of programs after removal of the cost cap in 2006. The EEU also actively manages its portfolio to maximize cost effectiveness, phasing out programs as needed while growing the most cost-effective program offerings. Managing non-incentive costs has also become increasingly important.

Advances in technologies like lighting have also been an important buoy for cost effectiveness. The EEU invests heavily in lighting programs and has transitioned its

incentive programs toward newer technologies like LEDs to reflect improvements in both commercial and residential lighting technologies.

Challenges and Opportunities

RESPONDING TO ECONOMIC CONDITIONS

Efficiency Vermont has a long history of delivering programs and has refined its program strategies over time. However even strong programs were affected by the economic downturn of 2009. In its 2009 Annual Report, Efficiency Vermont noted that economic conditions had affected both the commercial and the residential sectors. Commercial construction slowed significantly and unemployment peaked, and Efficiency Vermont saw many consumers choose to "defer cost-effective investments, no matter how attractive the long-term economic benefits" might have been. In response the EEU tried new tactics, for example, lowering the price of CFLs below market price and increasing marketing efforts. Staffers noted that uptake was outstanding. However increased spending in 2009 necessitated slowing programs in later years to make up for spending beyond what was expected following the economic downturn.

ENERGY EFFICIENCY AS A DISTRIBUTION-SYSTEM RESOURCE

Efficiency Vermont strengthens its partnership with energy utilities in the state by responding to requests for geotargeting of efficiency efforts that reflect transmission and distribution constraints.[27] Utilities identify areas where substations are in need of upgrades or where peak demand is high. Because utilities are mandated to consider efficiency before other supply-side resources, they specify counties where Efficiency Vermont should achieve savings. Over 2013 and 2014 Efficiency Vermont targeted two such areas.

WORKING UPSTREAM

Efficiency Vermont credits a large part of its success to being heavily embedded within energy efficiency equipment supply networks in the state. The EEU has built networks of contractors and suppliers and offers upstream incentives to ensure that these networks are stocking and promoting energy-efficient equipment. Efficiency Vermont provides training to contractors and account managers to help streamline the process of bringing new customers in the door as contractors refer them. The EEU also focuses on making efficient appliances visible to consumers, and brands lighting and appliances with an Efficiency Vermont label.

EXPANDING PROGRAM REACH

Performance indicators have also driven Efficiency Vermont to expand its reach in recent years, in terms of both the types of customers it is able to reach and the way it interacts with its customers. The EEU has goals around small businesses, comprehensiveness, and market transformation. To increase participation among hard-to-reach customers, Efficiency Vermont has focused on account management work. Particularly in the small-business sector, regular check-ins and a better understanding of capital flows and specific needs have allowed the EEU to deliver additional energy savings. Programs also focus on peer-to-peer

[27] See further discussion of geographic targeting in section 5.2 of the Efficiency Vermont 2014 Annual Report (EVT 2015).

learning. For example, Efficiency Vermont has organized a best-practices exchange so that businesses across the state can hear examples of how projects are working for similar customers.

Relationship-building has also been critical for meeting Efficiency Vermont's relatively new comprehensiveness targets, which are designed to encourage the EEU to look beyond lighting to increase the depth of savings at the project or customer level. Large multicomponent projects are often not feasible for customers in the state due to high up-front capital costs. Efficiency Vermont has adapted to this reality by working with customers over time, helping them pick and choose projects that can be implemented one after the other. While this requires additional time on behalf of both the EEU and its contractor network, it does lead to the comprehensive savings that regulators and stakeholders are looking for.

ENERGY TRUST OF OREGON

Energy Trust of Oregon (ETO) is an independent nonprofit organization that provides renewable-energy and energy efficiency services for customers of Portland General Electric, Pacific Power, NW Natural, and Cascade Natural Gas. In 1999 the Oregon legislature passed a restructuring law establishing consistent funding for investments in clean energy and energy efficiency. This resulted in the establishment of Energy Trust of Oregon. ETO began administering programs in 2002 and now covers a service territory with over 1.5 million utility customers.

Policy Drivers

Oregon is part of the four-state region that coordinates with the Northwest Power and Conservation Council (NWPCC). NWPCC holds responsibility for resource planning for the region and has identified energy efficiency as a priority resource for meeting load growth. ETO coordinates with NWPCC to develop avoided-cost assumptions and load shapes, but is ultimately accountable to the Oregon Public Utility Commission, filing quarterly and annual reports related to energy savings, renewable generation, and all costs.

ETO developed a long-range strategic plan in 2009 and again in 2014. The long-range plan sets internal goals for ETO that essentially function as an EERS for the area served by the program administrator. The strategic plan laid out electricity-savings goals (in average MW) equivalent to about 0.8% in 2009 and ramping up to 1% in 2013 and 2014.[28] ETO's second strategic plan includes goals of about 1.4% electricity savings per year through 2019. The integrated resource plans of the utilities whose customers are served by ETO incorporate forecasts of energy efficiency. The program administrator is required to meet at least 85% of those targets each year.

ETO's contract includes operating costs, but the program administrator does not receive a performance incentive.

Trends over Time

ENERGY SAVINGS AND PORTFOLIO SPENDING

ETO's electric efficiency programs are funded by investor-owned utility customers under a law passed in 1999. In 2008, Energy Trust's mission expanded under Oregon's SB 838. This legislation allowed Energy Trust to supplement its 3% public purpose charge with additional funding to acquire all cost-effective energy efficiency. Programs have grown as a result. Figure A11 shows spending and savings for electric efficiency programs.

[28] ETO's goals are given in average MW. To calculate goals as a percentage of retail sales, we converted average MW to MWh and divided by retail sales in the territories of the utilities whose customers are served by ETO.

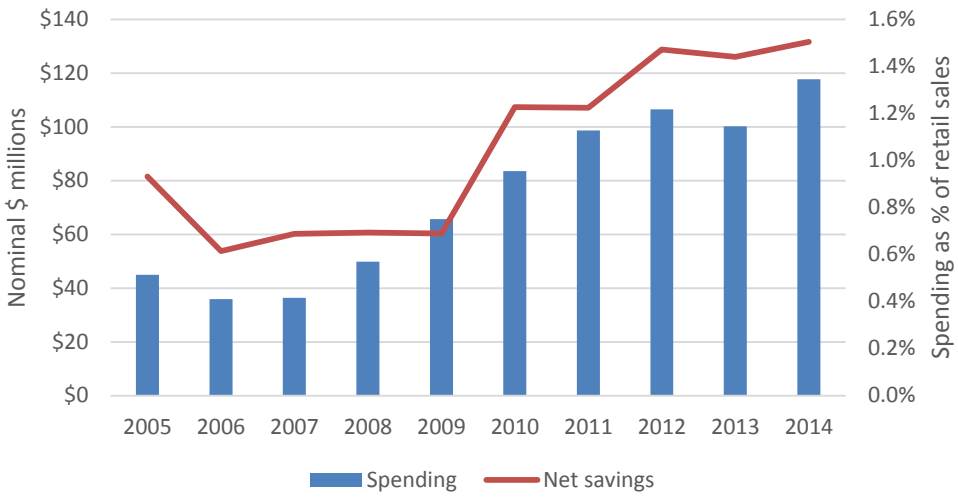

Figure A11. Net savings as a percentage of retail sales for utilities served by ETO and total electric efficiency portfolio costs for the program administrator. We adjusted reported savings to account for line losses using factors supplied by ETO staff. Spending data were reported by ETO staff and do not include costs for renewable and natural gas programs.

ETO's 2015–2019 Strategic Plan notes that the pace at which the program administrator was able to deliver programs changed dramatically after the passage of SB 838. In 2013 ETO saved double the amount of electricity than it did in 2009.

PORTFOLIO DESIGN

ETO's portfolio has grown in size across all sectors since 2002. Figure A12 shows savings by sector in the sample years 2006, 2008, and 2014.

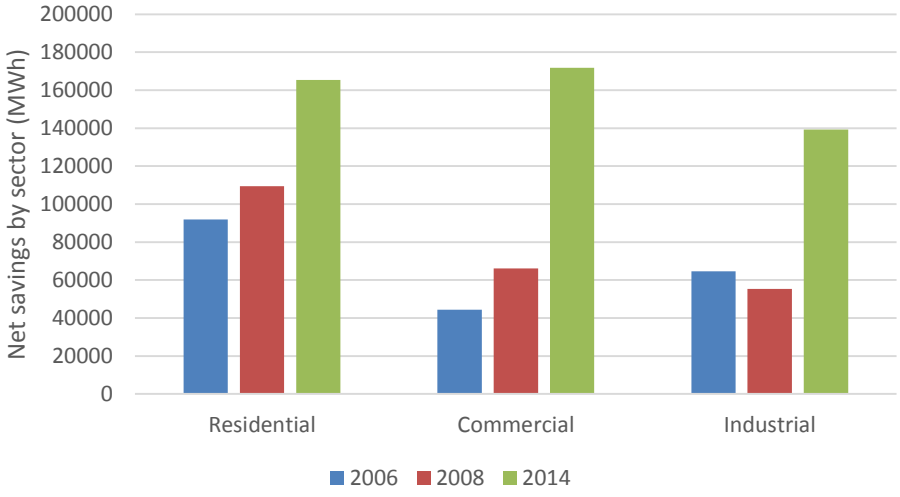

Figure A12. ETO's net electricity savings by sector in 2006, 2008, and 2014. Data were reported by ETO staff and adjusted for line losses.

ETO also regularly reports participation metrics. Table A2 shows participation figures for 2008 and 2014.

Table A2. Participation metrics reported by ETO

Program	2008	2014
New homes and major remodels	2,592	2,287
Weatherization retrofits	12,029	6,746
Home energy reviews	6,346	1,680
Residential heating systems	-	4,372
Residential water heaters	212	735
High-efficiency products	25,186	16,940
High-efficiency lighting	1,243,918	3,565,257
Appliances recycled	-	12,471
Energy-savings kits sent	-	35,057
Commercial new buildings served	272	463
Commercial existing buildings served	1,378	2,785
Commercial strategic energy-management projects	-	33
Existing multifamily sites served	10,110	2,260
Industrial projects	382	1124

Source: ETO annual reports

Lighting makes up a significant portion of ETO's portfolio. In 2008 lighting programs focused on upstream CFL incentives and lighting giveaways. ETO also credited an increase in industrial programs in 2008 to increased training and outreach to lighting trade allies. In 2014 lighting accounted for about 75% of total savings in ETO's New Homes and Products program, with LEDs accounting for 30% of installations. ETO's portfolio has seen other shifts in recent years. Savings in the commercial sector have grown dramatically, with emphasis shifting from new buildings to programs targeting existing buildings. ETO served many more industrial customers in 2014 than it did in 2008, and savings in this sector grew as a result.

COST EFFECTIVENESS

By law, public purpose funds may be invested only in cost-effective measures in Oregon. Figure A13 shows TRC cost-effectiveness ratios for electricity programs included in the ETO portfolio.

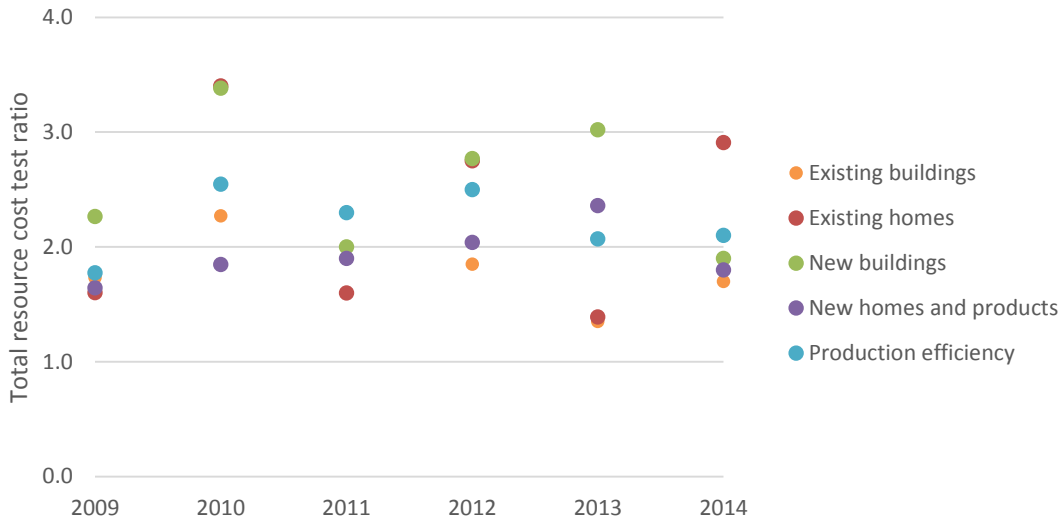

Figure A13. TRC test results for ETO electric efficiency programs as reported by ETO staff

ETO programs have remained cost effective over time.[29] In 2014 programs targeting electric efficiency improvements in existing homes were the most cost effective, but programs for new buildings have also been extremely successful over the past five years.

Challenges and Opportunities

MARKET CONDITIONS

As a provider of both electric and natural gas efficiency programs, ETO makes large retrofits attractive to commercial customers by packaging dual-fuel measures to maximize savings and minimize the payback period. Recently ETO reported that historically low natural gas prices had made retrofits less appealing to commercial customers. However part of ETO's challenge going forward will likely be a result of its own success. Staff noted that many traditional markets are saturated in its service territory, and with the spread of more-efficient technologies, loads are smaller.

BEHAVIOR AND CONTROL MEASURES

Staff indicated that behavior and control measures are likely to become a more important part of ETO's portfolio in the future. As programs mature there may be fewer opportunities to retrofit equipment or parts of buildings. Instead ETO seeks to guide people to use the systems they have more efficiently. This will likely mean an increased focus on onboard sensors and controls for LED lighting, and in the residential sector an emphasis on thermostats and security systems. Strategic energy management remains an area of opportunity in the industrial sector.

[29] ETO's 2013 Annual Report notes that the combined total resource cost–benefit ratio for NEEA programs fell below 1.0 due in part to the difficulty of quantifying single-year societal costs, as NEEA's portfolio includes multiyear market-transformation initiatives. However ETO could not be certain that the true cost–benefit ratio was below 1.0, and NEEA redesigned programs as a result. Figure A13 does not include NEEA ratios.

NEW STRATEGIC PLANNING PERIOD

In 2015 ETO began the implementation of its second strategic plan and noted that market conditions were likely to be very different from those of the first planning period. Rapid resource acquisition has given way to the following strategies:

- Acquiring more energy savings per project through deeper retrofits
- Faster introduction and testing of new technologies
- Attracting more-diverse customers and reaching smaller, more remote communities
- Leveraging partnerships and increasing the focus on additional benefits like water savings

ETO staff noted that although they have shifted strategies, energy efficiency remains a highly cost-effective investment. Costs of LEDs continue to fall, and ETO has developed new strategies to achieve deeper savings that go beyond equipment efficiency.

EVERSOURCE MASSACHUSETTS

Eversource is New England's largest energy-delivery company. The investor-owned utility operates across Massachusetts, Connecticut, and New Hampshire. In Massachusetts the utility's electric service territory includes 140 towns and covers more than 3,000 square miles. Eversource also delivers natural gas in parts of the state.

Within Massachusetts Eversource reports as two entities: Western Massachusetts Electric Company (WMECo) and NSTAR. WMECo's parent company, then Northeast Utilities, acquired NSTAR in 2010. In 2015 Northeast Utilities became Eversource.

Policy Drivers

In 2008 Massachusetts passed the Green Communities Act, which requires program administrators, including Eversource, to develop energy efficiency plans that account for all cost-effective energy efficiency. This resulted in a target-setting process, with program administrators using historic data and market-potential information to propose three-year savings targets. Final targets are approved as part of a negotiation process with the Energy Efficiency Advisory Council (EEAC). For the 2016–2018 period these targets call on program administrators to achieve savings of well over 2.5% of retail sales. The Green Communities Act also requires that at least 10% of portfolio budgets be dedicated to programs in the low-income sector.

Eversource and other program administrators in Massachusetts may receive a performance incentive. For the current program cycle the incentive mechanisms include both a savings mechanism, allocated on the basis of the dollar value of benefits, and a value mechanism, which is allocated on the basis of the dollar value of net benefits. Electric and gas utilities in Massachusetts, including Eversource, are decoupled pursuant to a 2008 Department of Public Utilities ruling.

Trends over Time

ENERGY SAVINGS

Pushed in large part by Massachusetts' energy-savings goals, Eversource (and WMECo and NSTAR in earlier years) has steadily ramped up both spending and savings for electric efficiency programs since 2009. Figure A14 shows spending and savings over time for the utility.

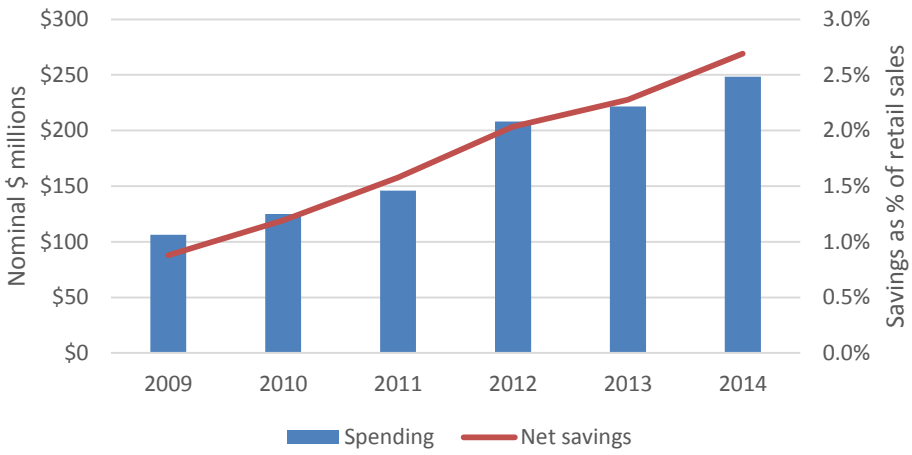

Figure A14. Net savings and total costs for Eversource electric efficiency portfolio, 2009–2014. Includes data for both NSTAR and WMECo. *Source:* Eversource data request.

Eversource has consistently achieved savings of over 2% for the past three years after a relatively sharp ramp-up from 2009 savings levels. The utility is one of the few in the country to achieve savings of over 2.5% of retail sales. Program costs have increased proportionally over time. These aggressive savings are driven by significant stakeholder input during the planning process and a commitment to capturing all cost-effective energy efficiency.

PORTFOLIO DESIGN

WMECo and NSTAR jointly form the Massachusetts arm of the company now known as Eversource. The two utilities still report separately. However program offerings have been aligned due to statewide coordination in Massachusetts. Figure A15 shows relative savings by program for 2010.

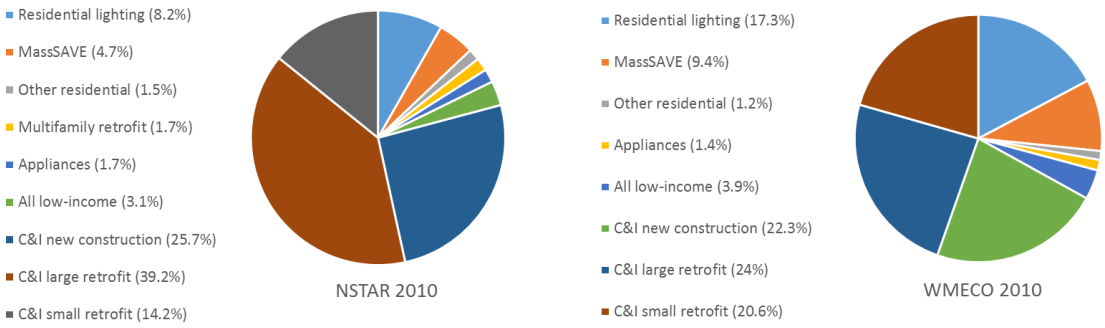

Figure A15. Portfolio savings by program type for WMECo and NSTAR, 2010. *Source:* 2010 annual energy efficiency reports.

Figure A16 shows savings by program type for both entities in 2014.

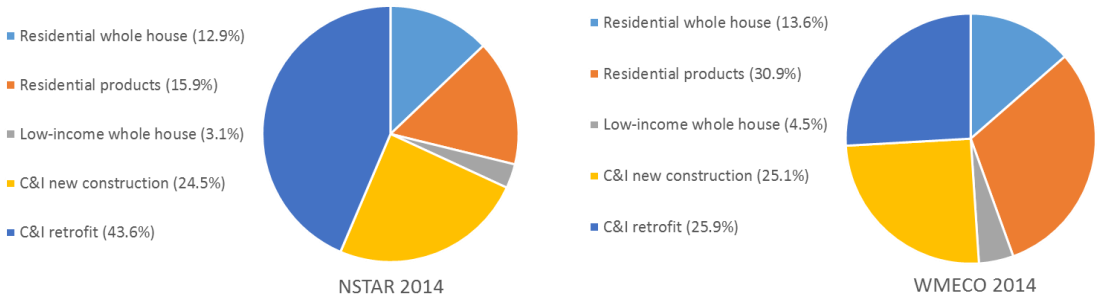

Figure A16. Verified portfolio savings by umbrella program for 2014. *Source:* WMECo and NSTAR annual reports.

Eversource offered more programs to its customers in 2014 than it did in 2010, but groups these programs under larger umbrellas. For example, the residential whole-house umbrella program includes four programs: new construction, multifamily retrofit, home energy services, and behavior. Of these Eversource saw the most savings from its home energy services program in 2014, closely followed by its behavior program offering. Of its residential products programs, lighting accounts for the greatest portion of savings.

Eversource achieves a significant amount of its savings from its C&I programs, with a relatively equal split between savings from retrofit and new construction programs in WMECo's service territory and savings from retrofit programs within the NSTAR service territory. Utility staff note that savings sources can vary significantly from year to year as large custom projects come in. Savings in this sector tend to be more uneven than savings achieved in the residential sector. Increasingly Eversource's C&I programs rely on segmentation efforts that address the needs of specific customer types (e.g., health care providers versus property management industries).

COST EFFECTIVENESS

The TRC test is the primary test used in Massachusetts. The Green Communities Act laid out guidelines around cost-effectiveness testing, which occurs at both the program and the portfolio levels. Figure A17 lays out TRC ratios by year for Eversource.

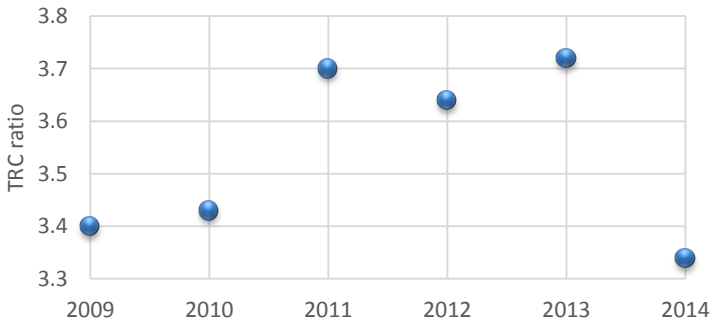

Figure A17. TRC ratios for Eversource. TRC ratios were calculated based on reported net TRC benefits and costs.

Portfolios have been highly cost effective since 2009. This is in part due to the high avoided costs in the region, estimated to be about 11 cents per kWh.[30] However, as with other parts of the country, program administrators face declining natural gas prices. This has had only a limited effect on the electric programs Eversource offers, but could pose a threat to some of the utility's natural gas efficiency programs. However electric programs may face other challenges. The state's most recent three-year plan notes that program administrators expect costs to rise due to continued market penetration and declining savings per customer.

Challenges and Opportunities

ACHIEVING DEEPER ENERGY SAVINGS IN MORE MARKETS

In part due to the success of existing program efforts, Eversource has had to look for new approaches to drive customer participation. Reaching more customers in different markets will be necessary to meeting aggressive targets in the 2016–2018 time frame. Statewide strategies for driving deeper market penetration include increased focus on renter participation in programs and augmented programs for low- and middle-income customers.

LOOKING BEYOND LIGHTING

Eversource staff express that the greatest challenge they see going forward is the impact of federal Energy Independence and Security Act (EISA) standards that significantly reduce claimable savings for lighting measures, a concern shared by staff at many other high-achieving utilities. Lighting presently accounts for well over 50% of portfolio savings. The state's current three-year plan estimates that by 2019 program administrators will have shifted heavily toward LEDs. In 2014 LEDs made up about 19% of total rebated lamps in the state, but it is anticipated that by 2018 LEDs will make up over 60% of the total.[31] In addition to the pivot toward LEDs, Eversource staff predict that other residential technologies will play a larger role in achieving energy savings. For example, home automation technology is an increasing area of focus, especially due to the link it provides between demand reduction and energy efficiency.

[30] The Massachusetts EEAC commissions regional avoided-cost studies periodically. For example, see ma-eeac.org/wordpress/wp-content/uploads/2015-Regional-Avoided-Cost-Study-Report.pdf.

[31] See the October 30, 2015, filed 2016–2018 three-year plan for more details. ma-eeac.org/wordpress/wp-content/uploads/Exhibit-1-Gas-and-Electric-PAs-Plan-2016-2018-with-App-except-App-U.pdf.

FORT COLLINS UTILITIES

Fort Collins Utilities (FCU) has provided electric service to the citizens of Fort Collins since 1935. Since 1973 Fort Collins has been a member-owner of Platte River Power Authority (Platte River), a collaborative agency of four cities that is charged with securing transmission and electricity.[32] Platte River owns and operates natural gas– and coal-fired power plants while also purchasing wind, solar, and hydropower to meet customer needs. Platte River Power Authority currently provides approximately 75% of Fort Collins' electricity from coal generation. The City of Fort Collins provides electric service to over 70,500 customers over a 55-square-mile service territory.

FCU offers all customers a comprehensive portfolio of programs, which are planned and implemented collaboratively with Platte River. In 2013 Platte River and the four communities created a regional brand for programs called Efficiency Works. As programs evolve or new ones develop, they are integrated under the Efficiency Works brand to provide more-consistent messaging and structure for both customers and efficiency service providers.

Policy Drivers

FCU's energy efficiency programs are guided by municipal-level policies. Fort Collins' energy policy planning is heavily focused on reducing carbon emissions, with the goal of making the city carbon neutral by 2050. The latest planning document released by the City of Fort Collins highlights energy efficiency as a primary resource to increase energy savings and decrease carbon emissions.[33] Table A3 shows the aggressive energy efficiency savings goals outlined in the energy policy. The savings targets represent incremental gross energy savings at the customer meter based on a historic three-year average of retail sales. The FCU savings targets are among the highest municipal electric-savings targets nationally.

Table A3. FCU savings targets, 2015–2020

Year	Savings target
2015	1.5%
2016	1.75%
2017	1.75%
2018	2%
2019	2%
2010	2.5%

[32] Fort Collins represents approximately half of the energy requirements of the Platte River Power Authority.

[33] See *Fort Collins Energy Policy* (City of Fort Collins: December 15, 2015). www.fcgov.com/utilities/img/site_specific/uploads/Fort_Collins_2015_Energy_Policy.pdf.

FCU does not have full revenue decoupling or a lost-revenue recovery mechanism. Instead rates are updated annually to reflect changes in forecasted sales. FCU also does not have performance incentives or penalties in place.

Trends over Time

ENERGY SAVINGS AND PORTFOLIO SPENDING

Figure A18 shows the program spending and electric savings as a percentage of sales from 2005 through 2014. FCU has substantially increased savings over this time period. The large bump in savings from 2009 to 2010 resulted from a significant increase in budget, higher savings goals, the implementation of the residential behavior program, and the completion of a few large projects in 2010 (started in 2009). The increase in 2013 is attributable to changes in the OPOWER methodology: instead of going only to a treatment and control group, reports were sent to all customers.

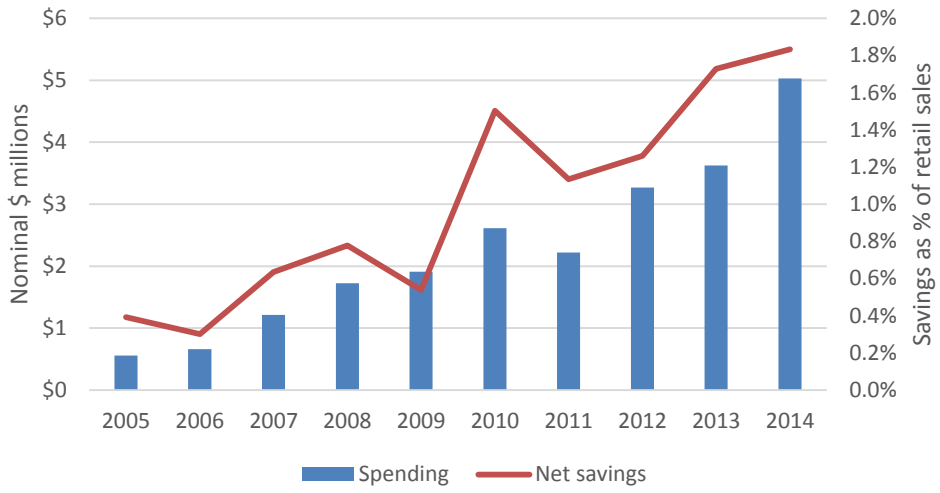

Figure A18. FCU program spending and gross energy savings as a percentage of retail sales, 2005–2014. Program spending does not include performance incentives. *Source:* FCU data request.

PORTFOLIO DESIGN

Figure A19 shows the breakdown of the FCU program portfolio by program for 2009 and 2014. In 2009 the FCU portfolio contained only three programs and was dominated by the Efficiency Works Business program. Efficiency Works Business is a mix of several programs including HVAC, C&I custom, lighting, and envelope measures. The other program that was significant in 2009, Consumer Products, is composed of residential appliance-recycling and lighting rebates. In terms of total savings, the Consumer Products program increased slightly from 2009 to 2014 but made up a much smaller portion of the total portfolio. The Home Energy Reports program grew significantly from 2009 to 2014. FCU also increased energy savings through several new programs including codes and standards achieved through local ordinances, voluntary business reporting of energy-saving projects (ClimateWise), low-income audits and direct installs, and an Efficiency Works Home

program aimed at increasing residential energy savings through audits, envelope measures, and HVAC savings.

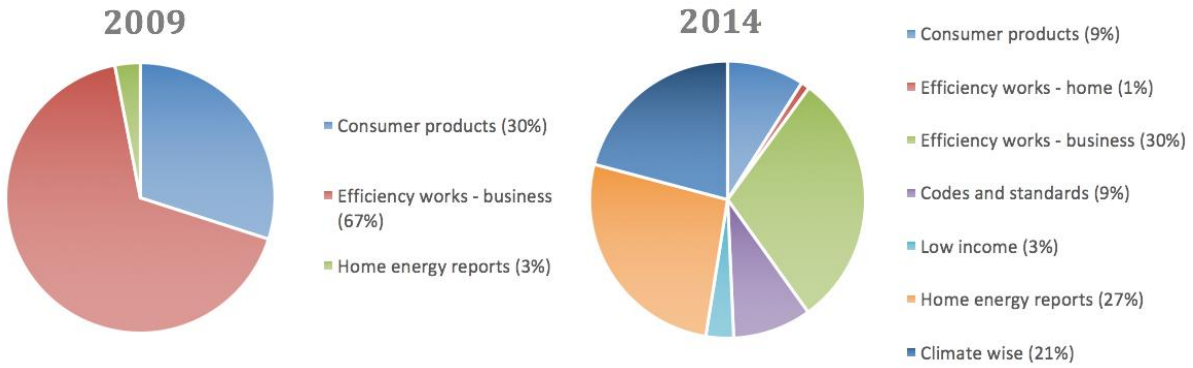

Figure A19. Top 10 energy-savings programs for 2009 and 2014 program portfolios. Percentage values indicate the percentage of savings of the entire portfolio. *Source:* FCU data request.

COST EFFECTIVENESS

FCU calculates an LCSE to determine the cost effectiveness of programs. This approach allows the company to better compare the cost of energy efficiency programs to other supply-side options such as wholesale purchases of electricity. The calculation is based on lifetime gross energy savings from programs and associated costs. Figure A20 shows the cost of saved energy compared to the average wholesale market price for electricity between 2010 and 2014.

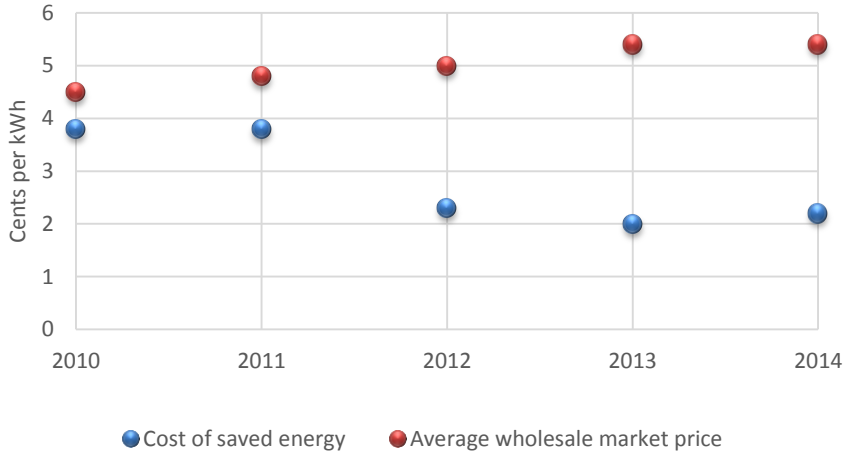

Figure A20. FCU cost of saved energy and average wholesale market purchase price for electricity, 2010 to 2014. *Source:* FCU data request.

This figure shows that the FCU programs since 2010 have been very cost effective. The cost effectiveness of the programs has also declined as total electric savings have increased. Additionally, this figure demonstrates that while the average wholesale market price for electricity has increased since 2010, it remained very low at approximately 5 cents per kWh.

Challenges and Opportunities

The energy-savings targets shown in table A3 present FCU with significant challenges. In order to meet this goal FCU will need to increase participation beyond the customers who have traditionally been engaged in its programs. Another significant challenge for FCU moving forward is the low cost of wholesale market purchases. FCU measures program cost effectiveness using the average wholesale market price for electricity. If the portfolio as a whole is below this cost, the programs are considered cost effective. Historically FCU has lowered the cost of saved electricity while increasing total savings. This will become increasingly difficult as the utility expands savings opportunities. The low price of natural gas also presents difficulties in implementing gas measures. Finally, the smaller service area presents challenges in achieving economies of scale for program offerings and maintaining strong networks of contractors and vendors for programs.

Fort Collins has planned several new programs and approaches to meet these challenges. FCU is currently piloting a neighborhood building retrofit approach to residential efficiency and renewables, offering measure packages to people in neighborhoods with similar residential buildings. These packages have different tiers (i.e., good, better, and best) and include standardized pricing and an integrated on-bill financing offer. Finally, FCU is participating in a new pilot of a national midstream retailer incentive model for ENERGY STAR® products such as clothes dryers, freezers, sound bars, and room air conditioners.

In the business-customer class, FCU is piloting a remote-audit approach using advanced metering infrastructure data and property records. There is also an ongoing collaboration between Platte River Power Authority and Xcel Colorado on an upstream program for commercial rooftop heating and cooling units. This pilot will potentially provide valuable information on the feasibility of such a program for Fort Collins. While FCU will be engaged in several new pilots, the primary focus for achieving higher savings levels in the future is increasing participation in existing programs.

NARRAGANSETT ELECTRIC COMPANY

Narragansett Electric Company (NEC) is a local distribution company serving 495,000 electric and 263,000 gas customers in the state of Rhode Island. The utility covers the majority of the state's service territory. The company is a wholly owned subsidiary of National Grid and does not own any generating assets. NEC's total retail sales have declined since 2008 while its total number of customers has increased. Average sales per customer have declined for both residential and business customers since 2008.

Policy Drivers

Several significant state policies guide NEC's energy efficiency efforts. Rhode Island requires utilities to pursue all cost-effective energy efficiency through the Comprehensive Energy Conservation, Efficiency, and Affordability Act of 2006. This requirement has produced significant savings for Rhode Island residents. According to NEC the cumulative impact of the programs has resulted in a 13% reduction in energy use.

While the law requires all cost-effective energy efficiency, actual energy-savings targets are proposed by the state's Energy Efficiency and Resource Management Council (EERMC), approved by the Rhode Island Public Utilities Commission, and established through a collaborative planning process on a triennial basis. The most recent energy-savings targets were approved for the 2015–2017 plan. These targets, based on a 2012 baseline sales year, are 2.5% for 2015, 2.55% for 2016, and 2.6% for 2017 (NEC 2014b).

Rhode Island also allows NEC the opportunity to earn financial incentives for high program performance. The performance incentive is based on earning a percentage of program costs (capped at 6.25%) for achieving energy and demand savings targets.

Trends over Time

Figure A21 shows portfolio spending and energy savings for NEC from 2007 to 2014. Both spending and savings have increased substantially since Rhode Island's least-cost procurement law was passed in 2006. With the exception of slight declines in energy savings in 2008 and 2010, NEC increased energy-savings levels every year. The large increase in savings from 2013 to 2014 was mostly attributable to one 12.5 MW CHP project.

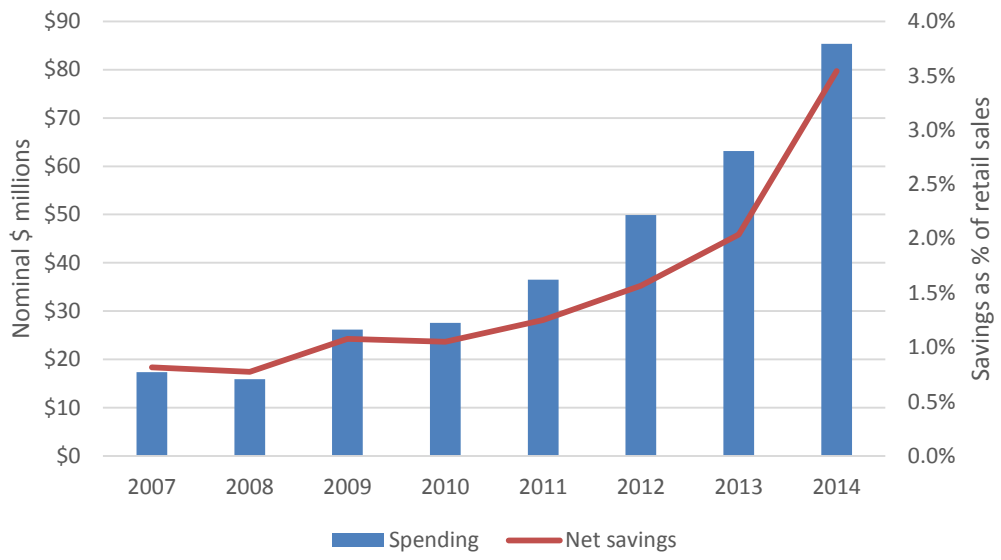

Figure A21. NEC program spending and net energy savings as a percentage of retail sales, 2007–2014. Program spending does not include performance incentives. *Sources:* NEC 2008–2015.

The high levels of cost-effective energy efficiency savings in Rhode Island have provided substantial value to Rhode Island customers, both program participants and non-participants. As figure A22 shows, the cumulative savings to customers from 2009 to 2015 was approximately 13%.

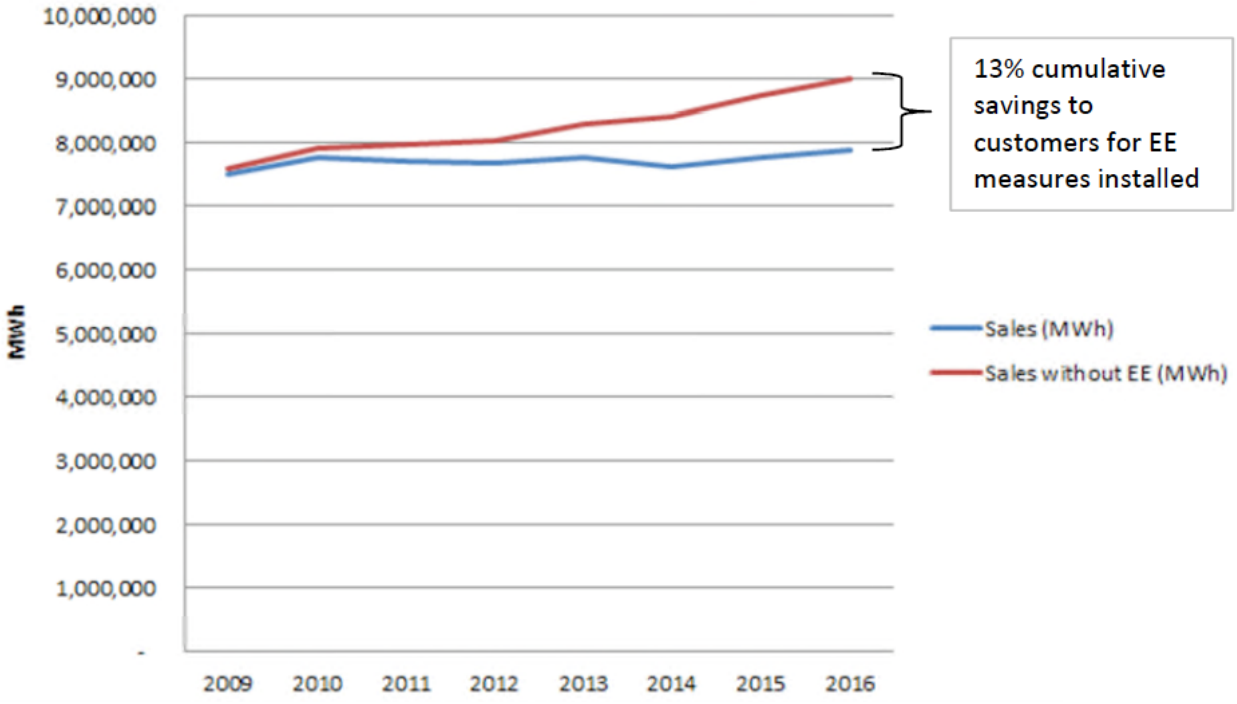

Figure A22. Cumulative impact of energy efficiency in Rhode Island, 2009–2015. *Source:* NEC 2015.

PORTFOLIO DESIGN

Figure A23 shows the NEC program portfolio in 2007 and 2014. The portfolio has changed significantly since 2007. C&I retrofits accounted for the majority of savings in both 2007 and 2014, growing from 31% to 43% of the total portfolio. Residential lighting has also declined as a share of portfolio savings, but has increased in total savings (from 18 GWh in 2007 to 30.7 GWh in 2014). The number of program areas also increased from 10 to 12 over the time period. New programs included residential behavior (14% of total savings in 2014) and a residential low-income multifamily program (1% of savings in 2014). The total split between C&I and residential-customer savings remained constant at 63% and 37% respectively.

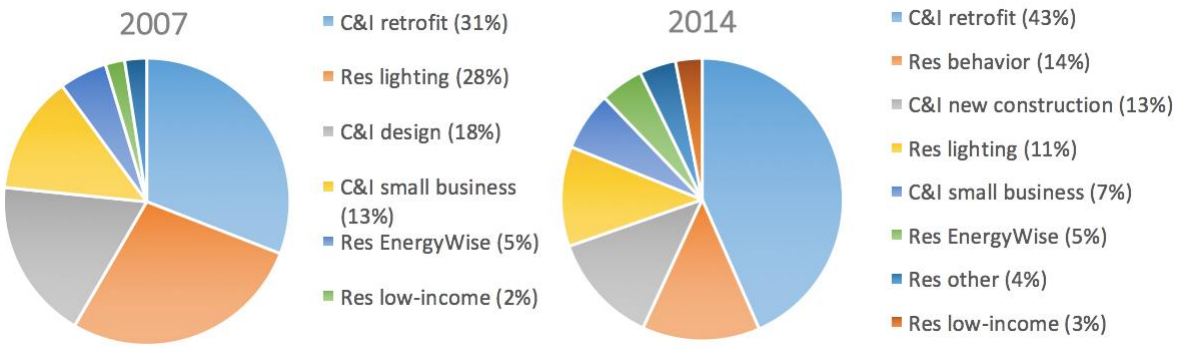

Figure A23. NEC program portfolio makeup for 2007 and 2014. Percentage values indicate the percentage of savings of the entire portfolio. *Source:* NEC 2008; NEC 2015.

COST EFFECTIVENESS

NEC relies on a modified TRC test to measure cost effectiveness. Figure A24 shows the cost–benefit ratio results for the portfolio from 2007 to 2014. As the figure shows, the portfolio remained cost effective for this period, never dropping below a ratio of 2. NEC includes traditional utility avoided costs (energy, generating capacity, and transmission and distribution capacity), but also includes specific participant and utility nonenergy benefits and capacity, energy, and cross-fuel demand induced price effect (DRIPE). It does not explicitly include environmental benefits, but many of these benefits are embedded in wholesale energy prices. CHP projects undergo a different cost-effectiveness analysis from other programs. The CHP analysis includes other economic benefits (NGMA 2015).

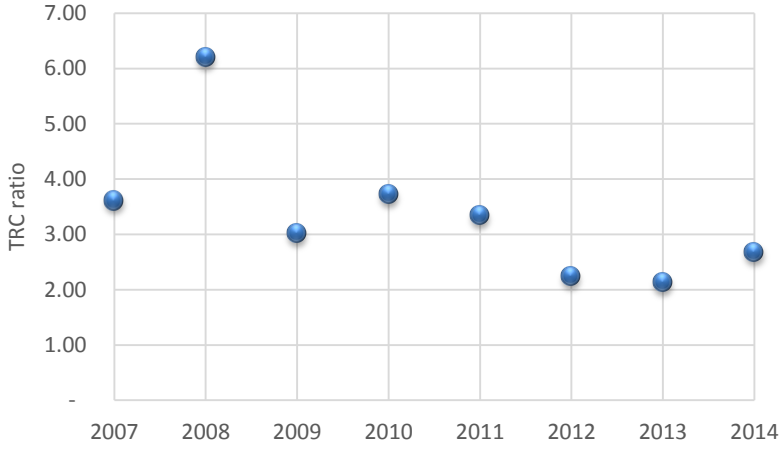

Figure A24. NEC TRC test ratio, 2007–2014. *Sources:* NEC 2008–2015.

Challenges and Opportunities

NEC faces several challenges moving forward. Changing codes and standards will limit some future savings opportunities, especially savings related to the lighting market. As figure A23 shows, NEC still achieves a significant level of energy savings from residential and commercial lighting programs. While the company now relies less on lighting than in previous years, it will need to make up the savings provided by lighting with other measures and programs. Even considering the changes to the lighting market, NEC intends to achieve high levels of savings from LED programs and lighting-control measures.

Despite these challenges, the potential for achievable energy efficiency in Rhode Island continues to grow. A recent update to the 2011 market potential study documented an increase in the estimated achievable potential for Rhode Island (EERMC 2013). The increased potential included new savings from company-promoted increased codes and standards, CHP, residential LEDs, and LED street lighting. The report also highlighted potential from additional savings from lighting controls and other new technologies, but did not include additional savings from these areas, as part of a conservative approach to analyzing potential.

In the future NEC intends to focus on improving existing programs and delivery of services. The company will focus on successful programs such as comprehensive residential retrofits and new construction. The primary strategies for increasing residential savings include community engagement and improved marketing. These strategies are intended to increase program awareness for existing and hard-to-reach participants. For commercial and industrial programs, the company will continue to focus on an upstream model and the Rhode Island Public Energy Partnership.

NATIONAL GRID MASSACHUSETTS

National Grid Massachusetts (NGMA) is composed of the Massachusetts Electric Company and the Nantucket Electric Company, both wholly owned subsidiaries of National Grid. The companies are both local distribution service companies operating in the New England Independent System Operator footprint. Combined, the companies serve over 1.3 million electric customers. Neither of these NGMA companies owns or operates any generation assets. The service territory contained approximately 60% business and 40% residential customers in 2014. Since 2008 total electric sales (in MWh) have declined while the total number of customers has slightly increased.

Policy Drivers

Massachusetts has in place one of the most aggressive utility energy efficiency savings targets in the nation. The EERS calls for utilities in Massachusetts to strive for implementing all cost-effective energy efficiency. The most recently approved statewide three-year plans call for an average annual savings of 2.93%. Goals for 2016–2018 also include an emphasis on new peak demand reduction efforts. While specific targets were not established in the most recent plans, a working group was directed to develop and implement new demand and peak reduction initiatives.

NGMA does have the opportunity to earn a performance incentive as part of a statewide performance incentive pool. This pool allows the company to earn an incentive based on savings (dollar value of benefits) and value (dollar value of net benefits) targets. Massachusetts previously allowed utilities to earn a performance incentive based on several key metrics to encourage other benefits not included in the value and savings mechanism, but this was discontinued in 2015 because these goals were being implemented through the statewide planning process. NGMA has had full revenue decoupling in place since 2009.

Trends over Time

ENERGY SAVINGS AND PORTFOLIO SPENDING

Net energy savings and program spending have increased annually since 2009. Figure A25 shows this trend for 2009 through 2014. NGMA was one of the highest-performing program administrators in 2014, achieving nearly 3% of savings as a percentage of sales. This trend is expected to continue in the next three-year cycle (2016–2018).

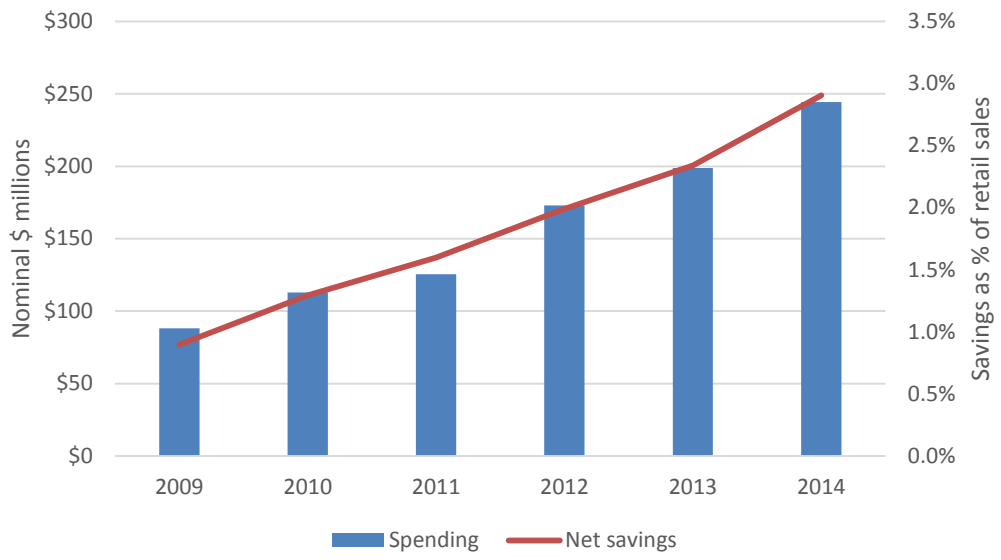

Figure A25. NGMA program spending and net energy savings as a percentage of retail sales, 2009–2014. Note: Program spending does not include performance incentives. *Source:* NGMA 2010–2015.

PORTFOLIO DESIGN

Figure A26 shows the NGMA program portfolio in 2009 and 2014. The figure highlights some significant changes to the portfolio over this five-year time period. In 2009 residential lighting dominated the portfolio, accounting for over 40% of the total savings. This share decreased to approximately 20% in 2014 with total savings growing from 248 GWh to 611 GWh during the time period. Two programs that were not offered in 2009 accounted for approximately 37% of total savings in 2014 (residential behavior, 14.5%, and C&I new construction, 22.5%). Finally, low-income programs as a share of the total savings have remained static since 2009 at approximately 3.5% of total savings.

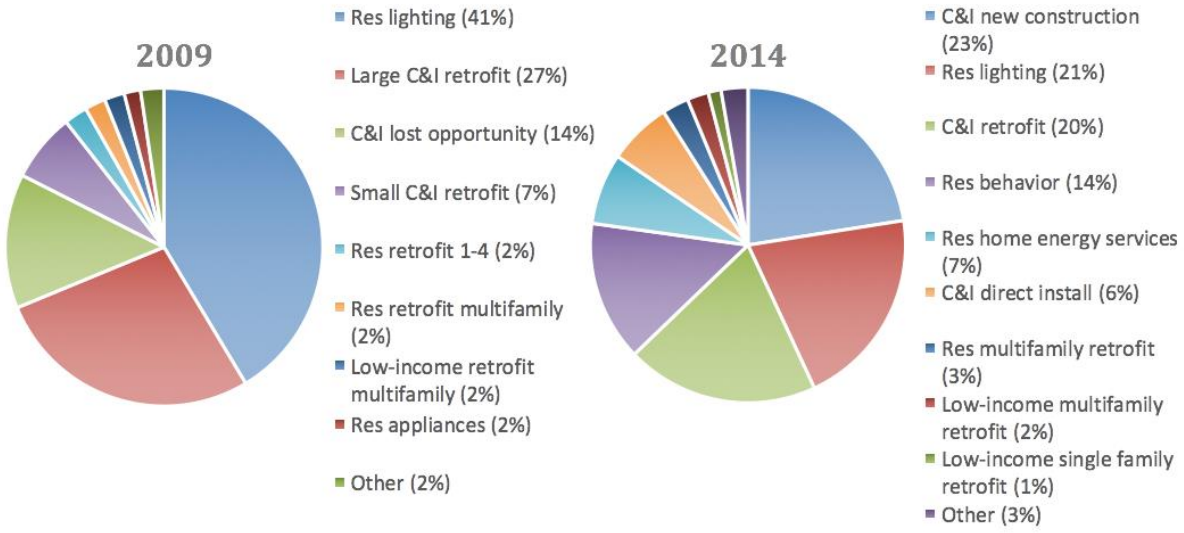

Figure A26. Top 10 energy-savings programs for 2009 and 2014 portfolios. Percentage values indicate the percentage of savings of the entire portfolio. *Sources:* NGMA 2010; NGMA 2015.

COST EFFECTIVENESS

NGMA relies on a modified TRC test to measure the cost effectiveness of programs. The modified TRC includes traditional utility avoided costs (avoided energy, generating capacity, and transmission and distribution capacity), but also includes avoided natural gas, propane, fuel oil, water, and several quantified nonenergy impacts of the programs. In addition it includes capacity DRIPE and natural gas DRIPE. Figure A27 shows the TRC ratio for the program portfolio from 2009 to 2014. The portfolio has remained highly cost effective in this period with ratios over 3 every year.

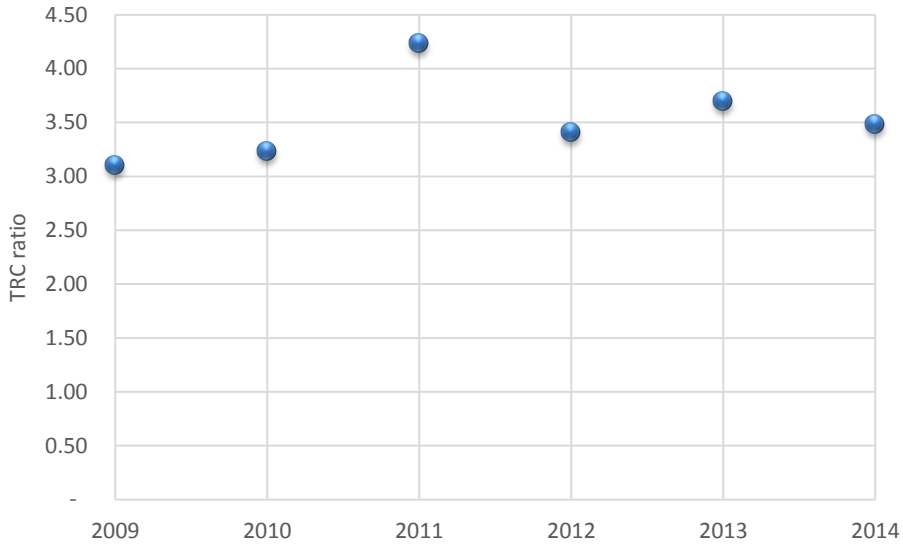

Figure A27. NGMA TRC test cost–benefit ratios, 2009–2014. *Source:* NGMA 2010–2015.

Challenges and Opportunities

In interviews with ACEEE staff NGMA highlighted several challenges in achieving and sustaining high levels of savings. NGMA faced several challenges in ramping up to high levels of savings. These included establishing the program-delivery network, recognizing and addressing the differences between customers by class and location, and improving marketing materials to ensure that customers understood the value of programs and got the right information.

Moving forward the greatest challenge for NGMA will be changing codes and standards, especially rising baselines for lighting measures. LEDs will be a significant area of focus for lighting programs in the future, but program managers also stressed the need to diversify the portfolio and not rely on one specific measure or program to carry it. NGMA will need to discover new savings opportunities in difficult markets.

NGMA participates in a statewide program planning collaborative led by the Massachusetts EEAC. The Massachusetts Department of Public Utilities then approves the plans. The most recent three-year plan highlighted several key strategies. For residential programs the plan includes enhancements to the multifamily initiative and renter-specific direct install, continuation of the LED program, and enhancements and continuation of existing low- and moderate-income program offerings. For commercial and industrial programs the plan

stresses the following strategies: broadening the upstream program-delivery mechanism, segment-specific outreach and implementation, and increased participation in the small-business initiative. Program plans also stress the critical importance of relying on process and impact evaluation results to guide changes in programs and producing real-time evaluations to the extent possible.

While Massachusetts currently does not count savings from CVR or CHP, both of these program types are potential savings targets in future years. NGMA program staff discussed the untapped high potential for savings in CHP opportunities. One priority moving forward in Massachusetts' most recent program plan is focusing on demand or peak demand savings. While no specific targets exist today an ad hoc group has been formed to explore these opportunities and increase demand savings. This group is reviewing demand-savings opportunities from existing energy efficiency programs, demand response, load-shifting programs, and geotargeted efforts to reduce demand.

NORTHERN STATES POWER COMPANY

Northern States Power Company (NSP) is a wholly owned subsidiary of Xcel Energy. The company currently serves 1.25 million electric customers in Minnesota. NSP owns approximately 9,000 MW of generation capacity of which 30% is coal-fired, 37% natural gas, 21% nuclear, 3% oil, and 10% renewables including biomass and wind generation. The company has experienced declining total sales and sales per customer since 2008. Approximately 71% of NSP's total electric sales are to business customers, with the remaining 29% to residential customers.

Policy Drivers

NSP has offered energy efficiency programs for decades, but the company has been subject to an EERS since 2010. The Next Generation Energy Act, passed in 2007, established targets for gas and electric utilities in Minnesota to achieve 1.5% gross incremental savings each year beginning in 2010. The baseline for this goal is established by averaging a weather-normalized adjusted sales total for a three-year period preceding the planning year in question. The total sales are adjusted by removing customers who have elected to self-direct their own programs. Customers under the self-direct option must show that they are making reasonable efforts to achieve energy savings (Minnesota Statute 216B.241 Subd. 1a (b)).

NSP is also able to earn an annual performance incentive for achieving specific energy-savings goals. The performance incentive mechanism is based on a shared net benefits approach that allows NSP to earn a percentage of the total net benefits resulting from the programs. The incentive payout is based on the performance of NSP in meeting electric savings as a percentage of its adjusted sales goal, and is capped at 20% of the net benefits. The company has performed well and has earned a performance incentive each year since 2010.

The Minnesota Public Utilities Commission approved a three-year pilot program for revenue decoupling for NSP in 2015. The pilot, which was approved as part of a larger electric-rate case and began in January 2016, is the first revenue-decoupling mechanism for an electric utility approved in Minnesota.

Trends over Time

ENERGY SAVINGS AND PORTFOLIO SPENDING

Gross energy savings for NSP have remained relatively stable since 2010 with a slight increase over time. Figure A28 below shows gross energy savings as a percentage of total retail sales since 2010.[34]

[34] The retail sales totals used to present this figure were not modified to remove opt-out customers. Removing these customers would have increased savings as a percentage of sales.

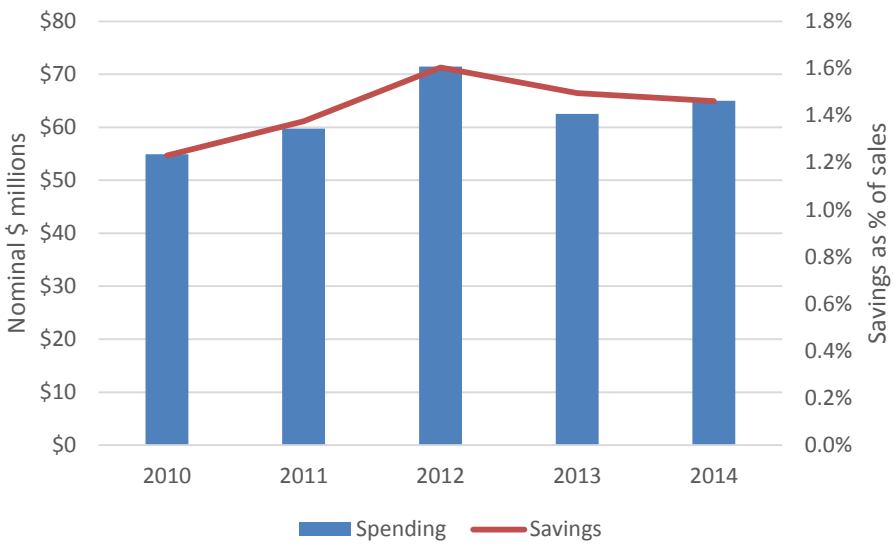

Figure A28. NSP program spending and gross energy savings as a percentage of retail sales, 2010–2014. Note: Program spending does not include performance incentives. *Sources:* NSP 2011–2015.

PORTFOLIO DESIGN

Figure A29 shows the difference in NSP's program portfolio energy savings between 2010 and 2014. In 2014 the programs with the highest level of savings included C&I new construction, C&I lighting, process efficiency, and residential lighting. Lighting in the residential and C&I sectors dominated the 2010 portfolio.

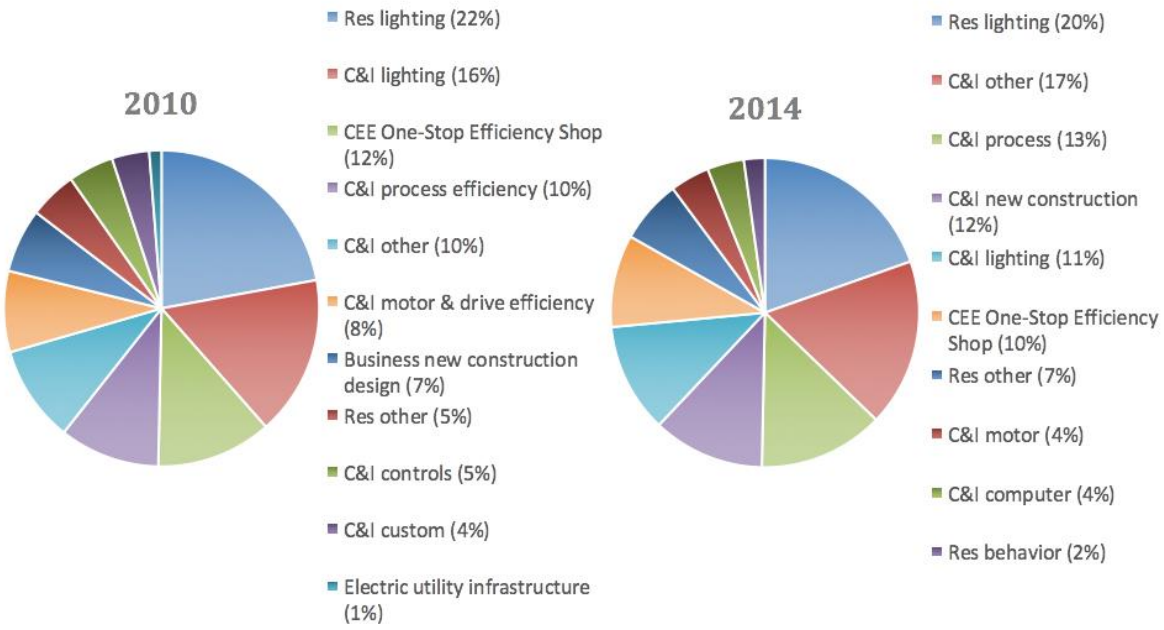

Figure A29. Top 10 end-use sectors for energy savings, 2010 and 2014 program portfolios. Percentage values indicate the percentage of savings of the entire portfolio. *Source:* NSP 2011; NSP 2015.

In 2010 approximately 40% of the total portfolio savings resulted from C&I and residential lighting programs. By 2014 this value had declined to roughly 31%. Several programs grew to cover the declines in savings from lighting programs. These programs include C&I New Construction, C&I Process Efficiency, Residential Behavior, Residential Heating Rebates, and C&I Cooling.

COST EFFECTIVENESS

While the Minnesota Department of Commerce, Division of Energy Resources, requires NSP to perform several California Standard Practice Manual cost-effectiveness tests, programs are screened using the SCT. The primary societal benefit included in cost-effectiveness testing is currently the value of environmental externalities. However these benefits are currently under review in a statewide proceeding. Figure A30 shows the cost-effectiveness results presented as the SCT ratio for 2010 through 2014. While this figure shows a modest decline from 2010 to 2014, NSP's portfolio has been highly cost effective since 2010 with ratios above 2.3 annually.

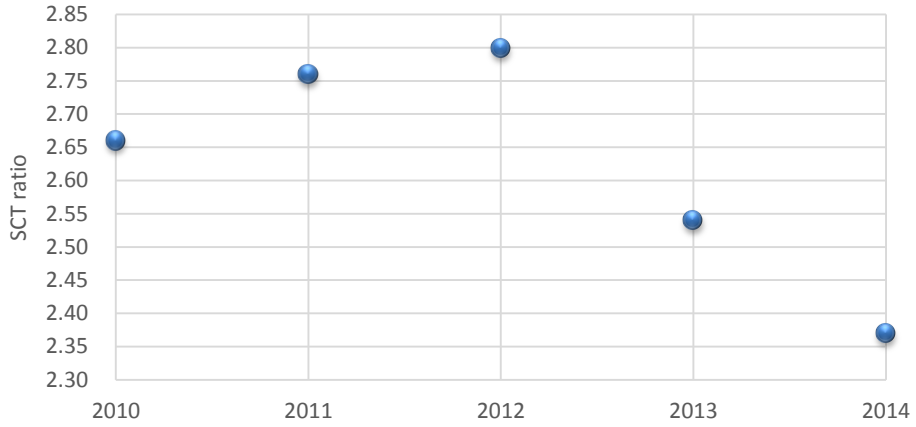

Figure A30. NSP SCT ratio results, 2010–2014. *Sources:* NSP 2011–2015.

Challenges and Opportunities

NSP staff highlighted two significant challenges to sustaining high levels of savings moving forward. The first is the changing baselines driven by more-efficient codes and standards, a challenge mentioned by most program administrators we interviewed. The changing codes and standards are expected to impact residential-savings opportunities at a higher level than commercial and industrial savings. The other significant challenge is the decline in cost effectiveness driven by declines in avoided cost. Staff noted that the declines in avoided cost are mostly a result of low natural gas prices and the increased use of wind power in the system. Low demand for additional peaking capacity is also impacting NSP's avoided costs.

NSP is the only program administrator we included in this study that has customers who opt out. (Otter Tail Power customers are also able to opt out, but none have done so.) The number of customers who have opted out of the programs has been small to date. Although the sales from these customers are removed from the calculation of NSP's electric energy-savings targets (savings as a percentage of sales), this still presents a challenge to the company as these customers are no longer required to pay the costs of implementing

programs, thereby reducing the total budget with which to offer these programs. Furthermore state statute explicitly forbids a utility from expending resources on energy efficiency at the site of a customer that has been granted an exemption by the Minnesota Department of Commerce (Minnesota Statute 216B.241 Subd. 2 (d)). These customers still enjoy the long-term benefits of the programs while not paying the costs.

Despite these challenges NSP staff are optimistic about their ability to continue to achieve and sustain high levels of savings in the future. NSP is now piloting or considering several program types including residential smart thermostats and business behavior-based programs. While lighting savings will likely not account for the large share of portfolio savings that it did previously, NSP still plans to achieve significant savings through new lighting measures such as LEDs. New AMI meters will also allow NSP the opportunity to take advantage of insights from the level of data provided by such metering technology. These data will allow for greater market segmentation and more-efficient marketing of programs to specific customers. The company also expects to achieve high levels of savings through deeper programs such as whole-home retrofits and commercial and industrial retro-commissioning. Finally, the company expects to continue its long-running partnership with CEE, a local nonprofit implementing a successful small-business program with direct funding from NSP. The savings from this program account for approximately 10% of the total portfolio for NSP annually.

OTTER TAIL POWER

Otter Tail Power Company (OTP) is an investor-owned electric utility headquartered in Fergus Falls, Minnesota. The utility has approximately 60,700 customers spread over 70,000 square miles in western Minnesota.[35] In 2014 approximately 80% of OTP's customers were residential, and the remaining 20% were commercial or industrial. The company owns 798 MW of generation. Its 2014 energy resource mix included 57% coal, 19% wind, 1% hydropower, and 23% market purchases. OTP's service territory is expansive and very rural. The average size of a community served by OTP is only 310 people. Finally, OTP is a winter-peaking utility operating in the Midcontinent Independent System Operator (MISO) regional transmission market.

Policy Drivers

OTP has offered energy efficiency programs in Minnesota since 1992. OTP's recent energy efficiency program performance has largely been driven by requirements in the Next Generation Act of 2007. The law requires electric and gas utilities in Minnesota to achieve a savings goal of 1.5% of annual retail sales. The baseline for determining compliance with this requirement is a three-year weather-normalized average of retail sales from the three years prior to the current plan.[36] OTP also complies with low-income spending requirements, which are based on a minimum spending of 0.2% of gross operating revenues from residential customers.[37] While the Next Generation Act allows revenue-decoupling pilot projects for both electric and gas utilities, OTP does not currently have decoupling in place.

Cost recovery and performance incentive mechanisms are critical drivers influencing OTP's success. According to the company these mechanisms put energy efficiency on par with supply-side investments as an earning opportunity (OTP 2013a). The performance incentive is a shared-savings mechanism allowing OTP to earn up to 20% of net benefits from programs. The company's most recent annual report describes the details of the performance incentive calculation (OTP 2015).

Trends over Time

ENERGY SAVINGS AND PORTFOLIO SPENDING

Figure A31 shows program spending and gross electric savings as a percentage of retail sales for 2007 to 2014. The graph shows OTP consistently achieving savings of 1.5% since 2008 with a slight decline in 2011.

[35] OTP also serves 57,900 customers in North Dakota and 11,600 customers in South Dakota.

[36] For example, the three-year goal of energy efficiency savings as a percentage of total sales for the 2014–2016 plan would be based on the average of the weather-normalized electric sales from 2010 to 2012.

[37] Minnesota Statute 216B.241, Subd. 7.

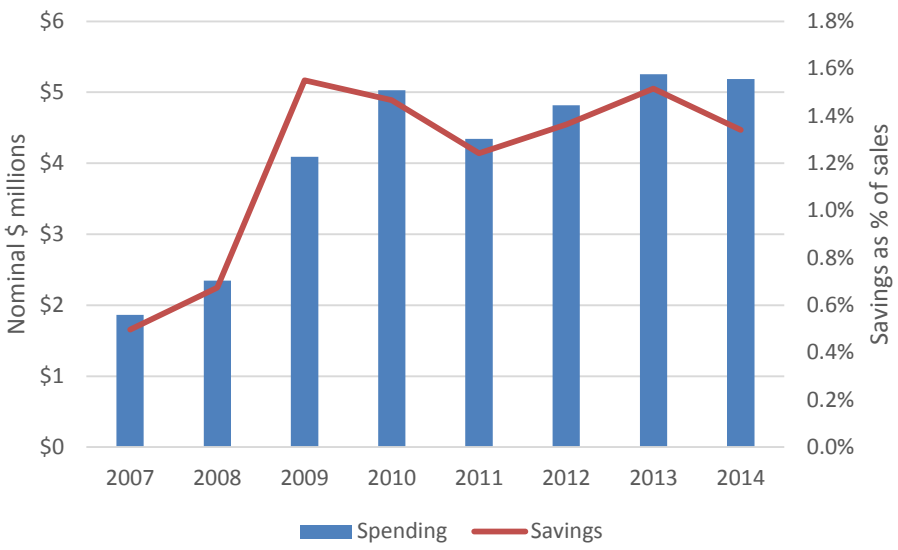

Figure A31. OTP program spending and gross energy savings as a percentage of retail sales, 2007–2014. Program spending does not include performance incentives. *Source:* OTP 2008–2015.

PORTFOLIO DESIGN

OTP's program portfolio changed significantly between 2009 and 2014. Figure A32 shows the top 10 programs in 2009 compared with the top 10 in 2014. As the figure demonstrates the 2014 portfolio is much more diverse than the 2009 one. Commercial and industrial savings accounted for over 90% of portfolio savings in 2009, but dropped to 69% in 2014. The residential sector's share of total portfolio savings grew from 9% in 2009 to 31% in 2014.

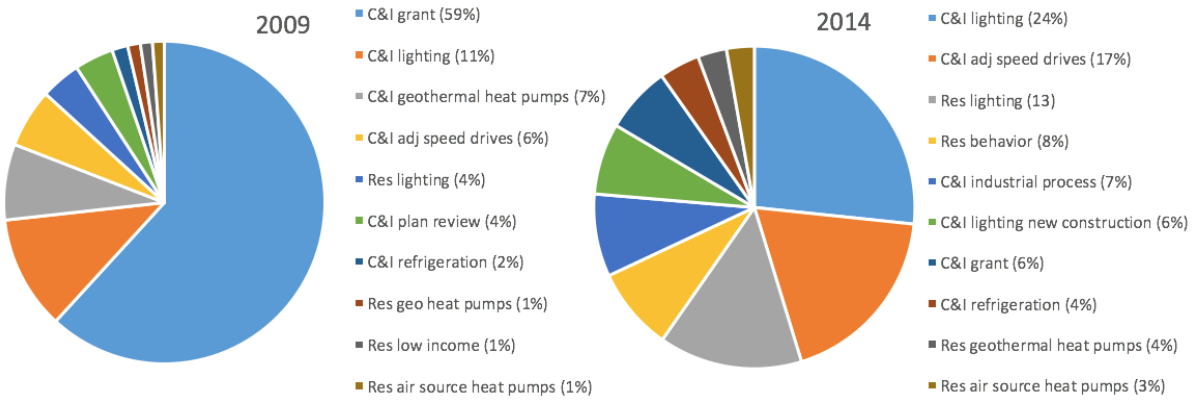

Figure A32. Top 10 energy-savings programs for OTP's 2009 and 2014 program portfolios. Percentage values indicate the percentage of savings of the entire portfolio. *Sources:* OTP 2010; OTP 2015.

Savings from lighting programs grew from 16% of the total portfolio in 2009 to 43% in 2014. These values do not include lighting savings from programs not exclusively focused on lighting. For example, OTP also introduced several large saving programs including C&I Industrial Processes and residential behavior–based energy-feedback programs. The C&I Grant (or custom) program's share of the total portfolio declined significantly after 2009. Savings from the grant program dropped from 21 GWh in 2009 to 2 GWh in 2014.

COST EFFECTIVENESS

OTP relies on the SCT and the PACT to screen programs and gauge effectiveness in evaluation. For the PACT the company relies on the utility average weighted cost of capital as the discount rate (8.61% in the most recent program plan). For the SCT the company uses the 20-year Treasury bill rate (2.68% for the most recent program plan). The SCT also includes quantified externality values for carbon dioxide, sulfur dioxide, and nitrogen oxide emissions.

Figure A33 shows annual cost-effectiveness results by sector for 2007 through 2014. These results indicate that OTP has continued to administer highly cost-effective programs since 2007. The trends of cost effectiveness also indicate that the company has improved cost effectiveness annually since 2010.

Figure A33. OTP SCT ratios by sector, 2007–2014. *Sources:* OTP 2008–2015.

Challenges and Opportunities

OTP anticipates several challenges in coming years as energy savings from behavioral and lighting programs decline. Declining avoided costs due to low natural gas prices and wind power are also a significant challenge. The company is working toward increasing energy savings through investments in distribution and transmission automation. The most recent three-year program plan discussed this effort, but it is not a current source of energy savings. However these investments are currently not eligible for the performance incentive.

These investments would include "the development of a robust system for demand response, distribution automation, remote meter reading, outage management, and customer data presentment and analysis" (OTP 2013a). The company currently does not have automated meter reading or advanced metering infrastructure installed. Investments in new meter technology and distribution system automation will allow the company to implement CVR or volt/VAR optimization to increase energy savings.

OTP is also focused on pricing structures to drive behavior changes from customers. Through the investment in advanced metering technology OTP will have the ability to implement more-advanced time-based pricing schemes such as time-of-use rates and critical

peak pricing. Finally, OTP intends to use interval-level data collected through advanced meters to drive analytical approaches to increasing energy savings, such as providing customers with valuable information on how behavior affects energy use (OTP 2013b).

Several other programs will make significant contributions to the OTP portfolio. Residential programs include smart thermostats, behavior programs, and geothermal heat pumps. The company also anticipates high savings levels from several industrial programs to continue to drive the portfolio, including industrial process efficiency, retro-commissioning, and variable-frequency drive motors. In interviews with ACEEE the company's staff noted that continued innovation in existing and new program opportunities will be essential for maintaining high savings levels in the future.

PACIFIC GAS AND ELECTRIC

Pacific Gas and Electric Company (PG&E) is one of the largest combined natural gas and electric utilities in the United States. PG&E provides energy to about 16 million people across northern and central California.[38] The utility's electric power mix is about 24% natural gas, 21% nuclear, 8% large hydroelectric power, and 27% renewables like wind, solar, and biomass.[39]

Policy Drivers

PG&E and other investor-owned utilities in California have been delivering energy efficiency programs for over three decades under the oversight of the California Public Utilities Commission (CPUC). California approved decoupling for its utilities in 1982 but removed these mechanisms in 1996 due to restructuring. Decoupling resumed for PG&E in 2004 and continues today.

PG&E is also subject to energy efficiency targets that are developed in response to the state's 2003 loading order, which requires utilities to pursue all cost-effective energy efficiency resources before pursuing other supply-side options.[40] The CPUC developed interim gross energy-savings goals through 2020, which averaged around 800 MWh annually for PG&E. However in more recent years the CPUC has approved higher energy-savings goals for PG&E, most recently in Decision 15-10-028. The CPUC indicated that these goals would likely be revised again in 2018. Utility staff noted that internal energy efficiency team members are extremely focused on meeting energy-savings goals and receive monthly reports on progress toward EERS targets.

There is also an incentive mechanism in place for PG&E. The most recent mechanism was approved in September 2013 and is linear in nature.[41] Previous iterations of PG&E's performance incentives included steps, whereby specific savings amounts triggered different earnings opportunities, as well as a penalty for poor performance.

Trends over Time

ENERGY SAVINGS AND PORTFOLIO SPENDING

Trends in spending generally correlate with PG&E portfolio periods, with increases in spending coming in the final year of a multiyear phase (2008 to 2012, for example). A portion of this increase is due to the large spending amounts associated with evaluation during these years, as well as ramping up activities after cultivating longer-term projects in

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[38] The utility has 5.4 million electric customer accounts and 4.3 million natural gas customer accounts.

[39] These numbers reflect the generation mix in 2014. Note that 21% of the electric power mix is "unspecified," which refers to electricity that is not traceable to specific generation sources. PG&E is working toward 33% renewable generation by 2020. For more details see www.pge.com/includes/docs/pdfs/myhome/myaccount/explanationofbill/billinserts/11.15_PowerContent.pdf.

[40] The loading order was adopted in the *2003 Energy Action Plan* prepared by the California Energy Commission (CEC), the CPUC, and the California Consumer Power and Conservation Financing Authority.

[41] For more details on the performance incentive mechanism, see "Decision Adopting Efficiency Savings and Performance Incentive Mechanism." California Public Utilities Commission, Decision 13-09-023, September 11, 2013. docs.cpuc.ca.gov/PublishedDocs/Published/G000/M076/K775/76775903.pdf.

earlier years of the phase. PG&E net savings have generally fluctuated between 0.8% and 1.26%. However baselines and freeridership have been a significant focus in California, leading to more-stringent net-to-gross ratios than average. PG&E gross savings are therefore significantly higher. Figure A34 shows net savings.

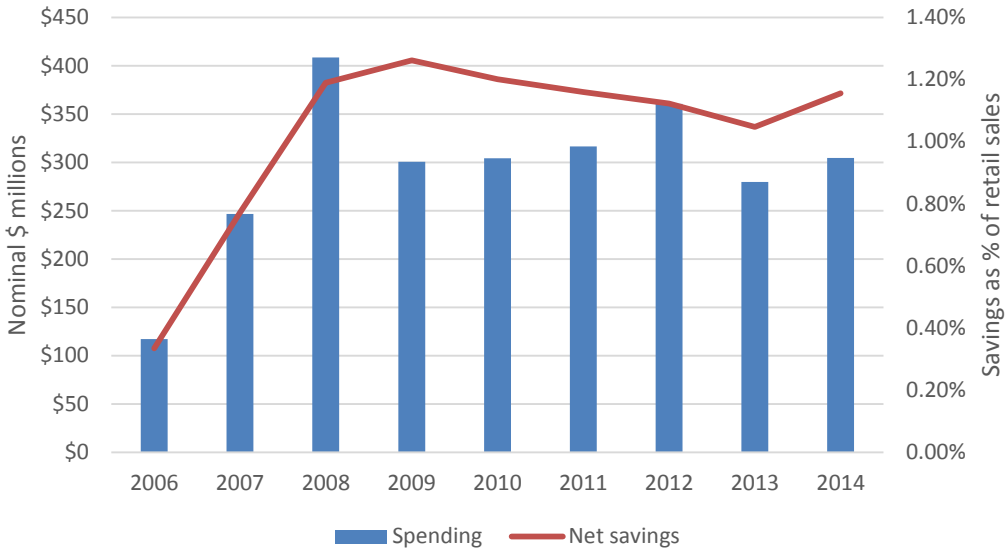

Figure A34. Net savings as a percentage of retail sales and total electric efficiency portfolio costs for PG&E (excluding performance incentives). Because PG&E is a dual-fuel utility, spending reflects the proportion of overall portfolio costs assigned to electric ratepayers, or about 82% of total portfolio spending (L. Nickerman, pers. comm., November 24, 2015). Savings data from 2006–2013 are from NRDC; 2014 data are as reported in PG&E's 2014 Annual Report.

PG&E also notes in its annual reports that it balances long-term strategies with long lead times and energy efficiency measures that customers can purchase and install in shorter time frames.

PORTFOLIO DESIGN

PG&E has a long history of delivering energy efficiency programs. Even programs in the mid-2000s targeted a variety of end uses. Figure A35 shows PG&E's portfolio savings by end use in 2008 and 2013.

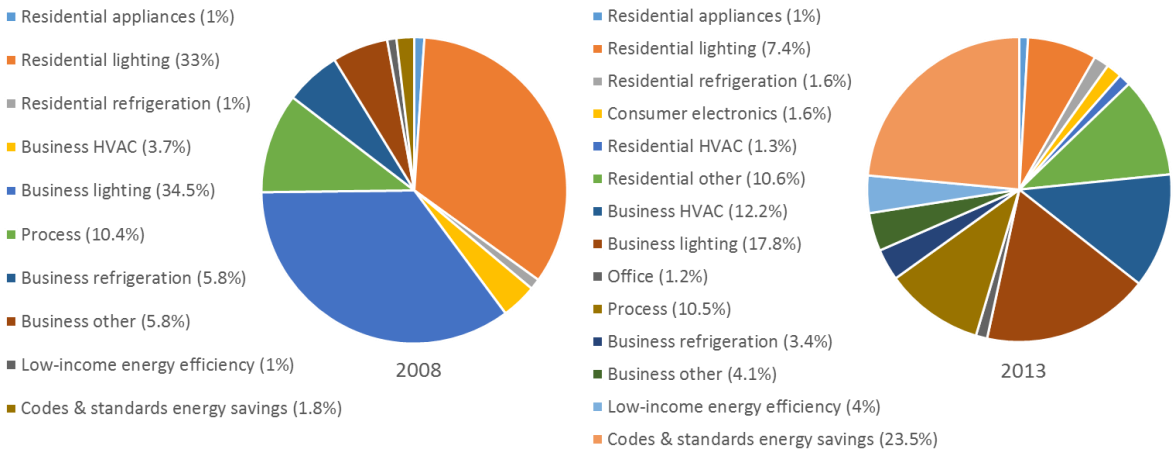

Figure A35. PG&E reported savings by end use. End uses of less than 1% of portfolio savings are not shown.
Sources: **PG&E 2009b; PG&E 2014.**

PG&E claims energy-savings credit from its work on codes and standards, which includes influencing standards and code-setting bodies to strengthen energy efficiency regulations, working with local governments to improve code compliance, and assisting local governments to develop green building codes. This makes up a growing portion of its total savings, rising from less than 2% of total portfolio savings in 2008 to about 16% in 2013.

Savings credited to lighting projects meanwhile have significantly declined. Lighting made up about two-thirds of total portfolio savings in 2008, but in 2013 made up only 17% of total savings. While this is still a large portion of total savings, the decrease is notable. In the residential sector, behavior programs make up a growing portion of overall portfolio savings. (These are included in the "other" category, which accounted for 7% of total savings and 35% of residential savings in 2013.)

COST EFFECTIVENESS

California investor-owned utilities use all five classic cost–benefit tests as outlined in the California Standard Practice Manual. PG&E reports cost-effectiveness values associated with the TRC and the PACT.[42] Cost-effectiveness tests exclude low-income energy efficiency programs. Figure A36 shows PG&E's reported TRC ratios.

[42] The PACT can also be referred to as the utility cost test (UCT).

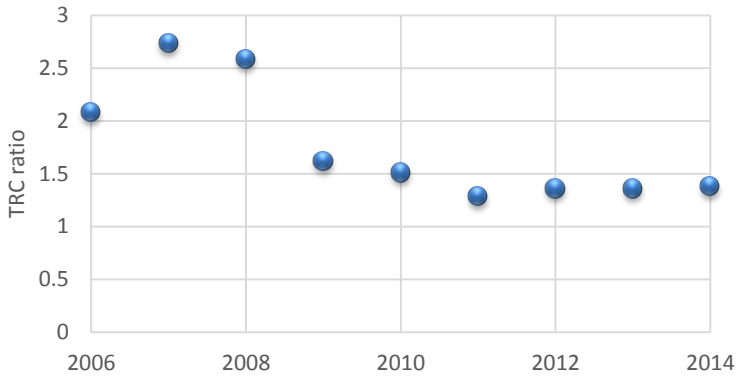

Figure A36. TRC results for PG&E portfolios as reported in annual reports. These may differ from statewide evaluations conducted periodically. *Source:* PG&E annual reports.

In interviews staff noted that maintaining a cost-effective portfolio has become more of a challenge in recent years. As is true for many other utilities we profiled, changing lighting baselines associated with EISA have eliminated some cost-effective measures. PG&E also designs its portfolio to meet several requirements that do not generate savings including workforce education and technical support. At the same time PG&E's commitment to market transformation and economy-wide efficiency has helped it find new ways to generate savings at low cost. For example, portfolio cost effectiveness is buoyed by PG&E's involvement in codes and standards work, which utility staff describe as "hyper cost effective."

Challenges and Opportunities

LEVERAGING DATA

PG&E's targeted demand-side management (DSM) initiative uses energy efficiency and demand response to defer distribution-system capital upgrades. The utility forecasts potential system overloading over the next few years to determine new capacity upgrades that may be deferred or avoided. Customer data are then used to determine the types of energy efficiency measures that may be appropriate. Because the utility has a varied customer base, some substations may be better served by measures targeting air-conditioning loads while other substations may serve large customers that can benefit from measures focused on industrial food processing, for example. PG&E also recognizes the importance of data in improving marketing efforts. The utility uses targeted outreach to guide mailers, maximizing uptake. There are currently four pilots under way as part of this effort.

MARKETING AND ACCESS TO INFORMATION

PG&E places significant emphasis on strategically marketing programs to customers. In the past the utility has used more-traditional approaches to marketing that involved reaching out to large portions of its customer base to highlight the availability of specific technologies. Current campaigns focus on hyper-local marketing to maximize community engagement. The goal of the marketing campaigns is twofold: to increase customer awareness of rebates and to encourage behavior change.

PG&E also recognizes the potential importance of ease of customer access to information and has launched a marketplace for customers to purchase energy-efficient technologies.[43] The marketplace provides energy scores and expected dollar savings for energy-efficient appliances, and links directly to websites where customers can purchase these items. Utility staff express that there may be some potential for savings through the marketplace even without the use of incentives.

PAY FOR PERFORMANCE

For the last few years PG&E has operated a pay-for-performance pilot designed to achieve deep savings in commercial buildings. These comprehensive measures target operational, behavioral, and equipment-based upgrades. According to PG&E staff large customers participating in the program have been able to fully redesign their lighting systems rather than simply swapping bulbs. The program has also allowed PG&E customers to incorporate lighting controls in a way that a widget-based approach would not. The pay-for-performance model is likely to gain more traction as California shifts to an evaluation, measurement, and verification (EM&V) approach that measures savings at the meter, as required under new legislation.[44] The utility is examining the potential for implementing this program in the residential sector.

DOUBLING IMPACT WITH LIMITED FUNDING

California has set a challenging but important path forward for PG&E. Senate Bill 350, enacted in 2015, calls on the CEC, CPUC, and investor-owned utilities to work together to double energy savings. Utility staff noted that while savings needed to double, budgets would not increase proportionally. However PG&E can adjust budgets through an application to the CPUC. Because energy efficiency investments must be cost effective, any increase in budgets for these programs would necessarily result in net benefits. Furthermore the utility also designs portfolios in response to an executive order calling for greenhouse gas reductions of 80% by 2050. Because energy efficiency can help meet this goal, its cost effectiveness compared to other emissions reduction strategies is also a consideration. To achieve these increased savings while keeping costs low, PG&E continues to refine its portfolio using a data-driven approach. It is also looking outside of ratepayer funding, the traditional source of capital. Utility staff noted that on-bill financing is an increasing focus as PG&E can leverage utility-bill financing to draw on private capital.

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[43] See marketplace.pge.com.

[44] California Assembly Bill 802 calls for energy savings to be measured based on "normalized energy consumption."

SEATTLE CITY LIGHT

Seattle City Light is a municipal utility that serves more than 400,000 customers in the greater Seattle area. The utility owns and operates several hydroelectric projects, which account for nearly 60% of total generation. Remaining demand is met through a mix of power sources including long-term contracts with the Bonneville Power Administration (BPA). About 4.3% of Seattle City Light's electricity is nuclear-generated, 3.6% is wind-generated, and less than 1% is coal-generated.[45]

Policy Drivers

Seattle City Light began offering conservation programs in the late 1970s. In 2006 a statewide voter initiative passed that requires utilities serving more than 25,000 customers to pursue all cost-effective energy efficiency. State law directs Seattle City Light to develop a Conservation Potential Assessment (CPA) every two years to be filed with the state Department of Commerce. The CPA contains energy-savings targets as well as 10-year potential savings estimates. Inputs come from the NWPCC's regional power plans, and the Seattle City Council adopts these targets as binding.

Washington is also one of only a few states with penalties in place for utilities that do not achieve planned energy savings. Seattle City Light is subject to these penalties and must pay $50/MWh if it fails to meet targets. Seattle City Light is not decoupled, and there are no incentives in place for meeting or exceeding targets.

Trends over Time

ENERGY SAVINGS AND PORTFOLIO SPENDING

Over the last seven years Seattle City Light has nearly tripled the amount of electricity savings it achieves each year, from about 0.6% of retail sales in 2007 to nearly 1.8% in 2014. Spending meanwhile has approximately doubled. Figure A37 shows savings and spending on electricity efficiency programs from 2007 onward.

[45] These numbers reflect the 2014 fuel mix as reported: www.seattle.gov/light/FuelMix/.

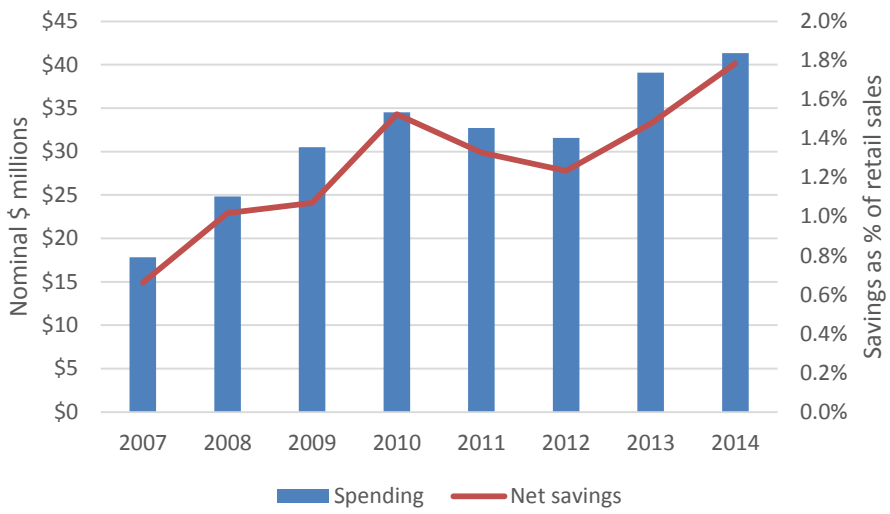

Figure A37. Reported savings as a percentage of retail sales and total portfolio costs for Seattle City Light. *Source:* Data request completed by Seattle City Light staff.

Staff noted that the EERS is a large driver of savings. Although the utility has been delivering efficiency services for a long time, it is conscious of targets, and savings have increased to account for all cost-effective energy efficiency. However local politics also influences savings and spending, as the municipal utility is responsive to the city council. Staff noted that over time spending has increased, as the utility funds more programs and invests in more memberships.

PORTFOLIO DESIGN

Figure A38 shows Seattle City Light program offerings in 2008 and 2014.

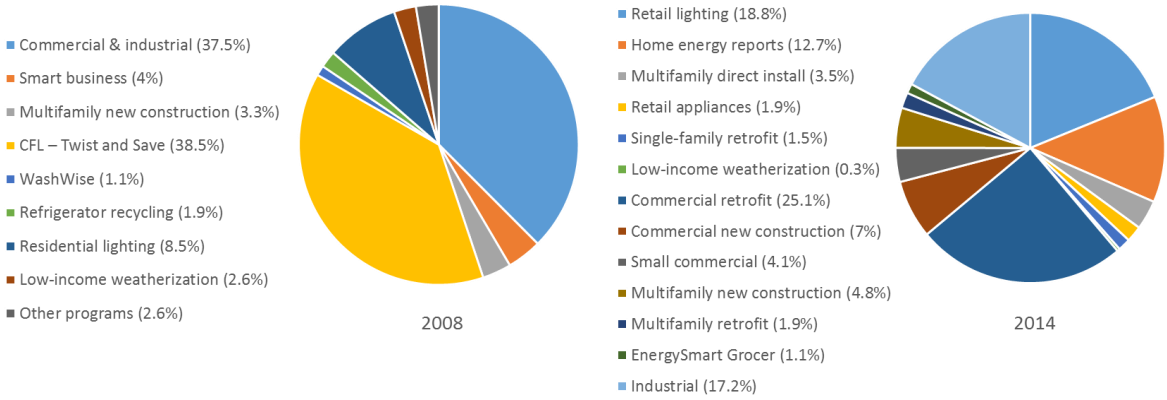

Figure A38. Seattle City Light reported savings by program. Savings from regional programs and avoided line losses are not shown. *Sources:* 2008 and 2013 annual reports.

Compact fluorescent lighting was a large focus area for the utility in 2008, making up more than a third of total savings. Seattle City Light reported that the savings achieved in 2008 from its CFL program alone were enough to power 3,700 homes for a year (2008 Annual Report). Upstream lighting programs still make up a large portion of overall savings but

significantly less than they did in 2008 (27.5% in 2014 compared to 38.5% in 2008). The single largest program delivering savings today is the utility's commercial retrofit program. In the residential sector, home energy reports that seek to change customer behavior now deliver a significant portion of total savings. Seattle City Light may eventually extend these services into the commercial sector and currently has a commissioning program with an operational focus. The utility also focuses on its industrial customer class, through which it achieved 25% of total savings in 2014.

COST EFFECTIVENESS

Unlike investor-owned utilities Seattle City Light is not required to report portfolio cost effectiveness and, until 2013, did not closely measure and track these data. Staff at Seattle City Light noted that the close involvement of city officials in portfolio planning and approval efforts can often mean that cost effectiveness is not the top priority. Instead the utility responds to other policy goals. However Seattle City Light does calculate cost effectiveness using the LCSE. Figure A39 shows the results of this analysis from 2011 to 2014. As the figure shows, Seattle City Light's program portfolio is very low cost, under 4 cents each year.

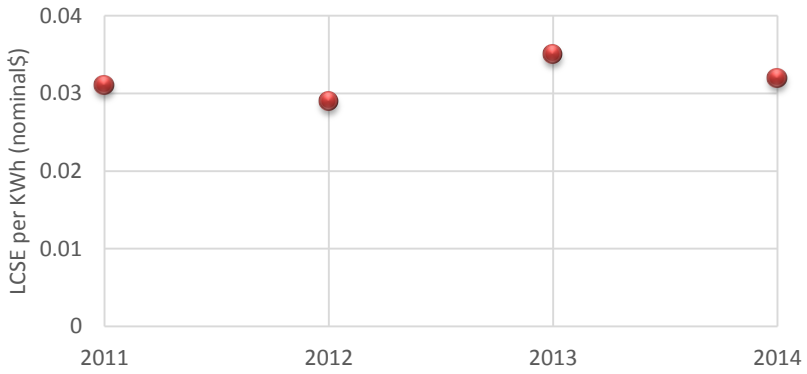

Figure A39. LCSE for Seattle City Light program portfolio, 2011–2014

Challenges and Opportunities

PAY FOR PERFORMANCE

Seattle City Light has a small pilot project focused on a pay-for-performance approach. To date three buildings have gone through the pilot. Staff noted that the approach, which relies on metered energy savings, is a good way of measuring energy savings for complex projects such as whole-building retrofits or new technologies. At the same time the challenge of the pilot program has been the need to customize everything, from measurement and verification of savings to a baseline model for each building. In particular Seattle City Light has been challenged by lack of internal capacity for quality baseline modeling. The utility expects to resolve these complexities and scale up the program over time.

EFFICIENCY AS A CUSTOMER SERVICE

Seattle City Light staff report that the utility is committed to being a good steward of the environment. This commitment reflects the goals of the city, which called on the utility to

become the first carbon-neutral utility in the country.[46] The utility is not decoupled, which has posed challenges in recent years, with weather-adjusted residential load decreasing year over year according to utility staff. This declining load puts pressure on rates. However both customers and city government officials have called for efficiency services, and Seattle City Light considers those services part of its core mission. The utility also recognizes efficiency as a resource. With most of its generation coming from hydropower facilities, Seattle City Light depends on energy efficiency to extend the life of its dam.

[46] See *Seattle City Light Annual Report* 2013, 1.

SOUTHERN CALIFORNIA EDISON

Southern California Edison (SCE) is a vertically integrated utility that owns 3,288 MW of generating capacity. The company serves nearly 5 million electric customers over a 50,000-square-mile service territory spanning much of Southern California. Its customers include 5,000 large businesses and 280,000 small businesses. Two-thirds of its total electric sales are to nonresidential customers with the remaining one-third to residential customers.

Policy Drivers

Several state policies guide SCE's energy efficiency programs. SCE is also subject to energy efficiency targets that are developed in response to the state's 2003 loading order, which requires utilities to pursue all cost-effective energy efficiency resources before pursuing other supply-side options.[47] Gross energy-savings goals for 2012 to 2020 were established in 2008.[48] The CPUC approved the 2015 energy-savings goals and budgets in late 2014.[49] The 2015 goal for SCE was 983 GWh, representing approximately 1.1% of 2014 retail electric sales.

SCE also has the ability to earn a financial performance incentive based on the performance results of four major categories. These categories are Energy Efficiency Resource Savings, Ex Ante Review Process Performance, Codes and Standards Advocacy Programs, and Non-Resource Program. The incentive payments are based on meeting specific goals and are capped at specific percentages of program expenditures.[50] The CPUC also approved full revenue decoupling for SCE in 2004.

Trends over Time

ENERGY SAVINGS AND PORTFOLIO SPENDING

Figure A40 shows program spending and savings results from 2007 to 2014. The spending and savings cycles mirror the program cycles approved by the CPUC. Generally the spending and savings values increase annually throughout the program cycle with an increase in spending in the final year. SCE performed well in the study period, producing savings higher than 2% during every year in the 2010–2012 program cycle. While savings have declined since 2012, SCE's 2015 energy-savings target of 983 GWh represents an increase in savings from 2014 levels.

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[47] The loading order was adopted in the *2003 Energy Action Plan* prepared by the CEC, the CPUC, and the California Consumer Power and Conservation Financing Authority.

[48] See "Decision Adopting Interim Energy Efficiency Savings Goals for 2012 through 2020, and Defining Energy Efficiency Savings Goals for 2009 through 2011." California Public Utilities Commission, Decision 08-07-047, August 1, 2008. docs.cpuc.ca.gov/word_pdf/final_decision/85995.pdf.

[49] See "Decision Establishing Energy Efficiency Savings Goals and Approving 2015 Energy Efficiency Programs and Budgets." California Public Utilities Commission, Decision 14-10-046, October 24, 2014. docs.cpuc.ca.gov/PublishedDocs/Published/G000/M129/K228/129228024.pdf.

[50] For more information on this performance incentive structure, see Nowak et al. 2015.

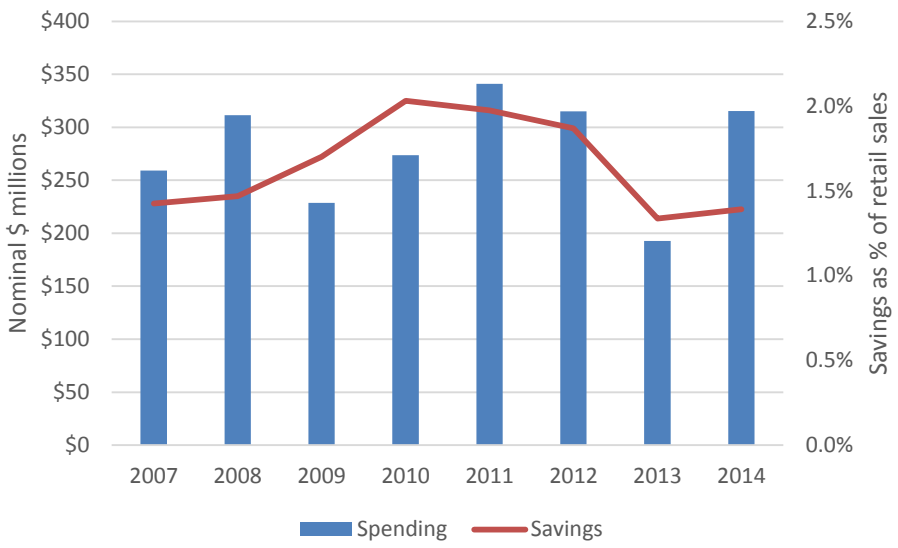

Figure A40. SCE program spending and gross energy savings as a percentage of retail sales, 2007–2014. Program spending does not include performance incentives. *Sources:* SCE 2008–2015.

PORTFOLIO DESIGN

Figure A41 shows the top 10 end-use sectors for energy efficiency programs in 2007 and 2014. End-use sectors with lower savings results are included in the "other" categories. The figure includes all customer class segments such as business, residential, and agriculture.

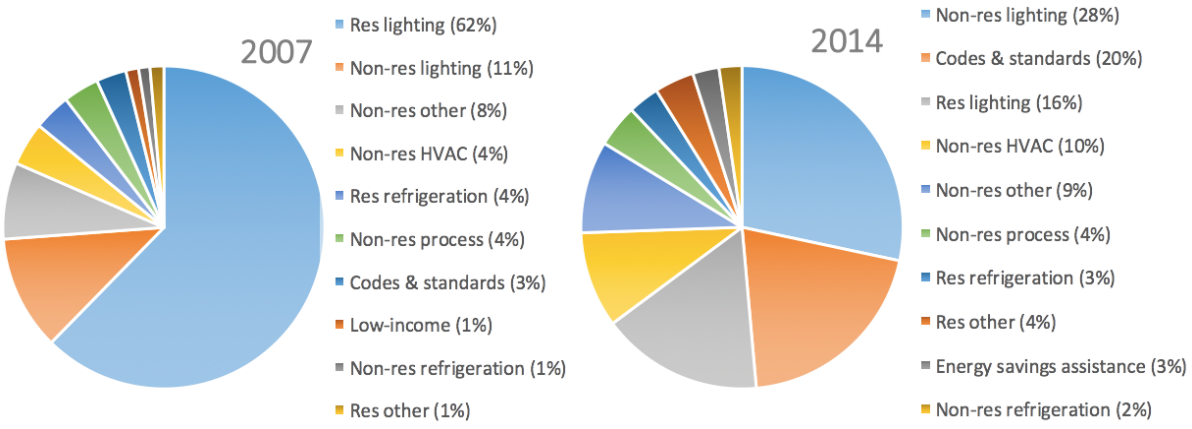

Figure A41. Top 10 end-use sectors for energy savings for SCE's 2007 and 2014 program portfolios. Percentage values indicate the percentage of savings of the entire portfolio. *Sources:* SCE 2008; SCE 2015.

The figure demonstrates a shift in the SCE portfolio away from lighting programs to a more diversified portfolio in 2014. Lighting accounted for approximately 74% of savings in 2007 but only 44% in 2014. Other programs such as Codes and Standards and Business HVAC have grown to fill the void left by the decline in lighting savings. The share of savings from the residential customer class shifted significantly from 2007 to 2014. In 2007 SCE achieved 67% of its savings in the residential sector and 28% in the nonresidential sector. In 2014 the residential sector accounted for only 23% of total savings, with 54% in the nonresidential sector.

Like many other program administrators reviewed for this study, SCE has diversified the sources of its energy savings over time. Instead of relying heavily on energy savings from residential lighting programs, SCE has increased the share of savings in several other programs to diversify its savings.

COST EFFECTIVENESS

SCE relies on the TRC test and PACT to determine cost effectiveness at the portfolio level. Figure A42 shows the TRC ratio results for the period of 2007 to 2014. The results show that SCE has maintained a cost-effective portfolio with a modest decline in TRC ratio over time.

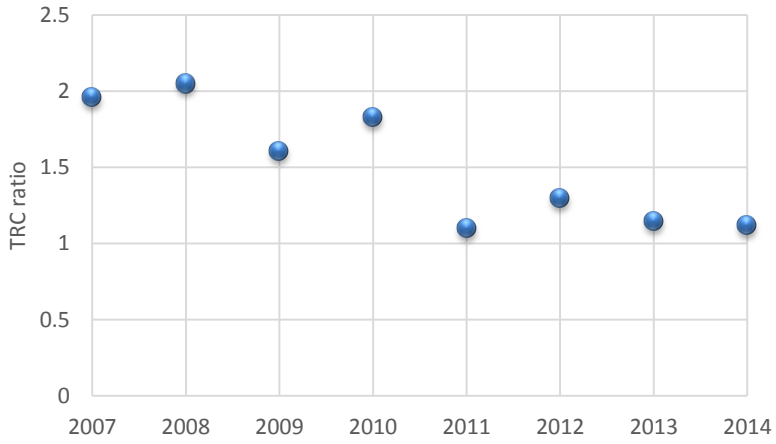

Figure A42. SCE TRC ratios, 2007–2014

TUCSON ELECTRIC POWER

Tucson Electric Power (TEP) is an investor-owned electric utility serving southern Arizona. TEP is a subsidiary of the international holding electric company Fortis. It provides electricity to more than 414,000 customers in Tucson's metropolitan area.

Policy Drivers

TEP is subject to Arizona's EERS, set by the ACC in 2009. The standard requires investor-owned utilities to achieve cumulative electricity savings equivalent to 22% of retail electric sales in calendar year 2019. The standard also sets incremental targets for each year, beginning at 1.25% of retail sales in 2011 and ramping up to 2.5% for 2016 through 2020. Peak-demand savings from demand-response programs may count toward two percentage points of the total cumulative goal.

In June 2013 the ACC approved a lost-revenue adjustment mechanism for TEP. The utility also has a performance incentive based on net benefits achieved through efficiency programs. The incentive is capped at $0.0125 per kWh saved.

Trends over Time

ENERGY SAVINGS

In general TEP's electricity savings have increased over time in line with the state's energy efficiency goals, as Figure A43 shows.

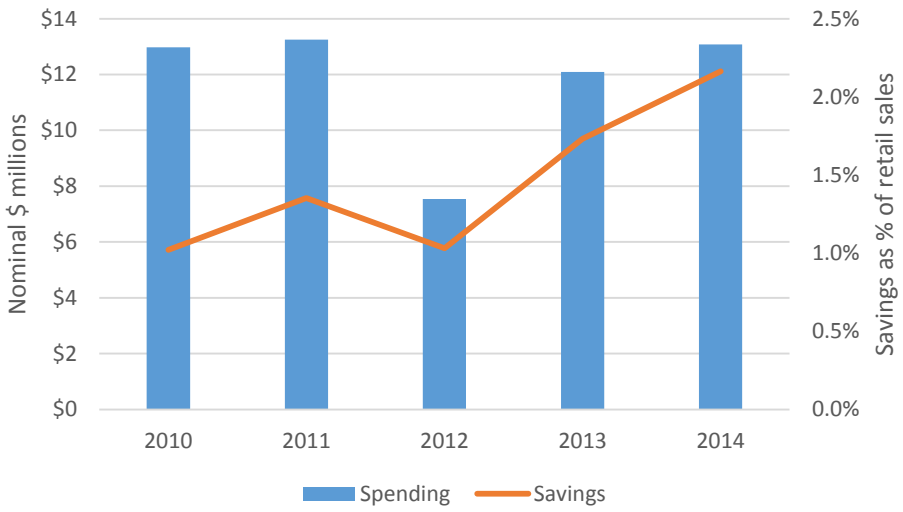

Figure A43. Net savings as a percentage of retail sales and total energy efficiency portfolio costs for TEP. *Source:* TEP data request.

TEP did see a drop in savings in 2012, which correlates to the more limited program budgets approved by the ACC for that year. In 2013 and 2014 TEP achieved significantly more first-year savings for each dollar spent. Savings in 2014 also included savings from TEP's first CHP project and a catch-up in-storage "adder" for lighting programs. In prior years savings for lighting programs had been discounted to account for uninstalled light bulbs, but TEP did not receive credit for these installations in later years. The savings shown for 2014 therefore reflect a one-time bump to account for these savings.

PORTFOLIO DESIGN

TEP delivers programs for residential, commercial, and industrial customers. In 2010 the utility had five programs for residential customers and three that focused on businesses or commercial buildings. By 2014 the utility's portfolio had expanded somewhat to include six programs targeted at residential customers and four programs for commercial and industrial customers, plus two additional sources of savings—building codes work and a CHP installation. Figure A44 below shows relative savings for program years 2010 and 2014.

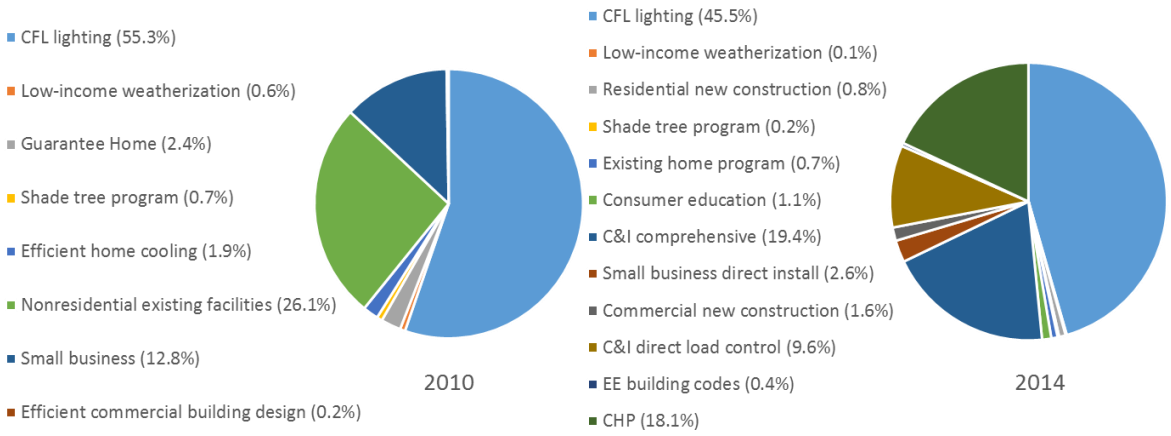

Figure A44. TEP portfolios in 2010 and 2014 by program type. *Sources:* TEP Annual DSM Progress Reports.

Lighting and retrofits for nonresidential buildings made up the majority of TEP's savings in 2010 and continued to do so in 2014. However the utility offered more-varied programs for its commercial and industrial customers in 2014. Arizona regulations allow TEP to claim savings from demand-response programs, and in 2014 the utility had 46 large customers enrolled in the program. TEP also reported on a pilot load-control program for residential customers in 2014, although it did not claim savings for these efforts.

TEP claimed significant savings from a CHP project in 2014, but staff noted that this will likely not be an ongoing focus for the utility as opportunities in this sector are limited.

COST EFFECTIVENESS

The primary cost test used to screen programs in Arizona is the SCT. However the test does not include most of the nonenergy benefits typically included in other jurisdictions. Nonetheless TEP energy efficiency programs have been highly cost effective over the years, as figure A45 shows.

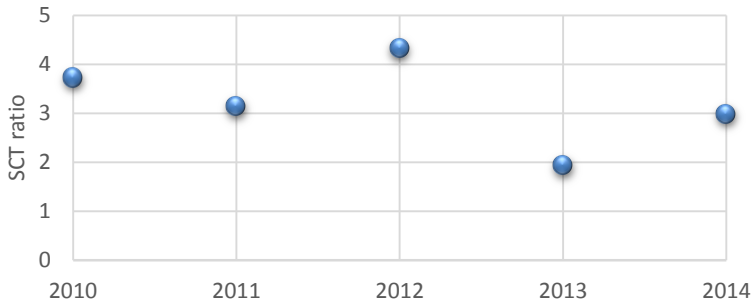

Figure A45. SCT ratios for TEP programs, 2011–2015

Challenges and Opportunities

APPROVAL FOR NEW PROGRAMS

TEP runs a fairly traditional portfolio of programs, relying heavily on lighting rebates and direct-install programs for savings. In recent years TEP has also run pilots for behavior programs and completed its first CHP project. However the utility has proposed several programs that have not been approved by the ACC, and has also dealt with cuts to existing programs (as seen in the drop in budgets and savings in 2012). While TEP staff expressed interest in testing new technologies and emphasizing harder-to-reach markets, they also noted that portfolio expansion was highly dependent on ACC approval.

TRANSITIONING TO NEW TECHNOLOGIES

TEP continues to rely heavily on CFLs to meet its savings goals. Utility staff noted that price points for LEDs were still prohibitive for low-income customers, even accounting for incentives. However the utility did receive approval for LED programs in December 2014, and staff predicted that these would slowly begin to make up a larger share of lighting incentives over the next several years. TEP is also expecting that smart-meter technologies and smart thermostats will play a greater role in portfolio savings in the future.

CLIMATE-SPECIFIC PROGRAMS

Arizona's warm, dry climate facilitates savings opportunities for electric utilities in several areas. TEP claims a small amount of savings from its shade-tree program, which has been in operation since 1992. The utility partners with Tucson Clean and Beautiful to run the program, which targets residential customers as well as community areas. In the future TEP staff expect pool pumps to be a growing area of focus.