Study of Potential for Energy Savings in Delaware

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Prepared for

by

with

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INTRODUCTION

BACKGROUND AND PURPOSE OF STUDY

The Delaware Department of Natural Resources and Environmental Control (DNREC) commissioned this study to estimate two achievable energy efficiency potential scenarios for Delaware for electricity, natural gas and unregulated fossil fuel usage (petroleum fuels) in the buildings sector.[1] Optimal Energy, Inc. led the study, with assistance from Shelter Analytics and Energy Futures Group. This Phase II report builds on an initial effort to estimate Delaware's economic energy efficiency potential report completed earlier in 2013.[2] By "potential" we mean the potential for increased adoption of energy efficient technologies above and beyond that which would naturally occur in the absence of funded programs to promote their adoption. The analysis considers a 12-year study period, from 2014-2025.

This study provides an estimate of the potential efficiency savings available to Delaware. To better inform future Delaware efficiency program goals and planning, the study also provides a realistic "proxy" set of programs that could be implemented to achieve those savings and the associated cost estimates for acquiring those resources. This "program potential" is intended to support the discussion and consideration of pending legislation in Delaware regarding energy efficiency goals. To that end, we conducted this analysis to be, as much as possible, neutral and unbiased with respect to the administrative and financial models that could ultimately be the basis of future energy efficiency achievements in Delaware. On the other hand, our analysis did assume integrated programs across all fuels. Although the focus of the study and this report is on the program potential, this report also presents an assessment of a maximum achievable scenario as a point of comparison for the program potential and the previously-developed economic potential.

SUMMARY OF RESULTS

Scenario Summaries

This section presents various slices of the study results. It begins with results at the portfolio level, comparing outputs from the different levels of potential assessed in the study. As discussed in detail in the methodology section, this study analyzed three levels of potential:

- Economic – Everything that is cost-effective, assuming no or limited market barriers

[1] Petroleum fuels included oil #2, #4 and #6, propane and kerosene. All petroleum fuel potential was estimated in aggregate and is not provided for each individual fuel.

[2] *Delaware Economic Energy Efficiency Potential*, prepared for Delaware Department of Natural Resources and Environmental Control by Optimal Energy, Inc. 24 May 2013.

- Maximum Achievable – The maximum level of program activity and savings that is possible given the market barriers to adoption of energy efficient technologies
- Program Achievable – A level of possible savings given a specific set of programs targeting specific markets. Program potential also considers the administrative costs necessary to capture the potential

Comparisons across potential types are useful for understanding the bounds of achievement. Following the portfolio level results we present more detailed results for the program potential, including disaggregated results for each sector.

Table 1 provides a summary of the economic, maximum achievable, and program potential of each fuel relative to the sales forecast. Overall, program potential for electricity is 18.7% of the forecasted load in 2025. The maximum achievable potential for electricity is 23% by 2025, roughly 30% greater than the program potential. The proximity of the two estimates reflects the aggressive targets forecasted in the program scenario. The potential for natural gas is lower than electricity at 9.1% relative to baseline load in 2025. The lower potential for natural gas is in part due to the low avoided costs of natural gas, which result in fewer measures passing cost-effectiveness screening. Petroleum potential is estimated at 12.4% by 2025.

Table 1 | Cumulative Potential Relative to Sales Forecast, 2025

	Electric	Natural Gas	Petroleum Fuels
Program Potential	18.7%	9.1%	12.4%
Max Achievable Potential	23.3%	12.5%	19.8%
Economic Potential	30.1%	18.1%	24.7%

Figure 1 shows the historic and forecasted sales of electric energy. While the historic consumption has been relatively flat over the past ten years, it is forecasted to gradually rise through 2025. If Delaware were to capture the full program potential, consumption would flatten out before beginning to decline within a few years.

Figure 1 | Electric Energy Savings Relative to Sales Forecast

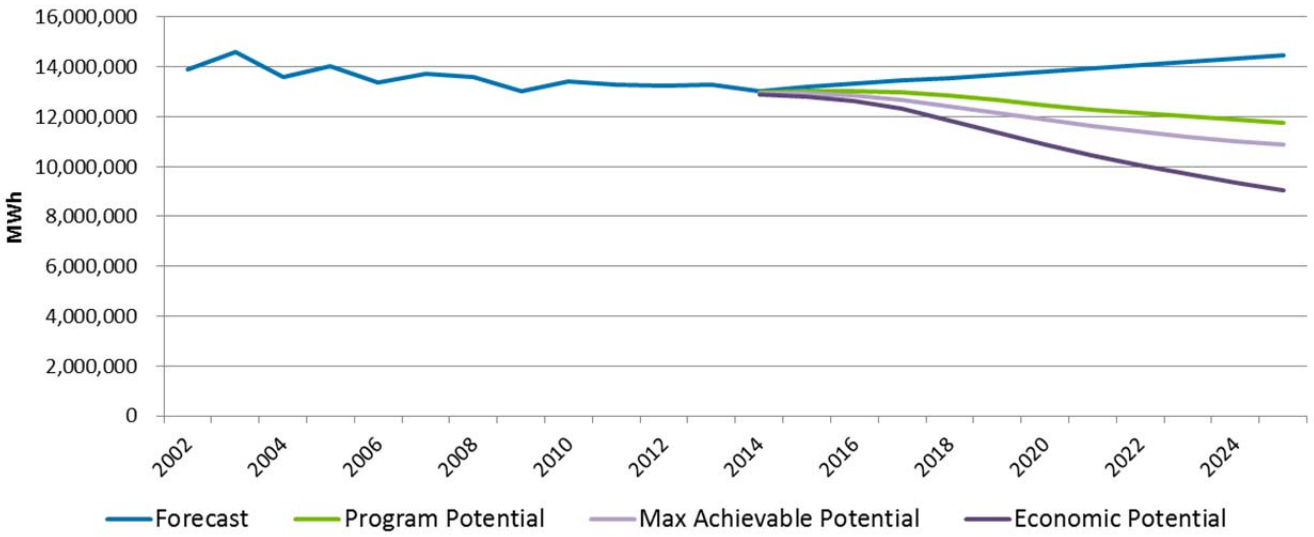


Figure 2 shows the historic and forecasted summer peak demand for electricity. Like electric energy, the baseline forecast for summer peak demand is steadily rising. As seen in the graph below, capture of the program potential would cause peak demand to level off and eventually decline.

Figure 2 | Electric Demand Savings Relative to Sales Forecast

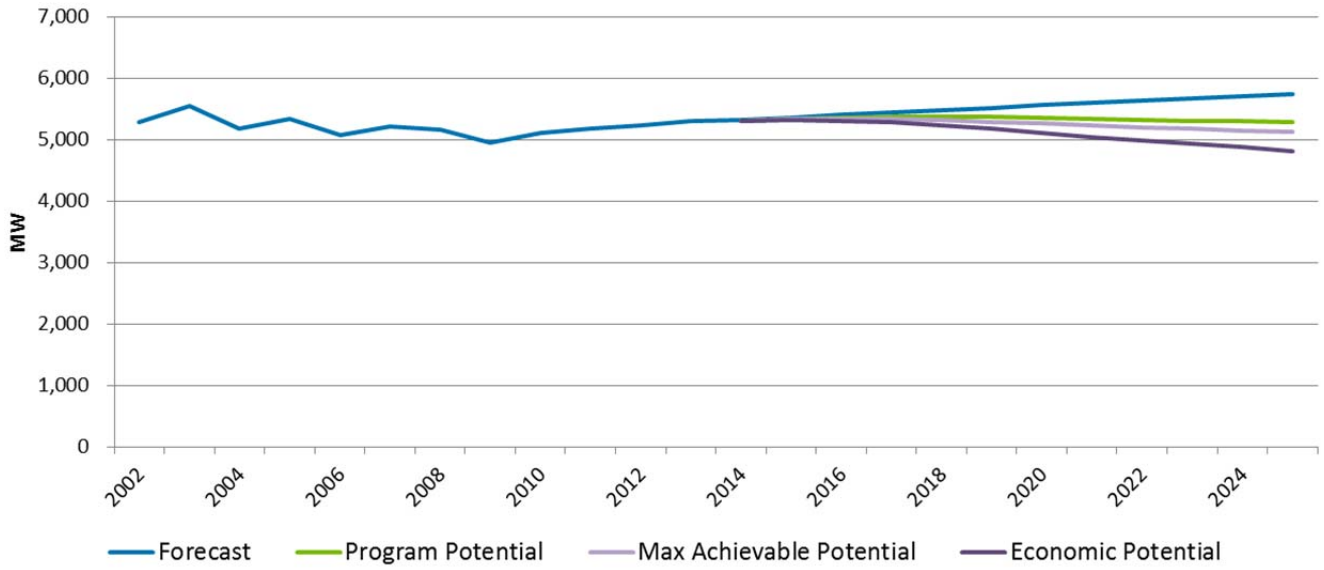


Figure 3 shows the historic and forecasted consumption of natural gas. The dip in usage in 2010 reflects the temporary closing of the Delaware City Refinery, which consumes around nine million MMBtu annually. Natural gas consumption is forecasted to rise steadily as distribution networks expand and low prices make it an economically attractive energy source. However, if the program potential were fully captured, gas consumption would level off and then gradually decline.

Figure 3 | Natural Gas Savings Relative to Sales Forecast

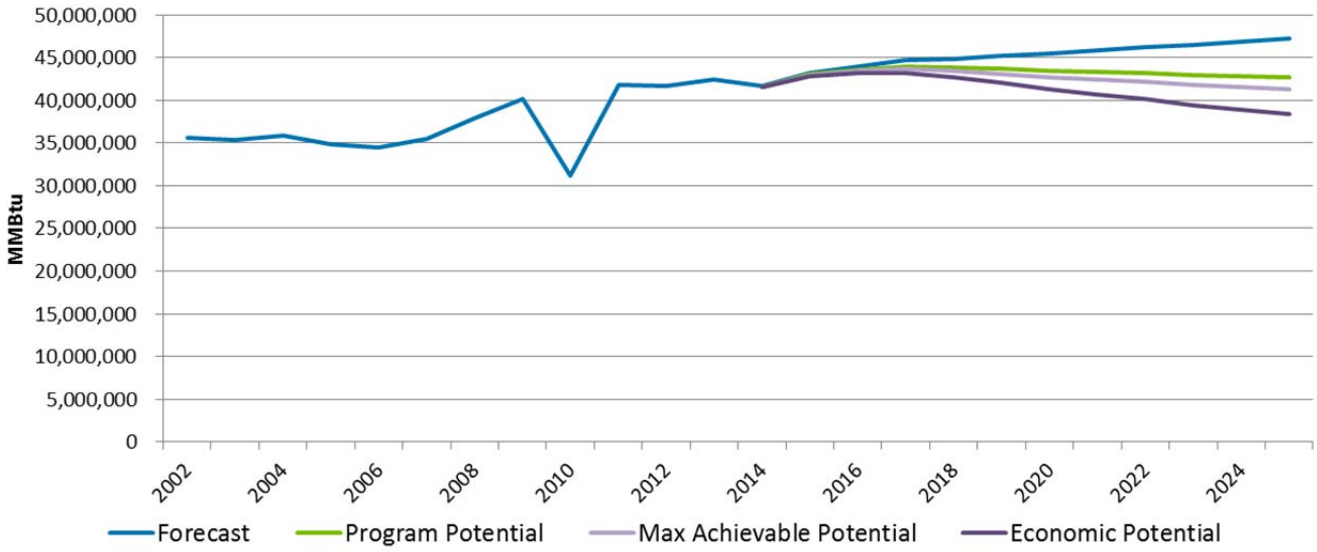
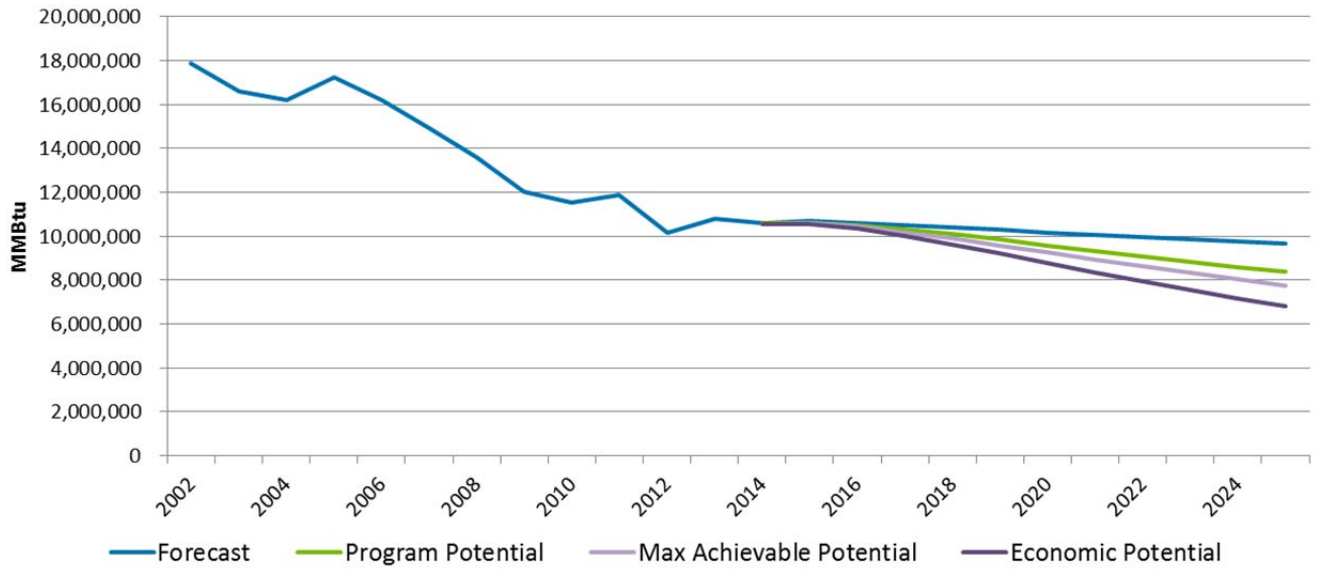


Figure 4 depicts the historic and forecasted consumption of petroleum fuels. Capture of the program potential for petroleum would further reduce forecast loads that are already predicted to drop as a result of the significant economic savings of conversions to gas and environmental policies to reduce carbon and particulate emissions from heavy oil.

Figure 4 | Petroleum Fuel Savings Relative to Sales Forecast



Program Potential Details

The results presented in this section, as well as all sector-level sections hereafter, correspond to the program potential. We focus on this scenario because it most closely reflects likely future energy efficiency investments and plans in Delaware. Results in this section are broken out for

comparison across sectors and fuels. Further disaggregation of the sector totals can be found in the sector-specific results sections. Several notes related to the analysis and presentation in this report are listed below.

- All dollar values are in real 2013 dollars
- All savings are net rather than gross, meaning they have been adjusted for anticipated impacts of free-ridership[3]
- When savings are presented for a specific year, they reflect the cumulative annual savings in that year, accounting for measures that have expired
- When costs and benefits are presented for different cost-effectiveness tests, they reflect the cumulative present value for the years 2014-2025
- Electric savings are presented at the wholesale level or at the utility's "point of purchase," and therefore have been "grossed up" to account for savings in transmission line losses
- Natural gas and petroleum savings do not include the negative impacts on space heating from installation of efficient lighting
- The Large Business Retrofit program includes the entire industrial sector
- When program or sector level costs are shown by fuel, the non-incentive costs have been apportioned to fuels based on the distribution of total resource benefits
- In the tables of "top measures," the "Percent of Total" column refers to the measures' savings relative to the entire sector, not just the sum of measures in the list

Savings

Table 2 provides a summary of the cumulative savings in 2025, by sector and fuel, in both absolute terms and relative to the sales forecast. The commercial sector exhibits the greatest potential for electric savings, followed by the residential sector and the industrial sector respectively. This result can partially be attributed to higher usage in the commercial sector, but also reflects the fact that commercial programs typically encounter lower barriers to adoption.

The industrial sector shows the most potential for natural gas savings in absolute terms, but the lowest potential relative to the sales forecast. High absolute potential is due to the fact that the industrial sector has higher gas consumption than the residential and commercial sectors combined. Lower industrial savings relative to forecast reflects the fact that the industrial sector can be difficult for efficiency programs to penetrate due to sophisticated, customized operations. Another important consideration when reviewing the industrial savings is the fact that the industrial sector in Delaware contains a small number of very large gas users, including the Delaware City Refinery, whose participation in the program (or lack thereof) would skew the results significantly. For the purposes of this analysis, we assumed that all industrial customers participate in the program.

[3] Free-ridership refers to the fact that some program participants would have selected high-efficiency options even in the absence of the program. Savings from free-riders are not included in overall program savings totals, but the costs associated with these participants are.

The residential sector shows the greatest potential for petroleum fuel efficiency due to the prevalence of home heating oil, which makes up the majority of petroleum fuel sales.

Table 2 | Cumulative Program Potential by Sector, 2025

	Cumulative Savings 2025	% of Sales Forecast
Electric (GWh)	**2,709**	**18.7%**
Residential	875	15.4%
Commercial	1,333	23.3%
Industrial	501	16.3%
Natural Gas (BBtu)	**4,319**	**9.1%**
Residential	1,125	10.6%
Commercial	1,233	11.5%
Industrial	1,962	7.6%
Petroleum Fuels (BBtu)	**1,203**	**12.4%**
Residential	708	13.9%
Commercial	380	18.6%
Industrial	115	4.6%

Table 3 shows the incremental annual savings for each fuel in absolute terms as well as relative to load. The electric programs ramp up much faster and reach a higher level of savings relative to sales than the other fuels. While there are multiple reasons for this, the most significant is simply that there are more opportunities for electric efficiency. Electric savings decline after 2020 due to codes and standards that increase baselines, and predicted increases in free-ridership as the programs begin to achieve market saturation.

Table 3 | Incremental Annual Savings by Fuel

	2014	2015	2016	2017	2018	2019	2020	-	2025
Incremental Annual Savings									
Electric (GWh)	58	101	154	219	294	348	370		339
Natural Gas (BBtu)	68	145	216	322	446	546	598		609
Petroleum Fuels (BBtu)	18	49	69	96	132	159	171		159
Savings relative to forecast									
Electric	0.4%	0.8%	1.2%	1.6%	2.2%	2.5%	2.7%		2.3%
Natural Gas	0.2%	0.3%	0.5%	0.7%	1.0%	1.2%	1.3%		1.3%
Petroleum Fuels	0.2%	0.5%	0.7%	0.9%	1.3%	1.5%	1.7%		1.6%

Note: Savings for years 2021-2024 are omitted from the table for simplicity and are similar to savings presented for years 2020 and 2025

Economics

Table 4 shows the cumulative economic impacts to the Delaware economy that would result from implementing programs to achieve the program potential through 2025. This scenario is highly cost-effective from a Total Resource Cost Test perspective. In addition, the results by sector are consistent with similar program portfolios of this type around the country. Total benefits amount to nearly $4 billion from an investment of roughly $1.7 billion. Net benefits are approximately $2.3 billion in present value 2013 dollars. The benefit cost ratio indicates that the programs would return $2.4 for every dollar invested. Nearly half of the benefits would accrue to the commercial sector, with the balance coming mostly from residential and about 24% coming from the industrial sector.

The majority of the costs and benefits accrue in the electric sector. This is primarily due to the greater level of savings relative to forecast and the faster ramp-up rate. Since the costs and benefits are represented in present value dollars, savings that accrue in later years are less significant due to discounting.

Table 4 | Portfolio Total Resource Cost Test Economics by Fuel and Sector, 2025

		Costs (Million$)	Benefits (Million$)	Net Benefits (Million$)	BCR
Electric		**1,438**	**3,424**	**1,987**	**2.4**
	Residential	449	990	541	2.2
	Commercial	816	1,834	1,018	2.2
	Industrial	172	600	428	3.5
Natural Gas		**148**	**324**	**177**	**2.2**
	Residential	72	107	35	1.5
	Commercial	29	64	34	2.2
	Industrial	46	154	108	3.3
Petroleum Fuels		**89**	**280**	**191**	**3.2**
	Residential	70	211	141	3.0
	Commercial	13	48	35	3.6
	Industrial	6	22	16	3.9
Total		**1,674**	**4,029**	**2,355**	**2.4**

Emissions

Table 5 shows the cumulative emissions reductions broken out by fuel type. Electricity savings account for the majority of carbon dioxide emissions reductions while natural gas savings account for the majority of nitrous oxide and sulfur dioxide emissions reductions. Cumulative carbon dioxide emissions reductions are roughly equivalent to 3.4% of Delaware's annual building sector emissions. Similarly, the carbon dioxide emissions reductions are

roughly equivalent to removing approximately 36,000 cars from the road for each year of the study period.[4]

Table 5 | Cumulative Emissions Reductions by Fuel Type, 2025

Source Fuel	CO_2 (metric tons)	NO_x (metric tons)	SO_2 (metric tons)
Electric	1,792,000	1,543	9,065
Natural Gas	229,000	201	1
Petroleum Fuels	81,000	105	65
Total	**2,102,000**	**1,849**	**9,131**

Other Impacts

Following completion of the initial potential study, DNREC requested some additional analysis of the impacts of reaching the achievable potential savings estimate. A rate and bill impact analysis considered the impacts on consumer retail rates and bills from Delaware pursuing the energy efficiency programs described in the potential study. If approved, the cost recovery and lower utility revenues from implementing efficiency programs would lead to higher rates in the near term, but these would be offset by energy savings so that the average customer bill is reduced in the longer term. Full results and discussion of the rate and bill impact analysis can be found in Appendix O: Rate and Bill Impacts Memo.

Additionally, we developed an estimate of the job impacts of the energy efficiency investments proposed as part of the potential analysis. Results suggest that investments in energy efficiency commensurate with the levels forecasted in the potential study will support between 3,000 and 4,800 job-years annually. Full results and discussion of this analysis can be found in Appendix P: Job Impacts Memo.

COMPARATIVE INFORMATION FROM OTHER JURISDICTIONS

To provide some comparison data, we gathered information from several other jurisdictions that have some form of coordinating council or oversight body with respect to energy efficiency. The table below summarizes some of the main features and outcomes of this research. Because the efficiency programs in Maryland and Vermont are not integrated gas and electric offerings, we present only the electric savings for those states.

[4] Calculated using the EPA estimated 4.8 metric tons of CO_2 emitted per vehicle per year. http://www.epa.gov/cleanenergy/energy-resources/refs.html

Table 6 | Comparative Information from Other Jurisdictions

State	State Population (million)	Oversight Body	Program Administrator(s)	2012 Savings as a Percent of Load*		2012 Total Spending ($million)
				Electric	Gas	
Connecticut	3.6	Energy Efficiency Board	IOUs and CMEEC	1.1%	0.5%	$150
Maryland	5.9	Public Service Commission	IOUs and SMECO	1.3%		$167
Massachusetts	6.6	Energy Efficiency Advisory Council	IOUs	2.1%**	1.1%	$522
Rhode Island	1.1	Energy Efficiency and Resource Management Council	Single IOU	1.7%**	0.8%	$60
Vermont	0.6	Public Service Board	Efficiency Vermont	2.6%		$40

* Savings as a percent of load were gathered from various state-specific reports. When this information was not available, reported savings from state reports were divided by state sales results from EIA Form 861 data to calculate saving as a percent of load.

** Savings in the table are actual. Massachusetts and Rhode Island both have planned goals that exceed 2.5% by 2016.

STUDY OVERVIEW

This section provides a brief overview of the study scope and approaches, with more detail provided in the sections below. The Phase II potential study included the following key components:

- Two 12-year efficiency potential scenarios for the period 2014-2025: maximum achievable and program potential
- A revised economic potential estimate
- An estimate of the program potential for electricity, natural gas, and petroleum fuels. Petroleum fuels included were analyzed in aggregate rather than separately, and included distillate (#2 and #4) and residual (#6) fuel oil, propane, and kerosene
- An estimate of the program achievable potential for the residential, commercial (including institutional and government), and industrial sectors. The study was restricted to the buildings sector and does not include transportation efficiency

The focus of Phase II was to revise the Phase I *economic* potential estimate and to estimate the *achievable* efficiency potential based on initial conceptions of efficiency program designs and delivery strategies. This program potential includes the likely amount of efficiency in response to specified levels of program support in the form of financial incentives, marketing and

education, and technical support as well as consideration of real world market barriers that often prevent people from adopting all cost-effective efficiency. Overall, the programs are all cost-effective from a Total Resource Cost (TRC) Test perspective. The estimate also considers the distribution of savings over time, allowing for gradual increases in potential as programs and supporting infrastructure build capacity to support efficiency investments in the market.

The Phase II scope was limited in several important respects:

- Relies primarily on existing available data, in some cases from outside Delaware
- Does not include combined heat and power (CHP) measures
- Does not include demand response measures
- Does not include a budget estimate for the maximum achievable potential

The Methodology section later in this report provides a detailed discussion of the methods and assumptions used in the analysis. The steps below lay out the basic methodological approach for assessing the two achievable potential scenarios.

- Develop energy use forecasts
- Disaggregate energy forecasts by sector, market segment, and end uses
- Characterize efficiency measures
- Develop measure penetrations
- Screen measures and programs for cost-effectiveness
- Adjust for measure interactions, finalize model, and develop outputs

PROGRAM POTENTIAL DETAILED RESULTS

This section presents detailed results from our analysis of the program potential scenario. Because our programs are designed to be customer-focused and multi-fuel, the results are organized first by sector, then fuel. That is, our program designs assume a customer can receive services and incentives for measures of *any* fuel-type without having to engage with multiple program entities. We present the savings within each sector on a fuel-specific basis for those readers who wish to better understand the nature of the efficiency opportunity as it relates to energy consumption and technology types. Results for the residential sector are presented first, followed by commercial and then industrial.

RESIDENTIAL (INCLUDING INCOME-ELIGIBLE SERVICES)

Sector Summary

Savings

Cumulative results through 2025 for the residential sector are presented by program and fuel in Table 7 below. The majority of electric energy savings (63%) are from the Residential Products Program, followed by Home Energy Services (18%) and Income-Eligible Single Family (11%). The same program ranking is seen with natural gas savings with Products comprising 44% of savings, Home Energy Services 25%, and Income-Eligible Single Family 19%. Similarly, Residential Products contributes the largest share of electric demand savings (42%), followed by Home Energy Services (18%), and Income-Eligible Single Family (18%). For petroleum fuels, the largest share of savings comes from Home Energy Services (45%), followed by Products (32%), and Income-Eligible Single Family (17%).

Table 7 | Cumulative Residential Savings by Program, 2025

Program	Electric Energy (MWh)	Electric Demand (MW)	Natural Gas (BBtu)	Petroleum Fuels (BBtu)
Residential New Construction	37,919	4	44	16
Home Energy Services	154,100	33	280	316
Multi-Family	13,215	3	44	11
Residential Products	548,167	46	497	224
Income-Eligible Single Family	97,780	20	216	119
Residential Behavior	23,906	3	44	22
Total	**875,087**	**109**	**1,125**	**708**

Costs and Cost-Effectiveness

All of the proposed residential programs are cost effective through 2025 from a Total Resource Cost (TRC) Test perspective. Program-level benefit cost ratios (BCRs) range from 2.7

(Residential Products) to 1.1 (Residential Behavior). The Residential Behavior program has a low BCR because the measures in that program only have a one-year measure life. At the sector level the residential programs have an aggregate BCR of 2.2 representing $687 million in net benefits through 2025.

The results in Table 9 reflect an all-fuels Program Administrator Cost (PAC) Test perspective. As with the TRC results, all of the programs are cost-effective with BCRs ranging from 3.7 (Residential Products) to 2.0 (Residential Behavior). The sector level PAC test BCR is 2.2. The programs' cumulative net benefits through 2025 are $820 million.

Finally, The Participant Test (Table 10) yields the highest BCRs of the three tests presented. BCRs range from 3.6 (Behavior) to 7.3 (Products), with all programs at a 6.1 BCR. These high BCRs indicate the large impact of the proposed program incentives on consumer economics and the fact that avoided energy consumption is valued at the retail cost of energy, as compared to a lower wholesale avoided cost used for the TRC and PACT.

Table 8 | Residential Total Resource Cost Test Economics by Program

Program	Costs (Million$)	Benefits (Million$)	Net Benefits (Million$)	BCR
Residential New Construction	31	56	25	1.8
Home Energy Services	167	316	149	1.9
Multi-Family	20	27	8	1.4
Residential Products	258	703	445	2.7
Income-Eligible Single Family	95	175	80	1.8
Residential Behavior	28	30	2	1.1
Total	**571**	**1,278**	**707**	**2.2**

Table 9 | Residential Program Administrator Cost Test Economics by Program

Program	Costs (Million$)	Benefits (Million$)	Net Benefits (Million$)	BCR
Residential New Construction	27	56	30	2.1
Home Energy Services	138	315	176	2.3
Multi-Family	15	25	9	1.6
Residential Products	186	703	517	3.8
Income-Eligible Single Family	93	175	82	1.9
Residential Behavior	28	60	32	2.1
Total	**487**	**1,333**	**846**	**2.7**

Table 10 | Residential Participant Cost Test Economics by Program

Program	Costs (Million$)	Benefits (Million$)	Net Benefits (Million$)	BCR
Residential New Construction	19	83	64	4.4
Home Energy Services	116	429	312	3.7
Multi-Family	15	43	28	2.9
Residential Products	215	1,020	805	4.7
Income-Eligible Single Family	67	261	194	3.9
Residential Behavior	20	60	40	3.0
Total	**452**	**1,896**	**1,444**	**4.2**

Residential Electric Detail

Figure 5 and Table 11 highlight the key role that lighting plays in achieving the proposed electric energy savings goals. Indoor lighting contributes 46% of total electric energy savings by 2025. Of the top ten electric energy savings measures, six are lighting measures, all of which are light emitting diode (LED) measures. The programs also support compact fluorescent lamps (CFLs) through both retail and direct installation efforts. CFLs make important near-term program savings contributions but support for these measures ceases in 2017 as LED prices are expected to decline significantly and represent a better lighting technology choice for consumers. After lighting, the next largest end use savings contributions come from space heating (17%), refrigeration (10%), and water heating (8%). In addition to the six lighting measures the other top ten electric savings measures are related to space heating (heat pump duct sealing), water heating (heat pump water heaters), cooling (air sealing), and refrigeration (refrigerator retirement).

Figure 5 | Residential Electric Energy Savings by End Use, 2025

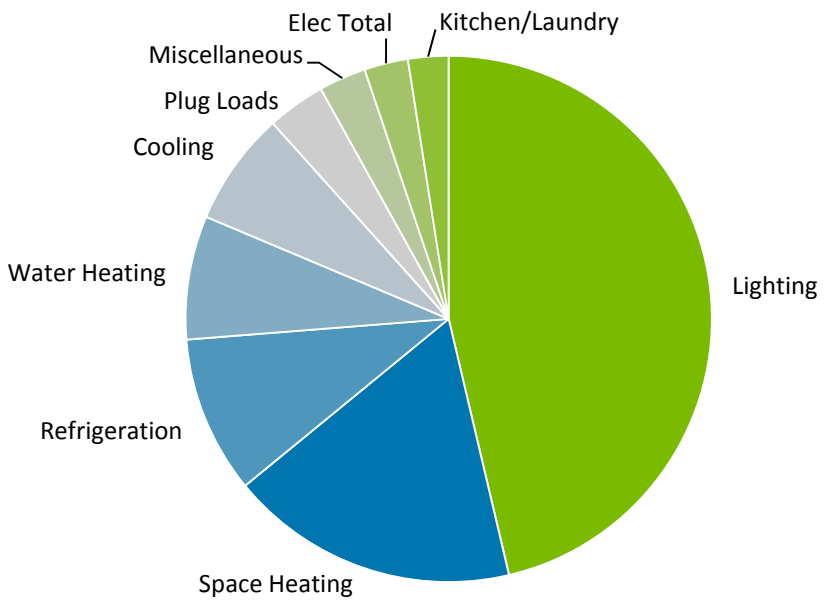


Table 11 | Residential Electric Energy Top Saving Measures, 2025

Measure Name	Cumulative MWh (2025)	Percent of Total	TRC BCR
LED Screw Based Lamp retail 450 to 1600 Lumens	129,852	14.6%	5.1
LED Direct Install	89,857	10.1%	4.8
Exterior LED >1600 Lumens	45,586	5.1%	8.6
Exterior LED 450 to 1600 Lumens	45,586	5.1%	6.5
Electric Heat Pump Water Heater <55gal	43,971	4.9%	1.6
Air Sealing –Heat	43,220	4.9%	1.1
Air Sealing –Cool	37,157	4.2%	2.8
LED Screw Based Lamp retail >1600 Lumens	36,342	4.1%	5.5
Refrigerator Retirement	35,349	4.0%	2.3
LED Screw Based Lamp retail <450 Lumens	34,179	3.8%	4.4
Total	**541,099**	**60.8%**	

While cooling only contributes 7% to electric energy savings, it comprises the largest share of electric demand savings (51%) given the high coincidence of cooling with the summer peak demand period (Figure 6). After cooling, the next largest end use contributions to demand savings are indoor lighting (24%) and refrigeration (8%). This latter end use category consists of behavior program activities. Four of the top ten electric demand savings measures (Table 12) are cooling related measures with air sealing making the largest contribution (43%). There are also

three lighting measures and one refrigeration measure among the top ten electric demand measures.

Figure 6 | Residential Electric Demand Savings by End Use, 2025

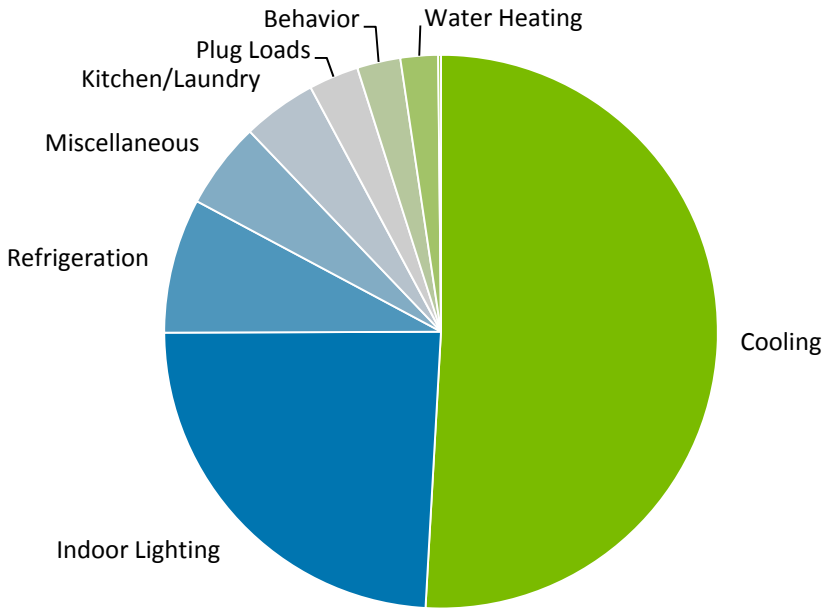


Table 12 | Residential Electric Demand Top Saving Measures, 2025

Measure Name	Cumulative MW (2025)	Percent of Total	TRC BCR
Air Sealing –Cool	33	33.7%	2.8
LED Screw Based Lamp retail 450 to 1600 Lumens	10	9.9%	5.1
High performance window –Cool	6	6.5%	4.7
Duct sealing –Cool	6	6.3%	3.0
Pool Pump	5	5.6%	3.7
Refrigerator Retirement	4	3.6%	2.3
LED Direct Install	3	3.4%	4.8
Efficient Window AC Tier I	3	2.9%	1.1
Enhanced Behavior Based Efficiency Initiative	3	2.8%	1.2
LED Screw Based Lamp retail >1600 Lumens	3	2.8%	5.5
Total	**76**	**77.6%**	

Residential Gas Detail

Natural gas usage in the residential sector is largely limited to space heating, hot water, and cooking. Because the vast majority of savings are attributed to space heating we are not including a pie chart of the savings by end use. Space heating accounts for 86% of the gas

savings, with an additional 10% from water heating measures. The remaining 4% are from behavioral program activities. Similarly, seven of the top ten gas savings measures are related to space heating and two are related to hot water (Table 13). The top three measures alone – air sealing (33%), WiFi thermostats (24%), and ENERGY STAR furnaces (15%) – represent over half of all cumulative residential sector natural gas savings by 2025.

Table 13 | Residential Natural Gas Top Saving Measures, 2025

Measure Name	Cumulative BBtu (2025)	Percent of Total	TRC BCR
Air Sealing, Fossil Fuel –Heat	355	31.7%	1.4
WiFi Thermostats	259	23.1%	2.4
Gas Furnace ENERGY STAR	162	14.5%	2.5
Insulation, Fossil Fuel –Heat	67	5.9%	1.3
High Performance Windows	64	5.8%	1.8
LF Showerhead	56	5.0%	3.6
Enhanced Behavior Based Efficiency Initiative	44	3.9%	1.6
High Efficiency Gas Storage Water Heater	39	3.5%	1.7
Duct Sealing, Fossil Fuel –Heat	32	2.9%	5.5
High-Efficiency Boiler	15	1.3%	1.1
Total	**1,092**	**97.5%**	

Residential Petroleum Detail

Space heating opportunities represent nearly half of residential petroleum fuels savings, at 94% of cumulative savings by 2025, due to its nearly exclusive use as a heating fuel. The remaining 6% of savings are split evenly between hot water measures and behavioral program activities. Seven of the top ten fuel savings measures are space heating measures (Table 14). Note, however, that one of these measures is an oil-to-heat-pump fuel displacement measure.[5] As with natural gas, air sealing contributes the most savings of all petroleum fuel measures (32%), followed by WiFi thermostats (23%) and heat pump displacement (20%).

[5] Fuel displacement refers to the fact that in many instances, mini-split heat-pumps do not completely replace existing fossil-fuel heating systems, but rather displace some portion of the heat load served by the fuel.

Table 14 | Residential Petroleum Fuels Top Saving Measures, 2025

Measure Name	Cumulative BBtu (2025)	Percent of Total	TRC BCR
Air Sealing, Fossil Fuel -Heat	223	31.6%	4.5
WiFi Thermostats	162	22.9%	8.0
Oil/LP to Ductless Mini Split Heat Pump	141	20.0%	3.9
High Performance Window	43	6.0%	5.6
Insulation, Fossil Fuel -Heat	42	5.9%	4.2
Oil Furnace ENERGY STAR	22	3.1%	1.7
Enhanced Behavior Based Efficiency Initiative	22	3.1%	5.4
Duct Sealing, Fossil Fuel -Heat	20	2.8%	17.8
High-Efficiency Boiler	9	1.3%	2.7
Low Flow Showerhead	7	1.1%	12.0
Total	**691**	**97.8%**	

COMMERCIAL AND INDUSTRIAL

Sector Summary

Because the non-residential programs are designed to serve both the commercial and industrial sectors with a unified approach, we first present the combined program-level results for these two sectors. To acknowledge and demonstrate the differences in energy consumption patterns and available efficiency opportunities between these two sectors, we then present fuel-specific detailed savings results individually for each sector in the subsequent sections. No cost-effectiveness results are presented at the sector or fuel level. This mirrors our analytical approach; whereas our program suite is designed to provide comprehensive coverage across all fuels for both the commercial and industrial sectors, our analysis is based on an understanding of how commercial and industrial customers use energy differently. For the purposes of our analysis, this only affects the Large Business Retrofit Program. Because even smaller industrial customers will likely be too large to qualify for the Small Business Retrofit Program and new construction activity in the industrial sector is likely to be low during the analysis period, the analysis assumes that all savings in the industrial sector are realized in the Large Business Retrofit Program.

Savings

Cumulative results through 2025 for the commercial and industrial sectors are presented by program and fuel in Table 15 below. The C&I Lost Opportunity Program achieves the largest electric energy savings, with 45% of the sector total, followed closely by Large Business Retrofit (43%). The Small Business Retrofit Program has significantly lower savings (12%) due to its focus on smaller energy users. The same ranking is seen with electric demand savings, with the Lost Opportunity Program responsible for the majority of savings (52%) and the Large Business Retrofit Program achieving 36% of the total. For fuel savings, the order is changed, with the Large Business Retrofit Program achieving a large majority of gas savings (77%), and a small

majority of petroleum savings (53%). This is due to significant gas savings opportunities from industrial customers in the Large Business Retrofit Program. For petroleum fuels, the largest share of savings comes from the Large Business Retrofit Program (53%), followed by the Lost Opportunity Program (33%), and the Small Business Retrofit Program (14%).

Table 15 | Cumulative Commercial and Industrial Savings by Program, 2025

Program	Electric Energy (MWh)	Electric Demand (MW)	Natural Gas (BBtu)	Petroleum Fuels (BBtu)
C&I Lost Opportunity	823,568	148	459	161
Small Business Retrofit	219,746	33	290	70
Large Business Retrofit	790,502	103	2,446	263
Total	**1,833,816**	**284**	**3,195**	**495**

Costs and Cost-Effectiveness

The tables below show the cost-effectiveness of the commercial and industrial programs from the perspectives of the Total Resource, the Program Administrator, and the Participant Cost Tests. As shown in Table 16, all of the proposed commercial and industrial programs are cost-effective through 2025 from a Total Resource Cost (TRC) Test perspective. Program-level benefit cost ratios (BCRs) range from 1.8 (Small Business Retrofit) to 2.7 (both C&I Lost Opportunity and Large Business Retrofit Programs). At the sector level, the C&I programs have an aggregate BCR of 2.5 representing $1.63 billion in net benefits through 2025.

Table 16 | Commercial and Industrial Total Resource Cost Test Economics by Program

Program	Costs (Million$)	Benefits (Million$)	Net Benefits (Million$)	BCR
C&I Lost Opportunity	413	1,122	708	2.7
Small Business Retrofit	200	354	154	1.8
Large Business Retrofit	469	1,246	776	2.7
Total	**1,083**	**2,721**	**1,638**	**2.5**

The results in Table 17 reflect an all fuels Program Administrator Cost (PAC) Test Perspective. As with the TRC results, all of the programs are cost-effective with BCRs ranging from 2.2 (Small Business Retrofit) to 5.4 (Large Business Retrofit). The sector level PAC test BCR is 4.1. The programs' cumulative net benefits through 2025 are $1.87 billion. Finally, The Participant Test (Table 18) yields the highest BCRs for the Lost Opportunity and the Small Business Retrofit program. The Large Business Retrofit Program is the only program with a lower BCR for the Participant Test because, given the higher incremental costs of retrofit projects, the utility pays a smaller percent of the total measure cost.

Table 17 | Commercial and Industrial Program Administrator Cost Test Economics by Program

Program	Costs (Million$)	Benefits (Million$)	Net Benefits (Million$)	BCR
C&I Lost Opportunity	255	1,033	778	4.1
Small Business Retrofit	137	305	168	2.2
Large Business Retrofit	209	1,139	930	5.4
Total	**601**	**2,477**	**1,876**	**4.1**

Table 18 | Commercial and Industrial Participant Cost Test Economics by Program

Program	Costs (Million$)	Benefits (Million$)	Net Benefits (Million$)	BCR
C&I Lost Opportunity	380	1,072	693	2.8
Small Business Retrofit	180	413	233	2.3
Large Business Retrofit	422	1,179	757	2.8
Total	**981**	**2,664**	**1,683**	**2.7**

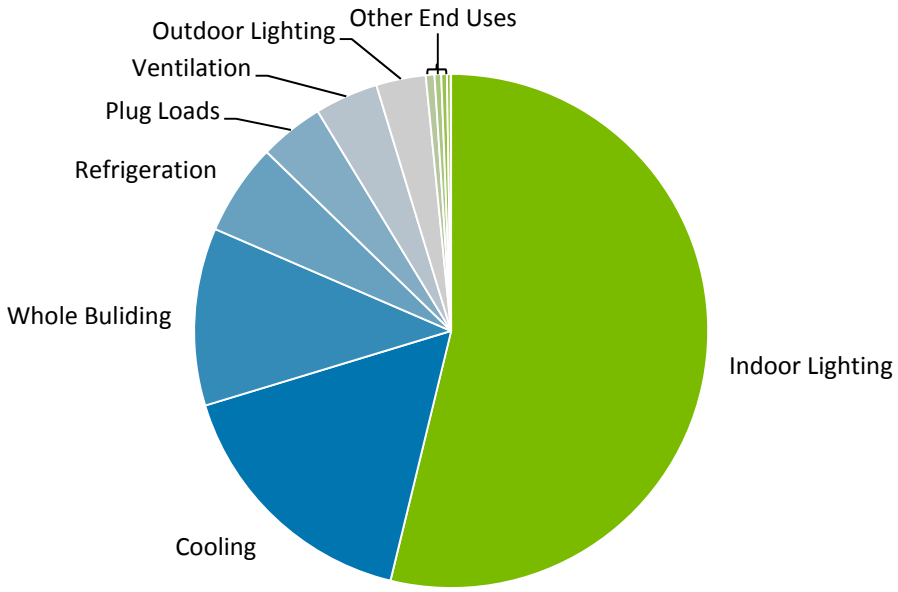
Detailed Results by Sector and Fuel

Commercial Electric Detail

Figure 7 shows the electric savings by end use from the commercial sector. Indoor lighting captures significantly more savings than any other end use and makes up just over half the total savings. As seen in Table 19, lighting measures represent seven out of the top ten measures. In fact, the top three lighting measures are all LEDs and make up almost a third of the entire savings from the portfolio. The two High Efficiency Fixtures/Design measures represent efficient lighting for new construction and major renovation projects.

The other half of the savings is roughly split between cooling, whole building, and other end uses. Whole building represents measures such as commissioning and behavioral measures that affect the consumption of multiple systems within a building. As Table 19 indicates, retro-commissioning is the largest measure in this end use category.

Figure 7 | Commercial Electric Energy Savings by End Use, 2025



Note: 'Other End Uses' represents savings from data centers, space heating, food service, water heating and other miscellaneous end uses.

Table 19 | Commercial Electric Energy Top Saving Measures, 2025

Measure Name	Cumulative MWh (2025)	Percent of Total	TRC BCR
LED Recessed Fixture	170,093	12.8%	2.1
LED Linear Lamps	152,836	11.5%	1.5
LED High-Low Bay	125,596	9.4%	2.1
Retro-commissioning	58,401	4.4%	9.6
Occupancy on/off Lighting Control	51,407	3.9%	3.5
High Efficiency Plug Loads	46,912	3.5%	4.9
LED Lamp, Standard and Decorative	44,384	3.3%	4.7
HE fixtures/design Tier III	42,846	3.2%	1.9
HE fixtures/design Tier II	35,266	2.6%	1.9
Optimize Unitary HVAC Distribution and Control Systems	35,045	2.6%	6.5
Total	**762,787**	**57.3%**	

Figure 8 shows the electric demand savings by end use from the commercial sector. While lighting continues to be a significant source of savings, cooling achieves significantly more demand savings than energy savings. Because savings from cooling measures are highly coincident with the system's peak energy period, it is nearly equal to the savings from indoor

lighting measures. This is also reflected in the top ten demand saving measures, where cooling measures consist of six of the top ten measures, as opposed to only one of the top ten measures for electric energy savings. The measures listed in Table 20 represent only the cooling end use for the measures; the heating end use for these measures are not among the top saving measures.

Figure 8 | Commercial Electric Demand Savings by End Use, 2025

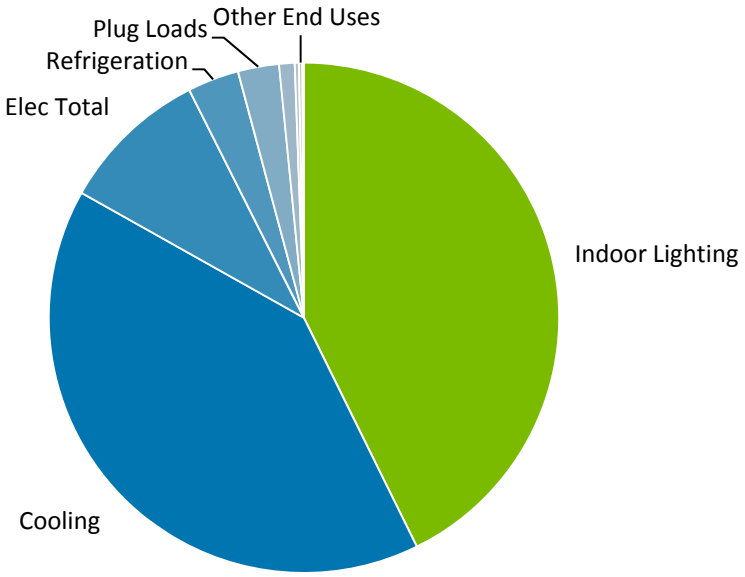


Table 20 | Commercial Electric Demand Top Saving Measures, 2025

Measure Name	Cumulative MW (2025)	Percent of Total	TRC BCR
LED Recessed Fixture	23	9.9%	2.1
LED Linear Lamps	21	8.7%	1.5
LED High-Low Bay	19	7.9%	2.1
Optimize Unitary HVAC Distribution and Control Systems	18	7.8%	6.5
Duct Sealing –Cool*	10	4.2%	23.9
High-Efficiency Chillers Tier II	10	4.2%	2.4
Demand Controlled Ventilation –Cool*	10	4.1%	13.9
High-Efficiency Air Conditioning CEE Tier II	9	4.0%	1.7
Retro-commissioning	9	3.9%	9.6
Optimize Chiller Distribution and Control Systems	7	3.1%	3.4
Total	**136**	**57.9%**	

*Measures are labeled with the suffix "cool" because these measures result in both the cooling and heating end and were divided into two line items for purposes of measure characterization and reporting

Commercial Natural Gas Detail

Figure 9 shows the natural gas savings by end use from the commercial sector. Space heating and whole building measures make up 90% of the total savings. Whole building refers to measures such as retro-commissioning and integrated building design that affect both space heating and water heating systems. As shown in Table 21, even though space heating measures have the most savings, the single largest measure, retro-commissioning, is actually associated with the whole building end use. Two other measures on the top ten list – integrated building design and deep energy retrofit – are also associated with the whole building end use. Thus, this end use consists of a smaller number of measures with relatively high savings, while space heating savings are captured with a larger number of measures with relatively lower savings.

Figure 9 | Commercial Natural Gas Savings by End Use, 2025

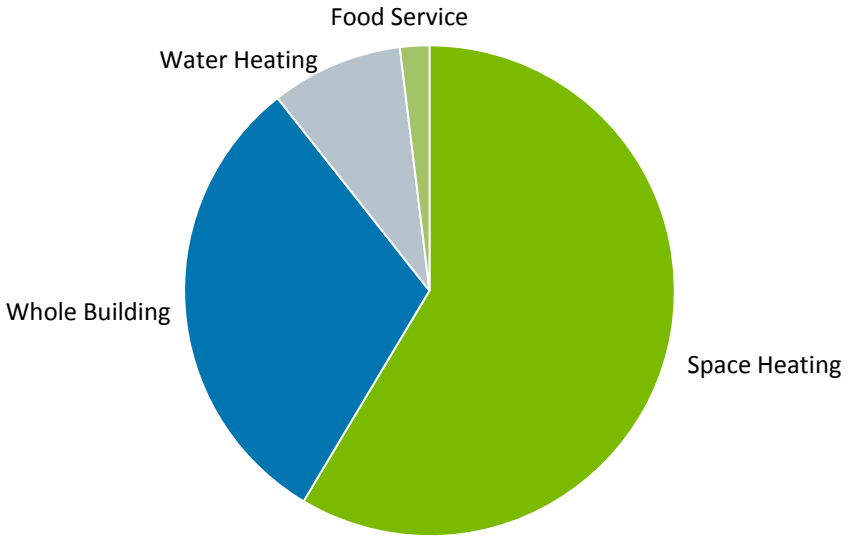


Table 21 | Commercial Natural Gas Top Saving Measures, 2025

Measure Name	Cumulative BBtu (2025)	Percent of Total	TRC BCR
Retro-commissioning	156	21.2%	2.0
Duct Insulation and Sealing	132	18.0%	3.7
Programmable Thermostat	79	10.7%	6.5
Boiler/Furnace Burner Replacement	54	7.3%	3.9
Boiler Reset Controls	46	6.3%	4.3
Boiler Trim Control	37	5.0%	2.2
Gas High Efficiency Tank-Type Water Heater	30	4.1%	3.2
High-Efficiency Boiler	29	4.0%	1.1
Deep Energy Retrofit	26	3.6%	1.3
Integrated Building Design Tier I	20	2.7%	0.6
Total	**609**	**82.9%**	

Commercial Petroleum Detail

Nearly three-quarters of commercial petroleum fuel savings come from space heating. Because savings are dominated by a single end use, we have elected not to show a chart. In addition to space heating, another 26% of savings can be attributed to whole building measures. Finally, a very small quantity of savings (~1%) will come from water heating efficiency. This pattern is also reflected in the list of top ten measures, with six of the ten measures addressing space heating and the remaining four addressing whole building. Whole building measures impact the consumption of multiple systems within a building, such as commissioning and behavioral measures.

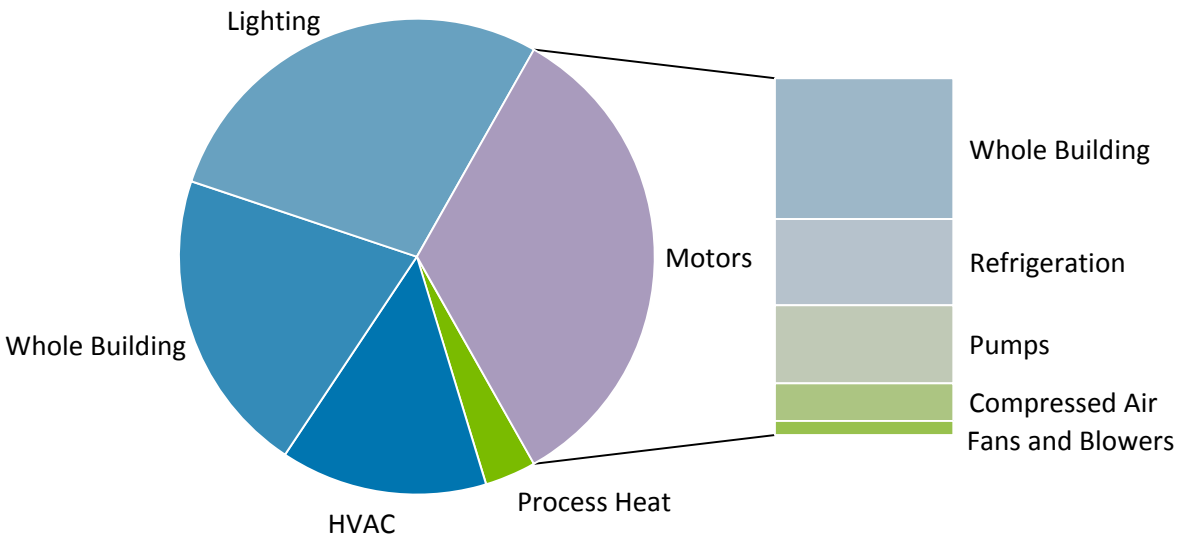
Table 22 | Commercial Petroleum Fuels Top Saving Measures, 2025

Measure Name	Cumulative BBtu (2025)	Percent of Total	TRC BCR
High-Efficiency Boiler	38	21.3%	2.2
Duct Insulation and Sealing	32	17.9%	10.5
Retro-commissioning	28	15.8%	5.8
Programmable Thermostat	19	10.8%	18.6
Boiler/Furnace Burner Replacement	13	7.3%	11.1
Boiler Reset Controls	11	6.2%	12.2
Boiler Trim Control	10	5.5%	5.5
Deep Energy Retrofit	5	2.7%	3.6
Integrated Building Design Tier I	4	2.0%	1.7
Behavioral Measures	3	1.7%	5.2
Total	**161**	**91.2%**	

Industrial Electric Detail

Figure 10 shows the electric savings by end use from the industrial programs. As shown, electric savings opportunities are relatively evenly distributed across end uses with no single end use responsible for the majority of the potential. The industrial sector is highly-dependent on motors for material handling and processing, pump and fan applications, compressed air, and refrigeration. Motors alone are responsible for nearly 60% of total electric energy consumption. Perhaps unsurprisingly, motors represent 34% of total electric savings potential.

Figure 10 | Industrial Electric Energy Savings by End Use, 2025



As shown in **Error! Not a valid bookmark self-reference.**, duct and pipe insulation for process heating and/or cooling applications has the highest potential for a single measure. This measure typically exhibits low technical barriers and the opportunity is common to most industries. In spite of the relative ease of implementation, this opportunity is commonly ignored.

While only 9% of industrial electric energy is consumed by lighting, this end use is responsible for 28% of total electric energy potential and two lighting measures — efficient fixtures and lamps and efficient lighting design — appear in the top five measures. Achievable savings for lighting measures relative to total load is very high due to the efficacy of current LED technologies and the savings from advanced control technologies such as multi-level dimming.

The high savings for the whole building end use reflects the opportunities from measures that save across all end uses such as energy information systems. These hardware-based systems provide real-time information on energy usage and pricing to facility managers and enable informed energy management decisions across all end uses.

Table 23 | Industrial Electric Energy Top Saving Measures, 2025

Measure Name	Cumulative MWh (2025)	Percent of Total	TRC BCR
Duct/Pipe Insulation	66,790	13.3%	3.0
Efficient Lighting Fixtures and Lamps	66,606	13.2%	1.9
Energy Information Systems	63,010	12.5%	5.4
Efficient Lighting Design	60,705	12.1%	7.7
Advanced Motor Designs	55,877	11.1%	6.7
Energy Management Systems	34,811	6.9%	2.0
Pump Efficiency Improvement	33,439	6.6%	10.3
Electric Supply System Improvements	28,122	5.6%	16.7
Fan System Efficiency	20,519	4.1%	3.7
Compressed Air System Management	16,183	3.2%	16.4
Total	**446,061**	**88.6%**	

Figure 11 shows the electric demand savings by end use from the industrial sector. Because both the overall industrial sector and the constituent end uses within a given facility typically exhibit a more constant load profile than other sectors, the top energy saving measures and top demand savings measures, as shown in Table 24, are nearly identical. The slight rearrangement in the measure ranking is due to the fact that some measures, such as lighting opportunities, have more impact at system peak relative to others.

Figure 11 | Industrial Electric Demand Savings by End Use, 2025

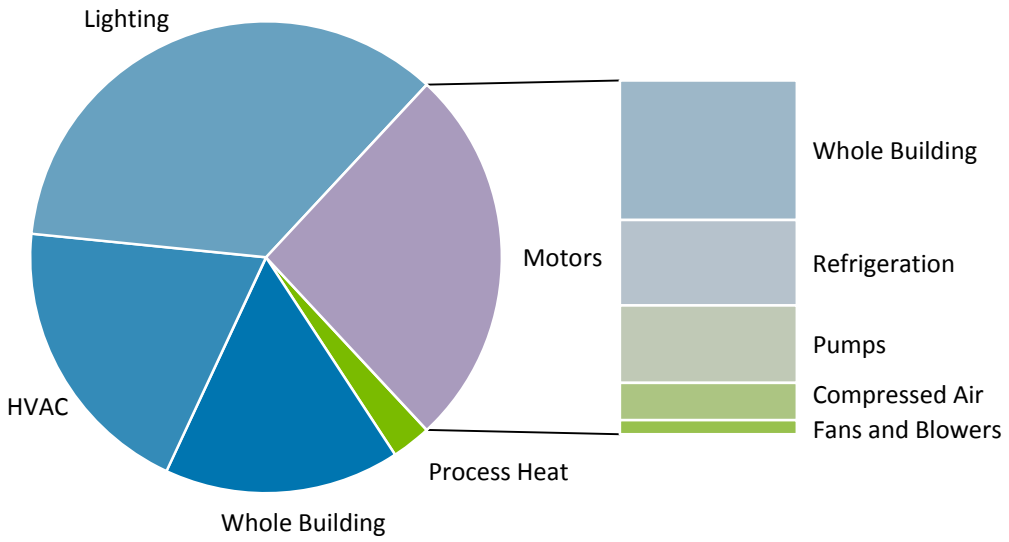


Table 24 | Industrial Electric Demand Top Saving Measures, 2025

Measure Name	Cumulative MW (2025)	Percent of Total	TRC BCR
Efficient Lighting Fixtures and Lamps	8	16.7%	1.9
Efficient Lighting Design	7	15.2%	7.7
Duct/Pipe Insulation	7	14.1%	3.0
Energy Information Systems	5	9.7%	5.4
Energy Management Systems	5	9.3%	2.0
Advanced Motor Designs	4	8.6%	6.7
Pump Efficiency Improvement	3	5.2%	10.3
Fan System Efficiency	2	5.1%	3.7
Electric Supply System Improvements	2	4.3%	16.7
Compressed Air System Management	1	2.5%	16.4
Total	**44**	**90.7%**	

Industrial Natural Gas Detail

Natural gas savings are almost evenly distributed between the boiler (54% of total savings) and process heat (44%) end uses. HVAC savings are marginal, consistent with the relatively minor natural gas consumption associated with the HVAC end use. Similar to the electric measure results, the list of top saving measure presented in Table 25 shows that improved insulation for boiler systems exhibits the greatest single-measure potential. By installing and maintaining insulation on piping or otherwise reducing losses, significant savings can be achieved with relatively minimal effort.

Process integration and process controls and management represent the second and fourth most significant natural gas savings opportunities, respectively, responsible for combined total of 22% of industrial natural gas portfolio savings. While all applications are unique, broadly speaking, process integration ensures that, for facilities with multiple processes, components and operations are well matched in terms of capacity and function. Particularly applicable to the food and beverage, paper, chemical, and petroleum manufacturing industries, process integration can reduce natural gas consumption by between 13 and 25%. As these industries account for more than 84% of Delaware's total industrial natural gas consumption, process integration represents a significant savings opportunity, albeit at a relatively high cost because of the technical knowledge required.

Boiler efficiency measures appearing on the list of the top ten measures contribute nearly 45% of total industrial portfolio natural gas savings. After improved insulation, load control (i.e., installing controls to properly stage boiler systems), improved steam trap monitoring and maintenance, and improved boiler process controls are the highest impact measures.

Table 25 | Industrial Natural Gas Top Saving Measures, 2025

Measure Name	Cumulative BBtu (2025)	Percent of Total	TRC BCR
Improved Insulation	409	20.9%	15.7
Process Integration	263	13.4%	1.2
Load Control	193	9.9%	7.6
Process Controls and Management	180	9.2%	11.5
Automatic Steam Trap Monitoring	121	6.2%	30.2
Efficient Burners	119	6.1%	5.0
Improved Process Control	91	4.6%	8.4
Improved Separation Processes	82	4.2%	5.1
Steam Trap Maintenance	73	3.7%	17.4
Oxyfuel	64	3.2%	2.1
Total	**1,594**	**81.2%**	

Industrial Petroleum Detail

As seen by comparing Table 25 and Table 26, the petroleum measure savings share much in common with the natural gas opportunities. However, some natural gas measures do not appear in the petroleum fuels analysis owing to the fact that petroleum fuels are typically not used for the associated purposes. Overall, measure-level BCRs are higher for petroleum measures than natural gas measures reflecting the cost-differential between the fuels.

Table 26 | Industrial Petroleum Fuels Top Saving Measures, 2025

Measure Name	Cumulative BBtu (2025)	Percent of Total	TRC BCR
Process integration	23	19.9%	1.6
Improved insulation	22	19.0%	21.6
Process Controls & Management	17	14.9%	16.1
Load control	10	9.0%	10.4
Fouling control	7	6.2%	14.6
Flare gas controls and recovery	7	5.7%	1.6
Automatic steam trap monitoring	6	5.6%	41.5
Improved process control	5	4.2%	11.5
Steam trap maintenance	4	3.2%	25.2
Improved separation processes	3	2.5%	6.9
Total	**104**	**90.2%**	

COSTS, BUDGETS, AND SUPPLY CURVES

Table 27 shows the annual program budgets by sector. The rise in budgets generally tracks the rise in savings. In both cases the trajectory is an S-curve, with a steady start, steep growth in the middle years, and a gradual plateau around 2020. This pattern reflects the reality that many programs take several years to develop the relationships, market awareness, and workforce, necessary to move high volumes of incentives while also achieving high levels of savings.

At its peak in 2020, the portfolio is estimated to cost $151 million, while saving roughly 2.5% of annual electric load, and 1.3% of annual gas load. Given the level of savings, the budget in 2020 is comparable to other states with aggressive energy efficiency targets. The commercial sector has the highest budget in the first year, reflecting the high start-up costs of the Large and Small Business Retrofit programs. The residential sector has higher budgets for the middle years, 2015 through 2018, due to the quick ramp-up of the Products program. The budgets for the industrial sector follow the same pattern as the commercial retrofit programs, with a slow start and steep growth in the middle years.

The residential and commercial budgets each account for roughly 45% of the total, with industrial making up the remaining 10%. The industrial sector's budgets are slightly lower than the sector's share of electric sales reflecting the fact that industrial savings can generally be achieved at lower costs.

Table 27 | Budgets by Sector (Million$)

Sector	2014	2015	2016	2017	2018	2019	2020	-	2025
Residential	9	17	26	36	49	59	65		65
Commercial	11	14	23	35	51	64	70		58
Industrial	3	4	6	9	11	14	15		16
Total	**22**	**34**	**55**	**80**	**111**	**137**	**151**		**139**

Note: Budgets for years 2021-2024 are omitted from the table for simplicity and are similar to budgets presented for years 2020 and 2025

Table 28 shows annual budgets for the residential sector programs. The Residential Products program consistently has the highest budget over the course of the study period. The products program is able to ramp-up and deliver a high volume of incentives to the market quickly because it operates in the retail and replacement markets. These markets do not require the same level of trade ally and other market actor support and coordination that characterize retrofit programs. Developing trade ally networks takes time, resulting in longer ramp-up schedules for the retrofit programs. The Residential Behavior program is fully operational by the second year.

Table 28 | Residential Budgets by Program (Million$)

Program	2014	2015	2016	2017	2018	2019	2020	-	2025
Residential New Construction	0.5	0.9	1.4	2.0	2.6	3.3	3.8		3.6
Home Energy Services	2.5	4.1	6.6	9.5	13.5	17.1	19.4		19.8
Multi-Family	0.3	0.4	0.7	1.1	1.5	1.9	2.2		2.1
Residential Products	3.3	6.0	10.3	14.6	19.0	22.0	23.6		23.1
Income-Eligible Single Family	1.5	2.5	4.1	6.1	8.9	11.6	13.3		13.6
Residential Behavior	0.5	2.9	2.9	3.0	3.0	3.0	3.0		3.1
Total	**8.5**	**16.8**	**26.1**	**36.2**	**48.5**	**58.9**	**65.4**		**65.3**

Note: Budgets for years 2021-2024 are omitted from the table for simplicity and are similar to budgets presented for years 2020 and 2025

As shown in Table 29, the Large Business Retrofit program incurs the highest start-up costs in the first two years of program implementation. The C&I Lost Opportunity program becomes the highest cost program in 2016 when it is anticipated that upstream programs could be fully operational. Upstream programs are able to touch large segments of the market and deliver a high volume of incentives by engaging directly with manufacturers and distributors. The Small Business Retrofit program has the smallest budget over the course of the study period. The program's growth is constrained due to its high cost of savings. This pattern is typical in many commercial and industrial portfolios.

Table 29 | Commercial and Industrial Budgets by Program (Million$)

Program	2014	2015	2016	2017	2018	2019	2020	-	2025
C&I Lost Opportunity	3	5	10	16	24	31	36		32
Small Business Retrofit	5	5	8	11	16	20	20		13
Large Business Retrofit	5	7	11	16	22	27	29		29
Total	**14**	**18**	**29**	**44**	**62**	**78**	**85**		**74**

Note: Budgets for years 2021-2024 are omitted from the table for simplicity and are similar to budgets presented for years 2020 and 2025.

Table 30 shows the net present value of spending in various administrative categories over the length of the study period for each program. Program cost subcategories vary substantially among the programs reflecting the large differences in how these programs operate and how they engage customers and trade allies. For example, the Residential New Construction program is largely focused on recruiting builders and developers and requires significant amounts of technical assistance for builder outreach, training, plan review, performance testing, etc. Conversely, the Products program is a broad based consumer program. While retailer and manufacturer recruitment and participation are critical to the Program's success, educating and motivating consumers requires substantial marketing and incentive expenditures.

Table 30 | Budgets by Program and Subcategory (Present Value, Million$)

Program	General Admin	Technical Assistance	Marketing	EM&V	Performance Incentive	Incentives	TOTALS
Res New Construction	1.1	7.2	0.8	0.6	0.8	10.6	21
Home Energy Services	4.2	19.5	12.2	3.1	4.1	65.9	109
Multi-Family	0.5	2.3	0.8	0.3	0.5	7.7	12
Residential Products	5.0	6.5	24.4	3.9	5.3	93.6	139
Income-Eligible Single Family	2.9	15.6	0.9	2.1	2.8	48.9	73
Residential Behavior	0.4	4.5	0.6	0.7	0.2	16.6	23
C&I Lost Opportunity	2.9	9.4	1.5	3.1	4.1	86.2	107
Small Business Retrofit	5.5	10.3	1.1	2.6	3.5	66.9	90
Large Business Retrofit	10.1	26.4	3.4	7.7	10.3	207.5	265
Total	**32.4**	**101.7**	**45.5**	**24.2**	**31.6**	**603.9**	**839**

Table 31 shows the hypothetical surcharge (sometimes referred to as the "System Benefit Charge" or "SBC") per unit of gas and electric consumption that would be required to fund the budgets under the program potential scenario. The electric surcharge tracks the growth in overall budgets, but never exceeds $0.008 per kilowatt hour, even when the program reaches its peak spending in 2020. The surcharge estimates for Delaware compare favorably with similarly aggressive states in the northeast due to the relative abundance of "low hanging fruit" in the state. In other words, because Delaware does not have a long history of efficiency programs, high savings should be easier and less expensive to achieve. Note also that the level of funding and resulting surcharge may differ by sector depending on state policy.

Table 31 | Utility Surcharge Calculation

	2014	2015	2016	2017	2018	2019	2020	-	2025
Sales Forecast									
Electric (GWh)	13,031	13,179	13,317	13,439	13,566	13,698	13,827		14,481
Gas (BBtu)	41,649	43,242	43,956	44,646	44,896	45,234	45,519		47,214
Total Budget (Million$)	22	34	55	80	111	137	151		139
Ratepayer-funded Portion*	19	29	47	68	94	116	128		118
Electric	16	25	39	57	79	98	108		99
Gas	3	5	7	11	15	19	21		19
SBC needed to meet budget									
Electric ($/kWh)	0.0012	0.0019	0.0030	0.0042	0.0058	0.0071	0.0078		0.0069
Gas ($/MMBtu)	0.073	0.108	0.170	0.243	0.335	0.411	0.451		0.400

*It is assumed that 15% of the budget will be funded through alternative sources, such as RGGI proceeds and forward capacity market revenues

The figures below show the cost curves for the achievable energy savings under the program potential scenario. Each block corresponds to a particular end use within a sector. The

width of each block represents the cumulative amount of efficiency potential in 2025, while the height corresponds to the average net levelized cost of that grouping of efficiency potential. The blocks are sorted and presented in order of increasing cost per unit of energy. It is difficult to directly compare the costs of efficiency presented in the supply curves to the avoided costs of energy for Delaware because the avoided electric costs used in this study vary considerably depending on the energy period. However, it is notable that all the efficiency block costs are below the summer and winter on-peak costs, which are close to $0.11/kWh in 2014 and rising thereafter.

The study found that achievable costs of electric efficiency start at *negative* $0.032/kWh of savings from commercial cooling improvements. The study obtained negative levelized cost values for some efficiency measures because it subtracted the value of non-electric resource savings (such as fossil fuel or maintenance savings) as well as avoided generating capacity costs from the total resource cost of the technologies. Thus, measures with negative net levelized costs would pay for themselves even if electric energy costs were zero.

As shown in Figure 12, the end use with the greatest electric efficiency potential is commercial lighting. This is not surprising as commercial lighting upgrades have relatively low market barriers and are implemented through proven program designs. However, the cost of this end use is more expensive than might be expected due to this study's emphasis on LED rather than fluorescent technology, which is expected to remain comparatively costly in the near term. Residential lighting, the second largest end use in terms of savings, benefits from similarly well-developed program designs, but can be achieved at lower costs than commercial lighting because LED technology is more advanced for the relevant applications. In general, the savings and costs of the entire portfolio are fairly evenly distributed among the three sectors.

Figure 12 | Electric Energy Supply Curve

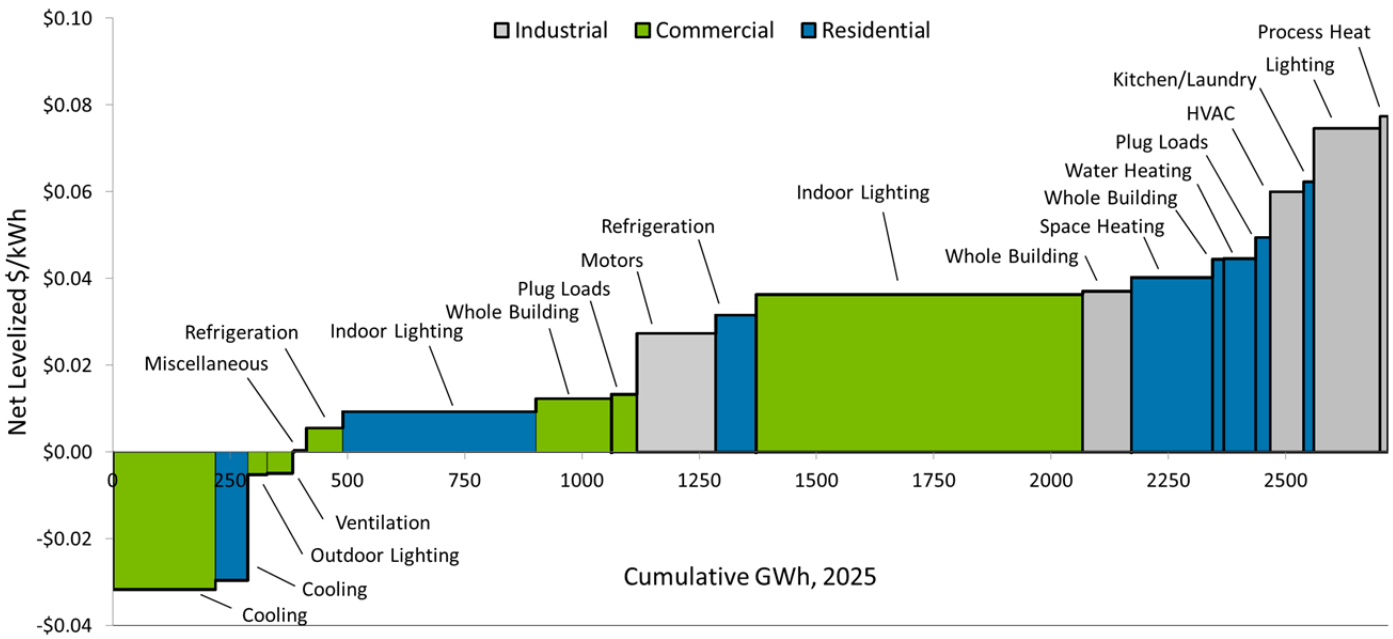


Figure 13 demonstrates that industrial boilers and process heating upgrades provide the greatest opportunity for natural gas savings. This finding bears out the fact that the industrial sector is by far the largest consumer of natural gas and thus provides a significant opportunity for efficiency savings. Residential space heating also has significant potential for gas efficiency, though at a higher cost than the industrial end uses. This finding reflects the fact that residential savings are generated by engaging many small customers, which requires significant administrative resources, while industrial savings generally come from a much smaller group of very large consumers. The whole building end use represents measures such as commissioning and building design that impact multiple end uses within a building, which affect both space heating and water heating.

Figure 13 | Natural Gas Supply Curve

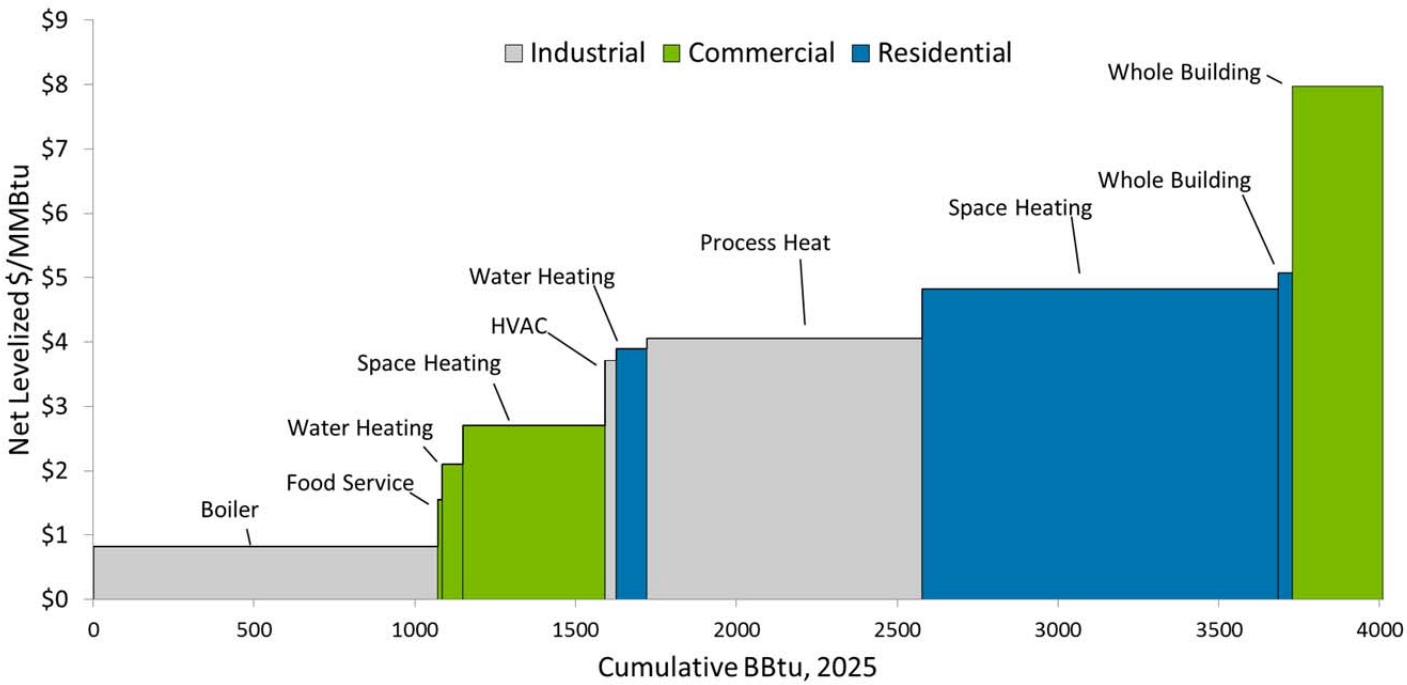
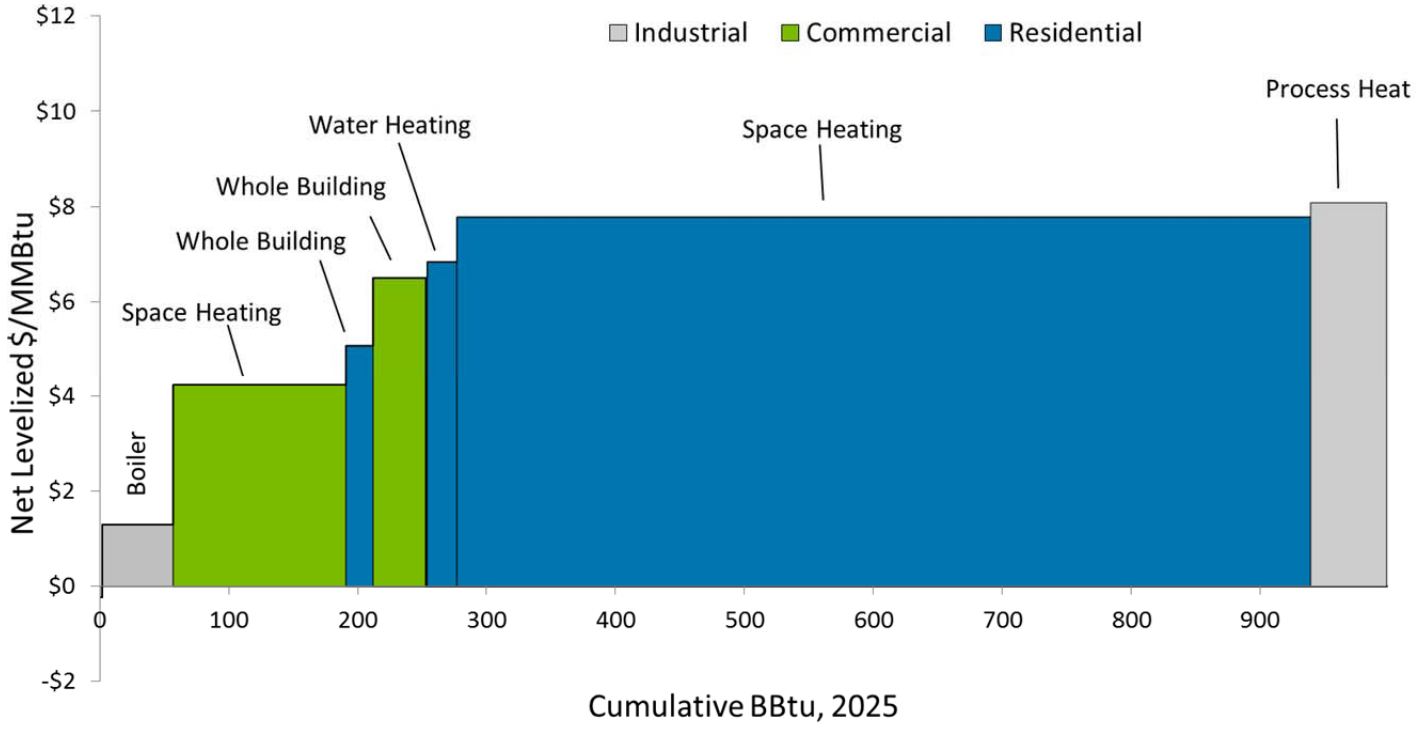


Figure 14, the supply curve for petroleum fuels, is clearly dominated by residential space heating. This finding is due to the fact that petroleum fuels, which include heating oils, propane, and kerosene, are mostly used to heat people's homes. The average price of petroleum fuels is more than $20/MMBtu, suggesting that the efficiency potential identified by this study would be a very economic investment for those customers.

Figure 14 | Petroleum Fuels Supply Curve



SENSITIVITY ANALYSES

Sensitivity analyses assess the impacts of changes in certain key input variables. This study uses sensitivity analyses to examine the impact of alternative assumptions for the discount rate, the avoided costs, and the value of reduced air pollution, as used to assess the costs and benefits of energy efficiency investments. The following table shows the sensitivity analyses that were performed.

Table 32 | Summary of Sensitivity Analyses Performed

Input	Base Case	Sensitivity Case
Discount rate	3%, as recommended by the U.S. Department of Energy as a societal discount rate for clean energy analysis	6%, placing a lower value on future costs and benefits
Avoided costs	Annual avoided costs by fuel type, as developed for this study	Avoided costs 50% higher than the base case
Externalities	No benefits for externalities	Externality benefits of $50/tonne[6] of reduced CO_2 emissions

A higher discount rate has the effect of placing a lower value on future costs and benefits. For efficiency measures the costs are generally incurred at the time of installation while the benefits of energy savings occur over the life of the measure. A higher discount rate thus lowers the value of the future energy savings relative to the costs, which lowers the cost-effectiveness of measures and programs.

Higher avoided costs reflect the possibility that the cost of energy may increase due to market disruptions. Projected avoided costs of electricity and natural gas have decreased in recent years due to the sharp decline in the cost of natural gas. The economic recession that started in 2008 reduced demand for energy in general, which has also suppressed the cost of energy. While energy costs are expected to increase gradually over the study period, disruptions to energy supplies are always possible. The scenario of higher avoided costs demonstrates the value that would come from the increased benefits of future energy savings.

Many efficiency programs include the benefits of reduced air pollution or other externalities in their assessment of the benefits of energy savings. For this sensitivity we have assumed externalities equivalent to $50/tonne of reduced CO_2 emissions. This is consistent with the U.S. government's current recommendations for a social cost of carbon, which increased substantially in 2013.[7] A value of $50/tonne is somewhat conservative. In their Fourth

[6] 1 tonne = 1 metric ton = 1.102 U.S. short tons. 1 U.S. short ton = 2000 lbs.

[7] http://www.epa.gov/climatechange/EPAactivities/economics/scc.html

Assessment Report, the Intergovernmental Panel on Climate Change (IPCC) notes that the methodology used to estimate the social cost of carbon very likely underestimates the associated damages.[8] The 2013 Avoided Energy Supply Cost Study for the New England states assesses externalities at a value of $100/tonne of CO_2.[9]

For assessing the cost-effectiveness and net benefits of efficiency measures and programs, the value of $50/tonne for reduced CO_2 emissions is roughly equivalent to having avoided energy costs that are 25% higher than those used in the base case for this study. Likewise, the sensitivity of 50% higher avoided costs is roughly equivalent to a cost of $100/tonne for reduced CO_2 emissions. The sensitivity analysis for 50% higher avoided costs can therefore be used as a proxy for $100/tonne externalities for CO_2 reductions.

To perform each sensitivity analysis we modeled the impacts of changing the given inputs to determine the associated changes to measure and program cost-effectiveness and net benefits. In general the sensitivity cases do not change whether individual measures pass or fail cost-effectiveness screening, except for a few marginal measures (i.e., those with a benefit-cost ratio close to 1.0). Therefore, the impact on overall savings is generally quite low. Because the base case scenario is based on specific annual savings targets, we adjusted measure penetrations so that the sensitivity scenarios would have the same savings as the base case. For example, if a marginal measure was no longer cost-effective in the case of the higher 6% discount rate, we assumed the penetration of other measures would increase to offset that measure no longer being included in the analysis. This approach also makes it easier to compare the effect of each sensitivity case relative to the base case in terms of benefit-cost ratios (BCRs) and net benefits, as the savings are the same as in the base case.

Table 33, Table 34, and Table 35 show the results for each sensitivity scenario. For the case of a higher discount rate, both the future costs and benefits are more highly discounted than for the base case, but the impact is greater on the future benefits. The associated program benefit BCRs are thus lower, but all programs remain cost-effective. The overall portfolio BCR changed from 2.4 in the base case to 2.1, and total net benefits decreased from $2.3 billion to $1.4 billion.

For the case of 50% higher avoided costs, the benefits are much higher than in the base case, which results in substantially higher BCRs for all programs. The overall portfolio BCR is 3.1, compared to 2.4 in the base case. Total net benefits increased from $2.3 billion to $4.0 billion.

For the case of including externalities of $50/tonne of reduced CO_2 emissions, the benefits are much higher than in the base case, but with less of an impact than the sensitivity for higher avoided costs (which are roughly equivalent to $100/tonne of reduced CO_2 emissions). The overall portfolio BCR changed from 2.4 in the base case to 2.7, and total net benefits increased from $2.3 billion to $3.2 billion.

[8] http://www.ipcc.ch/publications_and_data/publications_ipcc_fourth_assessment_report_synthesis_report.htm

[9] http://www.synapse-energy.com/Downloads/SynapseReport.2013-07.AESC.AESC-2013.13-029-Report.pdf

Table 33 | Sensitivity for 6% Discount Rate

	Sensitivity Scenario - 6% Discount Rate				Base Case			
Program	**Costs (Million$)**	**Benefits (Million$)**	**Net Benefits (Million$)**	**BCR**	**Costs (Million$)**	**Benefits (Million$)**	**Net Benefits (Million$)**	**BCR**
Residential New Construction	25	36	11	1.4	31	56	25	1.8
Home Energy Services	133	202	69	1.5	166	306	139	1.8
Multi-Family	8	12	5	1.6	20	27	7	1.4
Residential Products	198	464	267	2.3	256	695	439	2.7
Low Income Single Family	77	114	37	1.5	95	171	76	1.8
Residential Behavior	24	25	1	1.0	28	29	1	1.1
C&I Lost Opportunity	306	734	429	2.4	412	1,118	707	2.7
Small Business Retrofit	128	209	80	1.6	199	352	153	1.8
Large Business Retrofit	330	809	479	2.5	469	1,242	774	2.7
Total	**1,228**	**2,605**	**1,377**	**2.1**	**1,676**	**3,997**	**2,321**	**2.4**

Table 34 | Sensitivity for Externalities of $50/tonne of Reduced CO_2

	Sensitivity Scenario – Higher Avoided Costs				Base Case			
Program	**Costs (Million$)**	**Benefits (Million$)**	**Net Benefits (Million$)**	**BCR**	**Costs (Million$)**	**Benefits (Million$)**	**Net Benefits (Million$)**	**BCR**
Residential New Construction	36	84	48	2.3	31	56	25	1.8
Home Energy Services	188	457	269	2.4	166	306	139	1.8
Multi-Family	26	44	18	1.7	20	27	7	1.4
Residential Products	293	1,029	736	3.5	256	695	439	2.7
Low Income Single Family	108	257	149	2.4	95	171	76	1.8
Residential Behavior	26	42	15	1.6	28	29	1	1.1
C&I Lost Opportunity	466	1,646	1,180	3.5	412	1,118	707	2.7
Small Business Retrofit	231	532	301	2.3	199	352	153	1.8
Large Business Retrofit	500	1,799	1,299	3.6	469	1,242	774	2.7
Total	**1,875**	**5,890**	**4,015**	**3.1**	**1,676**	**3,997**	**2,321**	**2.4**

Table 35 | Sensitivity for 50% Higher Avoided Costs

	Sensitivity Scenario – Higher Avoided Costs				Base Case			
Program	**Costs (Million$)**	**Benefits (Million$)**	**Net Benefits (Million$)**	**BCR**	**Costs (Million$)**	**Benefits (Million$)**	**Net Benefits (Million$)**	**BCR**
Residential New Construction	36	84	48	2.3	31	56	25	1.8
Home Energy Services	188	457	269	2.4	166	306	139	1.8
Multi-Family	26	44	18	1.7	20	27	7	1.4
Residential Products	293	1,029	736	3.5	256	695	439	2.7
Low Income Single Family	108	257	149	2.4	95	171	76	1.8
Residential Behavior	26	42	15	1.6	28	29	1	1.1
C&I Lost Opportunity	466	1,646	1,180	3.5	412	1,118	707	2.7
Small Business Retrofit	231	532	301	2.3	199	352	153	1.8
Large Business Retrofit	500	1,799	1,299	3.6	469	1,242	774	2.7
Total	**1,875**	**5,890**	**4,015**	**3.1**	**1,676**	**3,997**	**2,321**	**2.4**

FRAMEWORK FOR PROGRAM ACHIEVABLE PORTFOLIO

UNDERSTANDING BARRIERS

The Energy Efficiency Gap

Implementation of efficient technologies and behavioral changes necessary to achieve energy savings is far below what would be expected. First used by Hirst and Brown (1990), the "energy efficiency gap" is a term that refers to the underinvestment in energy efficiency based on what would be anticipated given the economic and social benefits.[10] Households, governments, businesses, and manufacturers often fail to utilize cost-effective technologies to reduce energy consumption despite technical feasibility.

To explain the energy efficiency gap many have sought to identify the market barriers and market failures that prevent people and organizations from achieving optimal levels of energy efficiency. Although many different frameworks have been described, there appears to be much consensus in the literature about the types of barriers that impact energy efficiency.

Common Barriers to Economically Efficient Investment in EE

We developed a simplified set of five categories of barriers that we believe captures all of the common types. The following sections provide further discussion of several barriers as well as some of the potential solutions to overcome them. These barriers include split incentives, lack of information, transaction costs, financial constraints, and lack of availability. Although this list is not exhaustive, it touches on the most frequently cited and most important to overcome.[11] Appendix A presents a more detailed treatment of barriers to energy efficiency.

Split Incentives/Agency

Split incentives occur when the benefits and costs of investing in energy efficiency are divided between two parties or agents. Often referred to as the "principal-agent" problem, this challenge emerges because the party responsible for making energy efficiency investment decisions (the agent) is not the same party that benefits from the investment (the principal.) This barrier is frequently described with regards to the rental property market. For example, in the residential sector, approximately 80% of renters are responsible for paying their own utility costs.[12] Another less frequently discussed example of a principal/agent challenge relates to larger customers in the commercial and industrial (C&I) sectors. There, the employees who have the power to make capital investment decisions may not be the same as those who manage

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10 Hirst, E. and Brown, M. "Closing the Efficiency Gap: Barriers to the Efficient Use of Energy." *Resources, Conservation and Recycling* 3(4), 267-281. 1990.

11 For a broader discussion of market barriers, see: Eto, Prahl, and Schlegel, "Lawrence Berkeley National Laboratory, "A Scoping Study on Energy-Efficiency Market Transformation by California Utility DSM Programs." 1996.

12 Harvard Joint Center for Housing Studies. "America's Rental Housing: Meeting Challenges, Building on Opportunities." 2011.

the operations and maintenance of a facility and understand its energy use, nor is facility energy consumption considered to be part of their job description.

Solutions to this problem typically involve aligning owner and renter interests. One way this can be accomplished is through "green leases" that share the savings from efficiency investments between owners who charge slightly higher rents in exchange for lower tenant utility bills resulting from upgrades. Using the building code can also align incentives and ensure that landlords who invest in reducing tenant energy consumption are not put at a competitive disadvantage by leveling the playing field.

Lack of Information/Uncertainty

The quantity and complexity of information needed to make informed decisions about investments in energy efficiency makes the information barrier a significant challenge to overcome. Customers may not be aware of the building's performance and the opportunities for energy savings. Studies have suggested, for example, that only a small percentage of U.S. households are aware of how much energy they consume and how to best reduce their energy use.[13] Additionally, uncertain information can cause customers to consider investments in energy efficiency to be risky. For example, commercial customers could worry that the performance and quality of an unfamiliar technology might negatively impact their business.

Education and outreach is an obvious solution to barriers related to information and uncertainty. Mass market, targeted marketing, and one-on-one discussions with customers can all play a role. Providing comparative information and making energy consumption data widely available may also help close the information gap. Benchmarking can help customers understand where their energy use ranks among similar customers, while labeling and disclosure requirements inform prospective owners and tenants of a building's energy performance.

Transaction Costs

A barrier that is closely related to the information barrier involves transaction costs. Even when the information needed to help customers make decisions to invest in efficiency is available, acquiring that information can be burdensome in terms of time, money, or both. Customers must seek out information to identify and weigh their options and hire and manage professionals to complete the work. Such actions require effort that is above and beyond what they would likely undertake to maintain their current building. In the face of transaction costs, maintaining the status quo is usually the easier and more comfortable option.

For those customers with the capability to engage in some level of discussion and analysis over efficient investments, technical assistance can provide enough support to overcome the initial hurdle of knowing how to analyze options and where to find relevant data. For smaller customers, who typically have less available resources to address efficiency, the need for understanding and transaction time can be nearly eliminated through direct install programs.

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[13] Ehrhardt-Martinez, K. and Laitner, J., Editors, "People-Centered Initiatives for Increasing Energy Savings." 2010.

Financial Constraints

Although many energy efficiency measures can save customers money in the long run, implementing those measures often requires an additional investment. While customers receive the benefits of efficiency over time, the majority of the costs for these measures are required at the start of the project. Many customers weigh investments in terms of short payback periods and place greater value on first costs rather than on the life-cycle costs of the investment. However, even customers who recognize the lifetime savings potential from efficiency may lack the capital or borrowing power to make the initial investment.

Financial incentives in the form of direct payments to customers who invest in efficiency or reduced prices on efficient equipment or services have been the mainstay of efficiency programs for many years. These can be even more successful if paired with efforts to increase the availability of and access to capital to cover the remaining cost of efficiency upgrades through financing programs.

Lack of Availability

Customers with adequate resources and knowledge may be unable to improve efficiency if products or knowledgeable contractors are not available. In some instances, suppliers or buyers may exhibit market power and dominate supply channels, limiting competitors who produce energy-efficient products from penetrating the market.[14] Even in a competitive market, when newer, more efficient products are not available from suppliers and distributors, customers may not have access to the products when they need them.

Working with entities throughout the supply chain rather than solely at the retail level is developing as a best practice strategy to quickly transform markets for efficient equipment. Such "upstream" approaches take a variety of forms, but all are premised on the notion that applying leverage higher up in the supply chain where dozens, hundreds, or even thousands of units are involved in transactions is a more effective strategy than attempting to reach customers one at a time.

Multiple Barriers Require Multiple Strategies

Because the barriers described above exist throughout the supply chain, successful programs don't limit themselves to focusing on single solutions, but rather take a comprehensive approach that addresses multiple barriers simultaneously. Strategies need to be developed for providing solutions to barriers in three broad categories: structural, informational, and financial.

Structural

Strategies for addressing structural barriers are based on answering this question, "if people knew what to do to reduce their energy use, and if they had the money to do it, what shortcomings in the ability of the market to deliver those energy saving solutions would need to be addressed?" For example, if local distributors do not stock the desired high efficiency

[14] Sullivan, "Behavioral Assumptions Underlying Energy Efficiency Program for Businesses." February 2009.

equipment, and customer replacement timelines require it to be in stock when their equipment fails, a strategy must be devised for making that equipment available. Such a strategy might include paying modest incentives to the distributor for agreeing to stock the equipment so that it is readily available. If local contractors don't have the knowledge and training required to install the equipment so that it functions properly, a strategy must be devised for assuring that they can get the necessary training.

Informational

Strategies for addressing informational barriers are based on making sure that the people who are able to purchase high efficiency improvements understand both that the improvements are available and that they can provide solutions for issues that they want to solve. For example, the homeowner living in a drafty old farmhouse might not know that air sealing the home will both provide monetary savings and improved comfort. Or she might think that there is something that could be done to make the home more comfortable, but not know who to call. This homeowner is then left to sort through the promises of advertisers and the suggestions of family and friends, which may not lead to the answers she needs to be able to find. Alternatively, she may know what to do and who to call, but may not understand how her energy bill savings will offset the cost of the project over time. Typically successful programs must address all of these informational issues in order to assure sufficient participation.

Financial

Much is made of financial barriers in relation to energy efficiency. The higher first-cost of high-efficiency equipment is perhaps the primary reason that customers do not move forward with energy efficiency projects even when structural and information barriers have been removed. Financial barriers can include both the inability to pay for the improvements or objection to the cost even by those who could pay if they so choose. Strategies must be developed for both cases, and typically involve a combination of incentives and rebates, and in some cases financing to spread the impact of the installation cost out over time.

GATHERING BEST PRACTICES

Over the past several decades, energy efficiency programs have grown in prevalence across the country. Although program administrators all seek to help customers reduce their energy consumption, some programs have been more successful than others in terms of savings achieved, customer participation and satisfaction, transferability, cost-effectiveness, and impact on the market. Generally speaking, the most effective energy efficiency programs are those that best overcome the structural, informational, and financial barriers that hinder customers from investing in efficiency. The ways in which the most successful programs overcome these barriers share common characteristics and best practices. The following section of the report discusses the current state-of-the-art regarding best practices and strategies for achieving measurable cost-effective efficiency savings based on successful programs around North America.

Identifying Best Practices

Numerous studies and reports over the years have sought to identify the specific best practices in program design to improve the development and outcomes of such programs in other jurisdictions. A study published by the American Council for an Energy Efficient Economy (ACEEE) in 2013 is perhaps the most recent and geographically diverse best practices review included in the literature.[15] Based on our own and ACEEE's observations of exemplary programs as well as additional consideration of other best practices resources, Optimal distilled a list of characteristics shared by many of the country's leading efficiency programs. Best practice programs seek to provide many of the following features.

- Bundle financial incentives with technical and/or informational services
- Target market niches and customer sub-segments
- Reach previously underserved customers with new programs and program approaches; pilot test new program approaches
- Simplify processes to make participation easier for customers
- Provide "one-stop-shopping" and similar approaches
- Work to build relationships and partnerships
- Provide financing options, including an increasing variety of approaches and varying degrees of involvement by program administrators (PAs) in project financing
- Work to incorporate the latest energy-efficient technologies

Identifying Programs Relevant to Delaware

While many of the exemplary programs discussed in the ACEEE report represent approaches that Delaware should strive for, they may not be the most relevant programs to look to for current program design efforts. It is generally advised that PAs first look to successful models in other jurisdictions that can easily be transferred to new regions and be quickly implemented to achieve near term savings. For example, effective initial commercial programs often to include simpler approaches such as prescriptive incentives for efficiency measures like lighting, HVAC systems, and motors.

Because they evolve over time and in response to efficiency efforts, market conditions in nearby states may be more similar to Delaware than those of the best practice programs described in the ACEEE report and elsewhere. As a result, our set of best practice programs includes successful programs currently implemented in Vermont, Massachusetts, New Brunswick, Maryland, Pennsylvania, and New York. We also note that a successful efficiency program portfolio is greater than the sum of its parts. Simply implementing a series of best practice programs may not necessarily lead to success. Rather, the portfolio should be designed in such a way that the programs work together, are mutually supportive, achieve efficiencies of administration, and are simple for customers to understand.

[15] Nowak, et al., ACEEE Report Number U132, "Leaders of the Pack: ACEEE's Third National Review of Exemplary Energy Efficiency Programs." June 2013

Please refer to Appendix B for a more detailed discussion of best practices in energy efficiency programs.

LEARNING ABOUT THE DELAWARE MARKET

Market Research

Objective and Limitations

Building on the findings of our market barriers and program best practice research, Optimal conducted market research in Delaware to investigate specific market conditions and attitudes of potential energy efficiency program participants in Delaware. This research was not intended to be used for statistical analysis, but rather to gather qualitative information to identify and fine-tune those program strategies most likely to overcome efficiency market barriers specific to Delaware. The findings also help to identify areas worthy of further research that would optimize the operations of future efficiency programs.

Methodology

To conduct the market research, Optimal developed a questionnaire that covered four primary content areas: Market Barriers, Equipment Availability, Specific Market Channels, and Training and Labor (see Appendix C for full questionnaire). Optimal reached out to a total of 30 organizations and administered the questionnaire to 13 of those organizations over the phone. Many of the organizations contacted were identified by DNREC. Optimal received additional contacts through its conversations with respondents. The range of organizations interviewed included large customers, industry groups, housing agencies), electrical and HVAC companies, implementation contractors, and engineering design firms. A discussion of conclusions drawn from our discussions is summarized in the sections below. For a complete discussion, see Appendix E.

Market Barrier Findings

Optimal's market research effort included questions to better understand the real and perceived barriers to efficiency in Delaware and what could be solutions for overcoming or removing them. Many of the responses received verified findings from our previous market barrier research. For example, upfront costs for efficient technology and equipment are a significant barrier to energy efficiency in Delaware just as in many other jurisdictions. To address barriers to energy efficiency, many respondents agreed that funding opportunities such as rebates and low interest loans would be most effective. Respondents pointed out that an important program design consideration would be to determine which customers to target for rebates versus loans and how to structure low interest loans.

Lack of awareness of energy efficiency opportunities, technologies, and benefits, is another barrier that is prevalent in many jurisdictions. In Delaware, awareness presents a barrier to energy efficiency for some customers and service providers more so than others. Many respondents thought that architects and engineers were largely up to speed with efficient technologies and practices, since they are required to complete ongoing professional

development. Additionally, many of the large business customers with significant energy costs were aware of or took steps to become aware of cost-effective energy saving opportunities. However, respondents thought there was less awareness among residential, smaller business customers, and building and facility managers.

The difference in levels of awareness illustrates an important take away from this market research: different customers face different challenges to implementing efficiency programs. Developing a range of programs that segment and address specific markets can help to overcome these segment-specific barriers.

Some respondents indicated that they thought there was an attitude of indifference and resistant to change among Delawareans and thought people may not understand the benefits of saving energy. Several respondents indicated that reaching customers through channels they are already looking to for information could be a particularly helpful outreach strategy. Many interviewees also expressed a need for a simple, easy way to access information about program offerings for all types of customers.

Product/Service Availability and Market Channel Findings

The interviews also included questions to determine whether efficient options are available and being promoted in the marketplace and how efficient products move through the supply chain. There was a general sense among respondents that efficient equipment and products are available and that there is an adequate supply. Although some companies work with distributors out of state, they thought that there are also local distributors.

Although respondents suggested that efficient equipment and products are available, they are not necessarily being promoted to customers by the professionals selling them. They indicated that building professionals will usually work to meet their customers' selection criteria and not try to convince them otherwise. Because cost is the primary driver for most customers, standard, less expensive options are likely to be the most prevalent.

Training Findings

Training and education has been effective in other regions as a way to proliferate efficient products, technology and practice. The Delaware market research survey included questions to determine if training is needed in the State and if so, to what extent. Respondents indicated that some training is currently available in the state; yet the vast majority of interviewees support expanded training options for end users as well as building and equipment professionals. For example, an HVAC company representative indicated that there is a lot of training for technicians, but not enough training on energy systems thinking, at least not locally. She would like to see training for everyone including HVAC companies, builders, and contractors. A representative from a construction company agreed that training should be focused on the whole system and points out that lighting and HVAC, etc. go "hand in hand."

Partnering with organizations that already provide training or other support services to end use customers will be an effective strategy for delivering training programs. For example, a previous residential program participant thought small businesses and home owners could benefit the most from training. In particular, she thought the Delaware Technical Community

College could provide resources for training. Additionally, a respondent from a housing agency thought there might be a training opportunity for new home buyers in the area of assessing home energy efficiency.

Additional Considerations

A respondent with a government agency pointed out that many of the agency's municipal buildings located in the center of Dover are historic buildings. It can be extremely expensive to improve efficiency in these buildings since they need things like custom windows. To the extent that there are many historic buildings in Delaware, additional consideration, guidance, or program funding relevant to historic building owners may be worth exploring.

Market Research Conclusions

In many respects, customers in the state of Delaware face similar barriers to energy efficiency as those in other jurisdictions. A focus on upfront costs and lack of awareness among some customers represent significant challenges. Specific market segments and end users face distinct barriers that should be considered and addressed through program offerings. Attitudes in favor of energy efficiency may lag behind those states that have been implementing efficiency programs for many years. However, efficiency equipment and product availability does not appear to be a major hindrance to energy efficiency improvements. Training and partnership opportunities may help to shift attitudes, educate customers about the benefits of efficiency, and increase program participation. A concerted marketing and outreach effort that disseminates information through channels customers already turn to for information could also help to engage customers. Providing customers with a centralized place to find additional information and simple and transparent participation processes will help to ensure customers take advantage of energy savings opportunities in Delaware.

Secondary Data Collection

Overview and Purpose

To supplement the Delaware-specific primary market research, Optimal also collected a variety of secondary data sources. These sources were used to inform inputs and assumptions in the analysis that were not, or could not be, Delaware-specific.

Regional Studies

When state-specific data was not available, we attempted to use regional studies or data from nearby states. Northeast Energy Efficiency Partnerships (NEEP), a regional non-profit that coordinates energy efficiency efforts, provided a number of such studies on topics including incremental cost, emerging technologies, and load shapes. Similarly, we used a regional study on avoided energy costs in New England to inform the costs we used to evaluate natural gas efficiency.

National Studies

Many aspects of energy efficiency potential are not dependent on regional characteristics, such as the efficiency of a heat pump water heater. In these cases it is appropriate to use

national studies or findings from other areas of the country. For this analysis, we relied on an extensive set of reports and studies from around the country to inform a variety of assumptions including individual measure characterizations, applicability factors, and measure penetrations. One example is the series of reports the Department of Energy (DOE) publishes on Solid State Lighting (i.e. LEDs). The DOE tracks the cost and efficiency of products for various lighting applications which we use to inform our measure characterizations. In addition, the DOE projects the future cost of LED lamps in their Multiyear Program Plan, which we use to forecast the future performance of LED efficiency measures.

Evaluations and Technical Reference Manuals from Neighboring States

Evaluation studies and technical reference manuals (TRM) can often be treated like regional studies in that their information is frequently relevant beyond the immediate home state. To inform our assumptions about net-to-gross factors, we relied on the recent set of evaluations from Maryland's EmPower program as well as evaluations from Pennsylvania and New Jersey. Technical reference manuals from Vermont and Massachusetts were used to develop measure characterizations where the Delaware or Mid-Atlantic TRM fell short.

Utility Filings

Utility filings with state regulatory agencies often include useful information on program models, as well as details on the programs' savings and cost performance. We collected various utility filings to inform both program designs and our projections of non-incentive costs related to program delivery. This research included collecting both plans and annual reports for PECO (PA), Baltimore Gas & Electric (MD), National Grid (RI, MA), Northeast Utilities (MA), and Efficiency Vermont (VT).

PROGRAM PORTFOLIO DESIGN

This section presents our assumptions and preliminary descriptions of the programs on which we based our program potential scenario. While we have provided a substantial amount of detail regarding the programs and their major features, these should not be considered "final" program designs. On the other hand, the reader should not assume that these programs represent the only means by which to achieve savings comparable to those reported earlier. Should Delaware proceed to develop a broad and robust portfolio of efficiency programs, we believe that these program descriptions can serve as a starting point for discussions and planning efforts.

PROGRAM PHILOSOPHY, ASSUMPTIONS, AND CAVEATS

We developed the programs included in the program potential based on a wide range of information sources and on our team's own experiences with programs in several jurisdictions. We also relied on the information gathered and reported on in the previous "Framework" section. Our overall philosophy for developing the programs was to create a coordinated approach to efficiency program services that builds capacity within the market place and awareness among consumers in a sustained fashion over several years, thereby reaching aggressive savings levels in a cost-effective manner. Importantly, we did not assume any particular model for delivering the programs and services that compose our portfolio. These could be managed and delivered by individual utilities within the state, a state agency, a state-wide third-party administrator, or even some combination of these.

We caution that although we conducted some research into the nature of the efficiency market in Delaware, additional knowledge and data would be necessary to move from these program descriptions and concepts to detailed implementation plans. We do note that our limited initial research did not reveal any major obstacles to successful implementation of efficiency programs in Delaware.

RESIDENTIAL CUSTOMER PROGRAMS

The proposed portfolio of residential programs has been developed to comprehensively respond to the needs of Delaware's homeowners and tenants. All key savings opportunities from simple lighting improvements to whole-house retrofits will be addressed through a number of integrated and mutually supporting programs. These programs will engage and motivate customers to participate by removing barriers and by offering technical support and a variety of financial incentives. Trade allies will play a key role in the successful implementation of these programs. Program components will be developed that recognize and build on existing market channels for retailers, distributors, contractors, builders, manufacturers and other key trade allies

Program Concepts

Below is a table of program concepts used to develop the residential program designs proposed in this report. Refer to Appendix F for full residential program concepts descriptions.

Table 36 | Residential Program Concepts

Market Segment	Delivery Model	Services/ Incentives Provided	Best Practice Features
New Construction	3rd party building science-based technical assistance and verification	• Builder training • Plan review • Diagnostic testing • Incentives for multi-fuel, comprehensive projects • Code compliance support	• Bundled incentives and technical support for a comprehensive, multiple end use, multiple fuels approach • One-stop shopping for comprehensive services
Retrofit/Home Energy Services	Comprehensive certified contractor-driven delivery	• Technician training and certification • Fuel-neutral single measure incentives • Higher incentives for comprehensive savings • Robust quality assurance processes	• Bundled incentives and technical support for a comprehensive, multiple end use, multiple fuels approach • Partnerships with contractors and other interested organizations • Target marketing to customer sub-segments • Financing
Multi-family	Property owner/manager engagement providing turnkey solutions	• Fuel neutral single measure incentives • Higher incentives for comprehensive savings • Construction management oversight • Robust quality assurance processes	• Targeting of specific sub-sectors of the multi-family market (affordable housing, market rate) • Comprehensive solutions addressing tenant units and common areas and systems • Relationships built with property owners and managers for sustained engagement • Financial packaging including incentives and loans • One-stop shopping to receive a full range of support services
Efficient Products	Instant and Mail-in rebates at retail	• Upstream and midstream incentives to manufacturers and retailers • Sales staff training • Contractor training for HVAC and DHW installation practices	• Partnerships with manufacturers, distributors, and retailers • Reach different customer segments through multiple media channels and targeted outreach • Pursue alternative sales/promotional venues to reach a underserved customers • Supports latest technologies • Streamlined point-of-sale participation

Market Segment	Delivery Model	Services/ Incentives Provided	Best Practice Features
Income-Eligible Services	Working through existing services and agencies to engage eligible populations	• Rebates cover full measure cost • Address health and safety issues to the extent possible; leverage outside funding where available	• Partners with and extends the coverage of existing income-eligible efficiency services such as WAP • Targets unique customer sub-segment • One-stop shopping to coordinate with other programs, such as Multi-family new construction and Efficient Products to provide benefits in all income-eligible efficiency markets
Behavior	Customer engagement to reduce wasted energy	• Provide mailed and/or web-based home energy reports with customer-specific recommendations • Provide easy access to program offerings	• Simplified information for easy and direct actions • Integrate electric and gas reporting • Broad reach including underserved customers

Program Summaries

New Construction

The proposed Residential New Construction (RNC) Program will work with builders, contractors, architects, developers, code officials, and suppliers to promote the design and construction of efficient new homes. The program will provide similar program services regardless of heating or hot water fuel choice. The Program will emphasize not only the energy savings associated with efficient new construction but also its sustainability, increased comfort, lower carbon footprint, and lower overall cost of ownership, including in most cases lower monthly ownership costs. For builders and developers the program will promote increased consumer marketability and simplified code compliance documentation. Builders and developers will be provided technical assistance and financial incentives tied to the level of energy savings of each home.

The Program will offer a tiered approach, with greater incentives available for greater levels of efficiency. ENERGY STAR Homes Version 3 (V3) will be offered as one means of program participation. However, meeting all of the requirements associated with V3 may be a barrier to participation, particularly for builders new to ENERGY STAR and/or highly efficient construction. The other major Program compliance paths will include:

- An entry-level option that is less stringent than ENERGY STAR, with tiered incentives tied to building homes that are more efficient than residential code in Delaware (currently IECC 2009)
- An advanced option that significantly exceeds ENERGY STAR, with a net zero energy home specification consistent with Delaware legislative mandate (SB 59) that requires all homes built after December 31, 2025 be net zero energy capable

A program implementation contractor will be procured through a competitive solicitation and will be responsible for day-to-day implementation of the program. The program implementation contractor will be responsible for assuring that an array of technical services including plan review and recommendations, completion of code compliance documentation, performance testing (air and duct leakage), etc. are available to builders.

The RNC Program will address all key end uses and building systems in the home regardless of the compliance approach chosen. These include insulation, window performance, air leakage, HVAC system efficiency, mechanical ventilation, lighting, appliances, and hot water heating. Incentives will largely be provided for whole house performance depending on the compliance approach and/or savings tier. Additional incremental incentives may be offered for specific non-standard measures such as heat recovery ventilation, TopTen USA appliances, or drain water heat recovery.

Multiple paths to participation will encourage builders to increase their level of savings (and incentives earned) over time. Bundled technical support and financial incentives will simultaneously address multiple barriers, supporting the participation of a variety of builders with different levels of interest and current knowledge of efficient building practices. A net zero energy program component will align with longer term state policy objectives.

Retrofit/Home Energy Services

In order to be effective, comprehensive home retrofit services need to be delivered by a workforce that has specialized expertise not only in home construction and repair, but also in techniques that reliably deliver real energy savings. Home retrofit services for Delawareans will be delivered using a contractor-driven model, where Building Performance Institute (BPI)-accredited firms will sell their services to homeowners, using certified technicians to install long-lasting efficiency improvements while maintaining the integrity of the building and the health and well-being of the occupants. The Retrofit/Home Energy Services program will provide support both to the contractor base in the form of technical training and in the marketing of their services, and to homeowners by providing information, maintaining a list of participating contractors who comply with program expectations, and quality assurance to verify that participating contractors do indeed meet the requirements of the program.

Home retrofit services that are truly comprehensive will address three major areas that combine to determine how much energy is used in any given home. The Retrofit/Home Energy Services program will address all three of these areas through a combination of contractor services, education, and outreach. These are:

- The insulation and air leakage levels of the building structure, including walls, windows, ceilings, exposed floors, foundations, etc.
- The efficiency of the mechanical systems that heat and cool the indoor environment, heat water for domestic purposes, make light, clean and dry clothes, keep food cold and so on
- The ways that the buildings' occupants operate their homes- how they set the thermostat, how much laundry they do, etc.

The goal of this program is to provide motivation, opportunity, and financial support to Delawareans so that they invest in reducing the amount of energy used in their homes.

- Motivation: Inform homeowners about the benefits of home energy retrofits, provide testimonials re: benefits of efficiency projects, create the sense that having work done to save energy makes sense and makes one a strong member of the community
- Opportunity: Provide easy access to a listing of participating contractors who both agree to meet required business practice standards and have the training and technical qualifications required to perform effective retrofits
- Financial Support: Provide access to modest incentives and attractive financing to ensure that Delawareans can reap the benefits of reduced home energy use

Delaware's Retrofit/Home Energy Savings program will include the following features found in the industry's best programs:

- Fuel neutral services and incentives addressing all electricity, natural gas, fuel oil, propane and kerosene savings opportunities
- Building Performance Institute (BPI) certification of lead technicians and phased-in requirements for contractor accreditation. All contractors will be required to adhere to the installation standards promulgated by BPI
- Comprehensive assessments that include diagnostic testing and identification of any pre-existing or potential indoor air quality or safety issues
- Robust quality assurance protocols to ensure that program standards are met. The protocol will include both on-site verification for a random mix of projects and customer satisfaction surveys for all participants

Multi-family

Multi-family housing is an increasingly important segment of the housing market, yet providing comprehensive energy efficiency services to people who live in apartments can be difficult and is often overlooked by efficiency programs. At the root of this is the split incentive issue described previously in "Understanding Barriers." For instance, in many cases the tenants in an apartment building may receive heating and cooling from a central system for which the landlord pays the bills. This challenge is found across the full spectrum of multi-family housing, from subsidized affordable housing to market-rate luxury apartments. It also exists both in new construction, where the developer takes on the added costs of building-in efficiency, and in retrofit situations.

To address this and other challenges to increasing the efficiency of multi-family housing, Delaware's Multi-family program will take a comprehensive approach to providing energy efficiency services in this sector, and will work with property owners, managers and tenants to address the full spectrum of energy efficiency opportunities.

Initial engagement will be through the property managers, who serve as the liaison between the financial and operational needs of the property and the human needs of the people who live

there. Program staff will reach out to property managers to hear first-hand about the challenges they face in managing their properties and will develop packages of efficiency options that can either overcome existing constraints or work within them. This is a notably different approach than some have tried, where a prescriptive, one-size-fits-all rebate package is offered on a "take it or leave it" basis.

In addition to supporting common measures such as improved lighting and low-flow showerheads, cost-effective savings opportunities in improving the building's thermal shell (wall and ceiling insulation, draft reduction, window improvements) and in improving the common mechanical systems (e.g., heating and cooling equipment, water heating equipment, laundry, and ventilation systems) will be addressed.

Energy-saving opportunities will be identified first through a free walk-through audit that will assess improvement areas that merit further study. Opportunities will be assessed in the following areas:

- Direct install of low cost measures in tenant units, including energy efficient lighting and water savings showerheads and faucet aerators
- Efficient lighting for common areas such as hallways, entries, etc.
- Major system upgrades for heating, cooling, ventilation, and laundry equipment
- Thermal shell improvements such as added insulation and draft reduction

Cost and savings estimates will be developed and packaged with an offer of incentives and financing designed to meet the financial needs of the property. Packages will include targeted construction management support, tenant and facilities staff education on how to maximize the benefits of the energy efficiency project, and quality assurance and verification services to ensure that the project is installed according to specifications.

Affordable multi-family housing services are similar to those provided to the general multi-family housing market, but reflect the unique circumstances and barriers experienced in this housing. In affordable housing, financial packaging that fits the needs of the project becomes even more critical, as cash-flow margins are often almost non-existent. Major efficiency projects are often most likely to occur when affordable housing is re-structuring its financing for major rehabilitation. Building efficiency into projects of this sort requires strong relationships and regular communications between program staff and property managers in order to meet planning cycle deadlines.

Income-Eligible Services

The best income-eligible energy efficiency programs are deeply connected with the local service providers that deliver support to income-eligible people. This can mean that the program itself is completely delivered as an add-on to the local Weatherization Assistance Program, or it can mean that stand-alone efficiency program services are well-coordinated with the broad range of income-eligible service providers. Services provided will include:

- Comprehensive energy assessments (energy audits)

- Full cost incentives for eligible improvements (no out-of-pocket required for participants)
- Construction management, including identifying and contracting with installation firms
- Quality assurance

Delaware's income-eligible energy efficiency program will address opportunities for reducing the use of all fuels, including electricity, natural gas, fuel oil, and propane. For these fuels, all end uses where cost-effective improvements can be made will be assessed, and improvements will be made as comprehensively as possible. The program will adhere to the building science principles that are promulgated by the Building Performance Institute and the U.S. DOE for retrofitting buildings to increase their energy efficiency. Contractors will test for carbon monoxide issues and assure that no unsafe conditions are left after the building retrofit. End uses will include:

- Building shell improvements, including insulation and draft reduction
- Heating and cooling system efficiency improvements
- Appliance efficiency improvements
- Water heating efficiency improvements
- Lighting efficiency improvements

The goal of the income-eligible program is to assure that comprehensive efficiency services are provided to as many Delawareans who need them as possible, regardless of their ability to afford them. Program operation is based on an abiding respect for the income-eligible participants. These customers are treated no differently simply because they are less able to pay for the services they receive. The program will assess gaps in the energy efficiency services that are currently available to income-eligible customers in Delaware and will fill them as needed to assure that all fuels and all end uses are cost-effectively addressed. If the existing WAP delivery infrastructure is currently only able to deliver building shell improvements then this program might provide funding that allows it to also address heating and cooling mechanical improvements, lighting, and so on. If the WAP programs are comprehensive now, but only able to reach a small fraction of the eligible population, then this program might provide additional funding that allows WAP to reach more households.

Retail Products

The Retail Products Program (RPP) will work with manufacturers and retailers to promote the stocking, marketing and sale of efficient residential lighting, appliances, consumer electronics, DHW and HVAC equipment to consumers, landlords, contractors, builders and small businesses. Nearly all supported products will be ENERGY STAR qualified, though for some product categories higher levels of efficiency may be required to qualify for rebates or incentives. The Program will employ a variety of incentives and rebates supported by both broad based and targeted marketing and educational and outreach efforts. For HVAC the program will also promote quality installation practices.

A program implementation contractor will be responsible for day-to-day implementation of the program including partner recruitment and contractor training. Hard-to-reach populations that may not normally shop at home improvement and mass merchandisers, the largest sales venues for lighting, will be specifically identified and targeted. This may require increased recruitment of grocery, drug and other retailers such as "dollar stores."

The Retail Products Program will focus principally on the promotion of efficient lighting, which will be supported at retail with upstream incentives. Initially, the Program's lighting component will jointly promote both compact fluorescent lamps (CFLs) and light emitting diodes (LEDs). Over time the Program's focus will shift increasingly to LEDs as their price continues to fall and their performance improves. We expect that starting in 2017 the Program will no longer be supporting CFLs. In addition to financial support the program will provide consumers with information to inform and accelerate their choice of efficient products. For lighting these materials will address the shift to lumens as the appropriate means for lamp selection, the impacts of EISA on lamp choice and selection, and the growing advantages of LEDs as the preferred lighting technology of choice.

In addition to lighting, refrigerators, freezers, clothes dryers, clothes washers, and advanced power strips will be considered for inclusion in the 2014 RPP offering. For the HVAC and DHW markets the program will work closely with contractors, distributors and manufacturers to promote both efficient equipment and quality installation practices. HVAC and DHW promoted by the RPP will include efficient air source heat pumps, central air conditioners, ductless split heat pumps, furnaces, boilers, tankless water heaters, and heat pump water heaters.

The Program will also support the promotion of select appliances and consumer electronics. Appliances and consumer electronics will be largely supported with midstream retailer incentives, though mail-in coupons may also be required for either some products and/or for some retailers. Continued improvements in the efficiency of many consumer products and high market shares for ENERGY STAR qualified units may require measure eligibility criteria above ENERY STAR, such as efficiency levels established by TopTen USA and/or by EPA's ENERGY STAR Most Efficient program.

HVAC and DHW equipment will be supported with mail-in rebates that will be assignable to an installing contractor. The program will also offer contractor training on quality installation practices and incentives for duct sealing. There will be robust QA/QC procedures to ensure that contractors adhere to program requirements. HVAC and DHW program activities will be closely coordinated with HES, multifamily, RNC and income-eligible efforts. After the initial year of operation the program will assess whether to pursue an upstream incentive pilot. Based on the results from any such pilot the Program may move to an upstream model to supplement or fully replace the consumer and contractor targeted rebate model.

Behavior Modification

The residential sector portfolio includes a behavior modification program. This program would provide home energy reports to consumers on their specific energy usage patterns for metered fuels. This engagement would have the principal goal of motivating customers to

follow through on customer-specific efficiency recommendations. Some of these actions would be behavioral (e.g., turning down thermostats, turning off unused lights, etc.) while others would involve improvements to equipment or building components, with the aim of driving customers to more fully participate in other program offerings.

The home energy reports would be provided through either regularly mailed (typically monthly or bimonthly) hard-copy reports, web-based reporting, or a combination of the two. These reports would provide historic usage patterns, benchmark the customer's usage against other customers with similar home features and/or demographics, and provide energy efficiency recommendations that are tailored to the customer and to the time of year. These recommendations would provide the consumer with the resources, most notably program resources, and motivation to implement the recommended measures.

There are several vendors that can design and deliver behavioral programs to program administrators (e.g., Opower). Delaware's program administrator may pilot one or more approaches before picking a single statewide approach. Any such statewide approach should allow for integrated electric and gas home energy reports and should enroll participants on an "opt out" basis, meaning that participants must make a conscious decision and undertake specific actions *not* to participate. Delaware's behavioral program will also provide for a web-based option and be able to integrate with any current or planned smart grid efforts, e.g., incorporate near or real time usage reporting.

COMMERCIAL AND INDUSTRIAL CUSTOMER PROGRAMS

The commercial and industrial sectors (C&I) are far more diverse than the residential sector, encompassing, for example, both small independent retail stores and very large industrial facilities. Contrary to the residential sector, it is not practical to create separate programs to address the specific barriers and technologies of each sub-sector, as this would lead to marketplace confusion. Customers would face program offerings that are difficult to decipher and program administrators would find themselves struggling to manage and implement an overly complicated program suite. As a result, we propose three broad programs in the C&I sector, based on the most fundamental differences in the decision processes of this diverse array of customers. Instead of separate programs, the market barriers specific to certain subsectors of C&I will be addressed by including multiple initiatives within each program. Initiatives will be targeted to a specific type of C&I customer that may otherwise see low participation rates and are a good way to target specific opportunities without creating widespread confusion.

The first fundamental distinction in the decision process for the C&I sector is between retrofit and lost opportunity. This distinction recognizes the fact that there is a fundamental difference in the economic calculus used to evaluate efficiency projects as part of new construction or where existing equipment needs to be replaced, and for retrofit projects, where the existing equipment is in working condition and the project is motivated primarily by the energy savings. The lost opportunity program takes advantage of the fact that, when the customer is already purchasing new equipment, any incentive only needs to offset the difference in cost between the standard equipment and the efficient equipment rather than the

full installed cost of the equipment. The lost opportunity program includes design/technical assistance for new construction and large replace-on-failure projects, standard prescriptive incentives, and upstream incentives for common lighting measures.

The next distinction is between small and large customers. Small and large customers should be addressed by their own programs both because of their vastly different situations (e.g., facility characteristics, equipment types, purchasing processes, financial situation, familiarity with energy efficiency) and because certain program approaches may not be cost-effective for both segments. For example, experience shows that one-on-one account management is highly successful in achieving significant cost-effective savings from the largest C&I customers. However, this approach cannot cost-effectively scale to customers with one or a few small-to-medium-sized facilities. Further, energy costs for small businesses tend to be either fairly insignificant compared to other expenses or viewed as unimportant relative to other cost drivers. Small businesses are also unlikely to have staff dedicated to running the facility and keeping track of energy usage. For these reasons, achieving deep penetration with small and large customers requires different approaches and separate programs.

Program Concepts

Below is a table of program concepts used to develop the commercial program designs proposed in this report. Refer to Appendix G for full C&I program concepts descriptions.

Table 37 | Commercial & Industrial Program Concepts

Market Segment	Delivery Model	Services/Incentives Provided	Best Practice Features
C&I Lost Opportunity	• Instant and mail-in rebates at retail • Upstream rebates • Account management for large customers	• Prescriptive incentives for common measures • Custom incentives based on project economics and savings • Incentives to upstream partners • 3rd party TA and verification	• Bundled incentives with technical assistance • Simple program processes • One-stop shopping • Builds relationships with large customers and trade allies
C&I Small Business Retrofit	• 3rd party direct installation of lighting and other easy to install measures	• High prescriptive incentives for common measures • No-cost site visit to identify and install potential measures	• Combines information about needed measures with high financial incentives • Little participant action needed • Targets otherwise hard-to-reach segment • Provides financing options

Market Segment	Delivery Model	Services/Incentives Provided	Best Practice Features
C&I Large Business Retrofit	• Instant and mail-in rebates at retail • Account management for large customers • Engage contractors and trade allies to drive participation	• Prescriptive and custom incentives • 3rd party TA and verification	• Bundles TA and financial incentives • Specifically targets various market niches through market segmentation • Provides one stop shopping through account management • Builds relationships with large customers and trade allies • Incorporates all cost-effective efficiency technology

Program Summaries

The portfolio of efficiency programs directed at the C&I sectors consists of large umbrella programs with several different strategies or initiatives aimed at capturing savings from different segments of this diverse group of customers. The text below examines the major program strategies included in each of the umbrella programs.

C&I Lost Opportunity

As discussed above, the Lost Opportunity program aims to affect customer purchasing decisions by offsetting the incremental cost between standard practice and efficient practice. The Lost Opportunity program covers all end uses and technologies that produce cost-effective energy savings, and encompasses many different delivery models and services.

Account Management: One-on-one account management of the largest C&I customers is a vital aspect of the C&I sector programs. On-going relationships with Delaware's largest commercial and industrial facilities will familiarize the program with each customer's specific needs, barriers, and decision making processes, and thus help spur an ongoing stream of large projects. The account managers will help their customers apply and receive incentives for any cost-effective efficiency project, no matter the end use. Further, the account manager will help the program get ahead of any planned equipment upgrades, renovations, or new construction projects, and guide the customer through the process required to get incentives. The account manager will also look for opportunities for cost-effective retrofits, and steer these projects to the Large Business Retrofit program. The account manager will thus act as a "one-stop shop" for the customer, simplifying the program processes, and guiding the customer through the process of applying for and receiving an incentive. The account manager will also work with the customer to understand its needs, and potentially provide any technical assistance or financing options needed to get the project to move forwards.

Prescriptive Incentives: Standard incentives take the form of mail-in or instant rebates at retail. For mail-in rebates, customers fill out an application after purchasing efficient equipment, and receive a rebate based on the type and quantity of the equipment purchased. Instant rebates

are applied right at the counter, with no mailings necessary. Instant rebates should be used wherever possible, as they present significantly lower administrative burden on the customer. Incentives will be available for common efficiency measures with easy to understand savings, mainly lighting, appliances, and unitary HVAC. Prescriptive incentives reflect best practice elements since they are easy to understand and minimize administrative effort, both for the customer and the program administrator.

Upstream Incentives: Incentives provided to equipment distributors and/or manufacturers rather than to retail customers typically result in a lower price at the retail level. Upstream incentives can typically be lower than standard incentives with the same effect on the ultimate product price, since the retail markup is done on a lower base cost. In Delaware, we assume that fluorescent and LED lighting will be offered upstream. This is reflected in the analysis with lower incentive costs and higher penetration rates. Upstream incentives significantly lower the hurdle for participation in the program, as they do not require any action by the customer. In fact, many customers may not even realize they are receiving an incentive.

Custom Incentives: Custom incentives are provided on a case-by-case basis via a negotiation process between the customer and their account manager. Incentive amounts will average around 50% of the incremental cost, but will be adjusted based on this negotiation process. Custom incentives are available for all cost-effective measures and technologies that are not available prescriptively. In practice, this will apply largely to new construction and major renovation projects, as cases where existing equipment has failed are likely to be too urgent to go through the custom application process. However, there will also be situations where the current equipment is running poorly and needs to be replaced but has not failed.

Technical and Design Assistance: For this program, technical and design assistance will be delivered by competitively-procured 3rd party vendors with proven experience in the relevant field. The assistance will be available for large customers undergoing a renovation or new construction project, and pay for a portion of computer modeling, LEED certification, lighting and HVAC system design, or other studies examining how to minimize energy use in the project. Customers receiving the assistance would then be eligible for further incentives once they implement the ideas explored in the studies, thus bundling financial incentives with the technical assistance.

Large Business Retrofit

The large business retrofit program focuses on capturing energy savings from existing large commercial and industrial customers. The program will provide energy savings by encouraging the early replacement of old inefficient equipment before it stops working; adding controls or sensors such as motors, VFDs, and EMS's to lower the energy usage of existing systems; and helping businesses improve operational practices and optimize systems to lower energy usage. Large Business Retrofit program covers all end uses and technologies that produce cost-effective energy savings, and encompasses many different delivery models and services.

Account Management: As described above, account managers are a vital part of the C&I portfolio. Account managers are assigned to a customer, and will generate projects for both the C&I Lost Opportunity Program and the Large Business Retrofit Program, depending on

whether the opportunity is new construction, replace-on-burnout, or a retrofit. In either case, the account manager will work with the customer throughout the process of identifying a measure, getting any needed technical assistance, and receiving an incentive. The account manager will maintain a relationship with the customer, in hopes of generating more projects in the future. Account management is particularly important for addressing the industrial sector as both the sensitivity around production processes and longer project timelines require a strong relationship between customers and program staff.

Prescriptive Incentives: Mail-in or instant incentives similar to the downstream prescriptive incentives offered in the Lost Opportunity program, but may be larger to offset the full installed cost of the measure, rather than the incremental cost. These incentives will also cover retrofit add-on measures such as lighting controls and VFDs. The incentives will vary by measure, but will typically cover between 10% and 50% of the cost. Retrofit prescriptive incentives will be available for all customer sizes, but are expected to be mostly utilized by medium and large customers. Prescriptive incentives significantly reduce the administrative effort needed to receive a rebate, both on the part of the customer and the part of the program administrator.

Custom Incentives: Custom incentives are provided on a case-by-case basis via a negotiation process between the customer and their account manager. Depending on the results of the negotiation, and on the specifics of the project and the customer, the size of the incentive will typically end up at between 10% - 50% of the full installed cost. Custom incentives will be offered for any cost-effective technology that is not offered prescriptively. The incentives will be set up in a way to make them as easy as possible to receive, while maintaining reasonable confidence that claimed savings will actually be attained. The account manager will work with customer to ensure that the process of applying for and receiving an incentive goes as smoothly as possible. Further, the account manager may explore various financing options if they feel it will help move the project forwards.

Technical and Design Assistance: Technical and design assistance will be delivered by 3rd party firms with proven expertise in the relevant field. Program funds will be available to pay part of the cost for any ASHRAE audit, feasibility study, system optimization study, or retro-commissioning report that can be expected to lead to energy savings. It is expected that the program will only pay for a certain portion of any such study, with the rest covered out of pocket by the customer. Any projects identified in such studies will be eligible for further prescriptive or custom incentives, thus providing a package of both technical and informational services with financial incentives and potentially financing. As appropriate, building operator training will also be provided under the umbrella of technical assistance to capitalize on behavior-based opportunities and ensure persistence of savings.

Market Segmentation: Experience in other jurisdictions shows that many C&I subsectors have very low participation rates without specialized outreach designed to address their specific needs. Once the program has been up and running for a couple years, we assume that Delaware will dedicate resources to pursuing projects in these segments – namely municipalities, hospitals, commercial real estate, and food and hospitality. This will take the form of marketing and initiatives targeted directly to the specific needs of each segment. This may entail some specialized research to determine what specific barriers are preventing each

segment from participating in the efficiency program and how to best reach them. The technologies and specific offerings are thus dependent on each market segment. However, this additional effort will enable the program to reach previously underserved customers.

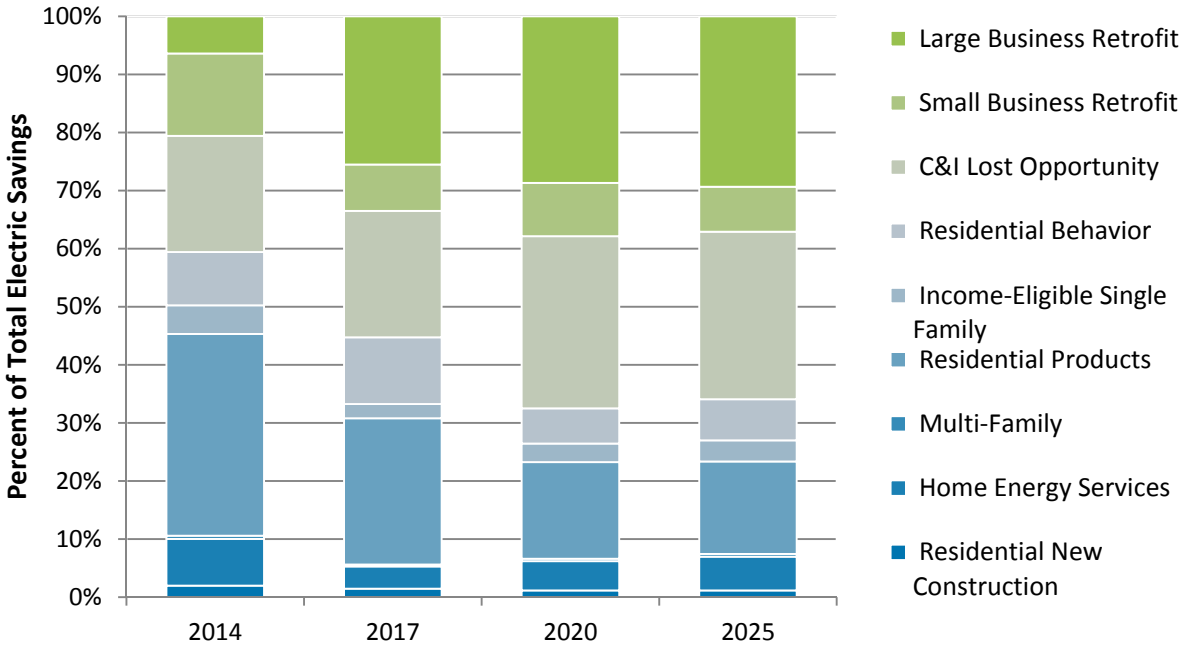
Small Business Retrofit

Small businesses are typically constrained by both staff time and financial resources. This makes it hard to invest the time and money in identifying and installing efficiency upgrades. Further, the small amount of per customer energy use in this segment means that the program administrators cannot cost-effectively spend too much time on each facility. The Small Business Retrofit program addresses these problems by providing a free onsite inspection, along with incentives covering around 70% of the full installed cost of a list of common, easy-to-install measures. Typically, this program would be bid out to a 3rd party contractor who uses fixed pricing for a menu of measures that can be installed as part of the program. The list of measures mainly consists of lighting, but also includes other common and easy-to-install measures such as faucet aerators, pipe and boiler insulation, and strip curtains for refrigeration. If the auditor notices a potential for a measure that's not on the list, the customer will be able to apply for a rebate through one of the other programs. However, these cases will be fairly rare. This program greatly boosts participation among small commercial facilities, which are otherwise very underserved by traditional program offering. It combines free on-site audits with high financial incentives and easy application processes to achieve significant savings from high efficiency lighting and other easy-to-install efficiency measures.

PROGRAM DEVELOPMENT OVER TIME

We have designed the portfolio of programs presented in the achievable scenario as a comprehensive and inter-related set of programs. Many of our assumptions regarding cost and program delivery rest on the concept of integrated program delivery. As such, the results for any one program are somewhat dependent on the other programs in the portfolio. For example, it is expected that the Home Energy Services program will lead directly to participation in the Residential Products program. Furthermore, we have assumed that the portfolio develops over time, with initial stages of program delivery requiring extra effort on administration and marketing in order to build momentum and create the foundation necessary for future savings. Some programs, such as Large Business Retrofit, contribute minimal savings in the initial years while still incurring administrative costs, but grow to become a significant part of the portfolio in later years. Conversely, other programs, such as Residential Products and Small Business Retrofit, can be ramped up quickly but gradually shrink as a portion of the overall portfolio. This point is illustrated in the figure below which shows how the total electric savings in select years are divided between the different programs.

Figure 15 | Program Development Over Time



As a final consideration, since efficiency programs are typically funded by a surcharge on electric bills, it is important to provide a pathway to participation for all ratepayers, in all markets. As such, we designed this comprehensive set of programs with the intent of reaching as many customer segments as possible.

The tables below briefly describe the major features of how each program develops from the short-term to the long-term with respect to costs and savings.

Table 38 | Residential Program Development

Program	Short Term	Long Term
New Construction	Significant early investment to engage the builder community and provide program requirements training precedes any significant savings. Early participants will be at entry level savings tier.	Gradual shift to increasingly efficient construction that approaches state statutory net-zero requirements lead to increased program reported savings. Training investment decreases gradually as builders increasingly participate at higher tiers.
Retrofit/Home Energy Services	Significant early investment is required to engage current and potential home retrofit contractors to increase BPI-certified installation capacity. Awareness and interest among homeowners will also be built over time. Early adopters and some targeted high use customers participate. Program administration costs are proportionally higher in early program years.	Contractors become more experienced and require less technical and sales support. Availability to provide financing increases. Participation numbers gradually increase as customer awareness becomes broader. Incentive and financing costs increase in proportion with savings while administrative costs decrease as a percentage of overall program costs.
Multi-Family	Significant early investment in building multi-family owner/developer/manager relationships is required. Early savings are mostly from direct-install lighting.	Relationship approach is used to develop comprehensive MF projects. Projects take time to develop technically and financially, and to install, similar to comprehensive C&I. Over time comprehensive savings become a routine feature of MF design and redevelopment projects. Incentive costs increase with savings, but sales/management costs are more constant.
Retail Products	Large savings are achieved relatively early in program. RFPs can be quickly developed for cooperative CFL and LED lighting promotions with major national retailers. Delivery costs are relatively proportional with savings over time, though incentive costs increase somewhat with shift to LEDs.	Savings and associated costs continue to increase as the product mix expands to appliances and HVAC, and as retail partners expand from large national retailers to smaller/local and regional retailers. A shift from CFLs to LEDs will increase costs over time.
Income-Eligible	Initial program development is contingent on a collaborative design process with local income-eligible service providers, but development costs will be modest. Early savings will be modest.	The program ramps up steady with costs and savings remaining relatively proportional as local providers build capacity to meet program targets.
Behavior Modification	Initially requires smaller pilot program to determine initial deemed savings. Can be at full operation by the second year.	Savings and costs over the long term are not expected to deviate significantly from early years, though co-promotion of other programs may increase.

Table 39 | Commercial & Industrial Program Development

Program	Short Term	Long Term
Small Business Direct Install	Third-party contractor(s) should be able to get a turnkey program running and achieving significant savings in the first year.	Slow and steady increase in customers served as market awareness for the program increases, in addition to increase in savings per customer as new measures are added, non-lighting measures are more strongly encouraged, and new financing options are developed.
Large Business Retrofit	Significant build out effort is involved in spreading awareness and familiarity of the program in the market, hiring account managers and technical support, and establishing relationships with large accounts, trade allies, and contractors. Also, projects often take a year from start to finish, so projects started in the first year may not be complete until later years.	Account managers have established relationships with large customers, and generate a continuous stream of projects; distributors and trade allies are familiar with the program and naturally shape their project designs and equipment stocking decisions based on program incentives; contractors use program incentives as marketing tools to upsell customers on efficient products. Once up and running, the program will likely be the largest generator of savings in the portfolio.
Lost Opportunity	Will take some time to develop rebate forms and raise market awareness. However, since most savings will be from prescriptive measures, less admin time and infrastructure build out is required than for the large business retrofit program. New construction projects are very complex and require significant education and communication between a variety of stakeholders. This infrastructure will take significant effort to build out.	Savings from prescriptive rebates will increase steadily as market awareness increases and new measures are added. As account managers establish relationships with large accounts, custom lost opportunity projects will be realized. As the program's presence in the new construction market place begins to assert itself, the program may see large chunks of savings from new buildings. Typically, these projects take multiple years to complete.

METHODOLOGY

OVERVIEW

This section provides a brief overview of our approach to the study analysis. The subsequent sections provide more detailed descriptions of the analysis methodology and assumptions.

The energy efficiency potential analysis involves several steps. The first several are required regardless of the scenario being analyzed, and were first performed during the Phase I economic potential study. These steps include:

- Assess and adjust energy usage forecasts for any known codes and standards and estimate naturally occurring efficiency adoption to ensure it properly reflects consistent base case assumptions about customers and end uses
- Disaggregate adjusted energy forecasts by sector (residential, commercial, industrial), by market segment (e.g., building types), and end uses (e.g., lighting, cooling, etc.)
- Characterize efficiency measures, including estimating costs, savings, lifetimes, and share of end use level forecasted usage for each market segment

To develop each scenario (economic, maximum achievable, and program potential) required additional steps specific to the assumptions in each scenario. These steps are listed below.

- Build up savings by measure/segment based on measure characterizations calibrated to total energy usage
- Account for interactions between measures, including savings adjustments based on other measures as well as ranking and allocating measures when more than one measure can apply to a particular situation
- Run the stock adjustment model to track existing stock and new equipment purchases to capture the eligible market for each measure in each year
- Run the efficiency potential model to estimate the total potential for each measure/segment/market combination to produce potential results
- Screen each measure/segment/market combination for cost-effectiveness. Remove failing measures from the analysis and rerun the model to re-adjust for measure interactions

Annual energy sales forecasts were developed for each energy type (electricity, natural gas, and petroleum fuels), and for each sector (residential, commercial, industrial), for the 12-year study period. Electric and natural gas forecasts were provided by Delaware utilities and cooperatives, as further described below. The petroleum fuels forecast was based on data from the U.S. Energy Information Administration (EIA). Sales forecasts were then disaggregated by end use and building type in order to apply each efficiency measure to the appropriate segment of energy use. This study applied a top-down analysis of efficiency potential relative to the

energy sales disaggregation for each sector, merged with a bottom-up measure level analysis of costs and savings for each applicable technology.

The efficiency potential estimate includes savings from a wide range of efficiency measures (i.e., efficient technologies and practices). The study analyzed both technologies that are commercially available now and emerging technologies considered likely to become commercially available over the study horizon.

The study applied a Total Resource Cost (TRC) Test to determine measure cost-effectiveness. The TRC test considers the costs and benefits of efficiency measures from the perspective of society as a whole. Efficiency measure costs for market-driven measures represent the incremental cost from a standard baseline (non-efficient) piece of equipment or practice to the high efficiency measure. For retrofit markets the full cost of equipment and labor was used because the base case assumes no action on the part of the building owner. Measure benefits are driven primarily by energy savings over the measure lifetime, but also include other benefits associated with the measures, including water savings, and operation and maintenance savings. The energy impacts may include multiple fuels and end uses. For example, efficient lighting reduces waste heat, which in turn reduces the cooling load, but increases the heating load. All of these impacts are accounted for in the estimation of the measure's costs and benefits over its lifetime.

There are two aspects of electric efficiency savings: annual energy and coincident peak demand. The former refers to the reductions in actual energy usage, which typically drive the greatest share of electric economic benefits as well as emissions reductions. However, because it is difficult to store electricity the total reduction in the system peak load is also an important impact. Power producers need to ensure adequate capacity to meet system peak demand, even if that peak is only reached a few hours each year. As a result, substantial economic benefits can accrue from reducing the system peak demand, even if little energy and emissions are saved during other hours. The electric benefits reported in this study reflect both electric energy savings (MWh) and peak demand reductions (MW) from efficiency measures.

The primary scenario for the study was the program potential, which best reflects what could actually be accomplished by efficiency programs given real-world constraints. We have also estimated the economic and maximum achievable potentials. The general approach for these three scenarios differed as follows:

- **Economic potential scenario:** We generally assumed that all cost-effective measures would be immediately installed for market-driven measures such as for new construction, major renovation, and natural replacement ("replace on failure"). For retrofit measures we generally assumed that resource constraints (primarily contractor availability) would limit the rate at which retrofit measures could be installed, depending on the measure, but that all or nearly all efficiency retrofit opportunities would be realized over the 12-year study period. Spreading out the retrofit opportunities results in a more realistic ramp up, providing a better basis for the achievable scenarios.

- **Maximum achievable scenario:** This scenario is based on the economic potential but accounts for real-world market barriers. We assumed that efficiency programs would provide incentives to cover 100% of the incremental costs of efficiency measures, so that program participants would have no out-of-pocket costs relative to standard baseline equipment. Measure penetration rates were then estimated assuming optimal program delivery, but recognizing that market barriers still remain even when measure incremental costs are fully offset by program incentives.
- **Program potential scenario:** For this scenario we assumed efficiency programs would start with fairly low levels of savings, ramping up over several years to levels of savings commensurate with the highest-performing efficiency programs in the country. Program activity was calibrated to meet specific targets for energy savings for each year.

ENERGY FORECASTS

Electric Forecast

The electric usage forecast was developed primarily from the individual utility forecasts provided by Delmarva Power, Delaware Electric Cooperative, and Delaware Municipal Electric Corporation.[16] Reported sales categories aligned with traditional utility categories, which closely mirror the three customer sectors that were analyzed. In some cases, energy loads were aggregated to the sector level using standard conventions (e.g., street lighting energy use is included in the commercial sector). The electric base case forecast represents a weather normalized forecast, and reflects an estimated average annual growth rate of 1.01% per year. Table 40 shows the electric forecast, by sector and year. This reflects electric usage at the meter level, in other words, not including line losses from the generator to the point of use.

Table 40 | Electric Sales Forecast by Sector and Year (GWh)

Sector	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Residential	4,510	4,586	4,661	4,729	4,798	4,869	4,942	5,016	5,090	5,172	5,256	5,338
Commercial	4,835	4,877	4,917	4,954	4,991	5,029	5,068	5,108	5,148	5,190	5,233	5,276
Industrial	2,735	2,754	2,768	2,776	2,787	2,801	2,809	2,815	2,822	2,820	2,814	2,810
Total	12,080	12,218	12,346	12,458	12,576	12,698	12,818	12,938	13,060	13,182	13,303	13,424

Natural Gas Forecast

The natural gas forecast was developed using forecasts provided by Chesapeake Utilities[17] and from the U.S. Energy Information Administration (EIA).[18] As only Chesapeake Utilities

[16] D. Pirtle, Delmarva Power, personal communication, March 8, 2013; M. Nielson, Delaware Electric Cooperative, personal communication, March 30, 2013; S. Lynch, Delaware Municipal Electric Corporation, personal communication, March 20, 2013.

[17] S. Hardy, Chesapeake Utilities, personal communication; February 22, 2013.

provided a natural gas forecast, the EIA data for Delaware was leveraged to estimate sales for other natural gas providers, i.e., Delmarva and Eastern Shore. Eastern Shore serves primarily as a transmission provider for local distribution companies but does provide direct sales to select industrial customers. While the EIA does report commercial and industrial sales for Eastern Shore, only the industrial sales were explicitly used as the commercial were reportedly already included in the forecast provided directly by Chesapeake Utilities. As the Chesapeake Utilities natural gas forecast was only provided through 2017, the annual growth rates for the remainder of the analysis period were estimated from the 2013 Annual Energy Outlook (AEO) assuming a simple average of rates from the Middle Atlantic and South Atlantic census divisions.[19] Similarly, the same AEO growth rates were leveraged to project 2011 Delmarva and Eastern Shore natural gas sales.

The gas base case forecast represents a weather normalized forecast, and reflects an estimated average annual growth rate of 1.21% per year. Table 41 shows the gas forecast, by sector and year.

Table 41 | Natural Gas Sales Forecast by Sector and Year (BBtu)

Sector	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Residential	10,593	10,752	10,902	11,048	11,001	10,959	10,919	10,874	10,813	10,741	10,664	10,584
Commercial	9,739	9,998	10,129	10,247	10,257	10,297	10,344	10,412	10,481	10,555	10,647	10,763
Industrial	21,317	22,492	22,925	23,351	23,638	23,978	24,257	24,594	24,935	25,199	25,539	25,866
Total	41,649	43,242	43,956	44,646	44,896	45,234	45,519	45,880	46,230	46,495	46,850	47,214

Petroleum Fuels Forecast

EIA data on current petroleum consumption in Delaware was used with estimated growth rates from the 2013 AEO to develop the petroleum fuels forecast.[20] The forecast reflects the on-going significant displacement of petroleum fuels by the expansion of natural gas service in the state.

The petroleum fuels base case forecast represents a weather normalized forecast, and reflects an estimated average annual growth rate of -0.79% per year. Table 42 shows the petroleum fuels forecast, by sector and year.

[18] U.S. Energy Information Administration, Natural Gas Annual Respondent Query System (EIA-176 Data Through 2011), November 2012

[19] U.S. Energy Information Administration, Annual Energy Outlook 2013, April 2013

[20] U.S. Energy Information Administration, Adjusted Sales of Distillate Fuel Oil by End Use, November 30, 2013; U.S. Energy Information Administration, Adjusted Sales of Residual Fuel Oil by End Use, November 30, 2013; U.S. Energy Information Administration, Adjusted Sales of Kerosene by End Use, November 30, 2013; U.S. Energy Information Administration, State Profiles and Energy Estimates, "Table F12: Liquefied Petroleum Gases Consumption Estimates," 2011

Table 42 | Petroleum Fuels Sales Forecast by Sector and Year (BBtu)

Sector	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Residential	6,174	6,067	5,958	5,846	5,737	5,636	5,545	5,455	5,365	5,278	5,194	5,111
Commercial	2,054	2,135	2,132	2,121	2,108	2,100	2,090	2,082	2,073	2,064	2,055	2,047
Industrial	2,369	2,478	2,523	2,522	2,536	2,544	2,539	2,523	2,519	2,513	2,512	2,512
Total	10,596	10,679	10,613	10,489	10,381	10,281	10,174	10,060	9,957	9,855	9,761	9,670

Forecast Disaggregation by Segment and End Use

The commercial, industrial, and residential sales disaggregations draw upon many sources. The industrial disaggregation is primarily based on the EIA Manufacturing Energy Consumption Survey (MECS) 2010, assuming the "South" census region (MECS data are only available for the four major census regions).[21] The commercial disaggregation relies on a number of sources. First, total forecasted energy sales are divided across building types using data from Optimal Energy's recent Energy Efficiency and Renewable Resource Potential in New York State study. Unfortunately, reliable data specific to Delaware was not available, so data for Long Island, NY has been used as a proxy. Next, data from the recent Pennsylvania Statewide Commercial & Industrial End Use & Saturation Study was used to develop the electric disaggregation at the end use level.[22] While a similar study was recently completed for Delaware, that study did not provide estimates of energy-use intensities that would support the disaggregation. The commercial natural gas and petroleum fuels end use break-outs were estimated using data from the EIA 2003 Commercial Buildings Energy Consumption Survey (CBECS)[23] The residential building type and end use disaggregation was developed using data from the EIA 2009 Residential Energy Consumption Survey (RECS),[24] the most recent Annual Community Survey from the US Census Bureau,[25] and the EIA 2013 Annual Energy Outlook.[26] Finally, relative changes in end use distribution over the analysis period were adapted from the EIA 2013 Annual Energy Outlook.

Sales were further disaggregated into sales for new construction and renovated spaces and those for existing facilities. New construction activity for commercial and industrial facilities was estimated using national projections of new additions and surviving square footage from the EIA 2013 Annual Energy Outlook and assuming simple sector-wide energy use intensities. Residential new construction was projected assuming the 7-year average annual growth rate (1995-2001) in housing units for Delaware from the U.S. Census Bureau Building Permits

[21] U.S. Energy Information Administration, Manufacturing Energy Consumption Survey, "Table 5.5 End Uses of Fuel Consumption, 2010," March 2013

[22] Nexant, Pennsylvania Statewide Commercial & Industrial End Use & Saturation Study, April 18, 2012

[23] U.S. Energy Information Administration, Commercial Buildings Energy Consumption Survey, "Table E7A. Natural Gas Consumption (Btu) and Energy Intensities by End Use for All Buildings, 2003," September 2008

[24] U.S. Energy Information Administration, Residential Energy Consumption Survey, "Table CE4.4 Household Site End-Use Consumption by Fuel in the South Region, Totals, 2009," August 2011

[25] U.S. Census Bureau, 2007-2011 American Community Survey, "DP04 Selected Housing Characteristics"

[26] U.S. Energy Information Administration, Annual Energy Outlook 2013, "Table 4. Residential Sector Key Indicators and Consumption," April 2013

Survey.[27] This period was assumed to reflect stable growth in housing starts before the housing boom and bust of the mid to late 2000s. Growth in number of housing units was translated to energy sales using average electric/fuel consumption per housing unit estimated from EIA 2009 Residential Energy Consumption Survey.

Appendix H shows the disaggregated annual energy forecasts. In all cases, the available forecast data relied upon was either not developed with (or the data was not available to understand) detailed end use modeling and explicit assumptions about future codes and standards, changes in baseline practices, major shifts among fuels (e.g., driven by electric vehicles). As a result, we assume the forecasts represent the best estimate of future weather normalized loads and reflect assumptions about future baselines and codes and standards consistent with our analysis at the measure level.

MEASURE CHARACTERIZATION

The first step for developing measure characterizations is to define a list of measures to be considered. This list was developed and qualitatively screened for appropriateness in consultation with DNREC and other stakeholders. The final list of measures considered in the analysis is shown with their characterizations in Appendix I, which also shows the markets for which each measure was considered.

A total of 188 measures were included and characterized for up to three applicable markets (new construction/renovation, natural replacement, and retrofit). This is important because the costs and savings of a given measure can vary depending on the market to which it is applied. For example, a retrofit or early retirement of operating but inefficient equipment entails covering the costs of entirely new equipment and the labor to install it and dispose of the old equipment. For new construction or other market-driven opportunities, installing new high efficiency equipment may entail only the incremental cost difference between a standard efficiency piece of equipment and the high efficiency one, as other labor and capital costs would be incurred in either case. Similarly, on the savings side, retrofit measures can initially save more when compared to older existing equipment, while market-driven measure savings reflect only the incremental savings over current standard efficiency purchases. For retrofit measures, often we model a baseline efficiency shift at the time when the retrofit measure being replaced is assumed to have needed to be replaced anyway.

For each measure, in addition to separately characterizing them by market, we also separately analyze each measure/market combination for each building segment (e.g., single vs. multifamily; office vs. retail vs. hospital, etc.). The result is that we modeled 2,374 distinct measure/market/segment permutations for each year of the analysis.

The overall potential model relies on a top-down approach that begins with the forecast and disaggregates it into loads attributable to each possible measure, as described in the following

[27] U.S. Census Bureau Building Permits Survey, "Table 2au. New Privately Owned Housing Units Authorized Unadjusted Units for Regions, Divisions, and States," 1995-2012

section. In general, measure characterizations include defining the following characteristics for each combination of measure, market, and segment:

- Measure lifetime (both baseline and high efficiency options if different)
- Measure savings (relative to baseline equipment)
- Measure cost (incremental or full installed depending on market)
- O&M impacts (relative to baseline equipment)
- Water impacts (relative to baseline equipment).

Energy Savings

For each technology, we estimate the energy usage of baseline and high efficiency measures based primarily on engineering analysis. We rely heavily on the Delaware Technical Reference Manual (TRM), as well as the Mid-Atlantic TRM, for measure savings for those measures covered by these documents. For more complex measures not addressed by the TRMs engineering calculations are used based on the best available data about current baselines in Delaware and the performance of high efficiency equipment or practices. Delaware baseline studies completed in 2012 for the residential and commercial-industrial sectors were drawn on to identify baseline efficiency levels and practices wherever possible.[28] Due to budget and time constraints we did not include any building simulation modeling or other sophisticated engineering approaches to establishing detailed, weather normalized savings.

Costs

Measure costs were drawn from Optimal Energy's measure characterization database when no specific Delaware costs were available. These costs have been developed over time, and are continually updated with the latest information, including a recent update for an ongoing potential study in New York State. Major sources include the Delaware and Mid-Atlantic TRMs, baseline studies, incremental cost studies, direct research into incremental costs, and other analyses and databases that are publicly available.

Lifetimes

As with measure costs, lifetimes are drawn from Optimal's measure characterization database. These have been developed over time, and were revised for this study based on the Delaware and Mid-Atlantic TRMs.

Operations and Maintenance Impacts

Operation and maintenance (O&M) impacts are those other than the energy costs of operations. They represent, for example, things like replacement lamp purchases for new high efficiency fixtures, or changes in labor for servicing high-efficiency vs. standard-efficiency measures. High efficiency equipment can often reduce O&M costs because of higher quality components that require less-frequent servicing. On the other hand, some high efficiency technologies require enhanced servicing, or have expensive components that need to be

[28] See Appendix J for full citations to all referenced documents.

replaced prior to the end of the measure's lifetimes. For most measures, O&M impacts are very minimal, as many efficient and baseline technologies have the same O&M costs over time. Where they are significant, we estimate them based on our engineering and cost analyses, the Delaware and Mid-Atlantic TRMs, and other available data.

Additional aspects of measure characterization are more fully described below in the potential analysis section, along with other factors that merge the measure level engineering data with the top-down forecast of applicable loads to each measure.

TOP-DOWN METHODOLOGY

The general approach for this study, for all sectors, is "top-down" in that the starting point is the actual forecasted loads for each fuel and each sector. As described above, we then break these down into loads attributable to individual building equipment. In general terms, the top-down approach starts with the energy sales forecast and disaggregation and determines the percentage of the applicable end use energy that may be offset by the installation of a given efficiency measure in each year. This contrasts with a "bottom-up" approach in which a specific number of measures are assumed installed each year.

Various measure-specific factors are applied to the forecasted building-type and end use sales by year to derive the potential for each measure for each year in the analysis period. This is shown below in the following central equation:

Measure Savings	=	Segment/ End use /year kWh Sales	x	Applicability Factor	x	Feasibility Factor	x	Turnover Factor (replace-ment only)	x	Not Complete Factor (retrofit only)	x	Savings Fraction	x	Net Penetration Rate

Where:

- **Applicability** is the fraction of the end use energy sales (from the sales disaggregation) for each building type and year that is attributable to equipment that could be replaced by the high-efficiency measure. For example, for replacing office interior linear fluorescent lighting with a higher efficiency LED technology, we would use the portion of total office building interior lighting electrical load consumed by linear fluorescent lighting. The main sources for applicability factors were the Delaware and Pennsylvania baseline studies.
- **Feasibility** is the fraction of end use sales for which it is technically feasible to install the efficiency measure. Numbers less than 100% reflect engineering or other technical barriers that would preclude adoption of the measure. Feasibility is not reduced for economic or behavioral barriers that would reduce penetration estimates. Rather, it reflects technical or physical constraints that would make measure adoption impossible or ill advised. An example might be an efficient lighting technology that cannot be used in

certain low temperature applications. The main sources for feasibility factors are the Delaware baseline studies and engineering judgment.

- **Turnover** is the percentage of existing equipment that will be naturally replaced each year due to failure, remodeling, or renovation. This applies to the natural replacement ("replace on failure") and renovation markets only. In general, turnover factors are assumed to be 1 divided by the baseline equipment measure life (e.g., assuming that 5% or 1/20th of existing stock of equipment is replaced each year for a measure with a 20-year estimated life).
- **Not Complete** is the percentage of existing equipment that already represents the high-efficiency option. This only applies to retrofit markets. For example, if 30% of current single family home sockets already have compact fluorescent lamps, then the not complete factor for residential CFLs would be 70% (1.0-0.3), reflecting that only 70% of the total potential from CFLs remains. The main sources for not complete factors are the Delaware baseline studies, and the findings of other baseline and potential studies.
- **Savings Fraction** represents the percent savings (as compared to either existing stock or new baseline equipment for retrofit and non-retrofit markets, respectively) of the high efficiency technology. Savings fractions are calculated based on individual measure data and assumptions about existing stock efficiency, standard practice for new purchases, and high efficiency options.
  - **Baseline Adjustments** adjust the savings fractions downward in future years for early-retirement retrofit measures to account for the fact that newer, standard equipment efficiencies are higher than older, existing stock efficiencies. We assume average existing equipment being replaced for retrofit measures is at 60% of its estimated useful life.
- **Annual Net Penetrations** are the difference between the base case measure penetrations and the measure penetrations that are assumed for an economic potential. For the economic potential, it is assumed that 100% penetration is captured for all markets, with retirement measures generally being phased in and spread out over time to reflect resource constraints such as contractor availability.

The product of all these factors results in the total potential for each measure permutation. Costs are then developed by using the "cost per energy saved" for each measure applied to the total savings produced by the measure. The same approach is used for other measure impacts, e.g., operation and maintenance savings.

COST-EFFECTIVENESS ANALYSIS

Cost-Effectiveness Tests

This study applies the Total Resource Cost (TRC) Test as the basis for excluding non-cost-effective measures from the potential. The TRC test considers the costs and benefits of efficiency

measures from the perspective of society as a whole. In addition, for the program potential scenario we report the cost-effectiveness of the efficiency programs using the Program Administrator Cost Test and the Participant Cost Test. The principles of these cost tests are described in the *California Standard Practice Manual*.[29]

The following table provides the costs and benefits from the perspective of each of the cost-effectiveness tests.

Table 43 | Overview of Cost-Effectiveness Tests

Monetized Benefits / Costs	Total Resource Cost (TRC)	Program Administrator Cost Test	Participant Cost Test
Measure cost (incremental over baseline)	Cost		Cost
Program Administrator incentives		Cost	Benefit
Program Administrator non-incentive program costs	Cost	Cost	
Energy & electric demand savings*	Benefit	Benefit	Benefit
Fossil fuel increased usage	Cost	Cost	Cost
Operations & Maintenance savings	Benefit		Benefit
Water savings	Benefit		Benefit
Deferred replacement credit**	Benefit		Benefit

*For the TRC and PACT, energy and electric demand savings are valued using avoided cost values that represent wholesale marginal costs, varying by time of day and season. For the Participant Cost Test, energy savings are valued at average retail costs for each customer sector.

**For early-retirement retrofit measures, the Deferred Replacement Credit is a credit for when the existing equipment would have needed replacement. The equipment's replacement cycle has been deferred due to the early replacement.

Discounting the Future Value of Money

Future costs and benefits are discounted to the present using a real discount rate of 3%. The U.S. Department of Energy recommends a real discount rate of 3% for projects related to energy conservation, renewable energy, and water conservation as of 2010, which is consistent with the Federal Energy Management Program (FEMP).[30] For discounting purposes we assume that initial measure costs are incurred at the beginning of the year, whereas annual energy savings are incurred half way through the year.

Gross and Net Energy Savings

We report potential estimates in terms of net savings. Net energy savings take into account free-riders, who would have installed the measures in the absence of the program, and spillover

[29] California Standard Practice Manual: Economic Analysis Of Demand-Side Programs And Projects, July 2002; Governor's Office of Planning and Research, State of California; http://www.calmac.org/events/SPM_9_20_02.pdf

[30] See page 1 in http://www1.eere.energy.gov/femp/pdfs/ashb10.pdf.

customers, who install measures due to program activities but never receive a program incentive. The formula for net savings (kWh or MMBtu) is:

Net savings = Gross savings X (1 – FR + SO)

where

FR = free-ridership rate as a % of program participation

SO = spillover rate as a % of program participation

See Appendix K for the free ridership and spillover assumptions used for this study.

AVOIDED ENERGY SUPPLY COSTS

Overview

Avoided energy supply costs are used to assess the value of energy savings (or increased usage). Development of full avoided costs was outside the scope of the project, thus we have relied on the best available data for this study.

The following criteria have been used for the avoided costs for this study:

- We have not included costs for externalities, such as air quality or reduced greenhouse gas emissions.
- We have not included the avoided costs of price suppression, or demand reduction induced price effect (DRIPE).
- We have not included a wholesale risk premium.[31]

The above factors are included in the avoided costs of many efficiency programs and may be considered for inclusion by Delaware for future efficiency programs. This study can be considered conservative in this respect, since these factors have not been included in the avoided costs. The sensitivity analysis for this study includes a scenario of higher avoided costs, which serves as a proxy for inclusion of the above factors.

Electricity

Electric avoided costs were developed in collaboration with Delmarva Power.

The energy costing periods include Summer On-Peak, Summer Off-Peak, Winter On-Peak, and Winter Off-Peak. These periods are defined as follows:

- On-peak hours are 8:00 a.m. to 9:00 p.m. during periods of the year when Eastern Standard Time is in effect, and 9:00 a.m. to 10:00 p.m. when Eastern Daylight Savings Time is in effect, Monday through Friday, including holidays falling on weekdays. All other hours are off-peak hours.
- Summer is June thru September. Winter is October through May.

[31] Wholesale risk premiums are estimated and provide energy savings benefits for some efficiency programs. For example, see "Avoided Energy Supply Costs in New England: 2013 Report", Synapse Energy Economics, 2013, http://www.synapse-energy.com/Downloads/SynapseReport.2013-07.AESC.AESC-2013.13-029-Report.pdf.

In addition to avoided costs for electric energy, avoided costs were developed for summer generation capacity, transmission capacity, and distribution capacity. The peak demand performance hours are from 2:00pm to 6:00pm Eastern Prevailing Time (EPT), inclusive, June through August, but not including weekends and federal holidays.

Natural Gas

Natural gas avoided costs were not available for Delaware. The best option for current avoided costs for natural gas were those developed in 2013 for southern New England (MA–CT–RI) by Synapse Energy Economics.[32] Delaware's natural gas supply is similar to southern New England in several key respects:

- Delaware is part of the northeast system, served largely from the Gulf Coast via the Transco pipeline
- Delaware has access to the emerging Appalachian/Marcellus shale gas through the Transco pipeline
- Delaware has proximity to an LNG import terminal (Dominion Cove Point, MD) which feeds into Transco and other pipelines
- Delaware has growing demand for natural gas

Petroleum Fuels

Because petroleum fuels are unregulated, the average retail rates for petroleum fuels were used for avoided energy supply costs. The retail rates data are described in the next section.

Water

Water avoided costs account for both water supply and sewer costs. The water avoided costs are estimated at $0.005/gallon.

ENERGY RETAIL RATES

Average energy retail rates are used to determine participant benefits for the Participant Cost Test.

Delaware 2011 average retail rates for electricity, natural gas, distillate fuel oil, residual fuel oil, and propane were determined by sector from the EIA State Energy Data System (SEDS).[33] The EIA estimates retail rates by dividing estimated utility revenue by estimated energy sales. Retail rates for each fuel were projected through the analysis period assuming growth rates for the "South Atlantic" region from the EIA's 2013 Annual Energy Outlook.[34] Retail rates for the

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[32] "Avoided Energy Supply Costs in New England: 2013 Report", Synapse Energy Economics, 2013, http://www.synapse-energy.com/Downloads/SynapseReport.2013-07.AESC.AESC-2013.13-029-Report.pdf.

[33] U.S. Energy Information Administration, Electric Power Annual - Form EIA-861, "Average Price by State by Provider 1990-2011," October 1, 2012; U.S. Energy Information Administration, State Profile and Energy Estimates, April 18, 2013.

[34] U.S. Energy Information Administration, Annual Energy Outlook 2013, "Table 3.3 Energy Prices by Sector and Source – South Atlantic," April 2013.

aggregated petroleum fuels were determined by weighting the individual fuel rates by their relative share of the projected 2013 fuel sales from the sales forecast on a Btu basis.

Appendix C shows the average retail rates, by fuel, sector and year.

ELECTRIC LOAD SHAPES

Electric energy load shapes are used to divide annual efficiency measure kWh savings into the energy costing periods of the avoided costs. End use specific load shapes were not available for Delaware. For this project, load shapes have been developed based on 2002 Itron eShapes 8760 load profile data for New York. The load shapes for the cooling end use were developed using the weather station for LaGuardia Airport and used the weather station for Islip, on central Long Island for other end uses. While the selected load shapes are based on weather stations from a different state, they provide the nearest and best data as Delaware eShapes data are no longer available. For the purposes of this study, it is unlikely that the load shapes in Delaware would differ significantly from the load shapes in New York. Moreover, weather sensitive load shapes for end uses such as cooling and space heating were manually adjusted to include Delaware-specific weather data such as heating and cooling degree days.

The eShapes data provide 8760 load profile data for electric energy usage, by sector, and for various end uses and building types. The data were based on approximately 20,000 building audits performed nation-wide mainly in the early 1990s. More than half of the roughly 20,000 audits were performed on-site. These were very highly detailed audits, including an inventory of building energy usage; specific equipment types, characteristics and quantities (e.g., down to numbers of lamps); end use metering; thermostat settings; operating schedules by zone; fuel types for hot water, space heating and cooking; thermal shell details; building orientation and size; etc. The mail surveys were less detailed, but attempted to collect the same information. Building simulations were then performed with proprietary modeling software for many of the audited buildings, to develop a set of prototype buildings calibrated to the measured data for individual sites.

APPROACH TO FINANCING

Initial costs are a major barrier to the implementation of energy efficiency and renewable energy projects in homes and businesses. While program incentives may offset a significant portion of that cost, the customer is still asked to contribute the rest of the project cost. Financing the remaining costs may be desired or necessary for some customers, and may make the difference in deciding whether or not to pursue a project. Often the financing payments can be arranged such that the customer has a positive cash flow due to the project's annual benefits so that the monetized benefits of the implemented project pay for the amortized loan payments. In addition to traditional bank loans, a variety of funding mechanisms have been used and proposed for financing energy efficiency and renewable energy projects, including interest-rate buydowns, on-bill financing, energy service performance contracting, and property tax financing (also known as Property Assessed Clean Energy or PACE).

While project financing can be important for increasing the implementation of clean energy options, the costs of financing and the degree to which access to capital is a market barrier are not easily quantified. As such, we have not specifically included the costs and impacts of financing options in our analysis. Rarely do potential studies include such costs. However, the incentives we specify provide enough flexibility to be applied either to equipment and/or financing options like interest rate buydowns. The important concept is that favorable financing options be available as they can lower the costs of achieving the same program impacts by reducing the need for incentives or other program intervention. Our program plans include the use of financing options where appropriate.

ECONOMIC POTENTIAL ANALYSIS

The top-down analysis, along with all the data inputs, produces the measure-level potential, with the economic potential being limited to installation of cost-effective measures. However, the total economic potential is less than the sum of each separate measure potential. This is because of interactions between measures and competition between measures. Interactions result from installation of multiple measures in the same facility. For example, if one insulates a building, the heating load is reduced. As a result, if one then installs a high efficiency furnace, savings from the furnace will be lower because the overall heating needs of the building have been lowered. As a result, interactions between measures should be taken into account to avoid over-estimating savings potential. Because the economic potential assumes all possible measures are adopted, interactions assume every building does all applicable measures. Interactions are accounted for by ranking each set of interacting measures by total savings, and assuming the greatest savings measure is installed first, and then the next highest savings measure. This is a conservative approach in that it is more likely that some measures with marginal savings may not pass the cost-effectiveness test after all interactions are accounted for.

Measures that compete also need to be adjusted for. These are two or more efficiency measures that can both be applied to the same application, but only one can be chosen. An example is choosing between replacing an incandescent lamp with either a CFL or an LED, but not both. In this case, the total penetration for all competing measures is 100%, with priority given to the measures based on ranking them from highest savings to lowest savings. If the first measure is applicable in all situations, it would have 100% penetration and all other competing measures would show no potential. If on the other hand, the first measure could only be installed in 50% of opportunities, then the second measure would capture the remaining opportunities.

To estimate the economic potential we generally assumed 100% installation of market-driven measures (natural replacement, new construction/renovation) constrained by measure cost-effectiveness and other limitations as appropriate, such as to account for mutually exclusive measures.

Implementation of retrofit measures was considered to be resource-constrained, i.e., it would not be possible to install all cost-effective retrofit measures all at once. The retrofit penetrations rates ramped up from 2% to 10% per year over the first 5 years, then continued at

10% per year through year 12. This effectively represented capturing all retrofit opportunities over the 12-year study period. With these assumptions the economic potential essentially captures all available cost-effective efficiency potential for retrofit measures by the end of the study period.

For measures that are market-driven only (new construction, renovation, and/or natural replacement) and which have measure lives longer than 12 years, the turnover rate is such that not all of the economic potential will be captured over the 12-year study period. For example, a high-efficiency boiler measure with a 20-year measure life may not be cost-effective for early-retirement retrofit, but passes for natural replacement. If so, only about 5% (1/20th) of the market turns over every year, so the entire market would not be replaced within the 12-year study period. For this measure the 12-year economic potential would be less than the 20-year economic potential.

PROGRAM POTENTIAL SCENARIO

Estimates of potential energy savings that can be captured through realistic program designs have been developed through a sequential and systematic process that combined a detailed review of available cost-effective savings at the measure or project level with a higher level review of applicable best practices in program implementation.

Measure Selection

Program potential is based on a detailed analysis of the energy savings of a wide range of energy efficiency measures. Estimated savings and costs for these measures were reviewed for a variety of different applications to determine which measures could be cost-effectively supported. This analysis involved reviewing an exhaustive list of possible measures and then grouping them in combinations based on how they can best reach Delawareans. For example, residential high efficiency furnaces can be promoted as a stand-alone measure for homeowners whose existing furnaces have failed, as an energy-saving "early retirement" program before they have failed, or for installation in a newly-constructed home. The costs of upgrading to a high efficiency furnace are different in each of these examples, and the amount of energy that can be saved compared with business as usual will also vary. Therefore, in this example each of these different scenarios was tested to determine where the measure could be cost-effectively promoted.

Program Definition

An analysis of likely delivery mechanisms for different energy efficiency measures was coupled with research on best practice programs to develop program scenarios for Delaware. Program frameworks were defined with the goal of delivering the greatest amounts of cost-effective energy efficiency that could be delivered with a high degree of reliability. This is in contrast to other design criteria that could have been used, such as delivering only the least costly savings, or designing programs that have potential to deliver very large amounts of energy efficiency, but that come with high levels of uncertainty. Program frameworks reflect research that was done to better understand the specifics about how energy efficiency markets

work in Delaware. Research explored demographic information as well as where homeowners shop, and what sort of distributer/installer networks exists for the sale and installation of energy efficient equipment.

For example, PSE&G's best-practice multi-family program is likely neither the least expensive per unit of energy saved nor is it designed to save extraordinary amounts of energy at any cost. However, by using a comprehensive approach that includes technical assistance and construction management, quality assurance, and both cash incentives and structured financing, the program addresses multiple barriers in a way that results in significant and reliable savings in a market sector that has traditionally been under-served by efficiency programs. This program achieves much greater savings than a simple direct-install multi-family program would, but in our modeling this type of program can deliver cost-effective savings in Delaware. For more information on the best practice program models that were reflected in the Delaware program potential study please refer to the "Gathering Best Practices" section. Please also see the earlier section titled "Multiple Barriers Require Multiple Strategies" for a discussion of the approach to addressing barriers to greater energy efficiency.

Measure Incentives and Penetration Rates

Measure penetration rates, or adoption rates, are affected by a broad variety of factors depending on the measure: the market barriers that apply and to what degree, the program delivery strategy, incentive levels, marketing and outreach, technical assistance to installers, etc. While penetration rates will generally increase with increased spending, how the spending is applied can have a huge impact on actual participation rates. Due to the complexity and interrelated nature of market barriers and the various methods used to promote efficiency measures, we base our assumptions for penetration rates on actual experience from efficiency programs coupled with the specific assumptions for each measure and program, rather than broadly applying a general formula based on a subset of factors. We believe this approach provides the best estimates of actual measure performance in a program potential scenario.

Incentive levels have been established as a percent of measure incremental cost at the program level. While in practice the incentive levels for individual measures will vary within a program, there is typically a good degree of commonality across measures and incentive levels can reliably be set at the program level for the program potential scenario. In this analysis, we developed an average incentive level for each program to simplify the analysis. In reality, different measures would receive incentives that represent different proportions of the measure cost. For each measure, the model multiplies the incentive by the penetration rate to establish the overall incentive cost in each year. Non-incentive program budget are then estimated relative to incentive spending, as described in the following section.

Non-Incentive Program Budgets

Non-incentive costs were set at the program level. These include the costs of general administration, technical assistance, marketing, EM&V, and performance incentives. Rather than create an administrative "program" that captures cross-program spending and common

support services (e.g., information technology and marketing), but which generates no savings, we allocate all administrative spending across all of the programs.

We used a three-step process to estimate non-incentive costs and allocate them to programs and measures. Non-incentive costs were categorized as follows:

- Administration (including management staff, information technology support, accounting, administrative support staff, incentive application processing, insurance, offices, equipment, legal, etc.)
- Technical Assistance
- Marketing
- Evaluation, measurement & validation (EM&V)
- Performance Incentive

We note that some other categories of non-incentive spending exist that may be important but minor components of an efficiency program's budget. These include items such as sponsorships for conferences, memberships in relevant industry organizations, partnerships will local institutions, and the like. While relevant, we are unable to determine to what extent these costs were captured in the data we used as the basis for our estimates. Furthermore, because they are relatively small amounts compared to the other categories, we have not explicitly added costs for them. As such time as Delaware proceeds with detailed program implementation, these costs should be included in program budgets.

First, we estimated the distribution of total program costs into incentives and the non-incentive categories listed above based on cost data from existing efficiency programs in other jurisdictions. Data were drawn from fully integrated (i.e., electric and fossil fuels) programs operating at the same high levels of savings as our projected program achievable potential for Delaware after several years of ramp-up, including programs in Vermont, Massachusetts, and Rhode Island. We also included cost data from regionally-appropriate integrated programs from Baltimore Gas & Electric and PECO. The table below presents the results of this analysis.

Table 44 | Percent of Total Cost at Full Program Ramp-Up by Cost Category

Program	Administration	Technical Assistance	Marketing	EM&V	Performance Incentive	Incentives	Total
Residential New Construction	4%	35%	3%	3%	4%	51%	100%
Home Energy Services	3%	18%	9%	3%	4%	63%	100%
Multifamily	3%	19%	5%	3%	4%	66%	100%
Residential Products	3%	5%	15%	3%	4%	70%	100%
Low Income Single Family	3%	21%	1%	3%	4%	68%	100%
Residential Behavior	2%	27%	3%	4%	1%	62%	100%
C&I Lost Opportunity	2%	9%	1%	3%	4%	81%	100%
Small Business Retrofit	2%	9%	1%	3%	4%	81%	100%
Large Business Retrofit	5%	12%	1%	3%	4%	75%	100%

The proportion of incentive vs. non-incentive budget costs varies among programs as does the distribution of the non-incentive cost categories. Programs like new construction (both residential and C&I) need significant technical resources for training, plan review, and code

compliance assistance. Income-eligible programs will have higher proportions of incentive costs, as incentive levels are typically set at the full measure cost. For programs like residential products and home energy services, proper funding of marketing is critical to build program participation and to educate consumers of the benefits of program participation.

Second, we developed year-by-year cost estimates for each category that reflect the changing nature of efficiency programs as they grow from new programs to fully mature offerings. The non-incentive dollar costs for years one to six are calculated as a percentage of the total costs at full ramp-up in year seven, as shown in the Table 45. Note that not all of the costs are ramped up equally or linearly over the seven-year period. For example, administration and marketing functions that are essential to early program success start at higher percentages and become fully operational prior to year seven. Conversely, EM&V activities will not start until the fourth year.

Table 45 | Ramp-Up Schedule with Costs Relative to Year 7

Year	Administration	Technical Assistance	Marketing	EM&V	Performance Incentive
2014	50%	20%	30%	0%	0%
2015	60%	30%	50%	16%	16%
2016	70%	40%	75%	32%	32%
2017	80%	50%	85%	51%	51%
2018	100%	50%	100%	75%	75%
2019	100%	75%	100%	92%	92%
2020	100%	100%	100%	100%	100%

* Percents are relative to year 7 (2020) value

Combining this ramp-up schedule with the actual pattern of spending based on program activity results in a changing allocation of spending for each program over time. As an example, the table below shows the year-by-year distribution of costs for the residential new construction program. Note that the year seven distribution matches the distribution shown for this program in Table 45 above.

Table 46 | Ramp-Up Schedule with Costs Relative to Total Budget

Year	Administration	Technical Assistance	Marketing	EM&V	Performance Incentive	Incentives	Total
2014	14%	49%	6%	0%	0%	30%	100%
2015	10%	44%	6%	2%	3%	35%	100%
2016	7%	37%	6%	3%	3%	43%	100%
2017	6%	33%	5%	3%	4%	49%	100%
2018	6%	26%	4%	3%	4%	56%	100%
2019	5%	30%	3%	3%	4%	54%	100%
2020	4%	35%	3%	3%	4%	51%	100%

The final step was to allocate costs between electric, gas, and petroleum fuel measures based on total resource benefits. That is, if electric measures in a particular program are responsible

for 46% of total resource benefits, we allocated 46% of the total non-incentive costs for that program to the electric measures for purposes of reporting fuel-specific cost-effectiveness.

Program Savings Targets

For the program potential, program activity has been projected to ultimately achieve a level of savings commensurate with those of the most successful efficiency programs around the country. We have assumed that programs start with very low levels of savings, particularly in the first year when programs would be required to hire staff, develop internal procedures, acquire training, establish contracts, and related activity. Commercial projects enrolled in the first year may not bear fruit for 12-18 months. Program activity will ramp up to full savings rates over a period of seven years.

The ultimate targets we assume for annual savings are:

- Electric: 2.5% of annual MWh sales
- Natural gas: 1.3% of annual MMBtu sales

Some electric measures, especially indoor lighting, have a "heating penalty" due to their decreased waste heat, which increases a building's heating load. The heating penalty can amount to a significant portion of the savings of natural gas measures. However, the increased usage of natural gas due to efficient electric equipment should not count against the savings of natural gas measures. Therefore, the natural gas targets apply to the savings of natural gas measures, and do not include the increased natural gas usage to make up for efficient electric equipment. The same approach applies to petroleum fuels.

We did not set a specific savings target for petroleum fuels. Instead, petroleum fuel savings were determined commensurate with the level of program activity for natural gas. However, the levels of petroleum fuel savings differ from the levels of natural gas savings due to their having different avoided costs and, for some technologies, different efficiency measures.

Sector Equity

The efficiency programs have been designed to assure that all customers can participate in the programs, and to preserve sector equity relative to sector funding. Although it does not affect the analysis, we presume that funds collected from residential customers would go to residential programs; the same would apply to commercial/industrial customers. We have not assumed that funds would necessarily be collected at the same rate (i.e., on a per-kWh or per-MMBtu basis) across sectors. Instead, for the program potential scenario we have generally pursued the most cost-effective savings, knowing that this results in a disproportionate portion of total savings from the C&I sector where there are less expensive efficiency opportunities. There may be policy considerations that would lead to a different allocation in portfolio spending. For example, some jurisdictions provide funding for income-eligible customer programs in greater proportion than their electric bills or usage would indicate. These decisions are not the purview of our analysis.

MAXIMUM ACHIEVABLE POTENTIAL

Our maximum achievable scenario analysis proceeded in a more simplified manner than the program potential, primary because we did not develop program costs in conjunction with the savings. Rather, we assumed that under such a scenario, unconstrained spending is available to overcome market barriers to the greatest feasible degree. In practice, this would translate to paying 100% incentives for all measures, across all programs, along with high levels of non-incentive spending. Given this assumption, but also recognizing that some market barriers cannot be fully overcome, even with unconstrained spending, we developed measure penetration rates based on the best performing programs around the country and professional judgment as to what would be possible with unconstrained spending.

As a result, our estimate of the maximum achievable scenario is somewhat theoretical, because it is unlikely that any efficiency program would be provided with such unconstrained spending. On the other hand, it does provide an upper bound comparison with the high level of savings targeted by the program potential scenario.

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- B: Task 3.2 Best Practices Final Memo
- C: Task 3.3 Interview Questionnaire
- D: Task 3.3 Completed Questionnaires/interview notes
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- P: Job Impacts Memo

Study of Potential for Energy Savings in Delaware

Appendices

2014

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APPENDIX A: TASK 3.1 MARKET BARRIERS FINAL MEMO

Optimal ENERGY Integrated Energy Resources

Market Barriers and Solution Strategies

DRAFT Task 3.1 Deliverable

Prepared for

DELAWARE DEPARTMENT OF NATURAL RESOURCES AND ENVIRONMENTAL CONTROL

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INTRODUCTION

A widely-cited report by McKinsey & Company (2009) estimated that the United States could decrease its annual energy consumption 23% by implementing efficiency measures, saving customers over a trillion dollars.[1] Yet the implementation of efficient technologies and behavioral changes necessary to achieve energy savings is far below what would be expected. First used by Hirst and Brown (1990), the "energy efficiency gap" is a term that refers to the underinvestment in energy efficiency based on what would be anticipated given the economic and social benefits.[2] Households, governments, businesses, and manufacturers often fail to utilize cost-effective technologies to reduce energy consumption despite technical feasibility.

To explain the energy efficiency gap many have sought to identify the market barriers and market failures that prevent people and organizations from achieving optimal levels of improved energy efficiency. These barriers inhibit consumers from making economically rational decisions and investing in cost effective energy efficiency measures. Although many different frameworks have been described, there appears to be much consensus in the literature about the types of barriers that impact energy efficiency. These barriers and market failures include split incentives, lack of information, transaction costs, financial constraints, and lack of availability, among others.

The following sections provide further discussion of several barriers as well as some of the potential solutions to overcome them. Although this list is not exhaustive, it touches on the most frequently cited and most important to overcome.[3]

SPLIT INCENTIVES/AGENCY

Split incentives occur when the benefits and costs of investing in energy efficiency are divided between two parties or agents. Often referred to as the "principal-agent" problem, this challenge emerges because the party responsible for making energy efficiency investment decisions (the agent) is not the same party that benefits from the investment (the principal.) This barrier is frequently described with regards to the rental property market. Typically, upgrading the efficiency of a current building or utilizing energy efficient building practices requires the owner of the building to make an initial capital investment. However, in the residential sector, for example, approximately 80 percent of renters are responsible for paying their own utility costs.[4] Therefore, tenants receive the benefits from the landlord's investment in the form of reduced energy bills. Since the building owners will not receive financial benefits from the upfront costs, there is no incentive for them to make the investment in energy efficiency.

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[1] McKinsey & Company, "Unlocking Energy Efficiency in the U.S. Economy. July 2009.

[2] Hirst, E. and Brown, M. "Closing the Efficiency Gap: Barriers to the Efficient Use of Energy." *Resources, Conservation and Recycling* 3(4), 267-281. 1990.

3 For a broader discussion of market barriers, see: Eto, Phrahl, and Schlegel, "Lawrence Berkeley National Laboratory, "A Scoping Study on Energy-Efficiency Market Transformation by California Utility DSM Programs." 1996.

[4] Harvard Joint Center for Housing Studies. "America's Rental Housing: Meeting Challenges, Building on Opportunities." 2011.

The agency issue also arises in the property ownership market. For example, builders may not opt to fund efficiency improvements in newly constructed buildings because buyers will be responsible for utility costs once the building is sold. Additionally, owners may not plan to occupy a building long enough for the payback from their investment to be realized. In that instance, the new occupants would receive the benefits of the investment rather than the original owners. Although discussion of the split incentive barrier often focuses on the residential sector, it is also relevant in commercial buildings in which the party that would make the investment in energy efficiency is different from the party that would reap the benefits of energy savings.

Another less frequently discussed example of a principal/agent challenge relates to larger customers in the commercial and industrial (C&I) sectors. Often, the employees who have the power to make capital investment decisions are not the same as those who manage the operations and maintenance of a facility and understand its energy use.

Green Leases

A "green lease" is tool that allows a building owner's investment in energy efficiency to be beneficial to both the owner and the tenant. Typically, the agreement enables to the landlord to charge tenants a higher rent in order to pay for the cost of funding the building's energy efficiency upgrades. In the commercial building sector, green leases have grown in popularity in recent years. One real estate consulting firm suggests that green leases can achieve a 20-40 percent reduction in energy use for a commercial property.[5] While this concept has been applied on a more limited scale in the residential sector, it could serve as a potential tool to address the residential split incentive problem. For example, a green residential lease program is being piloted on a small scale by the Cambridge Energy Alliance and the City of Cambridge, Massachusetts.[6] Enabling tenants to pay the cost of the energy efficiency improvements through increased rent aligns incentives by having the beneficiaries of the savings fund the cost.

On-bill Financing

One funding mechanism that may hold promise for reducing the split incentive problem is on-bill financing. On-bill financing programs allow customers to repay investments in energy efficiency on their monthly utility bills.[7] A funder, frequently the utility company, provides the upfront capital for efficiency improvements at no or low interest rates. Repayment periods are often three years or less. Loans can either be tied to customers or tied to meters. For loans tied to meters, the building occupant pays for the upgrades, but only so long as they live in the rental unit. If a tenant moves, the new tenant takes on responsibility for paying the remainder of the loan while occupying the building. On-bill financing reduces the split incentive problem because the landlord does not need to provide the upfront capital for the efficiency project and renters payback the cost.

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[5] LORD Green Real Estate Strategies as cited in Dingwell, J. "Using Green Leases to Improve Building Performance." Economy Post. http://greeneconomypost.com/green-leases-improve-building-performance-8003.htm. 2010.

[6] U.S. Dept. of Housing and Urban Development. "Evidence Matters: Split Incentives." http://www.huduser.org/portal/periodicals/em/summer11/highlight1_sidebar.html. 2011.

[7] Kats, G., Menkin, A., et al. "Energy Efficiency Financing - Models and Strategies." Updated 2011.

"Pay-as-You-Save (PAYS®)," for example, is a market-based system developed by the Energy Efficiency Institute that uses on-bill financing to fund efficiency upgrades.[8] The system allows a landlord or tenants to make energy efficient upgrades through funding from a third party with no upfront costs. The funding amount is then repaid through a monthly charge on utility bills at no additional interest. The charge incurred is lower than the savings received by the tenants. When a tenant moves, the new tenant takes over monthly payments for the upgrades. With this funding mechanism, incentives are aligned. Tenants pay for the cost of the upgrades, but less than the savings they receive, and only so long as they live in the unit. An example of a financing program based on the PAYS model is the How$mart energy efficiency program, implemented in Central and Western Kansas by Midwest Energy, Inc.[9]

Mandatory Codes and Standards

An additional strategy for reducing the split incentive problem includes mandatory codes and standards. By requiring landlords to meet certain standards of efficiency, regulations ensure that the energy performance of inefficient buildings gets improved, regardless of who benefits from the improvement. Codes and standards typically apply to newly constructed buildings, but some jurisdictions have also regulated the efficiency of existing buildings by mandating that efficiency improvements be made at a time or sale or be required for existing buildings meeting certain criteria. For example, the city of Boulder, Colorado's SmartRegs ordinance requires that current rental units obtain a Home Energy Rating System (HERS) score of 120 or achieve 100 checklist points on the SmartRegs prescriptive path checklist by January 2, 2019.[10] The checklist is designed to identify the most cost effective measures building owners can take to comply with the regulations.

LACK OF INFORMATION/UNCERTAINTY

The quantity and complexity of information needed to make informed decisions about investments in energy efficiency makes the information barrier a significant challenge to overcome. Customers may not be aware of the building's performance and the opportunities for energy savings. Studies have suggested, for example that only a small percentage of U.S. households are aware of how much energy they consume and how to best reduce their energy use.[11] Customers pay energy costs as one monthly bill (and only after energy has been consumed), so it is often unclear which end uses drive energy costs. Even if customers want to improve the energy efficiency of their buildings, they might not have relevant information about the technologies available, how to assess their options, or the level of savings to anticipate. If customers are not sure where to turn for technical or financial support, this information barrier may prevent them from moving forward.

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[8] Cillo, P. and Lachman, H., "Pay-As-You-Save Energy Efficiency Products: Restructuring Energy Efficiency." 1999.

[9] Volker, M. and Johnson, K., "Breaking Down the Barriers to Efficiency Improvements in the Rental Housing Market: One Utility's Approach." ACEEE Summer Study on Energy Efficiency in Buildings. 2008.

[10] City of Boulder, "SmartRegs Guidebook & The Rental License Handbook." 2011.

[11] Ehrhardt-Martinez, K. and Laitner, J., Editors, "People-Centered Initiatives for Increasing Energy Savings." 2010.

Additionally, uncertain information can cause customers to consider investments in energy efficiency to be risky. For example, commercial customers could worry that the performance and quality of an unfamiliar technology might negatively impact their business. Misperceptions about energy efficient products may also prevent customers from considering upgrades. Efficient products that were once inferior in other aspects of performance have been drastically improved in later models. For example, older models of compact florescent lamps (CFLs) used large and heavy magnetic ballasts, some of which created a humming or buzzing noise, while newer models address this problem.[12] There is also risk of uncertain information such as future energy prices, which could impact future benefit of the investment.

Education/Outreach

One way to reduce the information barrier is through various outreach and education activities. For example, California's "Flex Your Power" initiative was a multi-million dollar print, TV, and radio campaign that sought to get consumers and businesses to conserve energy during the 2001 energy crisis.[13] Community-based education efforts are another approach to educate renters about energy efficiency. One such example is Project Porchlight, a community-based campaign that promotes the use of CFLs rather than incandescent lamps. The campaign organizes volunteers and community groups to hand out CFLs at community events as well as door-to-door to engage residents. To date, the campaign claims to have been responsible for over 3.5 million changed light bulbs.[14] Competitions have also been successful tools for engaging communities and promoting energy efficiency. Community-wide competitions spur action and generate publicity and awareness about energy efficiency efforts.[15] For example, the Take Charge Challenge, an initiative of the Climate and Energy Project, engaged six Kansas towns in a year-long competition to reduce energy use.[16] During the year, participating towns saved over 6 million kWh. An additional 7 million kWh in annual savings is expected from the installation of permanent efficiency upgrades. Raising awareness about energy efficiency and providing information about opportunities for savings help customers to recognize the benefits and make rational decisions.

Case studies also help to provide information about energy efficiency projects that have been successful. On its commercial energy efficiency program website, Progress Energy lists several examples of ways in which organizations identified energy-savings opportunities and implemented cost-effective projects.[17] Case studies help to provide information about the types

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[12] ENERGY STAR, "Learn About CFLs." Accessed September 11, 2013. http://www.energystar.gov/index.cfm?c=cfls.pr_cfls_about.

[13] Bender, S., Moezzi, M., Gossard, M., et al," Using Mass Media to Influence Energy Consumption Behavior: California's 2001 'Flex Your Power' Campaign as a Case Study." In Proceedings of the 2002 ACEEE Summer

[14] Project Porchlight, "About Us." Accessed September 13, 2013. http://www.projectporchlight.com/.

[15] Harris, J., Hummer, J., and Cooney, K, "Evaluation of Consumer Behavioral Research." Navigant Consulting Report to Northwest Energy Efficiency Alliance. 2010.

[16] Fuller, M., Kunkel, M., et al. "Driving Demand for Home Energy Improvements." Lawrence Berkley National Laboratories. 2010.

[17] Duke Progress Energy, "Energy Efficiency for Business." Accessed September 13, 2013. https://www.progress-energy.com/carolinas/business/save-energy-money/energy-efficiency-for-business.page

of efficiency measures that can be implemented as well as reduce concerns about performance uncertainty by providing examples of projects that achieved anticipated savings.

Benchmarking/Energy Auditing/Energy Monitoring

Benchmarking, energy auditing, and monitoring all help to inform customers about the energy their buildings consume, how they compare to other similar buildings, and typical savings opportunities. Benchmarking refers to the documentation and comparison of a building's current energy use or historical energy use to that of a similar building. Benchmarking can be done using data gathered from utility bills, energy modeling, or home inspections and helps to inform customers about the potential energy savings available through implementing energy efficiency measures. Additionally, many programs offer energy auditing to customers to inform them about the specific end uses and cost effective measures that provide cost effective savings strategies. Moreover, energy monitoring systems provide real time information to customers about the energy use at their facility. In some jurisdictions, certain customers are required to benchmark their buildings and/or have them audited. For example, the City of Seattle requires non-residential and multifamily building owners in Seattle to track energy performance through the U.S. EPA's Portfolio Manager and report annually to the City.[18] Knowledge of building energy use and savings opportunities enables customers to make informed and rational decisions about energy efficiency investments.

Energy Services Performance Contracting (ESPC)

Energy Service Performance Contracting is also a tool that can help to reduce the risk of uncertain information about energy efficiency savings outcomes for larger customers. An Energy Services Company (ESCO) is a business that conceptualizes, implements, and coordinates financing for energy efficiency improvement projects over a set period of time. The ESCO manages a broad range of activities involved with the project and acts as a single point of contact and accountability during the term of the contact. The ESCO provides comprehensive technical knowledge to the customer, limiting their need to seek out vast amounts of unfamiliar information. Using ESPC, a customer enters into an agreement with an ESCO to identify and implement cost-effective energy conservation measures (ECMs) that will be paid for out of the achieved energy savings over the course of the agreement. Although there are different types of energy performance contracts, the most common is a "guaranteed savings contract." An important aspect of this type of ESPC is that the ESCO guarantees the level of savings will match or exceed the payments necessary to cover the projects' upfront and ongoing costs. In the event that energy savings to cover project costs are not achieved, the ESCO is responsible for paying the difference, thereby reducing the customer's risk of implementing ECMs. In the United States, ESPC is a $4 billion industry and is a frequently used tool by public and institutional entities.[19] In Kansas, Missouri, and Massachusetts, for example, the energy

[18] Seattle Office of Sustainability and Environment, "Energy Benchmarking & Reporting." Accessed September 12, 2013. http://www.seattle.gov/environment/benchmarking.htm.

[19] State of Idaho, "Guide to Energy Performance Contracting." August 2008.

efficiency of an estimated 50% of the floor area in state facilities has been addressed through ESPC.[20]

Labeling/Certification

Appliance and building labeling programs such as ENERGY STAR and LEED help to inform customers about energy efficient products and buildings. Labels signal to customers that such products have met minimum energy performance standards and should produce reliable savings. Labeling appliances also gives customers information that allows them to compare the energy use of a certain product with a number of other similar models and make a selection that takes operating expenses into account. ENERGY STAR products, for example, are independently certified to meet levels of energy efficiency without sacrificing features or functionality, removing much of the performance uncertainty for customers.[21] Therefore, customer can feel confident that product with an ENERGY STAR label will save a significant amount of energy and function at a high quality, removing some of the risk associated with making the investment. Additionally, building labels inform potential buyers, renters, or investors about the full cost of owning or leasing the property, which helps them to make a more rational decision when deciding between buying a conventional building or an efficient one.

TRANSACTION COSTS

A barrier that is closely related to the information barrier involves transaction costs. Even when the information needed to help customers make decisions to invest in efficiency is available, acquiring that information can be burdensome in terms of time, money, or both. Customers must seek out information to identify and weigh their options and hire and manage professionals to complete the work. Such actions require effort that is above and beyond what they would likely undertake to maintain their current building. In the face of transaction costs, maintaining the status quo is usually the easier and more comfortable option. This represents a particular challenge for small C&I customers who are unlikely to have employees who work specifically in building management. Additionally, during retrofit projects, business operations could be interrupted while new equipment is being installed and construction takes place. If current equipment is not broken, customer may be unwilling to take the time to pursue new, efficient options.

Technical Assistance

To reduce transaction costs for customers, many programs offer technical assistance. Technical assistance refers to support services that can occur at various stages in the efficiency planning and implementation process. These services include conducting feasibility studies that analyze the potential for cost-effective energy efficiency projects, reviewing existing proposals and designs, developing equipment performance specifications, and assisting with contractor and equipment bid selection. Providing these services helps to fill gaps in knowledge customers

[20] US Dept. of Energy, Building Technologies Program, "A Guide to Performance Contracting with ESCOs." September 27, 2011. http://www.pnnl.gov/main/publications/external/technical_reports/PNNL-20939.pdf.

[21] ENERGY STAR, "ENERGY STAR Qualified Products." Accessed September 13, 2013.

may have and limit the time and effort they must spend to complete these tasks. For example, NYSERDA's FlexTech Program, which is available to C&I customers as well as government and institutional customers, provides cost-sharing incentives for consultant support on a range of services to help customers make informed energy decisions.[22] Expert support and advice through technical assistance limits the amount of time and effort customers must spend to seek out information and implement efficiency upgrades, thereby reducing transaction costs.

Energy Services Performance Contracting (ESPC)

ESPC, as previously discussed, offers another strategy for reducing transaction costs. Unlike a traditional energy efficiency contracting process involving several different solicitations and contract awards, an ESPC typically requires one solicitation and the selection of one ESCO to provide comprehensive services for the entire duration of the project. Working with one company reduces transaction costs by minimizing the time and effort required to review proposals for multiple bids and manage the energy efficiency project.

Direct Install Programs

Direct install programs are designed to have contractors or other trained professionals install energy efficiency measures on-site. This reduces the time and energy customers must spend figuring out how to install the measure themselves or finding knowledgeable, reliable professionals to install them. Directly installing the measures also ensures that they are installed properly and function as intended, which helps to improve the performance of efficiency measures and enables customers to maximize energy savings. Direct install programs typically serve a high volume of customers and focus on prescriptive measures such as replacement lighting, pipe wrap, and low flow showerheads.[23] Some programs, however, may provide more services. For example, Southern California Edison's small business direct install program sends contractors to provide short consultations to identify savings opportunities such as lighting, signage, and refrigeration, and recommend improvements.[24] Additionally more comprehensive programs might include measures such as air or duct sealing among others. In all cases, direct install programs provide customers with information about the most effective efficiency measures to implement, preventing customer from having to seek out this information themselves.

FINANCIAL CONSTRAINTS

Although many energy efficiency measures can save customers money in the long run, implementing those measures often requires an additional investment. While customers receive the benefits of efficiency over time, the majority of the costs for these measures are required at

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[22] NYSERDA, "FlexTech Program." Accessed September 12, 2013. http://www.nyserda.ny.gov/BusinessAreas/Energy-Efficiency-and-Renewable-Programs/Commercial-and-Industrial/CI-Programs/FlexTech-Program.aspx

[23] Conservation Services Group, "Direct Install Programs for Energy Efficiency." Accessed September 12, 2013. http://www.csgrp.com/wp-content/uploads/2013/05/Direct-Installations-for-Energy-Efficiency-Programs-CSG-Conservation-Services-Group.pdf

[24] Southern California Edison, "Direct Install Program." Accessed September 12, 2013. https://www.sce.com/directinstall.

the start of the project. Many customers weigh investments in terms of short payback periods and place greater value on first costs than on the life-cycle costs of the investment. However, even customers who recognize the lifetime savings potential from efficiency may lack the capital or borrowing power to make the initial investment. Traditional sources of capital may not be available for or properly value energy efficiency improvements. For example, small businesses or low-income customers may be unable to borrow money as the result of income levels or credit-worthiness.[25] Additionally, although mortgage qualifications are intended to ensure that a borrower can repay a loan within its term, operating expenses usually are not considered when a property is purchased even though improved energy efficiency would enable a borrower to make larger mortgage payments.

Financial Incentives

One way to limit financial constraints to energy efficiency is to reduce the first-cost differential between efficient and conventional products. Rebates, taxes, and grants for installing efficiency equipment and products or building efficient structures are examples of methods for achieving this goal. Although the delivery mechanism for these incentives may differ between programs, the incentives are often designed to cover some portion of the incremental cost, or the difference in price, between the efficient product and the conventional product. MidAmerican Energy's Custom Systems program, for example, provides rebates to nonresidential customers to install high-efficiency buildings systems equipment. Rebates levels are customized based on the equipment's incremental cost as well as the level of energy savings.[26] More commonly, a deemed rebate is offered per unit of prescriptive efficient product installed. For example, Duke Energy's SmartSaver program offers customers in Kentucky $50 per setback/programmable thermostat installed.[27] Customers can also receive tax incentives through the federal government for installing ENERGY STAR qualified products. Customers can receive federal tax credits, for example, for 10% of the cost up to $500 or a specific amount from $50-300 for installing efficient HVAC systems and other types of equipment.[28]

Access to Financing

Even if financial incentives reduce the cost difference between efficient and conventional products, customers may still lack the capital to fund the upfront cost associated with efficiency upgrades. Various financing mechanisms have been developed to allow customers to pay back the cost of energy efficiency investments over time. Government loan programs as well as private unsecured loans are one such mechanism that has provided property owners with capital for energy improvements.[29] With the help of American Recovery and Reinvestment Act

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[25] Golove and Eto, "Market Barriers to Energy Efficiency: A Critical Reappraisal of the Rationale for Public Policies to Promote Energy Efficiency. March 1996.

[26] MidAmerican Energy, "Custom Systems." Accessed September 13, 2013. http://www.midamericanenergy.com/ee/ia_bus_custom_systems.aspx

[27] Duke Energy, "SmartSaver Prescriptive Incentives (Kentucky)." Accessed September 13, 2013. http://www.duke-energy.com/pdfs/SS-Incentives-comprehensive-final-KY.pdf

[28] ENERGY STAR, "Federal Tax Credits for Consumer Energy Efficiency." Accessed September 12, 2013. http://www.energystar.gov/index.cfm?c=tax_credits.tx_index

[29] Kats, G., Menkin, A. et al. "Energy Efficiency Financing - Models and Strategies." Updated 2011.

(ARRA) funding, many states and local governments established loan funds to provide short-term loans at below-market interest rates. Charter One's Energy Efficiency CRA Loan is an example of a private loan program that allows homeowners in the Chicago metropolitan area to finance efficiency improvements. Homeowners can receive an unsecured loan of $1,000 to $3,000 at 3% AAPR with a 3-year term, or a loan of up to $10,000 at 5% APR with a 5-year term.[30]

Some lenders and government agencies have started offering mortgages to borrowers that help fund energy efficiency upgrades. An energy efficient mortgage (EEM) can be used to buy a newly constructed energy efficient home or to fund energy improvements in existing homes.[31] An EEM is based on a traditional home mortgage, but factors the cost of energy improvements and savings into underwriting standards. The value of energy savings are factored into the loan calculations and provide building owners with a source of capital to fund energy upgrades when a property is purchased or refinanced. EEMs allow energy upgrade costs to be repaid over the full mortgage term. These programs are funded in several different ways, though they are largely based on traditional lending products or processes. The Federal Housing Agency, U.S. Department of Veteran Affairs, and Fannie Mae have all developed some type of energy efficient mortgage.[32] Although Freddie Mac does not provide EEMs, it does allow energy efficient improvements to be considered in underwriting. Additionally, several states such as New York and Kansas, as well as banks like Citibank and Bank of America, have created their own EEM products and take cost savings on energy bills into account when determining qualifying standards.[33] Allowing customers to borrow additional mortgage funds for energy efficiency improvements reduces the barrier of upfront costs and allows for greater investment in efficiency.

As previously discussed in relation to split-incentives, on-bill financing can be an effective a strategy for reducing the upfront costs associated with energy efficiency improvements. Such programs allow customers to payback their investment over time without providing the initial capital at the start of the project. Energy Service Performance Contracting, which also helps to reduce the uncertainty and transaction cost barriers, enables customers to avoid funding the full cost of an efficiency project upfront and supports an extended payback period. Both of these funding options help to reduce the financial constraints associated with energy efficiency investments.

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[30] Energy Impact Illinois, "Energy Impact Low Interest Loans." Accessed September 12, 2013. http://energyimpactillinois.org/residential/energy_impact_loan/?reload=y

[31] Housingpolicy.org, "Goal: Improve Residential Energy Efficiency, Policy: Provide Low-Cost Financing." Accessed September 12, 2013. http://www.housingpolicy.org/toolbox/energy_efficiency.html.

[32] ENERGY STAR, "Energy Efficient Mortgages." Accessed September 12, 2013. http://www.energystar.gov/index.cfm?c=mortgages.energy_efficient_mortgages

[33] Stinson, S. "Green Mortgages Save on Energy, Loan Costs," Bankrate.com. http://www.bankrate.com/finance/mortgages/green-mortgages-save-on-energy-loan-costs-3.aspx. March 30, 2009.

LACK OF AVAILABILITY

Customers with adequate resources and knowledge may be unable to improve efficiency if products or knowledgeable contractors are not available. In some instances, suppliers or buyers may exhibit market power and dominate supply channels, limiting competitors who produce energy-efficient products from penetrating the market.[34] Even in a competitive market, when newer, more efficient products are not available from suppliers and distributors, customers may not have access to the products when they need them. In cases where existing equipment has failed and a replacement is needed quickly, customers and contractors may not be willing to wait for a special-order efficient unit when a standard-efficiency unit is available "off-the-shelf."

Additionally, the notion of "gold plating" suggests that energy efficiency is often inseparable from and only available with other costly product features. Therefore, customers are required to pay for additional features they may not want in order to buy a more efficient product. For example, as noted in an International Energy Agency report, "the fuel economy of automobiles has historically been only one of a large number of features that come in a package for each make and model. Or in the case of electrical appliances, the standby power use is a part of the overall appliance package intended to provide a service like watching television or listening to music."[35]

Moreover, most customers must rely on the technical expertise of contractors and other building professionals to carry out upgrade projects. A lack of knowledgeable contractors or inability to determine which have the proper training and skills to achieve successful outcomes may inhibit customers from achieving the efficiency of their units. Professionals who improperly install or operate efficiency measures may prevent customers from fully realizing the potential savings. Without an adequate number of reliable professionals, even the most motivated customer will have a difficult time improving the efficiency of their properties.

Upstream Programs

Rather than offering customers a direct incentive for buying energy efficient equipment, upstream and midstream incentive programs offer incentives to manufacturers, distributors, and retailors to stock and sell energy efficiency products and equipment. For example, MassSave's C&I Upstream Lighting Program pays the higher cost of LED lamps and reduced-wattage linear fluorescent lamps to electrical distributors who participate in the program and agree to stock these products.[36] The distributors then sell these products at a comparable cost to conventional products. Partnering with suppliers and providing them with incentives to stock and sell efficient products helps to ensure that these products are adequately available to customers. Not only does this type of program reduce the product availability barrier, but it also addresses the additional upfront cost associated with more efficient products.

Workforce Training

[34] Sullivan, "Behavioral Assumptions Underlying Energy Efficiency Program for Businesses." February 2009.

[35] International Energy Agency, "Mind the Gap—Quantifying Principal-Agent Problems in Energy Efficiency." 2007.

[36] MassSave, "Bright Opportunities: Commercial & Industrial Upstream Lighting Program." Accessed September 12, 2013. http://www.masssave.com/professionals/incentives/upstream-lighting.

To address a lack of experienced professionals, various energy programs maintain a listing of contractors who have received some amount of training or who have gone through a verification process to demonstrate their ability to perform efficiency-related work.[37] In addition to ensuring the qualification and adequate supply of contractors, maintaining a network of these professionals helps to reduce the transaction costs landlords face when attempting to hire someone to work on their property. Program sponsors' recruiting process often provides classroom and field-based training to ensure contractors are properly skilled and vetted.[38] Some programs have looked to third party organizations, such as the Building Performance Institute, to help manage their contractor review, training, and certification processes.[39]

Workforce training programs have served a dual purpose in some areas of creating jobs as well as ensuring that enough knowledgeable professionals are available to carry out energy efficiency projects. For example, the New Jersey Department of Labor and Workforce Development created a Weatherization Training Program that is intended to train traditionally underserved men and women for entry-level jobs.[40]

ADDITIONAL BARRIERS

In addition to the frequently discussed barriers mentioned above, a recent paper by Stover, Sachs, and Lowenberger (2013) described some of the more "cryptic" (hidden or unrecognized) barriers that impact investments in energy efficiency.[41] These barriers do not necessarily result from the same market failures that cause most other barriers, but reflect a range of underlying issues such as "regulatory uncertainty, archaic or legacy regulations, and inaccurate ratings and standards."[42] For example, one cryptic barrier the paper identified was unrealistic testing procedures for electric water heaters. Test procedures require the water heater to sit on a wood base during testing, yet most water heaters are installed on concrete. The wood can act as an extra layer of insulation and cause efficiency ratings to be overstated. Many of the cryptic barriers discussed related to specific technologies or may only be relevant to some jurisdictions, which makes it difficult to identify all of them or generalize about them on a broad scale. Nevertheless, it is important for Program Administrators to recognize these types of challenges when they arise and to consider them in their program planning efforts.

CONCLUSIONS

The market barriers that impact energy efficiency investments are diverse and often interrelated. Although there is no single strategy or "silver bullet" to overcoming these market

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[37] ENERY STAR. "Financing Guidebook for Energy Efficiency Program Sponsors." 2007.

[38] Fuller, M. "Enabling Investments In Energy Efficiency: A Study of Energy Efficiency Programs that Reduce First-Cost Barriers in the Residential Sector." 2009.

[39] Energy Star. "Financing Guidebook for Energy Efficiency Program Sponsors." 2007.

[40] http://lwd.dol.state.nj.us/labor/forms_pdfs/employer/training/Weatherization%20One%20PagerUpdated3-25.pdf

[41] Stover, Sachs, and Lowenberger, ACEEE Report Number A135, "Cryptic Barriers to Energy Efficiency." August 2013.

[42] Ibid.

barriers, numerous strategies have been developed to reduce them and allow for increased investment in energy efficiency. Successfully addressing efficiency market barriers is likely to involve a combination of the strategies described above. Beyond direct financial incentives, providing marketing and outreach, financial incentives and technical assistance, motivating supply chains, and simplifying the implementation process are approaches that have been used to minimize the factors that inhibit achievable levels of efficiency. An understanding of the barriers to energy efficiency and the strategies for overcoming them can help to inform policy and program design to successfully meet savings targets.

APPENDIX B: TASK 3.2 PROGRAM BEST PRACTICES FINAL MEMO

Optimal ENERGY Integrated Energy Resources

Program Best Practices

DRAFT Task 3.2 Deliverable

Prepared for

DELAWARE DEPARTMENT OF NATURAL RESOURCES AND ENVIRONMENTAL CONTROL

by:

Optimal ENERGY

October 4, 2013

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INTRODUCTION

Over the past several decades, energy efficiency programs have grown in prevalence across the country. Although these programs all seek to help customers reduce their energy consumption, some have been more successful than others in terms of savings achieved, customer participation and satisfaction, transferability, cost-effectiveness, and impact on the market. Generally speaking, the most effective energy efficiency programs are those that best overcome the structural, informational, and financial barriers that hinder customers from investing in efficiency. The ways in which the most successful programs overcome these barriers share common characteristics and best practices. The following report discusses the current state-of-the-art regarding best practices and strategies for achieving measurable cost-effective efficiency savings based on successful programs around North America.

Identifying Best Practices

Numerous studies and reports over the years have sought to identify the specific best practices in program design to improve the development and outcomes of such programs in other jurisdictions. A study published by the American Council for an Energy Efficient Economy (ACEEE) in 2013 is perhaps the most recent and geographically diverse best practices review included in the literature.[1] To complete the review, ACEEE and an expert panel solicited nominations from organizations across the country. The panel selected exemplary programs based on many of the factors described above such as energy savings and cost-effectiveness. Additionally, the review identified a set of design features that were consistent among the programs deemed to be most successful. Based on our own and ACEEE's observations of exemplary programs as well as additional consideration of other best practices resources, Optimal distilled a list of characteristics shared by many of the country's leading efficiency programs. These best practices include:

- Bundles financial incentives with technical and/or informational services
- Targets market niches and customer sub-segments
- Reaches previously underserved customers with new programs and program approaches; pilot tests new program approaches
- Simplifies processes to make participation easier for customers
- Uses "one-stop-shopping" and similar approaches
- Works to build relationships and partnerships
- Provides financing options, including an increasing variety of approaches and varying degrees of involvement by program administrators (PAs) in project financing
- Works to incorporate the latest energy-efficient technologies

[1] Nowak, et al., ACEEE Report Number U132, "Leaders of the Pack: ACEEE's Third National Review of Exemplary Energy Efficiency Programs." June 2013

In addition to best practices common to all efficiency programs, there may be additional best practices related to certain program approaches. Both general and relevant program-specific best practices are referenced in the program descriptions provided in this report.

Identifying Programs Relevant to Delaware

While many of the exemplary programs discussed in the ACEEE report represent approaches that Delaware should strive for, they may not be the most relevant programs to look to for current program design efforts. It is generally advised that PAs should first look to successful models in other jurisdictions that can easily be transferred to new regions and be quickly implemented to achieve near term savings. For example, effective initial commercial programs often to include simpler approaches such as prescriptive incentives for efficiency measures like lighting, HVAC systems, and motors.[2] Portfolio offerings can later evolve in complexity as PAs build their infrastructure and capacity for delivering more comprehensive programs, gain a better understanding of local markets, and build relationships with stakeholders. For example, PAs may begin to provide alternative financing mechanisms or include custom measures in program design.[3] As ACEEE identified, a trend among successful programs is the ability to adapt core offerings to maintain and grow savings. In addition, many of the exemplary programs have greatly increased spending in recent years to reach more customers and achieve higher savings. For a full list and description of the exemplary programs identify by ACEEE, the report can be accessed for free online.[4]

Because they evolve over time and in response to efficiency efforts, market conditions in nearby states may be more similar to Delaware than those of the best practice programs described in the ACEEE report and elsewhere. Therefore, this report also describes successful programs currently implemented in Maryland, Pennsylvania, and New Jersey, and operated by utilities such as Delmarva Power and other relevant utilities. We compare program designs and approaches used in these jurisdictions to the general best practices identified and listed above to identify those programs that may be of greatest interest to Delaware.

It is also important to keep in mind that a successful efficiency program portfolio is greater than the sum of its parts. Simply implementing a series of best practice programs may not necessarily lead to success. Rather, the portfolio should be designed in such a way that the programs work together, are mutually supportive, achieve efficiencies of administration, and are simple for customers to understand.

Below, we summarize several programs that we feel provide relevant approaches and strategies for future programs in Delaware.

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[2] Environmental Protection Agency, "National Action Plan for Energy Efficiency." July 2006.

[3] Ibid.

[4] http://www.aceee.org/research-report/u132

SUMMARY OF PROGRAMS

Residential & Income-Eligible Customers

Residential New Construction

Program: Residential New Construction
State: New Jersey
Utility: Statewide

Program Description:

The New Jersey Board of Public Utilities, in conjunction with New Jersey utilities, offers the ENERGY STAR Homes Program (NJESH). The program provides incentives to builders who construct homes that are more efficient than homes built to the International Energy Conservation Code (IECC). In order to achieve this classification, a home must score 85 or less vs. IECC 2006 or 75 or less vs. IECC 2009 on the Home Energy Rating Scale (HERS). New homes and gut rehabs of existing homes throughout the state can qualify for the ENERGY STAR home designation and incentives, but new homes must be located in designated New Jersey Smart Growth areas in order to qualify.

How the Program Demonstrates Best Practices:

The NJESH program offers customers a bundle of technical support and incentives to improve new homes to save at least 15% over a code-compliant new home. The incentive structure offers the builder varying incentive amounts based on the type of residence (single-family, townhouse, and multi-family). The program is offered uniformly statewide (in designated smart growth areas) and offers online resources for customers, including information sheets and a list of eligible, participating contractors. Tiered incentives are available for qualified new homes meeting increasing levels of efficiency.

Relevance to Delaware:

A uniform, statewide program with consistent messaging, the New Jersey ESH program is the best example of a RNC program in a neighboring state. There are other examples of best practice slightly farther afield: the Connecticut RNC program and the Vermont Energy Star Homes program. These more mature programs offer additional contractor support, technical assistance, QA, financing options and marketing services. Important factors to consider are: contractor support in the form of training, loans for test equipment purchasing, and marketing. Also, consistent funding, consistency of messaging, QA/QC, and some level of program flexibility and homeowner support. In summary, the New Jersey program model may be a good place to start as Delaware builds its program infrastructure and capacity, while the more mature programs provided in Connecticut and Vermont indicate best practices to strive for with residential new construction programs in the medium-term.

Residential Retrofit

Program: Home Performance with Energy Star
State: Maryland
Utility: Baltimore Gas & Electric

Program Description:

Baltimore Gas & Electric Company (BGE) offers a Home Performance with Energy Star (HPwES) Incentive Program that provides residential incentives, including building envelope and HVAC systems, under the umbrella of the State's EMPower Maryland initiative. The HPwES-affiliated program offers comprehensive audits and home energy retrofit services through a network of BPI certified contractors. They offer a website and associated marketing and outreach that delivers a clear message and delivers reasonably good results.

How the Program Demonstrates Best Practices:

The combination of contractor support and customer education supported by the utility website (bgesmartenergy.com) helps to reduce technical and informational barriers facing residential customers. The menu of tiered measures and incentive ranges also matches the needs of most customers, while allowing the utility to operate the program without interruption due to oversubscription. Utilizing the existing BPI contractor training resources allows the program administrator to focus on other aspects of implementation and Quality Assurance. BPI training/certification is widely recognized as the industry standard and appropriate level of rigor. Customers can search a list of contractors based on proximity and area of technical expertise on the program website, simplifying the contractor selection process. In addition, the State supports local adoption of Property-Assessed Clean Energy (PACE) financing which effectively allows property owners to borrow money to pay for energy improvements. The amount borrowed is typically repaid via a special assessment on the property over a period of years. Maryland has authorized local governments to establish such programs.

Relevance to Delaware:

All of the program features listed above are good checklist items for Delaware as the State ramps up a residential retrofit program. However, no PACE-enabling legislation has been passed in Delaware to date. Therefore, the State may need to identify another financing mechanism for residential customers for retrofit projects. Another important missing factor is that programs benefit from the coordination offered by a central program administrator (as offered in New Jersey) which effectively eliminates utility-to-utility variation, even if only in the way of the address on applications and reporting forms. Most of all, contractors are the backbone of any HPwES program and support in the form of training, marketing and loans for test equipment will pay long term dividends in the form of realized savings and happy customers. Again, as the program in Delaware matures, we suggest looking to Massachusetts' Mass Save® Home Energy Services as a good example of industry-leading best practice, well developed and mature home retrofit program that serves multiple utilities. In particular,

financing available through the Mass Save HEAT loan program and on-bill financing from utilities have provided important resources to increase program participation.[5]

Multi-family

Program: Residential Multifamily Housing Program
State: New Jersey
Utility: Public Service Electric and Gas Company (PSE&G)

Program Description:

PSE&G's Residential Multifamily Housing Program provides customers with financial as well as technical and informational support to make energy efficient capital improvements to their buildings. The program is available to all multifamily housing located in the utility's service area, though priority is given to affordable housing projects financed through the New Jersey Housing and Mortgage Finance Agency (NJHMFA). Participating customers receive a free Investment Grade Audit performed by building professionals employed by PSE&G and hired through a competitive process. PSE&G also monitors the project implementation process, confirms equipment ordering and receipt, and checks project cash flows. All recommended measures with simple payback of fifteen years or less are eligible for program incentives. In addition to upfront incentives, the program provides "on-bill financing" which allows customers to pay back remaining project installation costs interest free on their utility bill over a period of 10 years.

How the Program Demonstrates Best Practices:

The program was designed to target a specific sub-segment of the residential market. Affordable multifamily buildings typically have high energy usage, old equipment, and lack the funding necessarily to make capital improvements. Moreover, building owners likely lack knowledge of how to manage or evaluate contractors to implement efficiency measures. Offering significant upfront incentives as well as providing low-cost financing allows the multifamily sector to invest in efficiency. In addition to financial incentives, PSE&G program managers oversee the project from start to finish, providing customers with information and technical support and assuring the quality and cost effectiveness of project implementation. By maintaining a group of pre-qualified audit and engineering professionals as well as reviewing contractor bids, PSE&G simplifies the process of planning for and implementing efficiency projects for customers. The program also allows for the incorporation of emerging technologies to the extent that they are cost-effective. All efficiency measures identified in the audit that have a payback period of 15 years or less may be implemented.

PSE&G's partnership with NJHMFA also plays a large role in PSE&G's multifamily program. NJHMFA has significantly knowledge of and credibility with the multi-family customer segment as well as an ability to contact building owners and property managers. The partnership reduces PSE&G program marketing costs and ensures adequate participation.

[5] http://www.masssave.com/residential/offers/heat-loan-program

NJHMFA is also acts as an additional source of customer support and informational services. The organization is active in providing audit and bid review as well as attending meetings with building owners and inspections.

Relevance to Delaware:

The challenges that multifamily building owners and managers face are similar throughout the Northeast and Mid-Atlantic, especially in the affordable housing sector. A similar comprehensive approach, addressing multiple barriers rather than simply offering incentives, would likely be a successful strategy to reach this market segment in Delaware. The process of providing energy audits and upfront incentives to fund cost-effective efficiency measures is easily transferable. Offering on-bill financing requires some additional considerations. Program Administrators must determine how to handle financial risk of holding loans as well as develop administrative efforts to originate and service loans.[6] Finding a financial partner such as a private lender or community development corporation can help to reduce these challenges, and may provide viable alternatives to on-bill financing if it is not possible to develop this in Delaware in the short term. Providing other support services may also require some relationship building up front to ensure program success. For example, the program would need to identify vetted building professionals who would be able to perform pre-bid energy audits and engineering services prior to moving forward. This would likely be done by researching potential candidates and issuing an RFQ or RFP.

The State may also wish to explore a partnership with a housing finance organization similar to the NJHMFA in order to enhance and support the program. In Delaware, the Delaware State Housing Authority (DSHA) is a similar government agency that acts as an entrepreneurial developer and lending institution.[7] Although the involvement of NJHMFA has enhanced PSE&G's program marketing and support services, program implementation would still be possible in the absence of such a partnership.

Residential Efficient Products

Program: Mass Save Residential Lighting Program
State: Massachusetts
Utility: Cape Light Compact, National Grid, NSTAR, Unitil, Western Massachusetts Electric Company

Program Description:

Mass Save is an initiative sponsored by Massachusetts' electric utilities and energy efficiency service providers. The Mass Save Residential Lighting Program works to increase

[6] Henderson, "On-Bill Financing Overview and Key Considerations for Program Design." NRDC Issue Brief. August 2012.

[7] U.S. Department of Housing and Urban Development, "Delaware State Housing Authority." Accessed October 2, 2013. http://portal.hud.gov/hudportal/HUD?src=/program_offices/public_indian_housing/programs/ph/mtw/delaware

availability of qualified CFLs and LEDs product in stores and online through incentive programs. It also uses marketing and promotions to target multiple customer segments and demographics on benefits and reduced cost of efficient lighting technologies. Manufacturers and retailers earn incentives for running sales promotions that allow customers to purchase lighting products at reduced costs. Incentive amounts vary by technology, application, and functionality and are set at an agree amount per unit of product shipped and/or sold. A "market lift" program model is also being piloted with Costco where the retailor will only receive an incentive if they outperform their baseline sales of efficient lighting products. Program Sponsors also implement marketing and educational strategies designed to increase knowledge of the benefits of efficient lighting products and influence customer purchase decisions. Improved awareness ultimately helps to increase sales, excitement, and word of mouth information sharing. For example, Mass Save's current campaign, *Do You Like to Save?*, aims to utilize social media channels to inform and engage customers.

How the Program Demonstrates Best Practices:

Developing partnerships with and offering incentives to manufacturers and retailers helps to ensure energy efficient product availability. It also provides an additional marketing channel for promoting efficiency programs and educating customers. Partnering with manufacturers and retailers also simplifies the process of participating in the program for residential customers. Rather than having to submit paperwork to receive rebates after purchasing efficient products, customers receive financial incentives at the point of sale. Promotional and marketing campaigns are designed to reach customers through various media channels, preventing customers from having to seek out the information themselves. Use of multiple media channels allows marketing promotions to target multiple customer segments and demographics and encourage program participation. In addition to the financial incentives, promotions run by Sponsors and partners help to inform customers of both the benefits of purchase efficient products as well as the specific product they should buy and where they can buy them. Incorporating incentives for LEDs in addition to CLFs helps to drive the adoption of the latest technologies that offer savings opportunities but are still expensive. Additionally, piloting a market lift approach may help to improve program results in the future.

Relevance to Delaware:

Although Massachusetts is outside of the mid-Atlantic region, the lighting market is largely being driven by national changes in federal lighting standards and the rapid proliferation of solid-state (i.e., LED) products. Therefore, the regional Mass Save residential lighting strategy is likely to be relevant for program design efforts in Delaware. The overall approach requires relationship development with manufacturers and retailers. To the extent that distributors are not already carrying efficient products, incentive levels would need to be set to adequately encourage partnership interest. Additionally, retailers should be adequately spread throughout the service area to ensure all customers have access to a local distributor. Marketing and promotional efforts are also a key aspect of the Mass Save Residential Lighting Program and expertise in these efforts would be important in Delaware. Thought should be given to outreach

approach for this type of program, as well as others. The specific marketing strategies and approaches used in Massachusetts may need to be adjusted to reach to demographics specific to Delaware customers.

Income-Eligible Services
Program: Efficiency Vermont Comprehensive Low Income Services
State: Vermont
Utility: Efficiency Vermont

Program Description:

Efficiency Vermont offers a suite of services to income-eligible (or "low-income") Vermonters. This approach addresses the reality that almost everyone with limited income can benefit from assistance to reduce energy costs, but that not everyone has exactly the same needs. The low income program includes:

- Weatherization Assistance Program (WAP) partnership that extends the resources of Vermont's WAP providers by funding for electric efficiency measures that historically have been out of scope for WAP. These measures include efficient lighting, smart power strips, ENERGY STAR qualified refrigerators and clothes washers, and efficiency ventilation fans. Efficiency Vermont bears the full cost of the measure installation and contributes to the audit and management costs for the projects.
- Vermont Foodbank acts as a "retail" location for providing CFLs at no cost to Vermont's most vulnerable population.
- Major Appliance Rehabilitation Service (MARS) delivers services to households who either earn slightly too much to qualify for WAP, or who received WAP services prior to the development of the WAP add-on program and did not receive the electrical efficiency measures currently offered.
- Vermont Fuel Efficiency Partnership (VFEP) is an initiative that pulls various funding sources together to deliver "deep energy retrofits" to affordable multi-family housing that is undergoing major rehabilitation. Measures may include insulation, air sealing, efficient windows. Funding sources include Efficiency Vermont, Regional Greenhouse Gas funds, EECBG Block Grants, WAP, and housing rehab funds from other sources.
- Multifamily New Construction and Major Rehabilitation Program provide technical assistance and financial assistance to the affordable housing development community, focusing on providing services to multifamily projects where the VFEP approach isn't viable.

How the Program Demonstrates Best Practices:

Efficiency Vermont recognizes that low income customers are often underserved because they do not have the financial resources to participate in sharing the cost of efficiency measures.

Therefore, low income program incentives for direct services are typically set at 100% of the measure cost (Multifamily may be different).

These initiatives effectively target low income customers through close partnership and coordination that Efficiency Vermont maintains with the WAP providers, human services and other agencies and organizations that are intimately linked to the low income community. Rather than attempt to layer on stand-alone low income energy efficiency services, Efficiency Vermont has adopted an approach that is well-integrated with those agencies and services that are already deeply connected to the low income communities trusted service. These partnerships also lower the cost of service delivery to Efficiency Vermont by avoiding redundant systems. Additionally, the approach simplifies the participation process by engaging customers using service providers who are going to be working at the home already.

Relevance to Delaware:

Vermont has successfully developed energy efficiency services that focus on reducing multiple barriers to participation by low income customers. These customers are historically harder to reach and harder to provide meaningful services to than other customers. A similar approach can and should be taken in Delaware in order to achieve significant impacts for the most vulnerable customers. In Delaware, as in Vermont, low income residents receive assistance through the WAP program as well as other human services organizations such as the Food Bank of Delaware. Developing efficiency initiatives in coordination and partnership with these organizations would leverage existing resources to better reach low income customers as well as reduce the administrative costs of multiple interactions with individual customers. Because the low income population is difficult to reach, Delaware may wish to engage a low income advisory board, with representatives who are familiar with the needs of the low income community. For example, in Massachusetts, the Low Income Energy Affordability Network (LEAN) coordinates with utility providers and other stakeholders in a statewide best practices working group. Setting incentive at 100% of the measure cost for single family participants is another aspect of Efficiency Vermont's initiatives can be included in Delaware's program model.

Commercial & Industrial Customers

There are a number of common program approaches used to address the Commercial and Industrial (C&I) sector that may be applied to one or more markets. These approaches include: market segmentation, prescriptive incentives, customized/negotiated incentives, upstream incentives, technical assistance, new construction, and direct install. For example, while direct install programs are most relevant to small business retrofit markets, customized incentives may be successful components of large business retrofit, and in some cases, market opportunity projects. Therefore, the C&I program section is organized by program approach, with relevant markets identified.

Market Segmentation
Market(s): Large Business Retrofit, Market Opportunity
Program: Existing Buildings
State: Vermont
Utility: Efficiency Vermont

Program Description:

Efficiency Vermont's (EVT) commercial and industrial buildings program tailors its marketing, outreach, and incentive approach to the needs of specific market sectors. C&I customers can receive standard rebates for a wide range of new, energy-efficient equipment relevant to their particularly industry. For example, for commercial offices, customers can receive incentives for measures such as lighting and HVAC equipment and controls and data center and IT equipment. Grocery stores, on the other hand, can also receive incentives for refrigeration and related controls and commercial kitchen equipment.

How the Program Demonstrates Best Practices:

The needs, timing, and specific barriers preventing efficiency investment vary significantly within different segments of the commercial and industrial sectors. These customers include a diverse range of building types including office space leased by small businesses, large industrial facilities, hospitals, and chain grocery stores and restaurants. It is clear that each of these business types have vastly different business needs, investment timing needs and resources, decision making processes, and applicable measures. Therefore, one single approach to marketing and incentives may not efficiently reach all segments. As a result, established efficiency program administrators have begun to market approaches tailored towards customer sub-segments under the C&I umbrella. The EVT website, for example, has separate portals for each sector, including agriculture, colleges, commercial offices, hospitals, grocery stores, lodging, retail, and wastewater facilities. For each sector, there is a list of resources related to efficiency in that sector, case studies, and a list of incentives available. Furthermore, outreach staff are familiar with the decision makers and barriers specific to each sector and tailor their approach accordingly. The targeted marketing approach allows EVT to reach C&I customer segments that may have been previously underserved.

Relevance to Delaware:

A high degree of market segmentation as described above is not typical in early year efficiency programs, but rather used by established administrators with aggressive efficiency goals. Nevertheless, it provides a roadmap for future efforts and a reason to begin tracking relevant customer data from early program participation. As the results of the initial programs come in, Delaware can keep an eye on different market segments are responding, which segments are not under- or over-represented, and begin to develop initiatives specifically aimed at increasing participation where necessary. Delaware may also wish to develop a small number of targeted initiatives for customer niches that represent particularly large opportunities in the State.

Custom/Negotiated Incentives

Market(s): Market Opportunity, Large Business Retrofit, some Small Business Retrofit
Program: Negotiated Incentives and Account Management
State: Massachusetts
Utility: Cape Light Compact, National Grid, NSTAR, Unitil, Western Massachusetts Electric Company

Program Description:

Massachusetts' C&I program has achieved significant savings at very reasonable costs, aided largely by the use of close account management and negotiated incentives for its largest customers. First, each large customer in Massachusetts is assigned an account manager from the relevant program administrator. This account manager will work closely with the customer and help develop efficiency plans, navigate the incentive process, receive technical assistance, and eventually close the deal. This account manager establishes an ongoing relationship with the customer in order to familiarize himself with their specific barriers to investment, where in the business cycle the customer is most likely to be able to make efficiency projects, decision making processes for the customer, etc. This familiarity also allows the account manager to get a sense of each customer's financial needs for efficiency projects. This allows some negotiation of the incentive size, typically up to some maximum amount. This flexibility may allow the account manager to close some projects that would not proceed with standard incentive amounts while completing others at lower incentive costs than would be achieved under standard incentive rates.

How the Program Demonstrates Best Practices:

It is typical that a majority of a utility's electric sales will consist of a small number of very large customers. These large customers typically provide more savings at lower cost than small to medium customers. Further, it is very hard for a utility to achieve significant savings in proportion to its total load without effectively addressing these customers. Account managers will provide specialized outreach to the largest customers, providing a single point of contact in order to streamline the process of applying for technical assistance, incentive offers, financing, or other program offerings. The account managers' one-on-one relationships with their large customers will also enable them to provide specialized marketing and sales pitches for efficiency and help design incentive offers that integrate with the customers' business plans. Further, this familiarity allows the account manager to offer personalized incentives, designed to be generous enough to spur the project into completion without overpaying for the savings. Informational and technical services in addition to financial incentives also help to reduce additional barriers C&I customers face.

Relevance to Delaware:

Like most other jurisdiction, a large portion of Delaware's electric load consists of large industrial and commercial customers. In order to appreciably reduce the state's electricity

consumption, Delaware will need to come up with an effective strategy to engage these customers with its efficiency programs. Account management has been shown in Massachusetts and other jurisdictions across the country to be successful at spurring efficiency investments among this customer class.

Upstream Incentives
Market(s): Market Opportunity
Program: Bright Ideas Commercial Lighting
State: New Brunswick, Canada
Utility: Efficiency New Brunswick

Program Description:

New Brunswick's Bright Ideas commercial lighting program used upstream incentives to lighting distributors in order to enlist the efforts of the regional lighting supply community to quickly bring High-Performance T8 lighting products to the market. Before the program launched in 2007, HPT8 products were unavailable in New Brunswick. The program provided incentives to lighting distributors for every high performance ballast and high-performance or reduced wattage lamp sold. These incentive levels were less than typical retail-level incentives for the same products in other jurisdictions. As a condition for participation, lighting distributors had to provide monthly reports specifying the type and number of qualifying units sold, the invoice number, the ship-to address, and the purchaser's billing address. This helped program administrators track program progress. By the fifth year of the program, HPT8 sales had increased from zero to approximately two-thirds of the replacement market.

How the Program Demonstrates Best Practices:

Upstream incentive programs effectively address many of the common market barriers associated with efficiency. Typically, the incentive will reduce the first cost of the product more than the same amount of incentive money on a downstream rebate, since retail mark-ups are now being made on a lower base cost. Further, upstream incentives tend to encourage lighting distributors to leverage their marketing resources in order to sell more of the efficient technology. Finally, upstream incentives quickly change the stocking practices of distributors by reducing the risk that inventory of efficient products will not sell. As an added benefit, administrative time and cost from the PA are significantly reduced. In a downstream approach, the PA will need to process applications from individual end-users or contractors/installers who may be unfamiliar with program requirements and thus need additional contact to collect missing pieces. In contrast, an upstream program collects only monthly forms from a few large lighting distributors who are used to dealing with the program requirements. The New Brunswick program needed only one-half of a full-time employee in its first five years of operation. An upstream program delivery model also simplifies participation for customers. They immediately receive incentives for purchasing efficient products through typical retailers.

Relevance to Delaware:

The New Brunswick program is relevant to Delaware in many ways. Although located in Canada, New Brunswick and Delaware are similar in size, with populations of approximately 750,000 and 920,000 people respectively. Second, when New Brunswick first launched its upstream program, there had been no previous efficiency infrastructure in the area, and they were looking for a program that could scale to significant savings quickly, using limited staff resources. Because Delaware is also in the early stages of developing and energy efficiency program infrastructure, the New Brunswick model could be very instructive for the State as it seeks to ramp up energy savings.

Small Business Retrofit
Program: C&I Small Business Program
State: Maryland
Utility: Pepco

Program Description:

Pepco's Small Business program targets businesses, non-profits, religious institutions, and government customers with a monthly demand of 100 kW or less over a twelve month period. Customers receive financial incentives for a broad range of eligible measures. Customers can also receive free Walk-Through Energy Assessment to help identify energy savings opportunities. The program will pay a Small Business Program trade ally to install low cost measures up to $250 that have been identified during the Energy Assessment Report. Incentives offered through this program are much greater than those available to larger customers through the Existing Buildings Program. Incentives are defined on a dollar-per-unit basis and range from 40 to 90 percent of the installed cost depending on the measure. Custom incentives are also available for measures not eligible as a standard measure.

How the Program Demonstrates Best Practices:

Due to limited financial, time, and knowledge resources, small businesses have historically been difficult customers to serve with traditional rebate programs. Pepco's Small Business program targets barriers specific to this sub-segment by providing incentive levels greater than those available to larger business customers. In addition to providing financial support, the program provides technical and informational support in the form of Walk-Through Assessments and recommended opportunities for savings. Maintaining a list of pre-qualified trade allies simplifies participation for customers because they do not need to evaluate contractors and building professionals independently. It also builds relationships with trade allies to ensure that qualified professionals are available to work with small businesses to achieve savings. Offering rebates for a range of measures allows small business customers to make many upgrades through one program. Moreover, providing incentives for customer measures would allow customers to implement emerging technologies to the extent that they are cost effective.

Relevance to Delaware:

Pepco's Small Business Program is one that would be relevant for Delaware's program offerings, as the barriers facing small businesses are common across jurisdictions. Delaware could also target small businesses by offering higher levels of incentives that those required for larger C&I customers if budget constraints allow. However, prior to implementation, Delaware may need to build a group of trade ally partners who are able to provide the informational and technical support that reduces barriers faced by small business customers.

Direct Install
Market(s): Small Business Retrofit
Program: Small Business Direct Install
State: Pennsylvania
Utility: PECO

Program Description:

PECO's small business direct install program provides the direct installation of easy to install lighting, refrigeration, and electric hot water efficiency measures. Incentives typically cover around 50-60% of the measure, and businesses are eligible for interest-free, on-bill financing for the remainder portion of the cost. To participate in the program, the business receives a free, comprehensive on-site analysis, resulting in a list of equipment installation recommendations, costs, and available incentives. A contractor will proceed to directly install any measure desired by the participant.

How the Program Demonstrates Best Practices:

Small businesses typically do not have the staff resources that enable them to focus on non-core issues, such as energy use. Further, they often do not have the financial resources enabling them to make large upfront investments, even on energy projects with short payback time. Small business direct install programs mitigate these two barriers by 1) identifying, through a free on-site audit, appropriate efficiency measures; 2) directly installing the measures in the business, with little to no action required of the business owners; 3) providing high incentives to offset the first cost of the product; and, 4) Offering zero interest on-bill financing so that the measures can be installed without an initial capital outlay, and so that ongoing energy savings can pay for the measures. Typically, direct install programs are run with a single contractor, with costs for each measure determined by the contract with the utility. Under this setup, high installation volumes for the contractor will typically allow it to offer measures for less than what a small business would typically pay outside of the program. Direct Installation programs are typically largely lighting, but best practices programs (such as PEPCO's) also offer easy to install refrigeration and hot water measures. The most successful measures will also note any needed upgrades in other major building systems, and refer them to another program for custom or prescriptive rebates.

Relevance to Delaware: Direct Install programs are common in jurisdictions throughout the US, and have had high levels of success of achieving much higher penetration rates in small business than would be achieved under traditional prescriptive or custom rebate programs. Further, direct install programs are easy to roll out, since it is a discreet piece of work than can be bid out to a firm that will likely have experience with similar programs in other states. As a result, a direct installation program could get up and running quickly in Delaware, and achieve significant results in early program years while some of the other more complex programs are still setting up the groundwork.

Prescriptive Incentives
Market(s): Market Opportunity, some Small and Large Business Retrofit
Program: Business Energy Services
State: Vermont
Utility: Efficiency Vermont

Program Description:

Efficiency Vermont's Business Energy Services program offers prescriptive incentives for a broad range of efficiency technologies. Through completion of simple forms, eligible applicants are paid standardized financial incentives for purchasing and installing qualifying energy efficiency equipment. Incentives are provided for agricultural, commercial, and industrial lighting; commercial kitchen equipment; compressed air systems; heating, ventilating, and air conditioning (HVAC) equipment; refrigeration equipment; residential rental property systems; and pool pumps. A user-friendly website is available to guide customers to the appropriate opportunities and applications.

How the Program Demonstrates Best Practices:

While the majority of energy efficiency programs include some prescriptive component, those that excel cover a broad range of equipment, offer significant financial incentives, facilitate the participation process through the use of well-designed applications, and are periodically updated to represent the latest energy-efficient technologies and market changes. Efficiency Vermont has made significant strides on all fronts. The rebate portfolio is periodically reviewed to ensure that incentive levels are appropriate and the latest energy-efficient equipment is represented. Perhaps most importantly, the program has developed clear, consistent prescriptive rebate forms that reduce customer confusion and simplify the application process.

Relevance to Delaware:

Commercial energy efficiency portfolios routinely achieve the majority of savings from prescriptive measures making them a critical component of comprehensive C&I program design. For example, in neighboring Maryland, prescriptive measures achieved more than half

of total C&I sector savings in 2012 for several utilities.[8] For new initiatives, prescriptive incentives are especially important as they are easy to establish, are key to capturing the lost-opportunity market, and serve customers who don't have the resources to pursue more involved program offerings. They offer a simple, streamlined application process where program requirements and estimated rebates are clear from the outset. Finally, prescriptive incentive portfolios can be easily augmented—even mid-year—with the latest efficiency technologies or otherwise expanded to address new end-uses and opportunities. This will be an important consideration as Delaware programs grow over time.

Technical Assistance

Market(s): Market Opportunity, Large Business Retrofit, possibly Small Business Retrofit
Program: FlexTech
State: New York
Utility: NYSERDA

Program Description:

NYSERDA's FlexTech Program provides commercial and industrial customers in New York State with customized technical assistance to enable informed energy decisions. Services are provided by consultants under contract with NYSERDA. These consultants are competitively selected and provide statewide geographic distribution of services. These services include, but are not limited to, feasibility studies, load management, process efficiency analysis, data center efficiency analysis, retrocommissioning, and CHP studies. In many cases, cost-sharing incentives are available to help defray costs of the studies. Through the FlexTech Program, customers may also work with an independent service provider of their choice.

How the Program Demonstrates Best Practices:

Because contracts are already in place between consultants and NYSERDA, there is very little delay between a customer's request for assistance and project initiation. Additionally, there are no required forms or paperwork for the customer to complete greatly simplifying the participation process. As FlexTech contractors are selected to cover a broad range of areas of expertise, market niches and customer sub-segments that may not be adequately served by other energy efficiency programs are able to obtain customized, expert assistance. The range of technical expertise available also prevents customers from having to seek support from multiple sources. Finally, the available cost-sharing incentives reduce financial barriers and promote the development of useful studies that can help achieve long-term energy efficiency improvements in customer facilities.

[8] The EmPOWER Maryland Energy Efficiency Act Standard Report of 2013, Maryland Public Service Commission, April 2013

Relevance to Delaware:

Large C&I facilities represent a significant portion of total building energy consumption in Delaware. Because of the complexity and variability of these facilities—particularly the industrial sector—a successful C&I program needs to be able to offer flexible, customized support. The FlexTech model allows a broad range of services to be offered while maintaining a streamlined participation process, an important consideration for new programs. In addition, using such a contractor driven approach limits program administration requirements while at the same time allowing consistency and continuity through the contractor pre-qualification process. Successful employment of this approach will be dependent on the availability of well-qualified contractors in Delaware or the surrounding region.

New Construction
Market(s): Market Opportunity
Program: New Construction Program
State: New York
Utility: NYSERDA

Program Description:

The New Construction Program provides technical assistance and incentives to promote energy efficiency in new construction and major renovations. Technical assistance is cost-shared and incentives are paid to offset a portion of the incremental cost between proposed equipment and energy code requirements. Additional incentives are available for commissioning services.
The program team includes in-house project managers, external contractors or Outreach Project Consultants (OPCs), and technical assistants (TAs). OPCs handle outreach, customer support, and act as field liaisons. TAs work with customers and design team to identify and analyze efficiency measures.

To address the different needs of large and small customers, the program provides multiple participation paths including pre-qualified equipment, custom measure analysis, and whole building design. The program offers a tiered incentive structure to encourage larger customers with more complex projects to pursue deeper savings opportunities.

How the Program Demonstrates Best Practices:

NYSERDA's New Construction Program simplifies the participation process by providing a single "one-stop-shop" regardless of whether simple prescriptive incentives, custom analysis, or whole building design is ultimately the most suitable approach for a given project. In addition, the program uses a novel tiered incentive structure to promote not only deep energy savings but also design team engagement. Aggressive program promotion through the use of outreach consultants leads to program involvement at the early stages of many construction projects. While this has the unintended effect of increasing program dropout rates as some construction projects are ultimately unrealized, it increases the likelihood that successful projects include comprehensive energy-efficiency design.

Relevance to Delaware:

While commercial and industrial new construction rates are still depressed as a result of the recent economic downturn, addressing the new construction market is still a critical component of successful C&I program design. Buildings constructed to satisfy the bare minimum energy code requirements represent a significant missed opportunity where energy efficiency improvements are unlikely to be realized for many years. Aggressive outreach will be critical to gain significant participation in this market as efficient programs are initiated. Employing outreach consultants could assist the state in reaching this objective. Finally, anticipating the varied needs of new construction projects through multiple participation paths will also likely bolster participation.

CONCLUSION

The programs described above represent design and delivery best practices that help to ensure program participation and savings goal achievement. Often, the most successful programs address multiple barriers facing customers by offering financing incentives as well as technical and/or informational services. Additional financing options further eliminate financial barriers and allow for greater program participation. Successful programs also target market niches and customer sub-segments, often striving to reach previously underserved groups. Programs that provide "one-stop-shopping" approaches and simplify participation processes are able to more effectively engage customers. Building partnerships and relationships with trade allies and other organizations can ensure quality project implementation as well as leverage existing resources to reach customers and minimize administrative resource needs. As Delaware begins to lay the groundwork for energy efficiency programs, it should incorporate these and other best practices into program planning and design to the extent possible. Although successful program design and implementation often requires a ramp-up period, looking to effective programs that have been implemented in other jurisdictions provides examples of both good models to start with as well as strive for.

APPENDIX C: TASK 3.3 INTERVIEW QUESTIONNAIRE

Delaware Potential Study Market Research Interview Script

Version 4 Oct 2013

Section A: Background Questions

The purpose of this section is to gather background information on the person being interviewed to see if there are patterns in the responses based on who is answering the questions.

1. Who is being interviewed?
    a. Vendor/Retailer ☐
    b. Distributor/Supplier ☐
    c. Contractor/Architect/Engineer ☐
    d. Consultant/Industry Expert ☐
    e. Auditor/Rater ☐
    f. Weatherization/Home performance contractor ☐
    g. Trade association ☐
    h. Customer ☐
    i. Manufacturer representative ☐
    j. Property manager ☐
    k. Other _____

2. If not a customer, what type(s) of customers are they associated with? If more than one, then estimate the percentage of work in each area.
    a. Residential (and whether low income) ☐
    b. Commercial ☐
    c. Industrial ☐
    d. State/local gov't/muni ☐
    e. Multifamily ☐
    f. Institutional ☐
    g. No specific customer type ☐

3. What kinds of equipment do they work with, and/or what kind of services offered? Write down all services and equipment mentioned, estimate sales volume by percentage.
4. What is your specific or most common/most important role related to your customers in these interactions?

Section B: Market Barrier Questions

Usually there are circumstances that are obstacles for people in doing an energy efficiency project or in purchasing efficient equipment. The purpose of this section is to find out what are real and perceived barriers to efficiency, and what could be solutions for overcoming or removing them.

1. What factors do you see that make it difficult for people to take action on efficiency projects? (Possible prompts: reliability or performance concerns, higher cost of equipment, lack of capital, lack of knowledge/information, lack of choice or availability, no new construction projects, others?)
2. Which of these factors are the most important?
3. How much impact does the current low cost of natural gas have in preventing people from doing efficiency projects for gas equipment?
    a. If a large impact, at what price do you think efficiency will start to look attractive again? (or percent increase in gas price)
4. What could be done to help in overcoming barriers? (Possible prompts: financing, information, training, technical assistance, sales assistance in persuading decision makers to act, incentives, other)
5. What could or should be done to make it easier for customers to implement efficiency projects?
6. What could or should be done to make it easier for customer to participate in efficiency programs?

Section C: Equipment Availability

The purpose of this section is to determine if efficient options are available and being promoted in the marketplace. Sometimes efficient equipment is not promoted because it is more expensive, is perceived negatively for some reason, or is simply not available locally. Questions will be based on one category of equipment (e.g., lighting, HVAC, construction materials/methods) appropriate to the person being interviewed.

1. Where are distributors of equipment (both regular and efficient) typically located: Delaware, neighboring states (MD, PA, NJ), or both? [If a customer interview, where do you purchase equipment? Where is equipment least expensive?]
    a. If multiple states, can you estimate market percentage by state, or where you think MOST people get their equipment?
2. Are efficient _____ (lighting, HVAC, etc.) options available from distributors in the region?
    a. Are Delaware distributors more or less likely to have and promote efficient equipment than competing vendors from neighboring states? If so, to what extent?
    b. To what extent are distributors promoting efficient equipment to customers/installers?
    c. How frequently are customers asking for efficient equipment? Are there specific customer sectors that tend to specify efficient equipment more than others?
3. Where are retail vendors of equipment (both regular and efficient) typically located: Delaware, neighboring states (MD, PA, NJ), or both?
    a. If multiple states, can you estimate market percentage by state?
4. To what extent are efficient _____ (lighting, HVAC, etc.) options available from retail vendors in the region?

   a. Are Delaware vendors more or less likely to have and promote efficient equipment than competing vendors from neighboring states? If so, to what extent?
   b. (to Vendors:) Would you be willing to expand your selection of EE equipment options if there were program support for your staff and customers?
   c. (to Vendors and Contractors) How quickly would you add EE options to your line if program support (training, marketing , incentives) were provided? [Immediately? A few months? Wait to see what others do?]
5. Are engineers/architects specifying efficient equipment? If so, what?
6. What technologies or energy saving opportunities (i.e., controls, equipment upgrades, maintenance, etc.) do your customers most often ask about? Are you able to help them?

Section D: Specific Market Channel Questions

The purpose of this section is to get specific information on how efficient products move through the marketplace.

1. What are the typical retail outlets for residential lighting (lamps, or 'light bulbs')?
   a. Mass merchandiser, home improvement stores, supermarkets, discount clubs, small retail (e.g., hardware stores)?
   b. If you know, what explains this distribution of the market?
2. Which of these outlets offer efficient as well as standard options, and to what extent?
3. What are the typical market channels for commercial lighting?
   a. To what extent do manufacturers' representatives have a presence in Delaware?
   b. Is the supply chain dominated by a few large distributors or spread across many small ones?
   c. Who specifies lighting equipment? Architects, electrical contractors, lighting designers?
4. What are the typical market channels for residential HVAC?
   a. What fraction of product comes from out-of-state distributors or retailers?
   b. Is the contractor/installer market dominated by a few large ones or distributed across many small ones?
5. What are the typical market channels for residential DHW?
   a. What fraction of product comes from out-of-state distributors or retailers?
   b. Is the contractor/installer market dominated by a few large ones or distributed across many small ones?
   c. Can you provide any information about heat pump water heaters, and whether these are typically purchased at retail vs. through distributors/supply houses?

Section E: Training and Labor Questions

The purpose of this section is to see if a lack of awareness or information is a barrier to more efficiency projects.

1. Training and education has been effective in other regions as a way to proliferate efficient products, technology and practice. Is this needed in Delaware, and if so, to what extent?
    a. If so, who should the training or education effort target? (possible prompt: vendors, installers, architects/engineers, or end use customers)
    b. If end use customers, any particular market segments? (prompts: commercial customers, residential customers, manufacturers, etc)
2. Are there specific training organizations that people look to in your (either geographic or topical) area?
3. What is the status of certifications and licensing with respect to efficient residential building practices? To what extent do local providers carry BPI, HERS, or other relevant certifications?
4. With respect to energy codes, is there a qualified labor force of code officials?
5. What subjects should be emphasized?
    a. Cooling
    b. Heating
    c. Ventilation
    d. Lighting
    e. Industrial process equipment
    f. Water heating (inc. pool and spa heaters and solar hot water)
    g. Other
6. Are there any other obstacles preventing an educated workforce that would identify and install efficiency measures?

APPENDIX D: TASK 3.3 COMPLETED QUESTIONNAIRES

To maintain confidentiality of interviewees, completed questionnaires are not included in the public version of this document. For more information, contact Optimal Energy.

APPENDIX E: TASK 3.3 MARKET RESEARCH FINAL MEMO

Optimal ENERGY Integrated Energy Resources

Delaware-Specific Market Research

DRAFT Task 3.3 Deliverable

Prepared for

DELAWARE DEPARTMENT OF NATURAL RESOURCES AND ENVIRONMENTAL CONTROL

by:

Optimal ENERGY

15 November 2013

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INTRODUCTION

Building on the research and findings of our market barriers and program best practice research, Optimal conducted market research in Delaware to investigate specific conditions related to market conditions and attitudes Delaware energy efficiency program potential consumers. The research findings will help to identify and fine-tune those program strategies most likely to overcome efficiency market barriers specific to Delaware energy consumers. The findings may also help to identify areas worthy of further research that would help to optimize the operations of future efficiency programs. Some of our primary findings include:

- Upfront Cost is the primary barrier among all sectors
- Specific sectors/industries have different needs/levels of awareness
- Customers purchase equipment/products both in DE and draw from neighboring states
- Availability does not seem to be a limiting factor, but efficient technology is not necessarily being promoted
- Seems to be an attitude of indifference and resistance to change among some Delawareans
- Training opportunities needed and welcomed across the board

Methodology

The market research was carried out through phone interview. Optimal developed a questionnaire broken into four primary content sections: Market Barrier Questions, Equipment Availability Questions, Specific Market Channel Questions, and Training and Labor Questions. DNREC then provided Optimal with a list of recommended organizations to contact. Optimal received additional contacts through its conversations with respondents. We reached out to a total of 30 organizations through a combination of phone calls and emails and spoke with 13 of those organizations. The range of organizations interviewed included large customers, industry groups, housing agencies, electrical and HVAC companies, implementation contractors, and engineering design firms. A complete discussion of conclusions drawn from our discussions, organized by questionnaire section, is summarized in the sections below.

MARKET BARRIER FINDINGS

As previously described in our market barriers research findings, there are a number of obstacles that prevent people from undertaking an energy efficiency project or purchasing efficient equipment. Optimal's market research effort included questions to better understand the real and perceived barriers to efficiency in Delaware, and what could be solutions for overcoming or removing them. Many of the responses received verified findings from our previous market research, while some responses revealed information specific to conditions and attitudes in Delaware.

Upfront Costs

Upfront cost costs for efficient technology and equipment are a significant barrier to energy efficiency in Delaware as well as many other jurisdictions. When asked why people do not implement efficiency projects, almost every respondent first mentioned cost. For example, large commercial customers' capital budgets may not allow for long payback periods. As a large business representative indicated, the company makes investments with a 3 year return on investment. Other respondents echoed the cost barriers as a particular challenge for large organizations. They suggested that building operations are not treated as a priority and most companies do not devote money in their budgets specifically for sustainability purposes. There is also a challenge when huge building owners lease property and pass on utility costs. Building operators, who own a building and rent it out, are not necessarily sure there is going to be demand for efficiency to make it worth the investment. On the residential side, an HVAC company representative suggested that the customers who are price shopping do not follow up about the company's geothermal systems because of the added price.

To address barriers to energy efficiency, many respondents agreed that funding opportunities would be most effective. A representative from an electrical supplier, for example, believes rebates would help to get many people to choose efficient lighting options the company quotes. A respondent from the Energy and Sustainability Roundtable suggested that in addition to rebates and grants, low interest loans might be an effective way to reduce the cost barrier for businesses. On the residential side, an interviewee from the Delaware State Housing Authority thought opportunities that require customers to payback loans would be less effective than grants. He indicated that an important consideration would be figuring out which customers to target for grants vs. loans and how to structure a low interest loan.

For both commercial and residential customers, respondents suggested that providing funding for energy auditing would be a helpful first step. Even if additional funding for upgrades is not available, customers would have the information about what measures they could implement should funding become available. A representative from a manufacturing industry group suggested that the Mid-Atlantic Industrial Assessment Center at the University of Delaware may be a good partner for conducting audits in the industrial sector.

Awareness and Attitudes

Lack of awareness of energy efficiency opportunities, technologies, and benefits, is another barrier that is prevalent in many jurisdictions. In Delaware, awareness presents a barrier to energy efficiency in some customers and service providers more so than others. Many respondents thought that architects and engineers were largely up to speed with efficient technologies and practices, since they are required to complete ongoing professional development. Additionally, many of the large customers with significant costs were aware or took steps to become aware of cost-effective energy saving opportunities. However, respondents seemed to think there was less awareness among residential and smaller business customers as well as building and facility managers.

The difference in levels of awareness illustrates an important take away from this market research: different customers face different challenges to implementing efficiency programs. Developing a range of programs that targets specific markets can help to overcome these specific barriers. For example, technical assistance may also be effective for residential and small business customers, but may not be necessary for large business customers. As on respondent indicated, the complexity of implementing efficiency projects is a major barrier to the average business owner, unless they're working with an ESCO that they handles it all. However, a large business representative pointed out that they have engineers on staff and people they can hire to provide guidance. For ShopRite, the most important program offering would be one that helps the company get a quicker return on investment from efficiency upgrades. In the respondent's experience with the state's fund matching program, funding caps were still too low to make the investment cost-effective to the company.

Awareness of energy efficiency cost savings and benefits may also be a barrier is some instances. Customers might be aware of the technology, but do not understand how they will benefit from efficiency given the additional upfront cost. As a representative from Rumsey Electric suggested, only about 10% of people purchase efficient equipment, though customers are aware of the technology and frequently ask about it. Additionally, some respondents indicated that they thought there was an attitude of indifference and resistant to change among Delawareans and thought people may not understand the purpose of saving energy. A representative form a manufacturing industry group suggested that a way to increase participation would be to help customer better understand "what's in it for them."

There has also been a lack of awareness of the energy programs offered in the state. Some respondents suggested that the SEU programs were a bit of a moving target and always seemed to be evolving, which was challenging. While the interviewees who had been involvement with programs run through the state or SEU were satisfied with them, most were informed about the program through some type of "word of mouth" rather than a concerted marketing effort by the SEU.

Many interviewees expressed a need for a simple, easy way to access information. An HVAC company representative pointed out that everything today is internet based and developing a website would be a good start. However, she thought that many government websites require you to read in circles and jump through hoops to get the information you're looking for. A central place for customers to receive clear information about energy savings opportunities seemed to be something many respondents thought would be useful.

Reaching customers through channels they're already looking to for information could be a particularly helpful outreach strategy. For example, someone from the Energy and Sustainably Roundtable recommends disseminating information through the Chambers of Commerce to reach business customers. The Roundtable itself may be a good forum for educating members about efficiency and programs provided in the state. The ESR is a member-based organization for the business and development communities that holds quarterly meetings. They have an educational component (i.e. speakers, case studies) and members also talk about sustainability efforts they're taking at their business (mostly in energy efficiency). To reach residential customers, a previous residential program participant recommends going neighborhood by

neighborhood and using homeowner association meetings as forums for explaining the benefits of energy efficiency and processes for implementation. Additional collaboration opportunities may exist with the Delaware State Housing Authority and Delaware Tech.

PRODUCT/SERVICE AVAILABILITY AND MARKET CHANNEL FINDINGS

The survey also included questions to determine whether efficient options are available and being promoted in the marketplace as well as how efficient products move through the marketplace. There was a general sense among respondents that efficient equipment and products are available. No one seemed to suggest that efficient equipment was hard to get or that the supply was limited. Although some companies work with distributors out of state, they seemed to think that there were distributors locally. For example, a representative from an HVAC company indicated that his company is located across the border in Pennsylvania, but does a large amount of business in Delaware. When he first started, the primary distributors were located in Pennsylvania and Baltimore, but there are now companies located in Delaware. Another HVAC company representative believes there are a number of small HVAC companies in Sussex County and Kent County, but much larger companies are located in New Castle.

There may be some exceptions, however. For example, a large grocery store chain works with an HVAC and refrigeration company in New Jersey called Cold Technologies to provide equipment design, installation, and maintenance. They suggest that there are no companies doing installation or maintenance in state that are the right size or have the experience for their facilities. ShopRite stores are large with many different end uses and the company needs an outfit that "really knows the business." The company also does grocery store chain's lighting design. However the company did not seem to be hindered by working with a company in New Jersey rather than Delaware.

Additionally, while people seemed to think efficient equipment and products are available, they are not necessarily being promoted to customers by the professionals selling them. If customers' primary concern is upfront cost, building professionals will work to meet that criteria and not try to convince them otherwise. Because cost is the primary driver for most customers, standard, less expensive options are likely to be the most prevalent. For example, a representative form an HVAC company that specializes in residential geothermal, suggested that many home builders have turn-key designs, and customers wanted something different than the standard option have to go out of their way to ask for it and cover the additional costs. A representative at an electrical supplier believes Delaware is crowded with electrical suppliers. He does not believe there are manufactures representatives in the area, but knows of lighting vendors who represents many manufacturers. Residential lighting is largely purchased at large box stores like Home Depot and Lowes. A previous residential program participant and Energy and Sustainability Roundtable member referenced a large Sears Outlet in northern Delaware where many homeowners purchase their appliances. She indicated that many of the displays shows energy star ratings. A representative from a construction company suggests that residential HVAC/DHW equipment also purchased at Home Depot, Lowes as well as Costco and BJs which

TRAINING AND LABOR FINDINGS

Training and education has been effective in other regions as a way to proliferate efficient products, technology and practice. The survey included questions to determine if training is needed in Delaware and if so, to what extent. Respondents indicated that some training is currently available in the state. An HVAC company representative stated that Delmarva Power offered a good training opportunity. Additionally, Rumsey Electric indicated that it provides training for customers. A representative from the Delaware State Housing Authority believes training was offered to contractors through the state weatherization program. When one representative's company implemented the SEU's Home Performance Program, the respondent indicated that they program offered training for contractors that required BPI certifications. There are also educational opportunities related to energy efficiency offered through the Delaware Technical Community College's Energy Management program also provides education related to energy efficiency.

The vast majority of interviewees support expanded training options for end users, as well as building and equipment professionals. For example, an HVAC company represeative indicated that there is a lot of training for technicians, but not enough training on energy systems thinking, at least not locally. She would like to see training for everyone including HVAC companies, builders, and contractors. She does not think we can achieve optimal building performance unless everyone is involved and on the same page. Training should really be focused on the whole system. A representative from a construction companies agrees that training should be focused on the whole system and points out that lighting and HVAC, etc. go hand in hand.

One grocery store chain representative thinks training would be useful at a store level related to equipment use on site as well as behavioral savings opportunities. Additionally, ShopRite would be interested in training sessions to make sure their managers and the businesses they work with are kept aware of cutting edge technologies and opportunities. For commercial customers who understand efficiency opportunities, the best training may to help customers understand how the project will payback investment costs and how fast. Andrea Kreiner of the ERS thinks there is a huge role for education and marketing, particularly with regard to ROI. Ms. Kreiner also thought training about cost-effectiveness could be useful to describe the options and benefits of efficiency to building and facilities managers.

A previous residential program participant and Energy and Sustainability Roundtable member thinks small businesses and home owners could benefit the most from training. She referenced opportunities to show people what efficiency means rather than telling them. When she had her home weatherized, she did not realize what it entailed and would have liked to see a video ahead of time showing the process. She also thinks the Delaware Technical Community College's, "energy house" at their Georgetown campus could teaches students to do energy audit and an open house could teach others about efficiency. She also believes there is an opportunity to train people about the importance of conserving energy.

A respondent from the Delaware Public Housing Authority thought there might be a training opportunity for new home buyers about assessing home energy efficiency. He

indicated that DSHA has a program that provides financial assistance to first time homebuyers. The program does not have a specific energy efficiency initiative attached to it, but assumes home buyers will assess as energy efficiency with criteria for home buying.

ADDITIONAL THOUGHTS

A respondent with a government agency pointed out that many of the agency's municipal buildings located in center of Dover are historic buildings. It can be extremely expensive to improve efficiency in these buildings since they need things like custom windows. To the extent that there are many historic buildings in Delaware, energy efficiency in these types of structures may require additional consideration, guidance, or program funding. For example, Pacific Power, in collaboration with the Oregon Main Street Program and Energy Trust of Oregon developed a guide to help small commercial building owners with energy efficiency in historic buildings. The guide provides information about opportunities for efficiency improvements while maintaining the historic character of the building.[1] A similar guide, or information specifically relevant to historic building owners, may be something worth exploring in Delaware.

CONCLUSIONS

In many respects, customers in the state of Delaware face similar barriers to energy efficiency as those in other jurisdictions. A focus on upfront costs and lack of awareness among some customers represent significant challenges. However, specific market sectors and end users face distinct barriers that should be considered and addressed through program offerings. Attitudes in favor of energy efficiency may lag behind those states that have been implementing efficiency programs for many years. However, efficiency equipment and product availability does not appear to hinder energy efficiency improvements. Training and partnership opportunities may help to shift attitudes, educate customers about the benefits of efficiency, and increase program participation. A concerted marketing and outreach effort that disseminates information through channels customers already turn to for information could also and help to engage customers. Respondents who have already participated in efficiency projects were generally satisfied with the process and outcomes. Providing them with a centralized place to find additional information and simple and transparent participation processes can help to ensure customers take advantage of energy savings opportunities in Delaware.

[1] Pacific Power, "Historic Preservation & Energy Efficiency." Accessed November 14, 2011. http://www.pacificpower.net/bus/se/tr/hpee.html

APPENDIX F: RESIDENTIAL PROGRAM CONCEPTS DESCRIPTIONS

NEW CONSTRUCTION

The Residential New Construction (RNC) Program is first described on page 49 of the "Program Portfolio Design" section of the report and is one of the program strategies used to develop Program Potential results. The Table below summarizes the energy this type of program could save in Delaware over the 12-year study period as well as the budget required to implement the program.

Residential New Construction Program Summary – Cumulative Annual Results in 2025

Electric Energy (MWh)	Electric Demand (MW)	Natural Gas (BBtu)	Petroleum Fuels (BBtu)	Total Budget 2014-2025 (Present Value Millions$)
37,919	4	44	16	21

Market Segment (including Major End-uses and Technologies Promoted)

The proposed Residential New Construction (RNC) Program will work with builders, contractors, architects, developers, code officials, and suppliers to optimize the energy efficiency of new homes in Delaware as they are designed and built. The program will focus on providing these services for single family homes, duplexes, and small multi-family structures that contain fewer than ten living units. The program will be available to both independent builders who may work on only one home at a time and those developers whose business model favors multi-year build-outs of residential developments that contain hundreds of homes. The program will provide similar program services regardless of heating or hot water fuel choice and will address all key end uses and building systems in the home. These include insulation, window performance, air leakage, HVAC system efficiency, mechanical ventilation, lighting, appliances, and hot water heating.

Delivery Model

The program will take a two-branched approach to generating more efficiency in residential new construction by engaging both with the designer/developer/builder communities and with Delawareans who are in the market to purchase new homes. A program implementation contractor will be procured through a competitive solicitation and will be responsible for day-to-day implementation of the program. The program implementation contractor will be responsible for assuring that an array of technical assistance including plan review and recommendations, completion of code compliance documentation, performance testing (air and duct leakage), etc. are available to builders. Ideally these technical services will be provided by independent Home Energy Rating (HERS) companies with program incentives designed to partially offset the rating costs in addition to the measure costs. However, if there is insufficient capacity of HERS companies, the program implementation contractor may need to provide these services on an interim basis either through subcontracts or direct staff.

Concurrent with outreach to the building community the program will provide information about the benefits of energy efficient housing to Delaware's current and future home buyers, primarily through the web, coop advertising with builders, and through earned media. This approach will increase awareness of efficient options in new housing while simultaneously increasing the market's ability to supply the housing that the market seeks.

Multiple paths to participation will encourage builders to increase their level of savings over time. Bundled technical support and financial incentives will simultaneously address multiple barriers, supporting the participation of a variety of builders with different levels of interest and current knowledge of efficient building practices.

Services/Incentives Offered

The services that will be offered in the new construction program are organized by the designated recipients: the design/develop/build community, and the pool of current and future homebuyers.

Services for the design/develop/build community

The energy efficiency expertise of Delaware's building community needs to be better understood prior to detailed implementation planning for the residential new construction program. In all likelihood, there are varying levels of knowledge and expertise. A strong focus of this program will be to ensure that all builders are able to participate, and that all builders who choose to participate are provided with technical assistance tailored to their specific needs. Insufficient technical knowledge is a consistent barrier to more efficient new construction. Any builder who uses modern building materials must address an increasingly complex set of building details that determine the difference between a durable, energy efficient and comfortable home and one that may face significant moisture damage, high energy bills, and uncomfortable residents. The program will provide training and one-on-one technical support to ensure that builders have the information they need to achieve the former. The program will also support increased building envelope and duct testing services, both as part of the verification process for program and building code compliance and as a training tool to assure that builders understand air and duct leakage issues and are equipped to address them. In addition, financial incentives will be provided to builders to offset the higher initial costs associated with more efficient construction practices.

Services for current and future homebuyers

The services that will be provided to homebuyers will largely consist of information services: information that will inform them of the benefits of energy efficient construction, and let them know how to identify homes that meet the efficiency criteria set forth by the program. This information will be provided through a website, coop advertising with builders, public service announcements, and participation in home shows and other events where potential homebuyers may congregate. Direct incentives to homebuyers are not contemplated for the initial program offering. Incentives will be paid to builders to offset the additional costs that they incur in building to a higher efficiency standard. Offsetting these costs allows the builders to build a more efficient home without putting themselves at a competitive disadvantage on price.

Incentives will be provided for whole house performance using a tiered approach, with greater incentives available for greater levels of efficiency. Additional incremental incentives may be offered for specific non-standard measures such as heat recovery ventilation, TopTen USA appliances, or drain water heat recovery, though these will not be the primary focus of the program. The three program compliance paths will include:

- An entry-level option comprised of technical assistance and tiered incentives tied to building homes that are more efficient than residential code in Delaware (currently IECC 2009). This option will be designed to be manageable for builders who are new to energy efficient construction practices. In other words, with technical support and modest incentives any Delaware builder should be able to succeed at this level without dramatic changes to current practices.
- ENERGY STAR Homes Version 3 (V3) will be offered as the second tier of program participation. Meeting all of the requirements associated with V3—especially the non-energy, durability-focused requirements—may be a barrier to participation, particularly for builders new to ENERGY STAR and/or highly efficient construction, however it will provide a highly visible achievement for participating builders, and will clearly distinguish them in a competitive marketplace.
- An advanced option that significantly exceeds ENERGY STAR will be the highest program tier. Homes built to this standard will be dramatically more efficient than a typical code-compliant home, and will require a significant level of additional effort of the designer/builder community. This tier will include a requirement that participating homes be net zero energy capable to provide a platform for meeting Delaware's legislative mandate (SB 59) that requires all homes built after December 31, 2025 to be net zero energy capable.

Best Practice Features

Delaware's residential new construction program will feature the following best-practice program elements:

- Bundle incentives with technical support and market outreach for a comprehensive, multiple end use, and multiple fuels approach
- Utilize tiered participation levels to engage builders and developers with different levels of experience with efficient construction and allow them to become increasingly efficient
- Offer increasing incentives for increasing levels of efficiency
- Address multiple barriers, including lack of technical knowledge, lack of awareness of energy efficient opportunities, and increased first costs
- Provide "one-stop shopping" for comprehensive services—meaning that there will be a single phone number, web site, and point of contact for builders and homebuyers to gain access to all of the program's services

- Emphasize not only the energy savings associated with efficient new construction but also its sustainability, increased comfort, lower carbon footprint, and lower overall cost of ownership, including potentially lower monthly ownership costs due to lower energy bills
- Support builders and developers through coop advertising to promote increased consumer marketability
- Provide simplified code compliance documentation as a benefit of participation
- Coordinate program standards with codes and state legislative mandates

RETROFIT/HOME ENERGY SERVICES

The Retrofit/Home Energy Services Program is first described on page 50 of the "Program Portfolio Design" section of the report and is one of the program strategies used to develop Program Potential results. The Table below summarizes the energy this type of program could save in Delaware over the 12-year study period as well as the budget required to implement the program.

Retrofit/Home Energy Services Program Summary – Cumulative Annual Results in 2025

Electric Energy (MWh)	Electric Demand (MW)	Natural Gas (BBtu)	Petroleum Fuels (BBtu)	Total Budget 2014-2025 (Present Value Millions$)
154,100	33	280	316	109

Market Segment (including Major End-uses and Technologies Promoted)

The Retrofit/Home Energy Services program will be offered to owners of single family homes, duplexes, and small apartment buildings having no more than nine living units. The program will be available both for owner-occupied homes and for rental properties where the owner agrees to the program terms. The program will be comprehensive in that it will be available to homes using any of the commonly used energy sources for heating and cooling: electricity, natural gas, fuel oil, and propane. It will also be comprehensive by providing efficiency solutions for all end uses in participating homes wherever those solutions are cost-effective and in the best-interest of the owners and occupants.

Home retrofit services that are truly comprehensive address three major areas to determine how much energy is used in any given home. These are:

- The insulation and air leakage levels of the building structure, including walls, windows, ceilings, exposed floors, foundations, etc.
- The efficiency of the mechanical systems that heat and cool the indoor environment, heat water for domestic purposes, clean and dry clothes, make light, keep food cold, etc.
- The ways that the buildings' occupants operate their homes: how they set the thermostat, how much laundry they do, etc.

The Retrofit/Home Energy Services program will address all three of these areas through a combination of contractor services and program-driven education and outreach.

Delivery Model

In order to be effective, comprehensive home retrofit services need to be delivered by a workforce that has specialized expertise not only in home construction and repair, but also in techniques that reliably deliver real energy savings. In order to ensure that such a workforce exists, and to manage day-to-day operations of the program, a program management and implementation contractor will be hired through a competitive solicitation. To the extent

needed, the program implementer will be responsible for providing training to the local workforce. Regardless of the experience level of the contractors, the program implementer will ensure that they adhere to standards by operating a rigorous quality assurance process. The implementer will also be responsible for creating and operating a job completion process that guides participants and contractors through the required steps from home energy assessment to final verification of the installed measures.

Home retrofit services for Delawareans will be delivered using a contractor-driven model, where Building Performance Institute (BPI)-accredited[1] firms will sell their services to homeowners, using certified technicians to install long-lasting efficiency improvements while maintaining the integrity of the building and the health and well-being of the occupants. The Retrofit/Home Energy Services program will provide support both to contractors in the form of technical training and in the marketing of their services, and to homeowners by providing information, maintaining a list of participating contractors who comply with program expectations, and by providing quality assurance to verify that participating contractors do indeed meet the requirements of the program.

Services/Incentives Offered

The goal of this program is to provide motivation, opportunity, and financial support to Delawareans so that they invest in reducing the amount of energy used in their homes. These goals are further described below.

- **Motivation –** The program will inform homeowners about the benefits of home energy retrofits, provide testimonials of friends and neighbors who can attest to the benefits of doing an efficiency project, and strive to create the sense that having work done to save energy makes sense and makes one a strong member of the community.
- **Opportunity –** Often homeowners want to save energy at home, but do not know what kind of work to have done or who to have do it. The program will maintain ready access to a listing of participating contractors who have the training to do effective energy efficiency retrofits, meet technical qualifications, have acceptable amounts of insurance, agree to program requirements for warranties, and meet the requirements of the program's Quality Assurance program.
- **Financial Support –** For many homeowners, even after they understand the opportunity and have found a qualified contractor, the costs of carrying out a project are simply too great, even when the savings will outweigh the costs over the long term. To ease the first-cost burden, the program will both provide access to modest incentives (designed to cover between 10% and 50%

[1] Depending on the market presence of BPI-Accredited contractors it is likely that a ramp-up period will be required before the accreditation requirement will be put in place. Regardless of the timing of the accreditation requirement, the program will require that jobs be conducted under the supervision of individuals who have the relevant BPI certifications.

of the measure costs) and attractive financing to ensure that Delawareans can reap the benefits of reduced home energy use.

Participating contractors will be required to take a comprehensive approach, meaning that the services offered to participants must tailored to the opportunities in each house they assess and include increasing insulation levels, reducing air and duct leakage, appliance upgrade opportunities, and improvements to HVAC and DHW systems. The program will also include direct-installation of efficient lighting products by participating contractors at no cost to homeowners.

Best Practice Features

Delaware's Retrofit/Home Energy Savings program will include the following features found in the industry's best programs:

- Financial incentives will be bundled with technical support and information to increase participation. Both direct financial incentives and financing will be available to participants.
- The program will address opportunities to save electricity and other fuels that provide energy in homes, including natural gas, fuel oil, propane, etc.
- Participation processes will be designed with the customer's interests in mind and kept simple and readily understandable by a non-technical audience.
- After a suitable ramp-up phase, participating contractors will be required to obtain accreditation from the Building Performance Institute, the independent body that oversees the technical qualifications of home energy efficiency contractors. Contractors will be required to adhere to the installation standards promulgated by BPI.
- From the outset, participating contractors will be considered to be partners in the program. They will have a role in identifying program priorities and will have input in designing participation processes.
- Contractors will carry out assessments of the opportunities to save energy in each home and will perform diagnostic testing to assure that opportunities are identified and that any pre-existing or potential indoor air quality or safety issues are addressed.
- The program will carry out a quality assurance protocol to ensure that program standards are met. The protocol will include both on-site verification for a random mix of projects and customer satisfaction surveys for all participants.

MULTI-FAMILY

The Multi-Family Program is first described on page 51 of the "Program Portfolio Design" section of the report and is one of the program strategies used to develop Program Potential results. The Table below summarizes the energy this type of program could save in Delaware over the 12-year study period as well as the budget required to implement the program.

Multi-Family Program Summary – Cumulative Annual Results in 2025

Electric Energy (MWh)	Electric Demand (MW)	Natural Gas (BBtu)	Petroleum Fuels (BBtu)	Total Budget 2014-2025 (Present Value Millions$)
13,215	3	44	11	12

Market Segment (including Major End-uses and Technologies Promoted)

Delaware's multi-family program will address residential structures that contain 10 or more living units. According to the 2011 American Housing Survey there are roughly 40,000 housing units in Delaware in buildings containing 10 or more units—or roughly 10% of Delaware's housing. To most effectively address the unique barriers that typically exist in the multi-family market, this single program will address a broad range of savings opportunities in the MF market segments. The program will address retrofit and new construction projects; all fuel types including natural gas, electricity, and delivered fuels; and all income levels, from limited income and affordable housing to luxury market rate housing.

Multi-family housing is an increasingly important segment of the housing market, yet providing comprehensive energy efficiency services to people who live in apartments can be difficult and is often overlooked by efficiency programs. At the root of this is the split incentive issue described previously in the "Understanding Barriers" section of the report. For instance, in many cases the tenants in an apartment building may receive heating and cooling from a central system for which the landlord pays the bills, providing the tenants with little incentive to use energy efficiently. The converse is also true; in multi-family structures where the tenants pay the utility bills the landlord may have little motivation to pay for efficiency improvements. This challenge is found across the full spectrum of multi-family housing, from subsidized affordable housing to market-rate luxury apartments. It exists both in new construction (where the developer who takes on the added costs of building-in efficiency may not reap the benefits of lower operating costs) and in retrofit situations.

The program will support cost-effective improvements in all end-uses regardless of the energy type used, including:

- Improved lighting, both in-unit and common areas
- Low-flow showerheads and faucet aerators
- Appliance upgrades
- Cost-effective savings in the building's thermal shell (wall and ceiling insulation, draft reduction, window improvements)

- Whole-building mechanical systems (e.g., heating and cooling equipment, water heating equipment, laundry, and ventilation systems)

Delivery Model

Delaware's Multi-family program will take a comprehensive approach to providing energy efficiency services in this sector and will work with property owners, managers and tenants to address the full spectrum of energy efficiency opportunities. A program implementation contractor will be procured through a competitive solicitation and will be responsible for day-to-day implementation of the program. Initial engagement will be with the property managers, who serve as the liaison between the financial and operational needs of the property and the human needs of the people who live there. Program staff will reach out to property managers to hear first-hand about the challenges they face in managing their properties and will develop packages of efficiency options that can either overcome existing constraints or work within them. This is a notably different approach than some have tried, where a prescriptive, one-size-fits-all rebate package is offered on a "take it or leave it" basis.

The key to success in the multi-family market is the strong relationships that program staff will build with property managers and developers. Typically multi-family housing represents a long term investment for its owners, who may be either development companies or affordable housing providers. While the technical opportunity for a multi-family retrofit may be available and "there for the taking," the financial and practical opportunities often vary due to circumstances that have nothing to do with energy. For example, the opportunity to replace appliances with more efficient ones is much greater when a property is already planning to replace the appliances for maintenance reasons. Similarly, it may be easier to persuade a property manager to install insulation when an unrelated renovation project—with its attendant disruption to the property and its tenants—is already planned. Establishing relationships with these decision makers allows the program to become aware of and be ready for these naturally occurring opportunities.

Services/Incentives Offered

For existing properties, energy-saving opportunities will be identified first through a free walk-through audit that will assess improvement areas that merit further study. For new construction projects or for those existing properties where significant renovations are already planned or underway, program staff will meet with the project design team to review plans and prioritize energy efficiency opportunities. Opportunities will be assessed in the following areas:

- Direct installation of low cost measures in tenant units, including energy efficient lighting and water saving showerheads and faucet aerators
- Efficient lighting for common areas such as hallways, entries, etc.
- Appliance upgrades
- Major system upgrades for heating, cooling, ventilation, and laundry equipment
- Thermal shell improvements such as added insulation and air leakage reduction

Cost and savings estimates will be developed and packaged with an offer of incentives and financing designed to meet the financial needs of the property. Packages will include targeted construction management support, tenant and facilities staff education on how to maximize the benefits of the energy efficiency project, and quality assurance and verification services to ensure that the project is installed according to specifications. The program will also provide technical assistance and limited construction oversight for energy efficiency measures.

The program will prioritize engaging property managers with comprehensive bundles of efficiency measures that address all end uses with cost-effective opportunities. The bundles will include simple measures such as direct-installation of efficient lighting, as well as any cost-effective appliance, thermal shell, and mechanical system improvements that are identified. Along with information about the benefits of the recommended measure bundle, the program will present property managers with a package of incentives and financing for the measure bundle that will be designed to overcome first cost and cash flow barriers. The packages will be comprehensive, but the program's representatives will understand that in many cases the property managers may not be able to move forward with the entire package at the time it is presented. Where necessary the program will work collaboratively with property managers to develop phased approaches to the work that will allow greater savings to occur over time rather than limit the savings potential to what the property manager can agree to at the time the offer is made.

Affordable multi-family housing services will be similar to those provided to the general multi-family housing market, but will reflect the unique circumstances and barriers experienced in this housing. In affordable housing, financial packaging that fits the needs of the project, including higher incentives, becomes even more critical, as cash-flow margins are often almost non-existent. Major efficiency projects are often most likely to occur when affordable housing is re-structuring its financing and contemplating other major rehabilitation. Building efficiency into projects of this sort requires strong relationships and regular communications between program staff and property managers in order to meet planning cycle deadlines.

Best Practice Features

The following features of industry-leading programs will be included in Delaware's multi-family program:

- Relationships built with property owners and managers for sustained engagement, allowing for greater depth of savings over time
- Both new construction and retrofit projects will be eligible for services through this program to capitalize on relationships with multi-family developers and property managers
- Targeting of specific sub-sectors of the multi-family market (affordable housing, market rate) and tailored solutions for each sector's unique needs
- Comprehensive solutions addressing tenant units and common areas and systems regardless of who pays the utility bills and whether the meters are on residential or commercial rates. Solutions will also address all fuels used in participating properties

- Financial packaging including incentives and loans designed to address both first cost issues and long term cash flows
- Coordination with C&I programs for mixed-use development
- Centralized program delivery (one-stop shopping) to provide a full range of support services

RETAIL PRODUCTS

The Retail Products Program is first described on page 53 of the "Program Portfolio Design" section of the report and is one of the program strategies used to develop program potential results. The Table below summarizes the energy this type of program could save in Delaware over the 12-year study period as well as the budget required to implement the program.

Retail Products Program Summary – Cumulative Annual Results in 2025

Electric Energy (MWh)	Electric Demand (MW)	Natural Gas (BBtu)	Petroleum Fuels (BBtu)	Total Budget 2014-2025 (Present Value Millions$)
548,167	46	497	224	139

Market Segment (including Major End-uses and Technologies Promoted)

Delaware's Retail Products program will focus on influencing consumers to make efficient choices when purchasing new appliances, lighting, heating, ventilation, and air conditioning (HVAC) equipment, domestic water heating (DHW) equipment, and select consumer electronics. When multiplied by thousands of transactions each year, the simple difference between purchasing a single "standard" efficiency light bulb, dehumidifier, or water heater and purchasing a high efficiency alternative will have an enormous effect on Delaware's overall energy consumption.

Initially, the Program's lighting component will jointly promote both compact fluorescent lamps (CFLs) and light emitting diode lamps (LEDs). Over time the Program's focus will shift increasingly to LEDs as their price continues to fall and performance in new lighting categories improves. It is expected that by 2017 the Program will no longer be supporting CFLs.

Refrigerators, freezers, clothes dryers, clothes washers, and advanced power strips will all be considered for inclusion in the initial retail program offering. The HVAC and DHW markets are typically not thought of as purely retail markets because contractors are generally hired to install the equipment. However, the potential effect of an individual time of sale decision on long term energy use is similar to that of a retail purchase, so these end uses are included in the Retail program. For HVAC and DHW the program will work closely with contractors and distributors to promote quality installation of efficient air source heat pumps, central air conditioners, ductless split heat pumps, furnaces, boilers, tankless water heaters, and heat pump water heaters.

Delivery Model

A program implementation contractor will be responsible for day-to-day implementation of the program including partner recruitment, requests for proposals (RFP) generation, and memorandum of understanding (MOU) execution, sales staff support and correct placement of point of purchase (POP) materials, responding to customer concerns, contractor training, and all other aspects of program operations. Marketing and outreach, which will be significant aspects

of the retail program, will either be coordinated with the portfolio's marketing team, or be included in the responsibilities of the retail program implementation contractor.

The retail program will focus principally on the promotion of efficient lighting, which will be supported at retail with upstream incentives to manufacturers and retailers to reduce the retail purchase price of their products. The program implementation contractor will issue RFPs specifying the desired lighting product types, quantities, and desired final retail pricing after incentives through a clear procurement process. Proposals will be selected and MOUs will be executed to lay out the terms of the lighting promotions.

Appliances and consumer electronics will be largely supported with midstream retailer incentives tied to the sale of qualifying products, though mail-in coupons may be required instead for some products and retailers. Continued improvements in the efficiency of many consumer products and high market shares for ENERGY STAR qualified units may allow the program to set measure eligibility criteria above ENERY STAR to further increase the efficiency of Delaware households. Efficiency levels could be tied to those established by TopTen USA and/or by EPA's ENERGY STAR Most Efficient program.

HVAC and DHW equipment will be supported with mail-in rebates that will be assignable to the contractor who installs the qualifying equipment. The program will also offer contractor training on quality installation practices. There will be robust quality assurance/control procedures to ensure that contractors adhere to program requirements. HVAC and DHW program activities will be closely coordinated with retrofit/home energy services, multi-family, residential new construction, and income eligible efforts. After the initial year of operation the program will assess whether to pursue an upstream incentive pilot. Based on the results from any such pilot the program may move to an upstream model for HVAC and DHW initiatives to supplement or fully replace the consumer and contractor targeted rebate model.

Services/Incentives Offered

The retail program will work with manufacturers and retailers to promote the stocking, marketing and sale of efficient residential lighting, appliances, consumer electronics, DHW and HVAC equipment to consumers, landlords, contractors, builders and small businesses. Nearly all supported products will be ENERGY STAR qualified, though for some product categories higher levels of efficiency may be required to qualify for rebates or incentives. The program will employ a variety of incentives and rebates supported by both broad based and targeted marketing and educational and outreach efforts. For HVAC the program will also promote quality installation practices.

In many, if not most cases, financial incentives will be in the form of payments to retailers and manufacturers to reduce the purchase price of specified equipment rather than rebates that are paid to the retail customer after the purchase. This approach, referred to as a buy down, markdown, or upstream model depending on the specific arrangement, has been highly effective at influencing the purchase of efficient equipment for much lower program costs than earlier coupon-based programs. Upstream models not only reduce processing fees paid by the program, but more importantly they dramatically reduce the time and effort required of

consumers, who no longer have to fill out coupons, find their utility account numbers, and so on.

In addition to financial support the program will provide consumers with information to inform and accelerate their choice of efficient products. This information will come in several forms, including point of purchase materials, a consumer-facing informational program website, advertising through local media channels, co-op marketing with retailers and manufacturers, and earned media. The materials will answer common questions that may have prevented customers from purchasing efficient products in the past. For lighting the materials will also address the shift to lumens as the appropriate means for lamp selection, the impacts of EISA on lamp choice and selection, and the growing advantages of LEDs as the preferred lighting technology of choice.

Hard-to-reach populations that may not normally shop at the largest sales venues for lighting such as home improvement and mass merchandisers, , will be specifically identified and targeted. This may require increased recruitment of grocery, drug and other retailers such as "dollar stores."

For HVAC and DHW products the program will work through local wholesale distributors to reach the local contractors who install equipment in homes. Distributors are a primary source of product training for installers, and the program will leverage this ongoing relationship to link program training to other distributor events. Initially this may mean simply having a program staff person come to distributor events to give a quick presentation on the availability of the program, but may evolve to more in-depth trainings on quality installation practices that may become a program requirement. The program will also assess the opportunities to promote efficient HVAC and DHW equipment through home improvement and mass market retailers such as Sears, Lowe's, Home Depot, and others.

Best Practice Features

Delivery of the retail program envisioned for Delaware will incorporate the following best-practice features:

- Coordinated approach to overcoming multiple barriers by raising awareness, increasing access to efficient products, and reducing first costs
- Partnerships with manufacturers, distributors, and retailers to promote high efficiency, high quality products that will meet or exceed consumer expectations
- Targeted outreach to different customer segments so that all have the opportunity to take advantage of the program's offerings
- Alternative sales/promotional venues to reach under-served customers who may not shop at big box retail locations
- Support for advancing technologies by regularly evaluating market opportunities and gradually increasing the efficiency requirements of eligible equipment
- Streamlined program participation through the use of buy down, markdown, and upstream program models

INCOME-ELIGIBLE

The Income-Eligible Program is first described on page 52 of the "Program Portfolio Design" section of the report and is one of the program strategies used to develop program potential results. The Table below summarizes the energy this type of program could save in Delaware over the 12-year study period as well as the budget required to implement the program.

Income-Eligible Program Summary – Cumulative Annual Results in 2025

Electric Energy (MWh)	Electric Demand (MW)	Natural Gas (BBtu)	Petroleum Fuels (BBtu)	Total Budget 2014-2025 (Present Value Millions$)
97,780	20	216	119	73

Market Segment (including Major End-uses and Technologies Promoted)

The goal of the income-eligible program is to assure that comprehensive efficiency services are available to as many Delawareans as possible, regardless of their ability to pay for them. Because they have less income to work with, lower-income households typically spend a much greater portion of their income on energy costs than does the average household. Therefore the need for efficiency is much greater, and the potential benefits can make a significant difference for these families. There are also potential benefits to the overall ratepayer base by reducing arrearages and the need for public assistance in paying utility bills. Threshold criteria for program eligibility will be established based on income criteria for related services in Delaware, such as affordable housing and Weatherization Assistance Program (WAP) eligibility. These criteria are typically either 200% of federal poverty level or 80% of area median income. The income-eligible program criteria will be determined with the goal of being as inclusive as possible while still aligning with other Delaware services for consistency across programs and ease of participation.

Fundamental to the income-eligible program is an abiding respect for the income-eligible participants. These customers are treated no differently simply because they are less able to pay for the services they receive.

Delaware's income-eligible program will be available to existing owner-occupied single family homes and to renter-occupied single and multi-family homes containing nine or fewer living units where occupants meet the program's income criteria. For rental properties the building owner must agree to the program's terms and conditions, which among other things, may include an agreement to maintain the affordability of treated units for a specified period of time. Typically, participation of renter-occupied properties will also include the expectation of a financial contribution from the property owner to cover part of the cost of the efficiency improvements.

The program will strive to increase the availability of comprehensive energy savings for income-eligible households. End uses to be addressed will include:

- Building shell improvements, including insulation and air leakage reduction
- Heating and cooling system efficiency improvements
- Appliance efficiency improvements
- Water heating efficiency improvements
- Lighting efficiency improvements

Delaware's income-eligible energy efficiency program will address opportunities for reducing the use of all fuels, including electricity, natural gas, fuel oil, and propane. For these fuels, all end uses where cost-effective improvements can be made will be assessed and improvements will be made as comprehensively as possible.

Delivery Model

The best income-eligible energy efficiency programs are deeply connected with the local service providers that deliver support to income-eligible people. Local providers have typically spent many years developing trusting relationships within the income-eligible community—years which will benefit the income-eligible program by increasing its ability to identify participants and the program's corresponding acceptance rate. This means more savings are achieved sooner for those Delawareans who are in the greatest need. The program will assess gaps in the energy efficiency services that are currently available to income-eligible customers in Delaware and will fill them as needed to assure that all fuels and all end uses are cost-effectively addressed. If, for example, the existing WAP delivery infrastructure is currently only able to deliver building shell improvements, then this program might provide funding that allows it to also address heating and cooling mechanical system improvements, lighting, and so on. If the WAP programs are comprehensive now, but only able to reach a small fraction of the eligible population, then this program might provide additional funding that allows WAP to reach more households.

Determining the best approach for Delaware will require a collaborative design process that includes stakeholders from area WAP providers, affordable housing advocates, and other income-eligible service providers. Stakeholders will be invited to work with program planners and staff to identify program characteristics that will lead to the greatest success. Every effort will be made in this process to reduce elements of competition for limited funding in favor of collaborative achievement of common goals.

There are several different forms that this collaborative program delivery could take. Working through local service providers might mean that the program will be most effective if it is completely delivered by local WAP providers using additional funding provided by the program. Alternatively, it might mean that an independent program delivery contractor is identified to offer stand-alone efficiency program services that are well-coordinated with a broad range of income-eligible service providers.

Services/Incentives Offered

Regardless of the final program delivery model, services provided through the income-eligible program will include:

- Comprehensive energy assessments that look at all energy sources used in the homes (energy audits)
- Full cost incentives for eligible improvements in owner-occupied units (no out-of-pocket required for participants)
- Partial incentives and financing assistance for owners of rental properties occupied by income-eligible tenants
- Construction management, including identifying and contracting with installation firms
- Energy education for homeowners, tenants, and property managers, to provide tools for managing energy use
- Quality assurance

The program will adhere to the building science principles that are promulgated by the Building Performance Institute and the US Department of Energy for retrofitting buildings to increase their energy efficiency. Contractors will test for carbon monoxide issues and assure that no unsafe conditions are left after the building retrofit.

For eligible owner-occupied housing, the program will pay the full cost of the efficiency project, including the assessment cost, construction management, measure installation costs, and quality assurance. While the exact mechanisms for program operation will not be known until the collaborative program design is complete, the program or its local partner will either hire staff to perform the assessments, construction management, and quality assurance, or it will contract with industry partners and/or qualified local businesses to provide these services. Importantly, there will not be an expectation that program participants need to identify and hire these services on their own. The role of program service providers will be managed and coordinated by the program.

Program representatives will explain the recommended improvements to the participants and secure approval for the project. In the case of rental properties, program representatives will meet with property management staff and building owners to explain the recommendations, the available financial support, and the expected contribution from the owner. With approval to proceed, the program will identify installation contractors to install the improvements, verify that the installation meets program requirements, and address any customer satisfaction issues that may arise through the project.

Best Practice Features

Delivery of the income-eligible program envisioned for Delaware will incorporate the following best-practice features:

- The program will partner with and extend the capacity of existing income-eligible efficiency services such as WAP
- The program will target a unique customer sub-segment— those income-eligible families who most need to reduce their energy costs

- All program services will be available through one-stop shopping—participants will not be required or expected to shop for services in the competitive marketplace
- Coordination with other programs, such as multi-family new construction and efficient products will provide benefits in all income-eligible efficiency markets

BEHAVIOR MODIFICATION

The Behavior Modification Program is first described on page 54 of the "Program Portfolio Design" section of the report and is one of the program strategies used to develop program potential results. The table below summarizes the energy this type of program could save in Delaware over the 12-year study period as well as the budget required to implement the program.

Behavior Modification Program Summary – Cumulative Annual Results in 2025

Electric Energy (MWh)	Electric Demand (MW)	Natural Gas (BBtu)	Petroleum Fuels (BBtu)	Total Budget 2014-2025 (Present Value Millions$)
23,906	3	44	22	23

Market Segment (including Major End-uses and Technologies Promoted)

The behavior modification program will target homeowners and renters to receive home energy reports that compare their household energy use with other similar households in their area. The program may identify target groups of customers using a number of criteria, such as local housing characteristics, relative amount of energy used, income characteristics, and so on. The specific messages contained in the reports are tailored to the target demographic. In other words, while the concept and intent are the same, the report that is sent to people who live in a neighborhood of modest, older homes might have subtly different messages than the report sent to residents of luxury condominiums. Over the course of the planned program duration more than half of Delaware's households are expected to receive home energy reports at regular intervals for at least one year. The program will target electric use in households and will also address natural gas in households where it is used.

All end uses in homes may be effected as a result of participant actions. Home energy reports include a general call for recipients to reduce energy use, and further include specific recommended actions that can reduce energy use in specific end uses. For example, a general theme in a report might be that the recipient is using 20% more energy than her neighbors, followed by a general call to reduce her energy use. The recipient might respond to that by trying to remember to turn off lights and televisions when not in use. The report might then go on to suggest a specific action— that more efficient appliances could reduce her energy use— and include a time-limited special offer for a "bonus" incentive if she replaces her refrigerator with an advanced, energy efficient model offered through the Retail Products program.

Delivery Model

The behavior modification program will be contracted out to one of several turnkey program contractors through a competitive solicitation. After executing agreements regarding data use, the selected contractor will obtain customer data from the utilities. The contractor will then analyze the data along with certain demographic information to identify groups of customers with higher typical energy bills. Energy reports will be provided through either

regularly mailed (typically monthly or bimonthly) hard-copy reports, web-based reporting, or a combination of the two. These reports will provide energy efficiency recommendations that are tailored to the customer and to the time of year. These reports will provide the consumer with the information and motivation to implement the recommendations.

There are several vendors, such as Opower, that can design and deliver behavioral programs to program administrators. Delaware's program administrator may pilot one or more approach before picking a single statewide approach. Any such statewide approach should allow for integrated electric and gas home energy reports and should enroll participants on an "opt out" basis, meaning that participants must make a conscious decision and undertake specific actions *not* to participate. Delaware's behavioral program may also provide for a web-based option and be able to integrate with any current or planned smart grid efforts, e.g., incorporate near or real time usage reporting.

Services/Incentives Offered

Home energy reports will provide historic usage patterns and benchmark the customer's usage against other customers with similar home features and/or demographics. Although the reports do not include direct financial incentives, they help customers to see the connection between their habits and utility costs and make more economically rational decisions. Such reports also appeal to customers' desire to contribute to community goals and engage in socially desirable behavior by saving energy. . Additionally, from time to time the reports may contain coupons, special offers, or other invitations to encourage participation in other residential programs.

Best Practice Features

Delaware's behavior modification program will feature the following best-practice program elements:

- Targeting and message tailored to specific customer groups based on sophisticated data analytics
- Simplified information for easy and direct actions
- Optimum report frequency determined based on contractor's experience in other jurisdictions
- Integrated electric and gas reports
- Broad reach including underserved customers, while maintaining targeting to households with the greatest opportunity for savings

APPENDIX G: C&I PROGRAM CONCEPTS DESCRIPTIONS

LOST OPPORTUNITY

The Lost Opportunity Program is first described on page 57 of the "Program Portfolio Design" section of the report. It consists of a large umbrella program with several different strategies or initiatives aimed at capturing savings from different segments of a diverse group of customers. The Lost Opportunity strategies in aggregate were used to develop program potential results. The Table below summarizes the energy savings this type of program could save in Delaware over the 12-year study period as well as the budget required to implement the program. The text following the table describes aspects of the specific program strategies that fall under the Lost Opportunity umbrella.

Lost Opportunity Program Summary – Cumulative Annual Results in 2025

Electric Energy (MWh)	Electric Demand (MW)	Natural Gas (BBtu)	Petroleum Fuels (BBtu)	Total Budget 2014-2025 (Present Value Millions$)
823,568	148	459	161	107

The Lost Opportunity Program attempts to influence purchasing decisions that are already occurring in the marketplace. In other words, when C&I facilities need to buy new equipment (due to existing equipment failure or planned replacement, renovation, or new construction) the program will attempt to influence the facility to purchase and install the most efficient and cost-effective equipment possible. If the facility instead gets standard efficiency equipment or builds a standard efficiency building, a "lost opportunity" is created as that building or equipment will continue to use more energy than necessary for the rest of its useful lifetime.

Because the lost opportunity market is highly time sensitive, the program needs to approach it in many different ways. Ideally, the program will integrate itself throughout the market, so that selecting higher efficiency equipment becomes the natural decision. To this end, prescriptive and upstream incentives are used to buy down the incremental cost of efficient equipment with minimal effort required by the customer. Account managers work to establish ongoing relationships with the larger customers in order to identify upcoming purchasing or renovation needs and give the program enough time to work with the customer to install the most efficient equipment possible. Technical and design assistance is available for new construction and renovation projects, in order to encourage the project to adhere to high efficiency design principles. These project components are described in greater detail below.

Account Management

Market Segment

Account managers are assigned to large customers, and work with those customers to implement projects regardless of technology, end-use, or what program is used to provide the incentives for the project. As such, account managers are not associated with particular programs or market segments, but with specific customers. The same account manager working with the same customer will often generate projects in multiple programs, depending on

whether the project is best defined as retrofit or lost opportunity. However, account managers are particularly helpful for lost opportunity projects. Since these projects are time sensitive, having pre-existing relationships with customers allows the account managers to identify possible lost opportunities (such as tenant fit-outs or scheduled industrial downtime) far enough in advance to allow a project to be planned and implemented, and can give customers the necessary confidence that any replace-on-failure project would move forward quickly enough to avoid significant downtime in building operation.

Delivery Model

Account managers form ongoing relationships with the customer. The account manager is the primary point of contact between the customer and the efficiency program, and will help the customer develop efficiency plans, navigate the incentive process, and receive technical assistance. As a result of the ongoing relationship, the account manager will get to know the customer's specific needs and barriers to efficiency investment, and so will be able to effectively identify possible lost opportunity projects when they occur, and structure incentives in a way to help overcome the barriers of each specific customer.

Services/Incentives Offered

Account management is not so much a service in itself but a means to access services offered through the rest of the program more easily. The account manager acts largely as a salesperson, selling the services of the programs to large customers and generating projects for the program. However, she may also ease the process of applying for and receiving incentives, and her close knowledge of the customer allows her to structure the incentives and offerings in the most effective and efficient way possible.

Best Practice Features

Account managers will provide specialized outreach to the largest customers, providing a single point of contact in order to streamline the process of applying for technical assistance, incentive offers, financing, or other program offerings. The account managers' one-on-one relationships with their large customers will also enable them to provide specialized marketing and sales pitches for efficiency and help design incentive offers that integrate with the customers' business plans. Further, this familiarity allows the account manager to offer personalized incentives, designed to be generous enough to spur the project into completion without overpaying for the savings.

Prescriptive Incentives

Market Segment

Prescriptive incentives for the Lost Opportunity Program are largely meant for new construction or normal replacement projects. Prescriptive incentives are particularly well suited for normal replacement projects, as the quick turnover and low administrative burden allow the projects to be approved and processed without causing significant downtime to any of the building's equipment.

Prescriptive measures typically use a deemed savings approach to calculate savings. The idea is to use average savings, so even if the actual savings for an individual customer differs

from the deemed value, it becomes accurate over large volumes of measures. This works well for measures such as lighting, with predictable savings, but for measures with high site-specific variability and lower expected volumes, some accuracy may be lost. Prescriptive incentives, then, often involve a tradeoff between accuracy of estimated savings and the administrative ease (for both the customer and the program administrator) of processing incentives and claiming savings. Ideally, as many measures as possible are offered prescriptively without losing an unacceptable amount of accuracy in the claimed savings. There is some judgment involved in where this line is drawn, but typical prescriptive incentives for lost opportunity projects may include:

- Lighting Fixtures
- Unitary HVAC
- Chillers
- Boilers and Furnaces
- Commercial Kitchen Equipment

Delivery Model

Prescriptive incentives are set at a standard rate for a particular piece of technology. For commercial and industrial facilities, prescriptive incentives will most often take the form of mail-in rebates and will typically be filled out by the contractor or vendor working on the project. Mail-in rebate applications should be designed to minimize the amount of effort and time needed to correctly fill out the application.

Services/Incentives Offered

Prescriptive incentives are a direct cash rebate, either right at the store, or after a customer makes a purchase and mails in the application.

Best Practice Features

Prescriptive incentives represent best practices primarily by reducing the amount of administrative burden required to disburse rebates and claim savings. As such, prescriptive incentives should be designed in a way to minimize the amount of work required by both the customer and the program administrator (but especially the customer). Further, since certain sub-segments of the C&I sector, such as commercial kitchens and groceries, tend to have similar types of technologies and efficiency opportunities, prescriptive forms can be designed that are specifically targeted to these subsectors.

Upstream Incentives

Market Segment

Upstream incentives are provided to equipment distributors and/or manufacturers rather than retail customers. Upstream incentives can typically be lower than standard incentives and have the same effect on the ultimate product price, because the retail markup is done from a lower base cost. Upstream incentives are completely invisible to the end customers, who are often unaware that they are buying a discounted product. As such, they are available to any market segment and building type that would buy the product in question – the program administrator has no control over who can buy and install the product. In this way, upstream

incentives significantly lower the hurdle for participation in the program, as they do not require any action by the customer. For the Delaware analysis, we assumed that only fluorescent and LED lighting will be offered upstream. However, if this program is successful, it can be expanded to other technologies, such as unitary HVAC equipment.

Delivery Model

In an upstream model, cash payments are given directly to manufacturers and distributors that make or distribute products meeting high efficiency performance criteria. The incentives are given directly to the distributor/manufacturer, depending on the number of units distributed to the market. The retail customer perceives the existence of the incentive only in the lower cost of the product – no additional work or paperwork has to be completed. The upstream model allows the program administrator to leverage the manufacturers' marketing resources and greatly increase the penetration of a desired technology.

Services/Incentives Offered

Upstream incentives are cash incentives to distributors and manufacturers that reduce the incremental cost of high efficiency products.

Best Practice Features

Upstream incentives greatly simplify the incentive process for the customer, often enough to make them unaware that they are actually participating in the program. Further, upstream incentives can achieve significant penetration more cheaply than downstream incentives, as the discount gets applied before retail markup, and the program administrator is able to leverage the pre-existing infrastructure of the region's manufacturers and distributors. For these reasons, other jurisdictions have seen enormous increases in the penetration rates of efficient technology once program focus is moved from traditional customer-focused downstream rebates to upstream incentives.

Custom Incentives

Market Segment

Custom incentives cover every cost-effective efficiency technology that is either too site-specific or not common enough to be covered prescriptively. Examples of technologies that would receive custom incentives in the lost opportunity program include:

- Newer types of LED fixtures
- Large HVAC system overhauls
- Comprehensive new construction and renovation work
- Replacement industrial equipment

Although there are no size requirements for custom projects, due to the increased administrative burden actual uptake will consist almost entirely of large and medium sized customers. Further, just because the program offers prescriptive rebates for a given technology or project type does not obligate the program administrator to treat it as a prescriptive project. This is especially true for larger customers where the program administrator may want to treat a project as custom if, for example, it is part of a larger whole building project or if the costs or

savings are very different than the deemed estimates. In these cases, the account manager will work with the customer to establish which approach works best both for the program and the customer.

Delivery Model

The process for disbursing custom incentives begins when a custom application is received from a customer, vendor, or, in the case of larger customers, an account manager. Engineers will review the information on the application and prescreen the project to ensure that it is cost-effective. If not enough information is provided on the application, the program administer or account manager may have to follow up with the customer. If the project passes the pre-screening, a site visit is conducted to ensure that the installation has not yet begun and that baseline conditions are accurately described by the application.

Next, an incentive amount is agreed upon, based on a negotiation between the account manager and the customer. Depending on the results of the negotiation, and on the specifics of the project and the customer, the size of the incentive will typically end up at between 25% and 100% of the incremental cost. However, since incremental costs can be very difficult to estimate for lost opportunity projects, the program administrator may prefer looking at the incentive level in terms of energy saving. Typical incentives for custom projects range from $0.12 to $0.20 per annual kWh saved . Further, the account manager may explore various financing options if they feel it will help move the project forward.

Once an incentive amount is established, the project is installed, a post-inspection site visit is conducted to ensure the project was installed as designed, and then the incentive is disbursed.

Services/Incentives Offered

A custom incentive is a sum of money designed to reduce the incremental cost of efficiency projects, and thus spur more efficiency investment. The incentive amount will depend on the project, and will depend on a negotiation between the customer and the account manager, who will strive to set the incentive at an amount that will move the project forward but not overpay for savings.

Best Practice Features

Because the process of applying for and receiving a custom incentive can be fairly complex, best practice implementation simplifies this process for the customer as much as possible. For large customers, their account managers can greatly simplify and guide the process and provide significant help to the customer throughout the application process. Also, a custom program will ideally be open to loans and other financing options in order to most effectively spur efficiency investment.

Technical and Design Assistance

Market Segment (including Major End-uses and Technologies Promoted)

Technical and design assistance is designed for large customers with potential for large savings, but who need experts with specialized knowledge to identify the opportunities and/or

design the projects. For the Lost Opportunity Program, this may include design assistance, energy modeling, or feasibility studies.

Delivery Model

Technical and design assistance is typically delivered by third-party firms with proven expertise in the relevant field. There are ideally many consultants under existing contract with the efficiency program administrator with a variety of expertise. This way, when technical assistance is needed, the program administrator and the customer can quickly select an appropriate consultant and get started on the study with very little paperwork needed and very little delay between the customer's request for technical assistance and project initiation.

Services/Incentives Offered

Through pre-existing contracts with a variety of consultants, the program offers customers quick and easy access to pre-vetted expertise in their field of need. Further, the program will pay for a certain portion of any technical or design study.

Best Practice Features

Because contracts are already in place between consultants and the program administrator, there is very little delay between a customer's request for assistance and project initiation. Additionally, there are no required forms or paperwork for the customer to complete greatly simplifying the participation process. As contractors are selected to cover a broad range of expertise, market niches, and customer sub-segments, customers are able to obtain customized, expert assistance even if their needs are relatively uncommon. Finally, the available cost-sharing incentives promote the development of useful studies that can help achieve long-term energy efficiency improvements in customer facilities.

LARGE BUSINESS RETROFIT

The Large Business Retrofit Program is first described on page 58 of the "Program Portfolio Design" section of the report and consists of an umbrella program with several different strategies or initiatives. The Large Business Retrofit strategies in aggregate were used to develop program potential results. The Table below summarizes the energy this type of program could save in Delaware over the 12-year study period as well as the budget required to implement the program. The text following the table describes aspects of the specific program strategies that fall under the Large Business Retrofit umbrella.

Large Business Retrofit Program Summary – Cumulative Annual Results in 2025

Electric Energy (MWh)	Electric Demand (MW)	Natural Gas (BBtu)	Petroleum Fuels (BBtu)	Total Budget 2014-2025 (Present Value Millions$)
790,502	103	2,446	263	265

The large business retrofit program attempts to encourage large businesses to replace or add controls to their existing equipment in order to increase the efficiency of the facility. Unlike lost opportunity projects, retrofit projects are not typically time-sensitive, since the current equipment is working as is. Because the customer is bearing the full installed cost of the project rather than just the cost increment from standard equipment to efficient equipment, the economics of retrofit projects may be more challenging than for lost opportunity projects. Further, since the existing equipment is functioning, looking for possible efficiency improvements may be low on the priority list of business owners. Nevertheless, there are many opportunities for retrofits that can offer a return on investment equal to or higher than most other investment opportunities.

The Large Business Retrofit Program has many different components that work together to allow the program to help large commercial and industrial facilities identify and implement these retrofit opportunities. Account managers establish relationships with the largest facilities to help them identify cost-effective projects on an on-going basis. Prescriptive and custom incentives are used to help facilities overcome the first cost hurdle of efficiency, and custom incentives may be specifically designed to let the project meet or exceed each facility's investment criteria. Technical and design assistance allows facilities to get audits and commissioning reports designed to identify existing efficiency or examine the feasibility of a specific project. Finally, market segmentation is used to meet the specific needs of different commercial and industrial market sectors. These programs strategies will work together to achieve significant savings from C&I retrofit projects, and each is described in greater detail below.

Account Management

Market Segment (including Major End-uses and Technologies Promoted)

In a typical utility, a large portion of total electric sales will be to a small number of very large customers. These large customers typically provide substantially greater savings at a lower cost than small to medium customers. Further, it is very hard for a utility to achieve significant savings in proportion of its total load without effectively addressing these customers. Therefore, account managers will be assigned to all large C&I customers. Account managers are agnostic to end-use, technology, or even specific program, and will work with the customer to help him take full advantage of the full range of the efficiency program's offerings. The account manager will work with the customer to facilitate any type of cost-effective efficiency project, whether it be a lighting retrofit, design for a renovation, or retro-commissioning on inefficient existing buildings.

Delivery Model

Account managers will form ongoing relationships with the customer. The account manager is the primary point of contact between the customer and the efficiency program, and will help the customer develop efficiency plans, navigate the incentive process, and receive technical assistance. As a result of the ongoing relationship, the account manager will get to know the customer's specific needs and barriers to efficiency investment, and so will be able to effectively identify possible lost opportunity projects when they occur, and structure incentives in a way to help overcome the barriers of each specific customer.

Services/Incentives Offered

Account management is not so much a service in itself as a means to easier access to the services offered through the rest of the program. The account manager acts largely as a salesperson, selling the services of the programs to large customers and generating projects for the program. However, she may also ease the process of applying for and receiving incentives, and her close knowledge of the customer allows her to structure the incentives and offerings in the most effective and efficient way possible.

Best Practice Features

Account managers will provide specialized outreach to the largest customers, providing a single point of contact in order to streamline the process of applying for technical assistance, incentive offers, financing, or other program offerings. The account managers' one-on-one relationships to their large customers will also enable them to provide specialized marketing and sales pitches for efficiency and help design incentive offers that integrate with the customers' business plans. Further, this familiarity allows the account manager to offer personalized incentives, designed to be generous enough to spur the project into completion without overpaying for the savings.

Prescriptive Incentives

Market Segment (including Major End-uses and Technologies Promoted)

In addition to the prescriptive measures offered under the Lost Opportunity Program, prescriptive incentives geared toward retrofit projects such as VFDs, lighting controls, pipe

insulation, and other controls and add-on measures will be offered under the Large Business Retrofit Program.

Prescriptive measures typically used a deemed savings approach to calculate savings. The idea is to use an average savings, so even if the actual savings for an individual customer differs from the deemed value, it becomes accurate over large volumes of measures. This works well for measures such as lighting, with predictable savings, but for measures with high site specific variability and lower expected volumes, some accuracy may be lost. Prescriptive incentives, then, often involve a tradeoff between accuracy of savings claims and the administrative ease (for both the customer and the program administrator) of processing incentives and claiming savings. Ideally, as many measures as possible are offered prescriptively, without losing an unacceptable amount of accuracy in the savings claims. There is some judgment involved in where this line is drawn, but typical prescriptive incentives for retrofit projects may include:

- Lighting fixtures
- Lighting relamp/reballast
- Lighting controls
- HVAC controls
- VFDs
- Pipe/boiler/water heater insulation
- Low-flow valves
- ECMs for refrigeration
- Refrigeration door controls
- Strip curtains/night covers for refrigerated cases

Delivery Model

Prescriptive incentives are set at a standard rate for a particular piece of technology. For commercial and industrial facilities, prescriptive incentives will most often take the form of mail-in rebates, and will typically be filled out by the contractor or vendor working on the project. Mail-in rebate applications should be designed to minimize the amount of effort and time needed to correctly fill out the application.

Services/Incentives Offered

Prescriptive incentives are a direct cash rebate, either right at the store, or after a customer makes a purchase and mails in the application.

Best Practice Features

Prescriptive incentives represent best practices primarily by reducing the amount of administrative burden required to disburse rebates and claim savings. As such, prescriptive incentives should be designed in a way to minimize amount of work required by both the customer and the program administrator (but especially the customer). Further, since certain sub-segments of the C&I sector, such as commercial kitchens and groceries, tend to have similar types of technologies and efficiency opportunities, prescriptive forms can be designed that are specifically targeted to these subsectors.

Custom Incentives

Market Segment (including Major End-uses and Technologies Promoted)

Custom incentives cover every cost-effective efficiency technology that is either too site-specific or not common enough to be covered prescriptively. Examples of technologies that would receive custom incentives include:

- Newer types of LED fixtures
- Industrial process work
- Insulation/air sealing
- Comprehensive HVAC work

Although there are no eligibility requirements for custom projects, due to the increased administrative burden actual uptake will consist almost entirely of large and medium sized customers. Further, just because the program offers prescriptive rebates for a customer does not obligate the program administrator to treat it as a prescriptive project. This is especially true for larger customers, where the program administrator may want to treat a project as custom if, for example, it is part of a larger whole building project or if the costs or savings are very different than the deemed estimates. In these cases the program administrator will work with the customer to establish which approach works best both for the program and the customer.

Delivery Model

The process for disbursing custom incentives begins when a custom application is received from a customer, vendor, or, in the case of larger customers, an account manager. Engineers will review the information in the application and prescreen the project to ensure that it passes cost-effectiveness. If not enough information is provided in the application, the program administer or account manager may have to follow up with the customer. If the project passes the pre-screening, a site visit is conducted to ensure that the installation has not yet begun and that baseline conditions are accurately described by the application.

Next, an incentive amount is agreed upon, based on a negotiation between the account manager and the customer. Depending on the results of the negotiation, and on the specifics of the project and the customer, the size of the incentive will typically end up at between 10% - 50% of the project cost. The account manager may also explore various financing options.

Once an incentive amount is established, the project is installed, a post-inspection site visit is conducted to ensure the project was installed as designed, and then the incentive is disbursed.

Services/Incentives Offered

A custom incentive is a sum of money designed to reduce the incremental cost of efficiency projects, and thus spur more efficiency investment. The incentive amount will depend on the project, and will depend on a negotiation between the customer and the account manager, who will strive to set the incentive at an amount that will move the project forward but not overpay for savings.

Best Practice Features

Because the process of applying for and receiving a custom incentive can be fairly complex, best practice implementation simplifies this process for the customer as much as possible. For large customers, their account managers can greatly simplify and guide the process and provide significant help to the customer throughout the application process. Also, a custom program will ideally be open to loans and other financing options in order to most effectively spur efficiency investment.

Technical and Design Assistance

Market Segment (including Major End-uses and Technologies Promoted)

Technical and design assistance is designed for large customers with potential for large savings but who need experts with specialized knowledge to identify the opportunities and/or design the projects. This may include ASHRAE audits, feasibility studies, system optimization studies, or retro-commissioning. For industrial customers, it will likely entail an industrial process study by a contractor with particular expertise in the applicable industrial segment.

Delivery Model

Technical and design assistance will be delivered by third party firms with proven expertise in the relevant field. There will ideally be many consultants under existing contract with the efficiency program administrator with a variety of expertise. This way, when technical assistance is needed, the program administrator and the customer can quickly select an appropriate consultant and get started on the study, with very little paperwork needed, and little delay between the customer's request for technical assistance and project initiation.

Services/Incentives Offered

Through pre-existing contracts with a variety of consultants, the program offers customers quick and easy access to pre-vetted expertise in their field of need. Further, the program will pay for a certain portion of any technical or design study.

Best Practice Features

Because contracts are already in place between consultants and the program administrator, there is very little delay between a customer's request for assistance and project initiation. Additionally, there are no required forms or paperwork for the customer to complete greatly simplifying the participation process. As contractors are selected to cover a broad range of areas of expertise, market niches and customer sub-segments that may not be adequately served by other energy efficiency programs are able to obtain customized, expert assistance. Finally, the available cost-sharing incentives promote the development of useful studies that can help achieve long-term energy efficiency improvements in customer facilities.

Market Segmentation

Market Segment (including Major End-uses and Technologies Promoted)

Because the C&I sector contains so many sub-segments, each with its own unique set of market barriers and program needs, it is inevitable that a standard set of program offerings will not achieve any significant penetration among certain segments. Market segmentation, then,

aims to customize the program approach to specific segments that would otherwise be underserved by the program. These segments will include:

- Municipalities
- Hospitals
- Commercial Real Estate
- Commercial Kitchens
- Hospitality

Delivery Model

Market segmentation will entail will take the form of marketing and initiatives targeted directly to the specific needs of each segment. This may entail some specialized research to determine what specific barriers are preventing each segment from participating in the efficiency program, and how to best reach them. The delivery model will likely vary from segment to segment, depending on what is expected to work best for each particular segment.

Services/Incentives Offered

Like the delivery model, the specific services and incentive provided will depend on the specific market segment being addressed. For example, the primary barrier to efficiency in commercial real estate is typically the split incentive barrier, where the landlord pays for capital improvements but the renter pays the monthly utility bills. In this case, a program may take an approach to market and support green leases, which align the financial and energy incentives of building owners and tenants. By contrast, the primary barrier for municipalities is typically the first cost of the efficiency investment. A primary service for municipalities, then, may be financing arrangements so that there is a positive cash-flow from the first year of the efficiency project.

Best Practice Features

Market segmentation reflects best practices by providing specialized approaches to marketing and delivery that suit specific market segments that would otherwise be underserved. Done correctly, market segmentation can significantly increase participation and achieve highly cost-effective savings that would otherwise go unrealized.

SMALL BUSINESS RETROFIT

The Small Business Retrofit Program is first described on page 60 of the "Program Portfolio Design" section of the report and is one of the program strategies used to develop program potential results. The Table below summarizes the energy this type of program could save in Delaware over the 12-year study period as well as the budget required to implement the program.

Small Business Retrofit Program Summary – Cumulative Annual Results in 2025

Electric Energy (MWh)	Electric Demand (MW)	Natural Gas (BBtu)	Petroleum Fuels (BBtu)	Total Budget 2014-2025 (Present Value Millions$)
219,746	33	290	70	90

Market Segment

The Small Business Retrofit program is specifically aimed at commercial buildings under a certain size threshold. Due to time and financial constraints, these customers tend to have very low participation in traditional prescriptive and custom programs. The nature of the program means that the majority of the savings will come from lighting and other easy to install measures such as boiler and pipe insulation, faucet aerators, and night covers for refrigeration. However, the installation contractor will ideally look for other more complex opportunities, such as HVAC in need of replacement or low insulation, and refer the customer to more specialized contractors for further action through prescriptive or custom incentives.

Delivery Model

The Small Business Direct Install program begins with a free walkthrough audit of a small commercial facility. The audit is typically done by a third-party contractor who has a pre-identified list of common measures and prices that was determined at the time of bid. During the walkthrough, the contractor will identify potential efficiency measures that are applicable to the facility in question. If the customer approves of the recommended measures, the contractor will install them in the same visit, at a large discount – usually about 70% of the total installed cost. Ideally, during the audit the contractor will also be looking for efficiency opportunities that are not on the list, such as HVAC units that need replacement. These opportunities may be on the list of measures for the contractor to check, but will not have associated pricing, as a separate contractor is needed for installation. In the event that these further opportunities are identified, they will be referred to more specialized contractors, who can work with the program administrator to get prescriptive or custom incentives through one of the other programs.

Services/Incentives Offered

The services offered through the Small Business Direct Install program consist of a free walkthrough audit, along with heavy discounts (around 70% of the full cost) for common, easy to install measures identified during the audit. A best practice implementation of the program

would also include on-bill, low/no-interest financing for the remaining 30% of the measure costs.

Best Practice Features

This program greatly boosts participation among small commercial facilities, which are otherwise very underserved by traditional program offering. It combines free on-site audits with high financial incentives and easy application processes to achieve significant savings from high efficiency lighting and other easy-to-install efficiency measures. The program will ideally also include financial options such as on-bill low/no-interest financing.

APPENDIX H: ENERGY SALES DISAGGREGATION, UPDATED FROM PHASE 1

INDUSTRIAL ELECTRIC SALES

Existing End Use Sales Forecast for 2014, MWh at Meter

	Agriculture	Mining	Construction	Food mfg	Beverage & tobacco product mfg	Textile mills	Textile product mills	Wood product mfg	Paper mfg	Printing & related support activities	Petroleum & coal products mfg	**Total**
Motors-Pumps	8,005	406	0	14,254	2,146	229	210	724	25,547	273	37,922	89,714
Motors-Fans and Blowers	6,404	135	0	6,519	2,441	148	210	1,809	16,109	774	6,106	40,654
Motors-Compressed Air	1,601	75	0	6,693	1,073	175	140	543	3,742	890	9,834	24,765
Motors-Material Handling	1,601	546	0	5,302	7,512	1,009	980	6,078	6,021	4,492	1,671	35,211
Motors-Material Processing	3,202	546	0	22,685	9,658	986	1,610	4,775	17,329	4,792	7,134	72,718
Motors-Refrigeration	3,202	0	0	25,553	16,920	435	415	455	4,068	774	450	52,272
Motors-Other Motors	0	0	0	5,823	2,113	0	0	0	8,624	0	1,221	17,782
Process Heating-Drying and Curing	1,601	0	0	28	0	222	158	821	1,649	1,092	1,212	6,783
Process Heating-Heat Treating	0	0	0	0	0	0	0	0	0	0	0	0
Process Heating-Heating	1,601	0	0	3,325	1,046	20	0	0	798	0	3,232	10,023
Process Heating-Melting and Casting	0	0	0	0	0	0	0	0	0	0	0	0
Other-HVAC	0	0	0	8,197	6,086	677	702	1,067	4,056	3,476	2,421	26,681
Other-Lighting	4,803	190	0	13,391	4,467	740	491	1,130	3,929	2,174	1,858	33,171
Other-Electro-Chemical Processes	0	0	0	163	55	4	20	3	1,717	34	44	2,040
Other-Other	0	0	21,686	8,332	0	290	0	0	5,986	967	3,766	41,027
Total	32,019	1,897	21,686	120,265	53,518	4,934	4,934	17,405	99,576	19,736	76,872	452,842

New Construction Sales for 2014, MWh at Meter

	Agriculture	Mining	Construction	Food mfg	Beverage & tobacco product mfg	Textile mills	Textile product mills	Wood product mfg	Paper mfg	Printing & related support activities	Petroleum & coal products mfg	**Total**
Motors-Pumps	329	17	0	586	88	9	9	30	1,050	11	1,558	3,686
Motors-Fans and Blowers	263	6	0	268	100	6	9	74	662	32	251	1,670
Motors-Compressed Air	66	3	0	275	44	7	6	22	154	37	404	1,018
Motors-Material Handling	66	22	0	218	309	41	40	250	247	185	69	1,447
Motors-Material Processing	132	22	0	932	397	41	66	196	712	197	293	2,988
Motors-Refrigeration	132	0	0	1,050	695	18	17	19	167	32	18	2,148
Motors-Other Motors	0	0	0	239	87	0	0	0	354	0	50	731
Process Heating-Drying and Curing	66	0	0	1	0	9	7	34	68	45	50	279
Process Heating-Heat Treating	0	0	0	0	0	0	0	0	0	0	0	0
Process Heating-Heating	66	0	0	137	43	1	0	0	33	0	133	412
Process Heating-Melting and Casting	0	0	0	0	0	0	0	0	0	0	0	0
Other-HVAC	0	0	0	337	250	28	29	44	167	143	99	1,096
Other-Lighting	197	8	0	550	184	30	20	46	161	89	76	1,363
Other-Electro-Chemical Processes	0	0	0	7	2	0	1	0	71	1	2	84
Other-Other	0	0	891	342	0	12	0	0	246	40	155	1,686
Total	1,316	78	891	4,941	2,199	203	203	715	4,091	811	3,158	18,606
Total Elec Sales (MWh)	33,335	1,975	22,577	125,206	55,716	5,137	5,137	18,120	103,667	20,547	80,030	471,447

INDUSTRIAL GAS SALES

Existing Sales Forecast for 2014 (MMBtu)

	Agriculture	Mining	Construction	Food mfg	Beverage & tobacco product mfg	Textile mills	Textile product mills	Wood product mfg	Paper mfg	Printing & related support activities	Petroleum & coal products mfg	Pharmaceutical & medicine mfg
Total	112,066	21,488	85,203	965,608	429,694	22,409	22,409	34,750	518,544	89,636	1,643,709	5,518,893

New Construction Sales Forecast for 2014 (MMBtu)

	Agriculture	Mining	Construction	Food mfg	Beverage & tobacco product mfg	Textile mills	Textile product mills	Wood product mfg	Paper mfg	Printing & related support activities	Petroleum & coal products mfg	Pharmaceutical & medicine mfg
Total	4,604	883	3,501	39,673	17,654	921	921	1,428	21,305	3,683	67,534	226,750
Total Gas Sales (MMBtu)	116,670	22,371	88,704	1,005,281	447,348	23,330	23,330	36,178	539,849	93,319	1,711,243	5,745,643

INDUSTRIAL GAS SALES (Cont.)

Existing Sales Forecast for 2014 (MMBtu)

	All other chemical products	Plastics & rubber products mfg	Nonmetallic mineral product mfg	Iron & steel mills & ferroalloy mfg	Steel product mfg from purchased steel	Fabricated metal product mfg	Machinery mfg	Computer & electronic product mfg	Electrical equipment, appliance, & component mfg	Transportation equipment mfg	Furniture & related product mfg	Miscellaneous mfg	**Total**
Total	3,638,344	69,208	1,065,717	211,066	211,066	121,308	22,279	47,043	22,158	40,347	71,018	125,571	15,109,538

New Construction Sales Forecast for 2014 (MMBtu)

	All other chemical products	Plastics & rubber products mfg	Nonmetallic mineral product mfg	Iron & steel mills & ferroalloy mfg	Steel product mfg from purchased steel	Fabricated metal product mfg	Machinery mfg	Computer & electronic product mfg	Electrical equipment, appliance, & component mfg	Transportation equipment mfg	Furniture & related product mfg	Miscellaneous mfg	**Total**
Total	149,485	2,843	43,786	8,672	8,672	4,984	915	1,933	910	1,658	2,918	5,159	620,792
Total Gas Sales (MMBtu)	3,787,830	72,051	1,109,503	219,738	219,738	126,292	23,195	48,976	23,069	42,005	73,936	130,730	15,730,331

INDUSTRIAL PETROFUEL SALES

Existing Sales Forecast for 2014 (MMBtu)

	Agriculture	Mining	Construction	Food mfg	Beverage & tobacco product mfg	Textile mills	Textile product mills	Wood product mfg	Paper mfg	Printing & related support activities	Petroleum & coal products mfg	Pharmaceutical & medicine mfg
Total	106,849	677	516,085	6,111	2,719	324	324	2,135	25,564	1,295	557,322	233,314

New Construction Sales Forecast for 2014 (MMBtu)

	Agriculture	Mining	Construction	Food mfg	Beverage & tobacco product mfg	Textile mills	Textile product mills	Wood product mfg	Paper mfg	Printing & related support activities	Petroleum & coal products mfg	Pharmaceutical & medicine mfg
Total	4,390	28	21,204	251	112	13	13	88	1,050	53	22,898	9,586
Total PF Sales (MMBtu)	111,239	705	537,289	6,362	2,831	337	337	2,223	26,614	1,348	580,220	242,900

INDUSTRIAL PETROFUEL SALES (Cont.)

Existing Sales Forecast for 2014 (MMBtu)

	All other chemical products	Plastics & rubber products mfg	Nonmetallic mineral product mfg	Iron & steel mills & ferroalloy mfg	Steel product mfg from purchased steel	Fabricated metal product mfg	Machinery mfg	Computer & electronic product mfg	Electrical equipment, appliance, & component mfg	Transportation equipment mfg	Furniture & related product mfg	Miscellaneous mfg	**Total**
Total	153,813	1,164	46,150	7,449	7,449	941	190	4,222	1,555	337	1,026	1,814	**1,678,829**

New Construction Sales Forecast for 2014 (MMBtu)

	All other chemical products	Plastics & rubber products mfg	Nonmetallic mineral product mfg	Iron & steel mills & ferroalloy mfg	Steel product mfg from purchased steel	Fabricated metal product mfg	Machinery mfg	Computer & electronic product mfg	Electrical equipment, appliance, & component mfg	Transportation equipment mfg	Furniture & related product mfg	Miscellaneous mfg	**Total**
Total	6,320	48	1,896	306	306	39	8	173	64	14	42	75	**68,977**
Total PF Sales (MMBtu)	160,132	1,212	48,046	7,755	7,755	980	197	4,396	1,619	351	1,068	1,889	1,747,806

COMMERCIAL AND RESIDENTIAL ELECTRIC SALES

Existing End Use Sales Forecast for 2014, MWh at Meter

	Office	Retail	Grocery	Warehouse	Education	Health	Lodging	Restaurant	Data Center	Multifamily Com	Streetlighting	Other Com	Single Family	Multifamily Res	Single Family Low Income	**Total**
Indoor Lighting	315,374	115,268	56,807	93,016	97,327	66,131	33,088	53,231	1,807	0	0	252,384	239,628	24,213	117,050	1,465,323
Outdoor Lighting	11,066	5,424	2,144	0	3,140	2,543	1,614	1,947	0	0	35,977	12,943	0	0	0	76,798
Cooling	164,764	68,325	28,226	6,353	60,697	92,577	25,674	39,004	45,173	0	0	139,980	217,980	22,026	106,476	1,017,256
Ventilation	84,753	39,170	9,475	22,096	73,257	26,622	16,260	17,711	18,069	0	0	91,350	63,381	6,404	30,959	499,508
Water Heating	5,533	12,205	1,072	2,448	21,977	1,272	0	2,597	0	0	0	6,471	328,278	33,171	160,353	575,375
Refrigeration	33,197	20,341	153,271	24,478	21,977	8,902	8,070	64,267	0	0	0	58,243	274,192	27,706	133,934	828,577
Space Heating	16,061	5,060	1,421	5,820	13,606	5,432	1,645	4,305	0	0	0	21,054	380,812	38,479	186,014	679,710
Plug Loads	143,855	8,137	4,823	4,896	18,837	15,261	4,035	3,895	0	0	0	38,828	215,798	21,805	105,410	585,581
Food Service/Prep	0	0	3,215	0	9,419	5,087	5,649	67,512	0	0	0	19,414	52,578	5,313	25,683	193,870
Kitchen/Laundry	0	0	0	0	0	0	0	0	0	0	0	0	158,382	16,004	77,364	251,750
Miscellaneous	5,533	16,273	7,503	14,687	62,792	27,978	6,456	7,790	0	0	0	58,243	447,814	45,249	218,742	919,059
Data Center	0	0	0	0	0	0	0	0	115,644	0	0	0	0	0	0	115,644
Total	780,136	290,203	267,956	173,794	383,029	251,806	102,491	262,260	65,049	0	35,977	698,910	2,378,842	240,369	1,161,984	7,092,807

New Construction Sales for 2014, MWh at Meter

	Office	Retail	Grocery	Warehouse	Education	Health	Lodging	Restaurant	Data Center	Multifamily Com	Streetlighting	Other Com	Single Family	Multifamily Res	Single Family Low Income	**Total**
Indoor Lighting	12,957	4,736	2,334	3,822	3,999	2,717	1,359	2,187	74	0	0	10,369	3,595	306	1,756	50,212
Outdoor Lighting	455	223	88	0	129	105	66	80	0	0	1,478	532	0	0	0	3,155
Cooling	6,770	2,807	1,160	261	2,494	3,804	1,055	1,603	1,856	0	0	5,751	3,270	279	1,597	32,705
Ventilation	3,482	1,609	389	908	3,010	1,094	668	728	742	0	0	3,753	951	81	464	17,880
Water Heating	227	501	44	101	903	52	0	107	0	0	0	266	4,924	420	2,405	9,951
Refrigeration	1,364	836	6,297	1,006	903	366	332	2,640	0	0	0	2,393	4,113	351	2,009	22,609
Space Heating	660	208	58	239	559	223	68	177	0	0	0	865	5,712	487	2,790	12,047
Plug Loads	5,910	334	198	201	774	627	166	160	0	0	0	1,595	3,237	276	1,581	15,060
Food Service/Prep	0	0	132	0	387	209	232	2,774	0	0	0	798	789	67	385	5,773
Kitchen/Laundry	0	0	0	0	0	0	0	0	0	0	0	0	2,376	203	1,161	3,739
Miscellaneous	227	669	308	603	2,580	1,150	265	320	0	0	0	2,393	6,717	573	3,281	19,087
Data Center	0	0	0	0	0	0	0	0	4,751	0	0	0	0	0	0	4,751
Total	32,053	11,923	11,009	7,141	15,737	10,346	4,211	10,775	2,673	0	1,478	28,716	35,684	3,042	17,430	192,217
Total Sales (MWh)	**812,188**	**302,127**	**278,966**	**180,934**	**398,766**	**262,152**	**106,702**	**273,035**	**67,722**	**0**	**37,455**	**727,626**	**2,414,526**	**243,411**	**1,179,414**	**7,285,024**

COMMERCIAL AND RESIDENTIAL GAS SALES

Existing Sales Forecast for 2014 (MMBtu)

	Office	Retail	Grocery	Warehouse	Education	Health	Lodging	Restaurant	Data Center	Multifamily Com	Streetlighting	Other Com	Single Family	Multifamily Res	Single Family Low Income	**Total**
Space Heating	1,413,759	1,154,583	133,362	165,465	345,420	427,234	77,100	146,609	0	799,197	0	94,355	3,314,698	236,707	2,070,462	10,378,951
Water Heating	79,908	116,687	9,879	5,963	61,742	232,466	149,382	152,039	0	320,207	0	4,529	1,363,035	97,336	851,393	3,444,564
Food Service/Prep	18,440	147,394	39,515	0	8,343	31,414	16,866	247,063	0	7,326	0	1,510	431,954	30,846	269,811	1,250,482
Miscellaneous	141,376	202,666	0	0	31,705	72,253	0	0	0	39,730	0	7,297	120,366	8,595	75,184	699,172
Cooling	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-
Total	1,653,483	1,621,329	182,755	171,428	447,210	763,367	243,347	545,710	0	1,166,461	0	107,691	5,230,052	373,485	3,266,851	15,773,169

New Construction Sales Forecast for 2014 (MMBtu)

	Office	Retail	Grocery	Warehouse	Education	Health	Lodging	Restaurant	Data Center	Multifamily Com	Streetlighting	Other Com	Single Family	Multifamily Res	Single Family Low Income	**Total**
Space Heating	58,086	47,437	5,479	6,798	14,192	17,553	3,168	6,024	0	32,836	0	3,877	49,722	2,995	31,058	279,226
Water Heating	3,283	4,794	406	245	2,537	9,551	6,138	6,247	0	13,156	0	186	20,446	1,232	12,771	80,992
Food Service/Prep	758	6,056	1,624	0	343	1,291	693	10,151	0	301	0	62	6,480	390	4,047	32,194
Miscellaneous	5,809	8,327	0	0	1,303	2,969	0	0	0	1,632	0	300	1,806	109	1,128	23,381
Cooling	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-
Total	67,935	66,614	7,509	7,043	18,374	31,364	9,998	22,421	0	47,925	0	4,425	78,453	4,726	49,004	415,793
Total Sales (MMBtu)	1,721,418	1,687,943	190,264	178,471	465,584	794,731	253,346	568,131	-	1,214,386	-	112,115	5,308,505	378,212	3,315,855	16,188,962

COMMERCIAL AND RESIDENTIAL PETROFUEL SALES

Existing Sales Forecast for 2014 (MMBtu)

	Office	Retail	Grocery	Warehouse	Education	Health	Lodging	Restaurant	Data Center	Multifamily Com	Streetlighting	Other Com	Single Family	Multifamily Res	Single Family Low Income	**Total**
Space Heating	326,964	326,609	36,815	34,533	90,314	96,608	49,354	109,931	0	182,989	0	21,694	2,725,219	0	1,383,062	5,384,092
Water Heating	0	7,685	866	813	4,014	32,203	0	2,587	0	61,508	0	510	255,759	0	129,799	495,743
Food Service/Prep	0	0	0	0	0	0	0	0	0	0	0	0	62,943	0	31,944	94,888
Miscellaneous	21,798	7,685	866	813	0	32,203	1,974	2,587	0	1,539	0	510	377,007	0	191,333	638,314
Cooling	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-
Total	348,761	341,979	38,548	36,158	94,328	161,013	51,328	115,104	0	246,036	0	22,715	3,420,929	0	1,736,138	6,613,037

New Construction Sales Forecast for 2014 (MMBtu)

	Office	Retail	Grocery	Warehouse	Education	Health	Lodging	Restaurant	Data Center	Multifamily Com	Streetlighting	Other Com	Single Family	Multifamily Res	Single Family Low Income	**Total**
Space Heating	13,434	13,419	1,513	1,419	3,711	3,969	2,028	4,517	0	7,518	0	891	40,880	0	20,747	114,044
Water Heating	0	316	36	33	165	1,323	0	106	0	2,527	0	21	3,837	0	1,947	10,311
Food Service/Prep	0	0	0	0	0	0	0	0	0	0	0	0	944	0	479	1,423
Miscellaneous	896	316	36	33	0	1,323	81	106	0	63	0	21	5,655	0	2,870	11,400
Cooling	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-
Total	14,329	14,051	1,584	1,486	3,876	6,615	2,109	4,729	0	10,109	0	933	51,316	0	26,043	137,179
Total Sales (MMBtu)	363,090	356,030	40,131	37,644	98,203	167,629	53,437	119,833	-	256,145	-	23,648	3,472,244	-	1,762,181	6,750,216

APPENDIX I: MEASURE CHARACTERIZATIONS, UPDATED FROM PHASE 1

Notes on Measure Characterizations:

1. The Data Source numbers refer to the indexed citations provided in Appendix J, Bibliography

2. Primary Fuel Abbreviations:
E = Electric
G = Natural Gas
P = Petroleum Fuels

3. Market Abbreviations:
NC = New Construction
Reno = Renovation
Repl = Natural Replacement
Ret = Retrofit

4. All costs are presented in 2013$

Commercial Electric Measures

Primary Fuel End Use	Applicable Markets	Measure Name	Measure Description	Baseline Description	Life (yr)	% Savings	Incre-mental Cost/kWh Saved	Annual Fossil Fuel Savings (MMBtu per kWh saved)	Data Sources: Measure Life Source	Data Sources: Savings Data Sources	Data Sources: Costs Data Sources
Indoor Lighting	Ret	HPT8 lamp/ballast (T12 baseline)	Install High Performance T8 lamps and low-ballast factor electronic ballast in existing fixtures, replacing T12 lighting	EE T12 with EEMAG ballast	15	32.4%	$ 0.67		1	168, 168	1
Indoor Lighting	Ret	HPT8 lamp/ballast (T8 baseline)	Install High Performance T8 lamps and low-ballast factor electronic ballast in existing fixtures, replacing standard T8 lighting	Standard T8s	15	16.4%	$ 1.67		1	168, 168	1
Indoor Lighting	Repl	Reduce W T8 lamp/ballast (for HPT8)	When replacing a High Performance T8 and ballast, replace with a 25 or 28 Watt lamp and high performance ballast as opposed to a HP 32 watt lamp.	32 Watt High Performance T8s	15	13.3%	$ -		1	168, 87	68
Indoor Lighting	Ret	Reduce W T8 lamp/ballast (for HPT8)	When replacing a High Performance T8 and ballast, replace with a 25 or 28 Watt lamp and high performance ballast as opposed to a HP 32 watt lamp.	32 Watt High Performance T8s	15	13.3%	$ 2.71		1	168, 87	68
Indoor Lighting	Repl	Reduce W T8 lamp/ballast (for stnd T8)	When replacing a Standard T8, replace with a 25 or 28 watt T8 and CEE certified ballast as opposed to a standard lamp and ballast	32 Watt Standard T8 lamp and ballast	15	16.4%	$ 0.71		1	168, 168	68
Indoor Lighting	Ret	Reduce W T8 lamp/ballast (for stnd T8)	When replacing a Standard T8, replace with a 25 or 28 watt T8 and CEE certified ballast as opposed to a standard lamp and ballast	32 Watt Standard T8 lamp and ballast	15	16.4%	$ 1.62		1	168, 168	68
Indoor Lighting	Repl	Reduce W T8 relamp (for HPT8)	When replacing a High Performance T8, replace with a 25 or 28 Watt lamp as opposed to a HP 32 watt lamp.	32 Watt High Performance T8 lamp and ballast	5	10.6%	$ -		1	168, 87	68
Indoor Lighting	Ret	Reduce W T8 relamp (for HPT8)	When replacing a High Performance T8, replace with a 25 or 28 Watt lamp as opposed to a HP 32 watt lamp.	32 Watt High Performance T8 lamp and ballast	5	10.6%	$ 2.42		1	168, 87	68
Indoor Lighting	Repl	Reduce W T8 relamp (for stnd T8)	When replacing a Standard T8, replace with a 25 or 28 Watt lamp as opposed to a HP 32 watt lamp.	32 Watt High Performance T8 lamp	5	21.9%	$ 0.14		1	168, 168	68
Indoor Lighting	Ret	Reduce W T8 relamp (for stnd T8)	When replacing a Standard T8, replace with a 25 or 28 Watt lamp as opposed to a HP 32 watt lamp.	32 Watt Standard T8	5	21.9%	$ 0.43		1	168, 168	68
Indoor Lighting	Ret	HPT8 fixture (T12 baseline)	High Performance T8 fixture w/ Electronic Ballast and tandem wiring where appropriate, replacing T12	EE T12 with EE Mag ballast	15	32.4%	$ 1.07		1	168, 168	68
Indoor Lighting	NC, Reno, Repl	HPT8 fixture (T8 baseline)	High Performance T8 fixture w/ Electronic Ballast and tandem wiring where appropriate, replacing standard T8	Standard T8s	15	16.4%	$ 0.76		1	168, 168	1
Indoor Lighting	Ret	HPT8 fixture (T8 baseline)	High Performance T8 fixture w/ Electronic Ballast and tandem wiring where appropriate, replacing standard T8	Standard T8s	15	16.4%	$ 2.67		1	168, 168	68
Indoor Lighting	NC, Reno, Repl	HE fixtures/design Tier I (2009 baseline)	High efficiency fixtures and design to reduce lighting power density. Generally reflects mid-level efficiency, typically including high efficiency fixtures and improved fixture layout, including use of indirect lighting. Does not include controls, which are covered elsewhere. Baseline of IECC 2009.	IECC 2009	15	21.4%	$ 0.37		168	168, 50	69
Indoor Lighting	NC, Reno, Repl	HE fixtures/design Tier II	High efficiency fixtures and design to reduce lighting power density. Generally reflects state-of-the-art systems to achieve maximum reductions. This can include numerous things, potentially including direct/indirect, auto dimming, low glare, T5s, specular reflectors, task lighting, distribution technologies (eg, light pipes, fiber optics), etc. Does not include controls, which are covered elsewhere.	HE fixtures/design Tier I	15	33.1%	$ 0.75		168	168, 52	69
Indoor Lighting	Ret	HE fixtures/design Tier II	High efficiency fixtures and design to reduce lighting power density. Generally reflects state-of-the-art systems to achieve maximum reductions. This can include numerous things, potentially including direct/indirect, auto dimming, low glare, T5s, specular reflectors, task lighting, distribution technologies (eg, light pipes, fiber optics), etc. Does not include controls, which are covered elsewhere.	HE fixtures/design Tier I	15	45.0%	$ 1.59		168	0	69
Indoor Lighting	NC, Reno, Repl	HE fixtures/design Tier III	Emerging technologies (e.g., LEDs, Organic LEDs, daylighting) combined with emphasis on increased overall system efficiency.	HE fixtures/design Tier II	15	40.7%	$ 0.75		168	168, 39	69

Primary Fuel End Use	Applicable Markets	Measure Name	Measure Description	Baseline Description	Life (yr)	% Savings	Incre-mental Cost/kWh Saved	Annual Fossil Fuel Savings (MMBtu per kWh saved)	Measure Life Source	Savings Data Sources	Costs Data Sources
Indoor Lighting	Ret	HE fixtures/design Tier III	Emerging technologies (e.g., LEDs, Organic LEDs, daylighting) combined with emphasis on increased overall system efficiency.	HE fixtures/design Tier II	15	53.1%	$ 1.59		168	0	69
Indoor Lighting	NC, Reno, Repl	CFL fixture - interior 2012-14	Permanently installed Compact Fluorescent Lamp fixture	Incandescent fixture meeting EISA 2007 lighting performance standards (e.g., efficient halogen lamp)	12	59.0%	$ 0.42		168	168, 1	168
Indoor Lighting	Ret	CFL fixture - interior 2012-14	Permanently installed Compact Fluorescent Lamp fixture	Incandescent fixture meeting EISA 2007 lighting performance standards (e.g., efficient halogen lamp)	12	59.0%	$ 1.34		168	168, 1	70
Indoor Lighting	NC, Reno, Repl	CFL spiral 2012-14	Compact Fluorescent Lamp spiral, for interior	High-efficiency halogen lamp	5	62.2%	$ 0.03		168	168, 53	71, 168
Indoor Lighting	Ret	CFL spiral 2012-14	Compact Fluorescent Lamp spiral, for interior	High-efficiency halogen lamp	5	62.2%	$ 0.04		168	168, 53	71, 168
Indoor Lighting	NC, Reno, Repl	LED track lighting	LED replacements for track lighting	Halogen Par 38	15	79.8%	$ 0.73		1, 157, 162	1, 156	1, 157
Indoor Lighting	Ret	LED track lighting	LED replacements for track lighting	Halogen Par 38	15	79.8%	$ 1.04		1, 157, 162	1, 156	1, 157
Indoor Lighting	NC, Reno, Repl	LED downlighting	LED replacements for recessed downlights. Recessed lights are used to concentrate light in a downward direction.	Weighted average of 65W BR30 & 50W PAR30 downlight lamps	15	67.6%	$ 0.48		1, 157, 162	1, 157	46, 157
Indoor Lighting	Ret	LED downlighting	LED replacements for recessed downlights. Recessed lights are used to concentrate light in a downward direction.	Weighted average of 65W BR30 & 50W PAR30 downlight lamps	15	67.6%	$ 0.98		1, 157, 162	1, 157	46, 157
Indoor Lighting	NC, Reno, Repl	LED Lamp, directional	LED screw and pin-based lamps that replace PAR bulbs in non-dedicated fixtures. These are common in retail and museum applications where directional highlighting is common	weighted average of CFL and Halogen PAR bulb	14	78.6%	$ 0.31		1, 62	1, 156	1, 157
Indoor Lighting	Ret	LED Lamp, directional	LED screw and pin-based lamps that replace PAR bulbs in non-dedicated fixtures. These are common in retail and museum applications where directional highlighting is common	weighted average of CFL and Halogen PAR bulb	14	78.6%	$ 0.47		1, 62	1, 156	1, 157
Indoor Lighting	NC, Reno, Repl	LED Lamp, standard and decorative	LED screw and pin-based lamps that fit into traditional incandescent and CFL sockets. Varieties include PAR, MR, decorative candelabra, and standard A-style lamps.	Weighted average of EC Halogens, and incandescents	9	66.7%	$ 0.48		1, 62	1, 157	46, 168
Indoor Lighting	Ret	LED Lamp, standard and decorative	LED screw and pin-based lamps that fit into traditional incandescent and CFL sockets. Varieties include PAR, MR, decorative candelabra, and standard A-style lamps.	Weighted average of EC Halogens, and incandescents	9	66.7%	$ 0.65		1, 62	1, 157	46, 1, 168
Indoor Lighting	NC, Reno, Repl	LED refrig case light fixtures	LED refrigerated case light fixtures are installed in walk-in refrigerated coolers and freezers where they excel due to the cold temperature. They replace linear fluorescent fixtures that perform poorly in cold temperatures.	T8 linear fluorescent	8	55.3%	$ 0.46		168	168	168
Indoor Lighting	Ret	LED refrig case light fixtures	LED refrigerated case light fixtures are installed in walk-in refrigerated coolers and freezers where they excel due to the cold temperature. They replace linear fluorescent fixtures that perform poorly in cold temperatures.	T8 linear fluorescent	8	55.3%	$ 0.90		168	168	168
Indoor Lighting	NC, Reno, Repl	LED Recessed Fixture	LED Recessed Fixtures replace linear fluorescent fixtures	average of T8 and HPT8 4' fixtures	19	37.2%	$ 1.70		1, 62, 158	1, 158	46, 1, 168
Indoor Lighting	Ret	LED Recessed Fixture	LED Recessed Fixtures replace linear fluorescent fixtures	average of T8 and HPT8 4' fixtures	19	37.2%	$ 3.03		1, 62, 158	1, 158	46, 1, 168
Indoor Lighting	NC, Reno, Repl	LED task lighting	LED task lighting is used to increase light levels in work spaces above ambient levels. Replaces Halogen and Fluorescent technology	Average of 50W Hal, 13W CFL and Linear T5	19	80.4%	$ 0.40		126, 162	124, 155	1, 124, 155
Indoor Lighting	Ret	LED task lighting	LED task lighting is used to increase light levels in work spaces above ambient levels. Replaces Halogen and Fluorescent technology	Average of 50W Hal, 13W CFL and Linear T5	19	80.4%	$ 0.61		126, 162	124, 155	1, 124, 155

Primary Fuel End Use	Applicable Markets	Measure Name	Measure Description	Baseline Description	Life (yr)	% Savings	Incre-mental Cost/kWh Saved	Annual Fossil Fuel Savings (MMBtu per kWh saved)	Measure Life Source	Savings Data Sources	Costs Data Sources
Indoor Lighting	NC, Reno, Repl	Fluor high-low bay fixture - interior	Fluorescent fixture for high and low bay applications (assumes 4-lamp fixture). Generally for industrial warehouse and similar applications. Low bay is 10-15 ft.	average of 200W and 320W PSMH	15	47.2%	$ 0.15		168	1, 168	1, 60
Indoor Lighting	Ret	Fluor high-low bay fixture - interior	Fluorescent fixture for high and low bay applications (assumes 4-lamp fixture). Generally for industrial warehouse and similar applications. Low bay is 10-15 ft.	average of 200W and 320W PSMH	15	47.2%	$ 0.49		168	1, 168	1, 60, 68
Indoor Lighting	NC, Reno, Repl	LED High-Low Bay	LED fixture for high and low bay applications. Generally for industrial warehouse applications. Low bay is 10-15 ft.	MH 250 W CWA Pulse Start	15	54.9%	$ 0.58		1, 158, 168	1, 158, 168	1
Indoor Lighting	Ret	LED High-Low Bay	LED fixture for high and low bay applications. Generally for industrial warehouse applications. Low bay is 10-15 ft.	MH 250 W CWA Pulse Start	15	54.9%	$ 1.20		1, 158, 168	1, 158, 168	1
Indoor Lighting	NC, Reno, Repl	Occupancy on/off lighting control	On/off lighting control based on space occupancy	Manual control	10	30.0%	$ 0.21		168	168	48, 60, 168
Indoor Lighting	Ret	Occupancy on/off lighting control	On/off lighting control based on space occupancy	Manual control	10	30.0%	$ 0.43		168	168	48, 60, 168
Indoor Lighting	NC, Reno, Repl	Occupancy hi/low lighting control	Multilevel lighting control based on space occupancy. For example, to reduce lighting in the aisles of a warehouse.	Manual control	10	30.0%	$ 0.59		168	168, 1	72
Indoor Lighting	Ret	Occupancy hi/low lighting control	Multilevel lighting control based on space occupancy. For example, to reduce lighting in the aisles of a warehouse.	Manual control	10	30.0%	$ 1.00		168	168, 1	72
Indoor Lighting	NC, Reno, Repl	Daylight dimming	Automatic dimming in response to daylight, lumen depreciation and task needs to maintain light levels. For NC, optimization of natural light through shell measures is included under integrated building design.	Manual control	8	30.0%	$ 0.27		168	168	1, 168
Indoor Lighting	Ret	Daylight dimming	Automatic dimming in response to daylight, lumen depreciation and task needs to maintain light levels. For NC, optimization of natural light through shell measures is included under integrated building design.	Manual control	8	30.0%	$ 0.38		168	168	1, 168
Indoor Lighting	Ret	Wireless on-off lighting controls	On/off lighting controls attached to occupancy sensors. Eliminates the need for expensive cabling attached to each controlled light.	Manual control	10	30.0%	$ 0.47		39	39	183
Indoor Lighting	Ret	LED exit sign	Light emitting diode exit sign	Fluorescent exit sign	7	94.3%	$ 0.26		1, 20	168	168
Outdoor Lighting	NC, Reno, Repl	LED minor exterior area lighting	LED general area lighting on the outside of commercial buildings. This includes walkway, security, signage, and façade lighting	175W MH	14	72.1%	$ 0.71		162	127	127
Outdoor Lighting	Ret	LED minor exterior area lighting	LED general area lighting on the outside of commercial buildings. This includes walkway, security, signage, and façade lighting	CFLs, Halogen, and linear t5	14	72.1%	$ 1.03		162	127	127
Outdoor Lighting	NC, Reno, Repl	CFL - exterior 2012-2014	Spiral CFL for exterior applications to replace incandescent, 2012-14	Halogen PAR38 spot lamp	4	62.1%	$ 0.04		1	1, 59	59
Outdoor Lighting	Ret	CFL - exterior 2012-2014	Spiral CFL for exterior applications to replace incandescent, 2012-14	Halogen PAR38 spot lamp	4	62.1%	$ 0.08		1	1, 59	59
Outdoor Lighting	NC, Reno	LED Parking/Roadway Fixtures	LED outdoor lighting for parking areas and general area lighting (not utility-owned). This includes cobra heads, other more decorative street lights and canopy lighting.	Weighted average of 400W MH, 250W MH and 250W HPS, lamps and housing/fixtures	11	71.9%	$ 0.49		162	46, 162	1
Outdoor Lighting	Ret	LED Parking/Roadway Fixtures	LED outdoor lighting for parking areas and general area lighting (not utility-owned). This includes cobra heads, other more decorative street lights and canopy lighting.	Weighted average of 400W MH, 250W MH and 250W HPS lamps	11	71.9%	$ 0.60		162	46, 162	1
Outdoor Lighting	NC, Reno, Repl	Exterior Occupancy Sensors	Occupancy sensors controlling outdoor lighting	no occ sensor	10	41.0%	$ 0.74		1	1	1
Outdoor Lighting	Ret	Exterior Occupancy Sensors	Occupancy sensors controlling outdoor lighting	no occ sensor	10	41.0%	$ 1.22		1	1	1
Outdoor Lighting	NC, Reno, Repl	LED Municipal Streetlighting	LED street lighting owned by utilities	Combination of 250W MH and 250W HPS cobra heads	11	41.1%	$ 0.76		19	169	169
Outdoor Lighting	Ret	LED Municipal Streetlighting	LED street lighting owned by utilities	Combination of 250W MH and 250W HPS cobra heads	11	41.1%	$ 1.15		19	169	169

Primary Fuel End Use	Applicable Markets	Measure Name	Measure Description	Baseline Description	Life (yr)	% Savings	Incre-mental Cost/kWh Saved	Annual Fossil Fuel Savings (MMBtu per kWh saved)	Measure Life Source	Savings Data Sources	Costs Data Sources
Outdoor Lighting	NC, Reno	Improved ext lighting design	Reduced light levels and better outdoor lighting design. Includes reduced wattage lamps, better spacing, and use of cut-offs and reflectors to better control light and minimize glare	Standard exterior lighting practice	15	42.0%	$ 0.37		1	1, 30	30
Outdoor Lighting	NC, Reno, Repl	Outdoor Lighting Timeclocks	Time controls save energy by reducing lighting time of use through preprogrammed scheduling. Generally they dim the fixture during periods of low activity, such as 12am-5am. Time controls are applicable to utility owned street lights as well as non-utility owned outdoor light fixtures such as those in parking garages and security lighting	Standard efficiency exterior area lighting using metal halide and high-pressure sodium technologies	15	50.0%	$ 0.36		1	39	154
Outdoor Lighting	Ret	Outdoor Lighting Timeclocks	Time controls save energy by reducing lighting time of use through preprogrammed scheduling. Generally they dim the fixture during periods of low activity, such as 12am-5am. Time controls are applicable to utility owned street lights as well as non-utility owned outdoor light fixtures such as those in parking garages and security lighting	Standard efficiency exterior area lighting using metal halide and high-pressure sodium technologies	15	50.0%	$ 0.72		1	39	154
Cooling	NC, Reno, Repl	High-eff AC CEE Tier I	Packaged or split system unitary air conditioner meeting CEE Tier I efficiency criteria (CEE Commercial Unitary AC & HP Specs, Jan 2012). High efficiency level reflects weighted average by size and type of units.	New unitary air conditioner meeting relevant energy codes or federal standards. Baseline efficiency reflects weighted average by size and type.	15	6.5%	$ 1.09		90	134,102,93, 168	135
Cooling	Ret	High-eff AC CEE Tier I	Packaged or split system unitary air conditioner meeting CEE Tier I efficiency criteria (CEE Commercial Unitary AC & HP Specs, Jan 2012). High efficiency level reflects weighted average by size and type of units.	Existing stock efficiency unitary air conditioner. Existing stock efficiency reflects weighted average by size and type.	15	19.3%	$ 2.91		90	134,92,93,1 02,168	3, 135
Cooling	NC, Reno, Repl	High-eff AC CEE Tier II	Packaged or split system unitary air conditioner meeting CEE Tier II efficiency criteria (CEE Commercial Unitary AC & HP Specs, Jan 2012). High efficiency level reflects weighted average by size and type of units.	New unitary air conditioner meeting relevant energy codes or federal standards. Baseline efficiency reflects weighted average by size and type.	15	10.3%	$ 1.09		90	134,102,93, 168	135
Cooling	Ret	High-eff AC CEE Tier II	Packaged or split system unitary air conditioner meeting CEE Tier II efficiency criteria (CEE Commercial Unitary AC & HP Specs, Jan 2012). High efficiency level reflects weighted average by size and type of units.	Existing stock efficiency unitary air conditioner. Existing stock efficiency reflects weighted average by size and type.	15	22.6%	$ 2.55		90	134,92,93,1 68	3135
Cooling	NC, Reno, Repl	High-eff HP CEE Tier I - Cool	Single or polyphase packaged or split system unitary heat pump meeting CEE Tier I efficiency criteria. High efficiency level will reflect weighted average by size and type of units.	New unitary heat pump meeting relevant energy codes or federal standards. Baseline efficiency reflects weighted average by size and type.	15	3.8%	$ 3.00		90	134,102,93, 168	136, 135
Cooling	Ret	High-eff HP CEE Tier I - Cool	Single or polyphase packaged or split system unitary heat pump meeting CEE Tier I efficiency criteria. High efficiency level will reflect weighted average by size and type of units.	Existing stock efficiency unitary heat pump. Existing stock efficiency will reflect weighted average by size and type.	15	14.3%	$ 5.35		90	134,92,93,1 68	136, 135
Space Heating	NC, Reno, Repl	High-eff HP CEE Tier I - Heat	See corresponding "Cool" measure.	New unitary heat pump meeting relevant energy codes or federal standards. Baseline efficiency reflects weighted average by size and type.	15	2.0%	$ 3.00		90	134,102,93, 168	136, 135
Space Heating	Ret	High-eff HP CEE Tier I - Heat	See corresponding "Cool" measure.	Existing stock efficiency unitary heat pump. Existing stock efficiency will reflect weighted average by size and type.	15	6.7%	$ 5.35		90	134,92,93,1 68	136, 135
Cooling	NC, Reno, Repl	High-eff HP CEE Tier II - Cool	Single or polyphase packaged or split system unitary heat pump meeting an efficiency criteria substantially above CEE Tier II. High efficiency level will reflect the maximum level available from multiple major manufacturers, weighted by size and type of units.	Standard efficiency new unitary heat pump. Baseline efficiency will reflect weighted average by size and type.	15	11.3%	$ 0.79		90	134,102,93, 168	136
Cooling	Ret	High-eff HP CEE Tier II - Cool	Single or polyphase packaged or split system unitary heat pump meeting an efficiency criteria substantially above CEE Tier II. High efficiency level will reflect the maximum level available from multiple major manufacturers, weighted by size and type of units.	Existing stock efficiency unitary heat pump. Existing stock efficiency will reflect weighted average by size and type.	15	22.1%	$ 3.37		90	134,92,93,1 68	136

Primary Fuel End Use	Applicable Markets	Measure Name	Measure Description	Baseline Description	Life (yr)	% Savings	Incre-mental Cost/kWh Saved	Annual Fossil Fuel Savings (MMBtu per kWh saved)	Measure Life Source	Savings Data Sources	Costs Data Sources
Space Heating	NC, Reno, Repl	High-eff HP CEE Tier II - Heat	See corresponding "Cool" measure.	Standard efficiency new unitary heat pump. Baseline efficiency will reflect weighted average by size and type.	15	10.6%	$ 0.79		90	134,102,93, 168	136
Space Heating	Ret	High-eff HP CEE Tier II - Heat	See corresponding "Cool" measure.	Existing stock efficiency unitary heat pump. Existing stock efficiency will reflect weighted average by size and type.	15	14.3%	$ 3.37		90	134,92,93,168	136
Cooling	NC, Reno, Repl	Water src HP v. air src - Cool	Water cooled heat pump using a water loop as a heat sink.	Standard efficiency unitary heat pump.	15	29.0%	$ 0.49		1, 18, 22	93, 102, 103, 168	1, 170
Space Heating	NC, Reno, Repl	Water src HP v. air src - Heat	Water cooled heat pump using a water loop as a heat sink.	Standard efficiency unitary heat pump.	15	39.9%	$ 0.49		1, 18, 22	93, 102, 103, 168	104
Cooling	NC, Reno, Repl	Ground source HP - Cool	Heat pump using ground as a heat sink. Either trench or well type.	Standard efficiency unitary heat pump.	20	49.1%	$ 1.71		1, 18, 22	93, 102, 103, 168	104
Space Heating	NC, Reno, Repl	Ground source HP - Heat	Heat pump using ground as a heat sink. Either trench or well type.	Standard efficiency unitary heat pump.	20	33.2%	$ 1.71		1, 18, 22	93, 102, 103, 168	104
Cooling	Reno, Repl	HE Room AC	A 'room air conditioner' is defined as a consumer product, other than a 'packaged terminal air conditioner,' which is powered by a single phase electric current and which is an encased assembly designed as a unit for mounting in a window or through the wall for the purpose of providing delivery of conditioned air to an enclosed space. It includes a prime source of refrigeration and may include a means for ventilating and heating. Upgrade to EER 10.8 (consistent with ENERGY STAR criteria for typical unit as of 5/27/09)	Standard efficiency Room AC unit meeting federal manufacturing standards.	9	9.3%	$ 0.39		90	15, 16, 93	17
Cooling	Ret	HE Room AC	A 'room air conditioner' is defined as a consumer product, other than a 'packaged terminal air conditioner,' which is powered by a single phase electric current and which is an encased assembly designed as a unit for mounting in a window or through the wall for the purpose of providing delivery of conditioned air to an enclosed space. It includes a prime source of refrigeration and may include a means for ventilating and heating. Upgrade to EER 10.8 (consistent with ENERGY STAR criteria for typical unit as of 5/27/09)	Old window AC unit (7.5+ years old)	9	9.3%	$ 1.70		90	15, 16, 93	17
Cooling	NC, Reno, Repl	High-efficiency chillers Tier I	High efficiency water cooled chillers (represents weighted average of different types and sizes) - Tier I	Standard efficiency water cooled chiller	25	19.9%	$ 1.54		1	102, 105, 93, 168	3, 39
Cooling	Ret	High-efficiency chillers Tier I	High efficiency water cooled chillers (represents weighted average of different types and sizes) - Tier I	Standard efficiency water cooled chiller	25	28.7%	$ 2.62		1	92, 93, 105, 168	3, 39
Cooling	NC, Reno, Repl	High-efficiency chillers Tier II	High efficiency water cooled chillers (represents weighted average of different types and sizes) - Tier II	Standard efficiency water cooled chiller	25	30.8%	$ 1.22		1	102, 105, 93, 168	3
Cooling	Ret	High-efficiency chillers Tier II	High efficiency water cooled chillers (represents weighted average of different types and sizes) - Tier II	Standard efficiency water cooled chiller	25	38.4%	$ 2.15		1	92, 93, 105, 168	3
Cooling	NC, Reno	Opt unitary hvac dist/ctrl sys	High efficiency distribution system for unitary systems, based on mix of measures to optimize the total system efficiency. Potentially including controls, economizers, VFDs, VAV, better design, etc. This is mainly a design measure, applicable to NC and large renovation.	New construction standard efficiency unitary HVAC distribution system	15	30.0%	$ 0.53	0.004	40	51,93	3, 74, 39
Cooling	NC, Reno	Opt chiller dist/ctrl sys	High efficiency distribution system for chiller systems, based on mix of measures to optimize the total system efficiency. Potentially including controls, economizers, VFDs, better design, etc.	New construction standard efficiency unitary HVAC distribution system	10	20.0%	$ 0.53		22	64, 39	3, 74, 39
Cooling	NC, Reno	EMS/Controls -Cool	Energy management system and/or other controls to optimize control of HVAC system. Could include scheduling, optimal start-stop, chiller reset control, dual enthalpy economizers, CO2 sensors, etc.	No building automation	15	17.5%	$ 0.70	0.003	22	41, 42,114, 150	48, 75, 114

Primary Fuel End Use	Applicable Markets	Measure Name	Measure Description	Baseline Description	Life (yr)	% Savings	Incre-mental Cost/kWh Saved	Annual Fossil Fuel Savings (MMBtu per kWh saved)	Measure Life Source	Savings Data Sources	Costs Data Sources
Cooling	Ret	EMS/Controls -Cool	Energy management system and/or other controls to optimize control of HVAC system. Could include scheduling, optimal start-stop, chiller reset control, dual enthalpy economizers, CO2 sensors, etc.	No building automation	15	17.5%	$ 1.05	0.003	22	41, 42, 114, 150	48, 75, 114
Ventilation	NC, Reno	EMS/Controls -Vent	See corresponding "Cool" measure.	No building automation	15	17.5%	$ 0.70	0.003	22	41, 42, 114, 150	48, 75, 114
Ventilation	Ret	EMS/Controls -Vent	See corresponding "Cool" measure.	No building automation	15	17.5%	$ 1.05	0.003	22	41, 42, 114, 150	48, 75, 114
Cooling	NC, Reno, Repl	Dual enthalpy economizer	Dual enthalpy economizers with electronic controls to optimize use of outside air to reduce cooling loads.	Standard efficiency economizers, represents a mix of dry-bulb and single enthalpy.	10	7.1%	$ 1.37		1	168, 1	3
Cooling	Ret	Dual enthalpy economizer	Dual enthalpy economizers with electronic controls to optimize use of outside air to reduce cooling loads.	Existing stock, represents a mix of dry-bulb and fixed dampers.	10	9.6%	$ 1.01		1	168, 1	3
Cooling	NC, Reno, Repl	Demand controlled ventilation -Cool	Adjust ventilation rates based on indoor-air quality (typically by monitoring CO2 levels with sensors)	Ventilation system in which the outside air ventilation rate is fixed when the building is occupied	10	19.4%	$ 0.26	0.021	1	41, 25, 76, 150, 168	109
Cooling	Ret	Demand controlled ventilation -Cool	Adjust ventilation rates based on indoor-air quality (typically by monitoring CO2 levels with sensors)	Ventilation system in which the outside air ventilation rate is fixed when the building is occupied	10	19.4%	$ 0.32	0.021	1	41, 25, 76, 150, 168	109
Ventilation	NC, Reno, Repl	Demand controlled ventilation -Vent	See corresponding "Cool" measure.	Ventilation system in which the outside air ventilation rate is fixed when the building is occupied	10	10.0%	$ 0.26	0.021	1	25, 150	76
Ventilation	Ret	Demand controlled ventilation -Vent	See corresponding "Cool" measure.	Ventilation system in which the outside air ventilation rate is fixed when the building is occupied	10	10.0%	$ 0.32	0.021	1	25, 150	77
Cooling	Ret	HVAC tune-up -Cool	Optimize an existing HVAC system by adjusting refrigerant charge, air flow, and control set-points for maximum efficiency.	HVAC system with non-optimized airflow and refrigerant charge	6	7.5%	$ 0.13	0.007	39	61, 150	78, 79
Cooling	NC, Reno	Duct sealing -Cool	Seal HVAC ductwork with aerosol-based sealant to reduce air leakage outside the conditioned space and the consequent energy loss.	Leaky and unsealed ducts	25	11.5%	$ 0.16		25	93, 150	80, 119
Cooling	Ret	Duct sealing -Cool	Seal HVAC ductwork with aerosol-based sealant to reduce air leakage outside the conditioned space and the consequent energy loss.	Leaky and unsealed ducts	25	11.5%	$ 0.16		25	93, 150	80, 119
Ventilation	NC, Reno	Duct sealing -Vent	See corresponding "Cool" measure.	Leaky and unsealed ducts	25	9.0%	$ 0.16		25	93, 80, 150	80, 119
Ventilation	Ret	Duct sealing -Vent	See corresponding "Cool" measure.	Leaky and unsealed ducts	25	9.0%	$ 0.16		25	93, 80, 150	80, 119
Ventilation	NC, Reno, Repl	Variable Frequency Drive (VFD)	Variable frequency drive on applicable fans and pumps	No control or manual control with Inlet/outlet dampers or throttle valves	15	39.7%	$ 0.14		1, 18	1, 65	1, 48, 82
Ventilation	Ret	Variable Frequency Drive (VFD)	Variable frequency drive on applicable fans and pumps	No control or manual control with Inlet/outlet dampers or throttle valves	15	39.7%	$ 0.13		1, 18	65, 93	1, 48, 82
Cooling	NC, Reno, Repl	Low Flow Fume Hood	High efficiency low-flow fume hoods, typically used in laboratories, operate on the principle of an air supply with low turbulence intensity in the face of the hood. This alternative design results in significantly reduced volumes of exhaust air, which means less energy needed to move that air, while still providing sufficient air flow to dilute contaminants in the hood.	Constant volume (CV) and variable air volume (VAV) fume hoods with an average face velocity of >= 90 ft/min	25	44.4%	$ 0.38	0.007	88	88, 89	88, 89
Cooling	NC, Reno, Repl	HE stove hood -Cool	Optimized stove hoods to minimize conditioned make-up air requirements.	Standard stove hoods	20	10.5%	$ 0.51		27	62, 63, 81	63, 81
Cooling	Ret	HE stove hood -Cool	Optimized stove hoods to minimize conditioned make-up air requirements.	Standard stove hoods	20	10.5%	$ 0.51		27	62, 63, 81	63, 81
Ventilation	NC, Reno, Repl	HE stove hood -Vent	See corresponding "Cool" measure.	Standard stove hoods	20	68.0%	$ 0.51		27	62, 63, 81	63, 81
Ventilation	Ret	HE stove hood -Vent	See corresponding "Cool" measure.	Standard stove hoods	20	68.0%	$ 0.51		27	62, 63, 81	63, 81

Primary Fuel End Use	Applicable Markets	Measure Name	Measure Description	Baseline Description	Life (yr)	% Savings	Incre-mental Cost/kWh Saved	Annual Fossil Fuel Savings (MMBtu per kWh saved)	Measure Life Source	Savings Data Sources	Costs Data Sources
Water Heating	Ret	Electric DHW pipe insulation	Electric Domestic Hot Water pipe insulation	Uninsulated hot water pipe	15	0.4%	$ 0.01		31, 32	93	127
Water Heating	Ret	Electric water heater tank insulation	Electric water heater tank wrap insulation	Hot water tank without a tank wrap	10	0.6%	$ 0.09		91	93	127
Water Heating	NC, Reno, Ret	Elec instant water heat vs. elec DHW	Electric point-of-use water heating with no storage capacity, as compared to electric DHW storage.	Standard centrally located electric storage water heater	10	33.8%	$ 0.01		30	45, 62	172
Water Heating	Ret	Elec instant water heat vs. elec DHW	Electric point-of-use water heating with no storage capacity, as compared to electric DHW storage.	Standard centrally located electric storage water heater	10	33.8%	$ 0.13		30	45	172
Water Heating	Ret	Low-flow pre-rinse spray valve, elec DHW	Low-flow pre-rinse spray valve for food service applications	Pre-rinse spray valve greater than 1.6gpm	5	46.7%	$ 0.03		168	168	39
Cooling	NC, Reno, Repl	HP window glazing Tier I -Cool	Currently available high efficiency glazing	The baseline condition is assumed to be single pane clear glass with a solar heat gain coefficient of 0.87	20	6.1%	$ 0.08		91	93	39
Space Heating	NC, Reno, Repl	HP window glazing Tier I -Elec Heat	Currently available high efficiency glazing	The baseline condition is assumed to be single pane clear glass with a solar heat gain coefficient of 0.87	20	23.6%	$ 0.08		91	93	39
Elec Total	Reno	Deep Energy Retrofit - Electric	Deep energy retrofit going after deep savings in every building systems, mostly for the renovation market	Energy use of the existing building, before the deep energy retrofit occurs. Assumes energy use of typical existing building.	20	43.0%	$ 0.37		143	137	137
Cooling	Ret	Window Film	Window films reduce solar heat gain in the summer by blocking infrared radiation passing through windows. This reduces the cooling load in the summer	single pane clear glass in commercial buildings with a solar heat gain coefficient of 0.87	10	4.7%	$ 0.68	(0.023)	39	93	91
Office Equipment	MD	HE plug loads	Plug Load equipment, including computers, display, copier, fax, printer, power supply, TVs, and set top boxes	Standard Office equipment	4	65.8%	$ 0.07		168	131	131133
Office Equipment	Ret	Office equipment control	Low cost measures that can be done as a retrofit to an office building. Includes Power Management, advanced plug strips/timers, monitor brightness settings, and occupant behavior.	Standard Office equipment control and standard power strips	3	29.0%	$ 0.11		131, 132	131	131
Indoor Lighting	NC, Reno, Repl, Ret	Hospitality control - lighting	System controlling HVAC and lighting for hotels/motels	Typical hotel room with no key card control or occupancy sensor	15	33.0%	$ 0.17		25	25	25
Cooling	NC, Reno, Repl, Ret	Hospitality control - cooling	System controlling HVAC and lighting for hotels/motels	Typical hotel room with no key card control or occupancy sensor	15	20.0%	$ 0.17		25	25	25
Heating	NC, Reno, Repl, Ret	Hospitality control - heating	System controlling HVAC and lighting for hotels/motels	Typical hotel room with no key card control or occupancy sensor	15	20.0%	$ 0.17		25	25	25
Office Equipment	Ret	Hotel guestroom plug load reduction	efficient TVs and refrigerators in hotel guest rooms	Standard efficiency TVs and refrigerators	12	11.8%	$ 0.53		146	147	147
Office Equipment	Ret, Repl	Smart strip plug outlets	A multi-plug power strip with the ability to automatically disconnect specific loads that are plugged into it depending on the power draw of a control load, also plugged into the strip.	Conventional power strip with no mechanism for disconnecting loads	8	2.9%	$ 0.66		39	118	118
Water Heating	NC, Reno, Repl	HE clothes washer, elec DHW	High-efficiency commercial coin-op washers	Standard efficiency washer, elec DHW, electric dryer	11	28.4%	$ 0.47		33	168, 33, 62, 94	168, 33
Water Heating	Ret	HE clothes washer, elec DHW	High-efficiency commercial coin-op washers	Standard efficiency washer, elec DHW, electric dryer	11	19.9%	$ 3.18		33	168, 33, 62, 94	33
Refrigeration	NC, Reno, Repl	Energy Star vending machine	High-efficiency refrigerated vending machines. Includes better lighting, controls and refrigeration.	Standard efficiency new vending machine purchases.	14	42.1%	$ -		34, 35, 26, 94	94	47
Refrigeration	Ret	Vending miser	Vending miser or equivalent control to reduce lighting and refrigeration energy during low use periods	No control	10	37.5%	$ 0.28		1	93	85
Refrigeration	NC, Reno, Repl	High-eff built-up refrigeration	High-efficiency built-up refrigeration systems for grocery and refrigerated warehouses. This potentially includes HE compressors, better design and controls, HE motors and VFDs.	Standard efficiency built-up refrigeration systems	10	25.3%	$ 0.48	0.004	18, 34	34, 62	34

Primary Fuel End Use	Applicable Markets	Measure Name	Measure Description	Baseline Description	Life (yr)	% Savings	Incre-mental Cost/kWh Saved	Annual Fossil Fuel Savings (MMBtu per kWh saved)	Measure Life Source	Savings Data Sources	Costs Data Sources
Refrigeration	Ret	High-eff built-up refrigeration	High-efficiency built-up refrigeration systems for grocery and refrigerated warehouses. This potentially includes HE compressors, better design and controls, HE motors and VFDs.	Existing stock efficiency built-up refrigeration systems	10	31.4%	$ 2.59	0.004	18, 34	34, 62	34
Refrigeration	NC, Reno, Repl	High-eff reach-in refrig, freezers	High-efficiency stand-alone reach-in refrigeration & freezer units for grocery, convenience stores, restaurants and cafeterias. Efficiency improvements include better door heater control, better lighting, HE compressors, greater insulation.	Standard efficiency new reach-in refrigeration units.	9	26.0%	$ 0.39		20, 34, 35	93	97
Refrigeration	NC, Reno, Repl	HE Ice Makers	High efficiency new ice machines	Standard efficiency new ice machines	8	9.0%	$ 0.09		98, 97	97	97
Refrigeration	NC, Reno, Repl	High-efficiency small walk-in	High-efficiency small walk-in cooler with self-contained refrigeration system	Standard efficiency walk-in refrigeration system	13	54.0%	$ 0.10		1	34, 62	34
Refrigeration	Ret	Walk-in refrig retrofit package	High efficiency walk-in refrigeration system retrofit improvements (includes economizer, humidistat, evaporator fan control, etc.)	Standard efficiency existing stock walk-in refrigeration systems	16	16.8%	$ 0.23		34, 38	49	49
Refrigeration	NC, Reno, Repl	High-efficiency display coolers	High-efficiency refrigerated display coolers	Standard efficiency one door beverage merchandiser	9	35.1%	$ 0.26		34	62	34
Refrigeration	Ret	High-efficiency display coolers	High-efficiency refrigerated display coolers	Standard efficiency existing stock display cooler	9	35.1%	$ 4.01		34	62	34
Water Heating	NC, Reno, Repl	Heat pump H2O heat from refrig -WH	Heat pump water heating using waste heat recovery from refrigeration systems (water heating component)	Air cooled refrigeration, traditional gas or electric water heating (note some electric water heating savings result as well)	14	43.0%	$ 0.35		20	64, 20	20
Water Heating	Ret	Heat pump H2O heat from refrig -WH	Heat pump water heating using waste heat recovery from refrigeration systems (water heating component)	Air cooled refrigeration, traditional gas or electric water heating (note some electric water heating savings result as well)	14	50.0%	$ 0.38		20	64, 20	20
Refrigeration	NC, Reno, Repl	Heat pump H2O heat from refrig -Refrig	Heat pump water heating using waste heat recovery from refrigeration systems (refrigeration component)	Air cooled refrigeration, traditional gas or electric water heating (note some electric water heating savings result as well)	14	5.0%	$ -		20	62	20
Refrigeration	Ret	Heat pump H2O heat from refrig -Refrig	Heat pump water heating using waste heat recovery from refrigeration systems (refrigeration component)	Air cooled refrigeration, traditional gas or electric water heating (note some electric water heating savings result as well)	14	5.0%	$ -		20	62	20
Elec Total	Ret	Retrocommissioning - Elec	Optimizing energy usage of existing buildings and systems using O&M, control calibration, etc.	A typical existing building that hasn't been commissioned	7	9.0%	$ 0.09		25, 54, 55, 56	115, 25	115
Elec Total	NC, Reno	Commissioning -Elec	Whole building commissioning of new buildings to ensure optimized design, installation and operation of systems.	New Construction building with no commissioning performed	7	7.3%	$ 0.55		25, 54, 55, 56	115	115
Elec Total	NC	Integrated bldg design Tier I -Elec	Reflects comprehensive, optimized design of new buildings addressing all end-uses and interactions between them on a systems basis. Measures include, but are not limited to, improved air barrier performance, minimum IAQ performance, lighting controls, improved lighting power density, improved mechanical equipment efficiency, and demand controlled ventilation.	New building conforming to ASHARE 90.1-2007	15	36.4%	$ 0.61		58	184	184
Cooling	Ret	Cool roof	White roofing material or coating, to reflect the sun and reduce air-conditioning loads	Typical black roof	20	32.2%	$ 5.13	(0.000)	90	141	142
Cooling	NC, Reno, Repl	Cool roof	White roofing material or coating, to reflect the sun and reduce air-conditioning loads	Typical black roof with typical reflectance and absorption	20	32.2%	$ 0.46	(0.000)	90	141	142
Elec Total	NC	Building operational efficiency (behavioral)	Reflects an amalgamation of both post-consumption (indirect) and real-time (direct) energy usage feedback to building managers and occupants via monthly mailing, on-site displays, etc., as could be supported by Advanced Metering Infrastructure (AMI) - an emerging technology.	New building without planned direct / indirect feedback on electric usage	5	3.0%	$ 0.52		39	39	25, 39

Primary Fuel End Use	Applicable Markets	Measure Name	Measure Description	Baseline Description	Life (yr)	% Savings	Incre-mental Cost/kWh Saved	Annual Fossil Fuel Savings (MMBtu per kWh saved)	Measure Life Source	Savings Data Sources	Costs Data Sources
Elec Total	Ret	Building operational efficiency (behavioral)	Reflects an amalgamation of both post-consumption (indirect) and real-time (direct) energy usage feedback to building managers and occupants via monthly mailing, on-site displays, etc., as could be supported by Advanced Metering Infrastructure (AMI) - an emerging technology.	Building without direct / indirect feedback on electric usage	5	3.0%	$ 0.52		39	39	25, 39
Data Center	NC, Reno, Repl	Data centers virtualization -IT	Data Center energy savings for information technology (computer loads) at facilities or rooms used to house computer servers and data systems through the use of server virtualization.	Typical data center without server virtualization	5	47.9%	$ 0.17		57	57, 62	86, 39
Data Center	Ret	Data centers virtualization -IT	Data Center energy savings for information technology (computer loads) at facilities or rooms used to house computer servers and data systems through the use of server virtualization.	Typical data center without server virtualization	5	47.9%	$ 0.17		57	57, 62	86, 39
Cooling	NC, Reno, Repl	Data centers virtualization -Cool	Data Center reduced cooling loads associated with electric savings for computer loads.	Typical data center without server virtualization	5	47.9%	$ 0.17		57	57, 62	86, 39
Cooling	Ret	Data centers virtualization -Cool	Data Center reduced cooling loads associated with electric savings for computer loads.	Typical data center without server virtualization	5	47.9%	$ 0.17		57	57, 62	86, 39
Miscellaneous	NC, Reno, Repl	Water & sewer process	Municipal water and wastewater treatment system optimization, including replacing coarse-bubble aeration with fine-pore aeration, right-sizing pump, impeller trimming, addition of pony pump for smaller loads or VFD, leak reduction, better O&M practices.	Existing practices including coarse-bubble aeration, oversized pumps with no VFD.	10	31.7%	$ 0.38		39	200	200
Miscellaneous	Ret	Water & sewer process	Municipal water and wastewater treatment system optimization, including replacing coarse-bubble aeration with fine-pore aeration, right-sizing pump, impeller trimming, addition of pony pump for smaller loads or VFD, leak reduction, better O&M practices.	Existing practices including coarse-bubble aeration, oversized pumps with no VFD.	10	31.7%	$ 0.38		39	200	200
Miscellaneous	Ret	ECM Circulator Pump	Install a variable speed circulation pump instead of a constant speed pump	Circulator pump using a low efficiency shaded pole motor installed on the primary loop of a multiloop	20	64.7%	$ 0.65		1	1	1
Water Heating	Ret	Low-flow showerhead, elec DHW	0	0	10	0.1%	$ 0.01		91	91, 1, 116	91, 116
Food Preparation	Ret	HE kitchen equipment - elec, 2 meal	High-efficiency commercial electric kitchen cooking/warming equipment (holding cabinet, steamer, combination oven, deep	Standard Food Preparation Equipment	12	27.1%	$ 1.35		91, 97	97	97
Food Preparation	NC, Reno, Repl	HE kitchen equipment - elec, 2 meal	High-efficiency commercial electric kitchen cooking/warming equipment (holding cabinet, steamer, combination oven, deep	Standard Food Preparation Equipment	12	27.1%	$ 0.12		91, 97	97	97
Food Preparation	Ret	HE kitchen equipment - elec, 3 meal	High-efficiency commercial electric kitchen cooking/warming equipment (holding cabinet, steamer, combination oven, deep	Standard Food Preparation Equipment	12	25.9%	$ 1.41		91, 97	97	97
Food Preparation	NC, Reno, Repl	HE kitchen equipment - elec, 3 meal	High-efficiency commercial electric kitchen cooking/warming equipment (holding cabinet, steamer, combination oven, deep	Standard Food Preparation Equipment	12	25.9%	$ 0.11		91, 97	97	97
Elec Total	Ret	Behavioral Measures - Elec	Includes occupant training, interactive meters w/ real-time pricing capability.	No Behavioral Modification Program	1	2.0%	$ 0.09		185	185	39
Water Heating	Ret	Switch elec DHW to gas	40-gal electric DHW tank to 40-gal gas condensing gas water heater (standalone)	40-gallon electric DHW tank	13	100.0%	$ 0.22	(0.003)	29	191, 168	29
Water Heating	Repl	Switch elec DHW to gas	40-gal electric DHW tank to 40-gal gas condensing gas water heater (standalone)	40-gallon electric DHW tank	13	100.0%	$ 0.14	(0.003)	29	191, 168	29
Space Heating	Ret	Fuel switch elec unit heater to gas	Fuel switch elec unit heater to gas	Electric unit heater	20	100.0%	$ 0.19	(0.004)	138	39	198
Space Heating	Repl	Fuel switch elec unit heater to gas	Fuel switch elec unit heater to gas	Electric unit heater	20	100.0%	$ 0.01	(0.004)	138	39	197198
Space Heating	Ret	Fuel switch elec unit heater to infrared gas	Fuel switch elec unit heater to infrared gas	Electric unit heater	20	100.0%	$ 0.05	(0.003)	138	39	199

Commercial Fossil Fuel Measures

Primary Fuel End Use	Applicable Markets	Measure Name	Measure Description	Baseline Description	Life (yr)	% Savings	Incre-mental Cost/kWh Saved	Annual Fossil Fuel Savings (kWh per MMBtu saved)	Data Sources: Measure Life Source	Data Sources: Savings Data Sources	Data Sources: Costs Data Sources
Space Heating	NC, Reno, Repl	HP window glazing Tier I -FF Heat	Currently available high efficiency glazing	The baseline condition is assumed to be single pane clear glass with a solar heat gain coefficient of 0.87	20	3.2%	$ 0.08		91	93	39
Space Heating	Reno	Deep Energy Retrofit - Fossil Fuel	Deep energy retrofit going after deep savings in every building systems, mostly for the renovation market	Energy use of the existing building, before the deep energy retrofit occurs. Assumes energy use of typical existing building.	20	43.0%	$ 107.99		143	137	137
Space Heating	Ret	Envelope Upgrade	Add attic insulation,wall insulation, and air sealing to small commercial building envelopes	Typical envelope insulation levels and tightness for existing northeastern small commercial buildings	15	14.8%	$ 85.95	$107.29	144	149, 152	149
Fuel Total	Ret	Retrocommissioning - Fossil Fuel	Optimizing energy usage of existing buildings and systems using O&M, control calibration, etc.	A typical existing building that hasn't been commissioned	7	16.0%	$ 25.94		25, 54, 55, 56	115	115
Fuel Total	NC, Reno	Commissioning -Fossil Fuel	Whole building commissioning of new buildings to ensure optimized design, installation and operation of systems.	New Construction building with no commissioning performed	7	13.0%	$ 161.62		25, 54, 55, 56	115	115
Space Heating	NC	Integrated bldg design Tier I -Fossil Fuel	Reflects comprehensive, optimized design of new buildings addressing all end-uses and interactions between them on a systems basis. Measures include, but are not limited to, improved air barrier performance, minimum IAQ performance, lighting controls, improved lighting power density, improved mechanical equipment efficiency, and demand controlled ventilation.	New building conforming to ASHARE 90.1-2007	15	36.4%	$ 179.58		58	148	184
Space Heating	NC, Reno, Repl	High-efficiency fossil fuel furnace	Higher Efficiency (typically condensing) gas fired Furnace	Standard efficiency furnace (non-condensing for gas)	20	15.2%	$ 101.08		90	39	39
Space Heating	NC, Reno, Repl	High-efficiency boiler	Higher Efficiency gas or oil fired boiler, AFUE 85% or greater	Standard efficiency gas fired boiler, AFUE 80%	25	14.9%	$ 176.39		39	116	91
Space Heating	NC, Reno, Repl	High-efficiency boiler	Higher Efficiency gas or oil fired boiler, AFUE 85% or greater	Standard efficiency gas fired boiler, AFUE 75%	25	20.2%	$ 208.88		39	91, 116	91
Space Heating	NC, Reno, Repl	Condensing gas unit heater	High-efficiency power-vented unit heaters have a sealed flue which reduces losses when the heater is not firing	Power Driven Unit Heater (78% AFUE)	20	14.3%	$ 133.06		138	140	140
Space Heating	Ret	Condensing gas unit heater	High-efficiency power-vented unit heaters have a sealed flue which reduces losses when the heater is not firing	Gravity Driven Unit Heater (63% AFUE)	20	30.8%	$ 71.89		138	140	140
Space Heating	NC, Reno, Repl	High-efficiency gas infrared heater	High efficiency gas-fired infrared heating unit	Standard efficiency gas unit heater	17	17.4%	$ 15.20		91	91, 116	91
Water Heating	Ret	Gas boost H2O heater on HE dishwasher	Gas fired boost heater for intake hot water pipe on HE commercial dishwasher	Commercial dishwasher with the tank temperature set to deliver sanitized water (180° F) without a boost heater	20	38.0%	$ 3.49		117	97	97
Water Heating	NC, Reno, Repl	Gas HE tank-type water heater	Gas fired high efficiency stand-alone tank-type water heater	Stand-alone gas-fired tank type water heater with a thermal efficiency of .8	13	12.0%	$ 15.00		93	116	91
Water Heating	Ret	Gas HE tank-type water heater	Gas fired high efficiency stand-alone tank-type water heater	Stand-alone gas-fired tank type water heater with a thermal efficiency of .8	13	21.0%	$ 27.27		93	116	91
Space Heating	Ret	Programmable thermostat, fossil fuel heat	Programmable thermostat allows user to automatically cycle space heating equipment on and off to desired set point throughout the day using pre-programmed timers, for gas heat	Assume space heating equipment size of 1,000 Mbtu/h at 75% AFUE	12	5.3%	$ 11.65		93	116	91
Space Heating	MD	Duct insulation and sealing, FF heat	Seal HVAC ductwork with aerosol-based sealant to reduce air leakage outside the conditioned space and the consequent energy loss.	Leaky and unsealed ducts	25	11.5%	$ 46.50		119	93	39
Space Heating	Ret	Duct insulation and sealing, FF heat	Seal HVAC ductwork with aerosol-based sealant to reduce air leakage outside the conditioned space and the consequent energy loss.	Leaky and unsealed ducts	25	11.5%	$ 46.50		119	93	39
Water Heating	Ret	Low-flow showerhead, FF DHW	reduces flow rate on showers	Standard shower head (average rated at 3.25 GPM)	5	61.5%	$ 2.85		116	91, 1, 116	116
Water Heating	Ret	Faucet aerator, FF DHW	reduces flow rate on sinks	Standard faucet (average rated at 2.2 GPM)	5	31.8%	$ 22.42		93	91, 1, 116	116
Water Heating	NC, Reno	Commercial clothes washers, FF DHW	High efficiency commercial clothes washers save both kWh and MMBtu. 2.84 cu. ft. machine that meats CEE Tier II (1.60 MEF).	Regular efficiency commercial clothes washer hooked up to Gas-fired hot water (assumes 2.84 cu. ft. machine) at NAECA required efficiency of 1.04 MEF	12	43.4%	$ 174.09		91	94	94
Water Heating	Ret	Pre-rinse spray valves, FF DHW	Reduces flow rate for commercial food service dish pre-rinse sprayers	Pre-rinse spray valve at 3.2 gpm (1.5 hours/per day; 360 day/year. Water temperature rise 70F; gas heater thermal efficiency 0.8)	5	3.6%	$ 2.33		91	91	91, 177

Primary Fuel End Use	Applicable Markets	Measure Name	Measure Description	Baseline Description	Life (yr)	% Savings	Incre-mental Cost/kWh Saved	Annual Fossil Fuel Savings (kWh per MMBtu saved)	Measure Life Source	Savings Data Sources	Costs Data Sources
Water Heating	Ret	Water heater tank insulation, FF DHW	Wrapping a stand-alone water heater in insulating blanket	Stand-alone gas-fired water heater (thermal efficiency .8) without tank insulation	10	0.7%	$ 20.97		116	91, 1, 116	116
Water Heating	Ret	Hot water pipe insulation, FF DHW	Wrapping hot water send and return pipes in Insulation	Stand-alone gas-fired water heater (thermal efficiency .8) without outlet pipe insulation	10	0.4%	$ 3.43		116	91, 1, 116	116
Water Heating	NC, Reno	Hot water pipe insulation, FF DHW	Wrapping hot water send and return pipes in Insulation	Stand-alone gas-fired water heater (thermal efficiency .8) without outlet pipe insulation	10	0.4%	$ 3.43		116	91, 1, 116	116
Food Preparation	Ret	Gas kitchen equipment, 2 meal	High-efficiency commercial gas kitchen cooking/warming equipment (holding cabinet, steamer, combination oven, deep fryer, griddle, grill) - 2 meals per day	Non-Energy Star gas-fired commercial kitchen equipment, prototype setup	12	32.7%	$ 138.67		91, 97	97	97
Food Preparation	NC, Reno, Repl	Gas kitchen equipment, 2 meal	High-efficiency commercial gas kitchen cooking/warming equipment (holding cabinet, steamer, combination oven, deep fryer, griddle, grill) - 2 meals per day	Non-Energy Star gas-fired commercial kitchen equipment, prototype setup	12	0.0%	$ 15.21		91, 97	39	97
Food Preparation	Ret	Gas kitchen equipment, 3 meal	High-efficiency commercial gas kitchen cooking/warming equipment (holding cabinet, steamer, combination oven, deep fryer, griddle) for a restaurant that serves 3 meals per day	Standard Food Preparation Equipment	12	29.2%	$ 168.79		91, 97	97	97
Food Preparation	NC, Reno, Repl	Gas kitchen equipment, 3 meal	High-efficiency commercial gas kitchen cooking/warming equipment (holding cabinet, steamer, combination oven, deep fryer, griddle) for a restaurant that serves 3 meals per day	Standard Food Preparation Equipment	12	29.2%	$ 15.78		91, 97	97	97
Space Heating	Ret	Behavioral Measures - Fossil Fuel Heat, DHW	Includes occupant training, interactive meters w/ real-time pricing capability.	No Behavioral Modification Program	1	2.0%	$ 5.00		185	39	39
Water Heating	NC, Reno	Point of use water heat, gas DHW	Electric water heating at point of use with no storage capacity	0	10	28.1%	$ 8.19		87, 91	97, 91	97, 91, 119
Food Preparation	NC, Reno, Repl	Turbo Pot	24 qt. Stock Pot	Standard stock pot	3	27.8%	$ 10.30		192	189, 190	190
Water Heating	NC, Reno, Repl, Ret	Ozone Laundry	Ozone Laundry systems for large laundromats and facilities with on-site laundry	Standard Laundry System	20	91.0%	$ 21.95	$4.06	193	194	194
Space Heating	Ret	Steam Traps	Replace steam traps for commercial steam heating systems	Failed Steam Traps	6	33.4%	$ 5.54		196	196	196
Space Heating	Ret	Fuel switch oil burner to dual fuel	replace oil burner with a burner using gas as primary fuel	Oil burner on commercial boiler	25	100.0%	$ 334.00	$0.89	90	39	39

Industrial Electric Measures

Primary Fuel End Use	Applicable Markets	Measure Name	Measure Description	Baseline Description	Life (yr)	% Savings	Incre-mental Cost/kWh Saved	Annual Fossil Fuel Savings (MMBtu per kWh saved)	Data Sources: Measure Life Source	Data Sources: Savings Data Sources	Data Sources: Costs Data Sources
Industrial Process	NC, Repl	Industrial process	Represents a comprehensive suite of industrial energy efficiency measures addressing electric process energy.	Standard efficiency for aggregated measures	14	21.5%	$ 0.09		181, 182	181, 182, 39	181, 182, 39
Industrial Process	Ret	Industrial process	Represents a comprehensive suite of industrial energy efficiency measures addressing electric process energy.	Standard efficiency for aggregated measures	14	21.3%	$ 0.09		181, 182	181, 182, 39	181, 182, 39
Indoor Lighting	NC, Reno, Repl	Industrial lighting	Represents a comprehensive suite of industrial energy efficiency measures addressing indoor lighting.	Standard efficiency for aggregated measures	12	25.4%	$ 0.15		181, 182	181, 182, 39	181, 182, 39
Indoor Lighting	Ret	Industrial lighting	Represents a comprehensive suite of industrial energy efficiency measures addressing indoor lighting.	Standard efficiency for aggregated measures	12	33.8%	$ 0.15		181, 182	181, 182, 39	181, 182, 39
Cooling	NC, Reno, Repl	Industrial space cooling	Represents a comprehensive suite of industrial energy efficiency measures addressing space cooling	Standard efficiency for aggregated measures	10	6.0%	$ 0.75		181, 182	181, 182, 39	181, 182, 39
Cooling	Ret	Industrial space cooling	Represents a comprehensive suite of industrial energy efficiency measures addressing space cooling	Standard efficiency for aggregated measures	10	6.0%	$ 0.75		181, 182	181, 182, 39	181, 182, 39
Motors-Pumps	Ret	Sensors and controls - Motors-Pumps	Implement process control systems to improve the efficiency industrial processes. Sensors are inexpensive to install, reliable, and analyze in real-time.	Industrial processes with no-, inadequate, or inoperable controls and sensors/	15	3.0%	$ 0.10		11	11, 39	11, 39
Motors-Fans and Blowers	Ret	Sensors and controls - Motors-Fans and Blowers	Implement process control systems to improve the efficiency industrial processes. Sensors are inexpensive to install, reliable, and analyze in real-time.	Industrial processes with no-, inadequate, or inoperable controls and sensors/	15	3.0%	$ 0.10		11	11, 39	11, 39
Motors-Compressed Air	Ret	Sensors and controls - Motors-Compressed Air	Implement process control systems to improve the efficiency industrial processes. Sensors are inexpensive to install, reliable, and analyze in real-time.	Industrial processes with no-, inadequate, or inoperable controls and sensors/	15	3.0%	$ 0.10		11	11, 39	11, 39
Motors-Refrigeration	Ret	Sensors and controls - Motors-Refrigeration	Implement process control systems to improve the efficiency industrial processes. Sensors are inexpensive to install, reliable, and analyze in real-time.	Industrial processes with no-, inadequate, or inoperable controls and sensors/	15	3.0%	$ 0.10		11	11, 39	11, 39
Process Heating-Drying and Curing	Ret	Sensors and controls - Process Heating-Drying and Curing	Implement process control systems to improve the efficiency industrial processes. Sensors are inexpensive to install, reliable, and analyze in real-time.	Industrial processes with no-, inadequate, or inoperable controls and sensors/	15	3.0%	$ 0.10		11	11, 39	11, 39
Process Heating-Heat Treating	Ret	Sensors and controls - Process Heating-Heat Treating	Implement process control systems to improve the efficiency industrial processes. Sensors are inexpensive to install, reliable, and analyze in real-time.	Industrial processes with no-, inadequate, or inoperable controls and sensors/	15	3.0%	$ 0.10		11	11, 39	11, 39
Process Heating-Heating	Ret	Sensors and controls - Process Heating-Heating	Implement process control systems to improve the efficiency industrial processes. Sensors are inexpensive to install, reliable, and analyze in real-time.	Industrial processes with no-, inadequate, or inoperable controls and sensors/	15	3.0%	$ 0.10		11	11, 39	11, 39
Process Heating-Melting and Casting	Ret	Sensors and controls - Process Heating-Melting and Casting	Implement process control systems to improve the efficiency industrial processes. Sensors are inexpensive to install, reliable, and analyze in real-time.	Industrial processes with no-, inadequate, or inoperable controls and sensors/	15	3.0%	$ 0.10		11	11, 39	11, 39
Other-HVAC	Ret	Energy Management systems -Other-HVAC	Install energy management systems to properly monitor and control lighting and HVAC systems.	Facilities with no energy management systems	10	7.0%	$ 0.63		11	11, 39	11, 39
Other-Lighting	Ret	Energy Management systems -Other-Lighting	Install energy management systems to properly monitor and control lighting and HVAC systems.	Facilities with no energy management systems	10	7.0%	$ 0.63		11	11, 39	11, 39
Elec Total	Ret	Energy Information Systems	Install hardware-based systems providing real-time information (e.g., real-time pricing or load shedding requests) on energy usage to facility managers locally or over the internet	Facilities with no energy information systems	10	1.0%	$ 0.25		11	11, 39	11, 39
Elec Total	Ret	Efficient Transformers (Tier 2)	Install energy efficient transformers. All electric power passes through one or more dry-type transformers on its way to service equipment, lighting, and other loads. Energy efficient transformers save a fraction of every kWh delivered to the plant.	Standard efficiency transformers	30	1.6%	$ 1.07		11	11, 39	11, 39
Motors-Refrigeration	Ret	Duct/Pipe Insulation - Motors-Refrigeration	Install insulation to reduce heat loss from non-insulated surfaces that are above or below ambient conditions.	No-, inadequate, or damaged duct/pipe insulation	7	20.0%	$ 0.30		11	11, 39	11, 39

Primary Fuel End Use	Applicable Markets	Measure Name	Measure Description	Baseline Description	Life (yr)	% Savings	Incre-mental Cost/kWh Saved	Annual Fossil Fuel Savings (MMBtu per kWh saved)	Measure Life Source	Savings Data Sources	Costs Data Sources
Process Heating-Heating	Ret	Duct/Pipe Insulation - Process Heating-Heating	Install insulation to reduce heat loss from non-insulated surfaces that are above or below ambient conditions.	No-, inadequate, or damaged duct/pipe insulation	7	20.0%	$ 0.30		11	11, 39	11, 39
Other-HVAC	Ret	Duct/Pipe Insulation - Other-HVAC	Install insulation to reduce heat loss from non-insulated surfaces that are above or below ambient conditions.	No-, inadequate, or damaged duct/pipe insulation	7	20.0%	$ 0.30		11	11, 39	11, 39
Motors-Refrigeration	Ret	Cooling and storage	Utilize innovative designs of cooling/refrigeration equipment in food preservation. Specific to the food and beverage manufacturing industries.	Standard efficiency cooling/refrigeration equipment; no thermal storage	15	20.0%	$ 3.50		11	11, 39	11, 39
Elec Total	Ret	electric supply system improvements	Modify existing power supplies to reduce phase unbalance, voltage variations, and poor supply waveforms that reduce equipment efficiency and cause equipment damage.	Standard efficiency electric supply systems	5	3.0%	$ 0.04		11	11, 39	11, 39
Process Total	Ret	Microwave processing	Implement microwave processing. Microwave processing has a number of advantages such as precise control of the heating process, improved yield, higher production rate and improved product quality.	Conventional heating processes	10	3.0%	$ 1.25		11	11, 39	11, 39
Process Heating-Drying and Curing	Ret	RF heating and drying - Process Heating-Drying and Curing	Implement radio frequency (RF) heating and drying processes to provide a thermal profile that conventional heating and drying methods alone are not able to achieve.	Conventional heating and drying methods	10	1.0%	$ 1.25		11	11, 39	11, 39
Process Heating-Heating	Ret	RF heating and drying - Process Heating-Heating	Implement radio frequency (RF) heating and drying processes to provide a thermal profile that conventional heating and drying methods alone are not able to achieve.	Conventional heating and drying methods	10	1.0%	$ 1.25		11	11, 39	11, 39
Other-Lighting	Ret	Efficient lighting design -- Office	Implement efficient lighting design applicable to office space, warehouses, and production areas.	Standard efficiency lighting design	8	44.0%	$ 0.12		11	11, 39	11, 39
Other-Lighting	Ret	Efficient lighting design -- Manuf	Implement efficient lighting design applicable to office space, warehouses, and production areas.	Standard efficiency lighting design	8	23.0%	$ 0.14		11	11, 39	11, 39
Other-Lighting	Ret	Efficient lighting design -- Warehouse	Implement efficient lighting design applicable to office space, warehouses, and production areas.	Standard efficiency lighting design	8	86.0%	$ 0.14		11	11, 39	11, 39
Other-Lighting	Ret	Efficient lighting fixtures and lamps -- Office	Install efficient lamps and ballasts applicable to office space, warehouses, and production areas.	Standard efficiency lighting fixtures and lamps	12	17.0%	$ 3.68		11	11, 39	11, 39
Other-Lighting	Ret	Efficient lighting fixtures and lamps -- Manuf	Install efficient lamps and ballasts applicable to office space, warehouses, and production areas.	Standard efficiency lighting fixtures and lamps	14	40.0%	$ 0.93		11	11, 39	11, 39
Other-Lighting	Ret	Efficient lighting fixtures and lamps -- Warehouse	Install efficient lamps and ballasts applicable to office space, warehouses, and production areas.	Standard efficiency lighting fixtures and lamps	15	46.0%	$ 0.97		11	11, 39	11, 39
Motors Total	Ret	Advanced motor designs	Implement advanced motor system designs.	Standard efficiency motor systems designs	20	6.2%	$ 0.39		11	11, 39	11, 39
Motors Total	Ret	motor management	Implement motor rewind best practices so degradation of efficiency is minimized during the rewinding. Best practices include using low burn-out temperatures to remove old windings and rewinding per the original pattern.	Conventional motor rewind practices	20	0.8%	$ 0.18		11	11, 39	11, 39
Motors Total	Ret	Advanced lubricants	Replace conventional petroleum-based oils and greases with synthetic, engineered lubricants to reduce energy consumption and equipment wear while extending lubricant life.	Conventional lubricants	1	3.0%	$ 0.03		11	11, 39	11, 39
Motors-Pumps	Ret	Motor system optimization -Motors-Pumps	Improve systems performance by optimizing the flows in motor-driven systems, principally fan and pump systems, to meet end use requirements.	Non-optimized motor systems	10	1.2%	$ 0.07		11	11, 39	11, 39
Motors-Fans and Blowers	Ret	Motor system optimization -Motors-Fans and Blowers	Improve systems performance by optimizing the flows in motor-driven systems, principally fan and pump systems, to meet end use requirements.	Non-optimized motor systems	10	1.2%	$ 0.07		11	11, 39	11, 39

Primary Fuel End Use	Applicable Markets	Measure Name	Measure Description	Baseline Description	Life (yr)	% Savings	Incre-mental Cost/kWh Saved	Annual Fossil Fuel Savings (MMBtu per kWh saved)	Measure Life Source	Savings Data Sources	Costs Data Sources
Other-HVAC	Ret	Motor system optimization -Other-HVAC	Improve systems performance by optimizing the flows in motor-driven systems, principally fan and pump systems, to meet end use requirements.	Non-optimized motor systems	10	1.2%	$ 0.07		11	11, 39	11, 39
Motors-Compressed Air	Ret	Compressed air system management	Improve compressed air system performance by addressing the individual components, the supply and demand sides of the system, and the interaction between the components and the system. Savings opportunities include repairing leaks, eliminating inappropriate uses of compressed air, and optimizing system pressure level.	Non-optimized compressed air system	10	17.0%	$ 0.08		11	11, 39	11, 39
Motors-Compressed Air	Ret	Air Compressor Systems Advanced Controls	Install air compressor controls to efficiently match the air supply from the compressors with system demand.	Conventional compressor capacity controls	10	3.5%	$ 0.14		11	11, 39	11, 39
Motors-Pumps	Ret	Pump efficiency improvement	Improve pump system efficiency giving consideration to flow requirements, required delivered pressure, and the system effects.	Standard efficiency pump systems	10	20.0%	$ 0.13		11	11, 39	11, 39
Motors-Fans and Blowers	Ret	Fan system efficiency - Motors-Fans and Blowers	Improve fan systems efficiency by reducing air demand, improving control, and establishing proper maintenance.	Standard efficiency fan systems	10	6.0%	$ 0.33		11	11, 39	11, 39
Other-HVAC	Ret	Fan system efficiency - Other-HVAC	Savings in industrial fan systems include efficient fans, reduction in air demand, improved control and proper maintenance.	Standard efficiency fan systems	10	6.0%	$ 0.33		11	11, 39	11, 39
Motors-Refrigeration	Ret	Efficient refrigeration systems	Opportunities include system design, component design (e.g. adjustable speed drives), and improved operation and maintenance practices.	Standard efficiency refrigeration systems	15	10.0%	$ 0.45		11	11, 39	201, 39
Process Heating-Drying and Curing	Ret	Advanced Curing Technologies	Implement advanced curing technologies such as ultraviolet (UV) curing.	Conventional curing technologies	15	15.0%	$ 0.98		11	11, 39	11, 39
Process Heating-Heat Treating	Ret	Electric IR heating and drying -Process Heating-Heat Treating	Install electric infrared (IR) heating equipment to cure coatings in materials fabrication and other applications.	Conventional curing and drying technologies	18	15.0%	$ 2.91		11	11, 39	11, 39
Process Heating-Heating	Ret	Electric IR heating and drying -Process Heating-Heating	Install electric infrared (IR) heating equipment to cure coatings in materials fabrication and other applications.	Conventional curing and drying technologies	18	15.0%	$ 2.91		11	11, 39	11, 39
Process Heating-Drying and Curing	Ret	E-beam sterilization	Install electron-beam sterilization equipment in place of less efficient sterilization technologies	Conventional sterilization technologies	15	10.0%	$ 0.01		11	11, 39	11, 39
Process Total	Ret	industrial heat pumps	Install high-efficiency heat pumps for industrial process applications	Conventional process heating technologies	15	10.0%	$ 1.24		11	11, 39	11, 39

Industrial Fossil Fuel Measures

Primary Fuel End Use	Applicable Markets	Measure Name	Measure Description	Baseline Description	Life (yr)	% Savings	Incre-mental Cost/kWh Saved	Annual Fossil Fuel Savings (kWh per MMBtu saved)	Data Sources: Measure Life Source	Data Sources: Savings Data Sources	Data Sources: Costs Data Sources
Industrial Process	NC, Reno, Repl	Industrial Process - NG	Represents a comprehensive suite of industrial energy efficiency measures addressing Natural gas process energy.	Standard efficiency for aggregated measures	15	15.0%	$ 45.00		181, 182	39	39
Industrial Process	Ret	Industrial Process - NG	Represents a comprehensive suite of industrial energy efficiency measures addressing Natural gas process energy.	Standard efficiency for aggregated measures	15	15.0%	$ 45.00		181, 182	39	39
Industrial Process	NC, Reno, Repl	Industrial Process - Oil	Represents a comprehensive suite of industrial energy efficiency measures addressing Petroleum Fuels process energy.	Standard efficiency for aggregated measures	15	15.0%	$ 90.00		181, 182	39	39
Industrial Process	Ret	Industrial Process - Oil	Represents a comprehensive suite of industrial energy efficiency measures addressing Petroleum Fuels process energy.	Standard efficiency for aggregated measures	15	15.0%	$ 90.00		181, 182	39	39
Fuel Total	Ret	Improved process control	Install monitors and controls to maximize boiler combustion efficiency	Non-optimized boiler combustion efficiency	15	3.0%	$ 12.28		166	166	166
Fuel Total	Ret	Maintain boilers	Implement proper and timely boiler maintenance procedures	No- or inadequate boiler maintenance procedures	2	10.0%	$ 2.43		166	166	166
Fuel Total	Ret	Flue gas heat recovery/economizer	Use waste heat from boiler flue gas to preheat boiler intake water or provide space heating	No heat recovery systems	15	2.0%	$ 17.41		166	166	166
Fuel Total	Ret	Blowdown steam heat recovery	Use waste heat from boiler blowdown to preheat boiler intake water or provide space heating	No heat recovery systems	15	1.3%	$ 15.28		166	166	166
Fuel Total	Ret	Upgrade burner efficiency	Install more effcient burners on boilers	Standard efficiency burners	20	1.3%	$ 49.98		166	166	166
Fuel Total	Ret	Water treatment	Treat boiler water to reduce mineral buildup which reduces heat transfer efficiency	No- or inadequate water treatment technologies	10	1.0%	$ 6.34		166	166	166
Fuel Total	Ret	Load control	Install controls to properly stage boiler systems	No- or inadequate boiler staging controls	15	4.0%	$ 13.64		166	166	166
Fuel Total	Ret	Improved insulation	Install and maintain insulation on boiler piping	No-, inadequate, or damaged duct/pipe insulation	15	8.0%	$ 6.55		166	166	166
Fuel Total	Ret	Steam trap maintenance	Properly maintain steam traps to ensure rapid remediation of malfunctions	No- or inadequate steam trap maintenance procedures	2	12.5%	$ 0.84		166	166	166
Fuel Total	Ret	Automatic steam trap monitoring	Install automated monitors to allow diagnosis of steam trap conditon	No automatic steam trap monitoring	15	5.0%	$ 3.41		166	166	166
Fuel Total	Ret	Leak repair	Repair leaks in steam distribution lines and fittings	Unrepaired leaks in steam distribution system	2	4.0%	$ 1.08		166	166	166
Fuel Total	Ret	Condensate return	Reuse condensate water for boiler feedwater	No condensate reuse	15	10.0%	$ 9.57		166	166	166
Fuel Total	Ret	Improve ceiling insulation	Install and maintain ceiling insulation to reduce HVAC energy use	No- or standard efficiency ceiling insulation	20	24.3%	$ 85.70		166	166	166
Fuel Total	Ret	Install HE(95%) cond furnace/boiler	Install high efficiency furnaces and boilers for HVAC	Standard efficiency furnaces and boilers	20	18.0%	$ 37.88		166	166	166
Fuel Total	Ret	Stack heat exchanger	Install heat exchangers to recover heat from or reject heat to HVAC system exhaust air to minimize heating and cooling requirements	No heat recovery systems	20	5.0%	$ 18.41		166	166	166
Fuel Total	Ret	Duct insulation	Install and maintain insulation on HVAC ductwork	No-, inadequate, or damaged duct insulation	20	2.0%	$ 7.04		166	166	166
Fuel Total	Ret	EMS install	Installing energy management system to control HVAC systems	Facilities with no energy management systems	20	10.0%	$ 31.79		166	166	166
Fuel Total	Ret	EMS optimization	Optimize existing energy management system to control HVAC systems	Facilities with non-optimized energy management systems	5	1.0%	$ 0.61		166	166	166
Fuel Total	Ret	Process Controls & Management	Implement various computer-based process controls to maximize efficiency of process operations. Specific applications are dependent on industry type.	No- or inadequate process controls and management	8	5.4%	$ 4.99		166	166	166
Fuel Total	Ret	Heat Recovery	Recovering and reusing waste heat from manufacturing process for other processes or space heating	No heat recovery systems	20	20.4%	$ 92.06		166	166	166
Fuel Total	Ret	Efficient burners	Install more efficient burners for process applications	Standard efficiency burners	10	18.3%	$ 14.27		166	166	166
Fuel Total	Ret	Process integration	Optimize operations such that components and operations are well matched in terms of capacity and function across multiple processes.	Unintegrated processes	15	16.5%	$ 87.04		166	166	166
Fuel Total	Ret	Efficient drying	Install more efficient direct drying equipment	Conventional drying technologies	20	16.5%	$ 61.55		166	166	166
Fuel Total	Ret	Closed hood	Install enclosed hood on paper machines to reduce thermal energy requirements. Specific to paper manufacturing industries.	Open-hood paper machines	15	5.0%	$ 34.82		166	166	166
Fuel Total	Ret	Extended nip press	Install more efficient paper pressing technologies to reduce drying requirements. Specific to paper manufacturing industries.	Conventional paper press technologies	20	16.0%	$ 92.59		166	166	166

Primary Fuel End Use	Applicable Markets	Measure Name	Measure Description	Baseline Description	Life (yr)	% Savings	Incre-mental Cost/kWh Saved	Annual Fossil Fuel Savings (kWh per MMBtu saved)	Measure Life Source	Savings Data Sources	Costs Data Sources
Fuel Total	Ret	Improved separation processes	Implement improved separation processes such as combined reaction and distillation, ion exchange and bio-separation, and hybrid processes. Specific to chemical manufacturing facilities.	Conventional separation processes	20	10.0%	$ 26.30		166	166	166
Fuel Total	Ret	Thermal oxidizers	Install regenerative thermal oxidizers to recover waste heat from VOC incineration processes. Specific to chemical manufacturing facilities.	Conventional thermal oxidizers	15	60.0%	$ 208.90		166	166	166
Fuel Total	Ret	Flare gas controls and recovery	Install improved recovery systems to reduce or eliminate flaring. Specific to petroluem manufacturing industries.	Uncontrolled flare gas	15	50.0%	$ 87.04		166	166	166
Fuel Total	Ret	Fouling control	Implement improved controls and maintenance practices to reduce fouling of heat-exhange surfaces. Specific to petroluem manufacturing industries.	No specific fouling controls or maintenance practices	5	7.0%	$ 3.53		166	166	166
Fuel Total	Ret	Efficient furnaces	Implement various furnace design improvements to maximize furnace efficiency. Specific to petroluem manufacturing industries.	Standard efficiency furnaces	20	6.0%	$ 13.89		166	166	166
Fuel Total	Ret	Oxyfuel	Install oxy-fuel furnace, i.e., using oxygen rich combustion air, to improve furnace efficiency. Specific to nonmetallic mineral product manufacturing industries.	Standard efficiency furnaces	20	20.0%	$ 63.13		166	166	166
Fuel Total	Ret	Batch cullet preheating	Install a cullet (scraps of broken or waste glass) pre-heater utilizing furnace waste heat. Specific to nonmetallic mineral product manufacturing industries.	No heat recovery systems	15	16.0%	$ 27.85		166	166	166
Fuel Total	Ret	Preventative maintenance	Implement a preventative maintenance plan training personnel to increase energy-conserving behaviors	No- or inadequate preventative maintenance plans	5	2.0%	$ 1.21		166	166	166
Fuel Total	Ret	Combustion controls	Install controls to improve combustion efficiency. Specific to fabricated metal products manufacturing industries.	No- or inadequate combustion controls	8	8.0%	$ 5.32		166	166	166
Fuel Total	Ret	Optimize furnace operations	Implement various strategies to optimize combustion and heat transfer efficiency. Specific to fabricated metal products manufacturing industries.	Non-optimized furnace operations	10	10.0%	$ 9.52		166	166	166
Fuel Total	Ret	Insulation/reduce heat losses	Install insulation to reduce heat loss from non-insulated surfaces that are above or below ambient conditions. Specific to fabricated metal products manufacturing industries.	No-, inadequate, or damaged insulation	15	5.0%	$ 29.79		166	166	166

Residential Electric Measures

Primary Fuel End Use	Applicable Markets	Measure Name	Measure Description	Baseline Description	Life (yr)	% Savings	Incre-mental Cost/kWh Saved	Annual Fossil Fuel Savings (MMBtu per kWh saved)	Data Sources: Measure Life Source	Data Sources: Savings Data Sources	Data Sources: Costs Data Sources
Refrigeration	NC, Reno, Repl	Efficient Refrigerator, ESTAR	An Energy Star labeled refrigerator replaces a minimum federal standard efficiency unit	Federal standard efficiency refrigerator	17	20.0%	$ 0.81		168	168	168
Refrigeration	NC, Reno, Repl	Efficient Refrigerator Tier II	A high efficiency refrigerator replaces a minimum federal standard efficiency unit	Federal standard efficiency refrigerator	17	25.0%	$ 0.65		168	168	168
Cooling	NC, Reno, Repl	Efficient Window AC ESTAR	Replace room AC with energy star labeled unit; 8-13kbtu, >10.8 EER	Federal standard efficiency window air conditioner, EER 9.8	12	9.3%	$ 1.53		168	168	168
Cooling	NC, Reno, Repl	Efficient Window AC Tier I	Replace room AC with CEE tier 1 unit; 8-13kbtu, >11.3 EER	Federal standard efficiency window air conditioner, EER 9.8	12	13.3%	$ 2.14		168	168	168
Cooling	NC, Reno, Repl	Efficient Central AC ESTAR	Replace standard efficiency central AC with Energy Star qualified model (SEER 14.5, EER 12)	Federal standard efficiency central air conditioning system, SEER 13, EER 11	18	10.3%	$ 6.97		176	176	176
Cooling	Ret	Efficient Central AC ESTAR	Replace standard efficiency central AC with Energy Star qualified model (SEER 14.5, EER 12)	Federal standard efficiency central air conditioning system, SEER 13, EER 11	18	10.3%	$ 6.97		176	176	1005
Cooling	NC, Reno, Repl	Efficient Central AC Tier II	Replace or upgrade standard efficiency central AC with CEE Tier 2 model (SEER 15, EER 12.5)	Federal standard efficiency central air conditioning system, SEER 13, EER 11	18	13.3%	$ 6.59		168	168	1005
Cooling	Ret	Efficient Central AC Tier II	Replace or upgrade standard efficiency central AC with CEE Tier 2 model (SEER 15, EER 12.5)	Federal standard efficiency central air conditioning system, SEER 13, EER 11	18	13.3%	$ 6.59		168	168	1005
Cooling	Ret	Efficient CAC early Replacement	Replace existing low efficiency central AC with CEE Tier 2 model (SEER 15, EER 12.5)	Low efficiency central AC	18	42.0%	$ 6.78		168	168	168
Cooling	Ret	Window AC replacement	an existing, functioning window ac is replaced with an energy Star model	An existing, inefficient window AC	12	28.7%	$ 2.91		168	176	176
Cooling	NC, Reno, Repl	Air Source Heat Pump ESTAR -Cool	Replace existing electric ASHP cooling system with Energy Star qualified model (SEER 14.5, EER 12)	Standard efficiency, ducted, ASHP, 13 SEER, 11 EER	18	10.3%	$ 2.84		176	176	176
Space Heating	NC, Reno, Repl	Air Source Heat Pump ESTAR -Heat	Replace a standard efficiency electric ASHP with Energy Star qualified unit, min 8.2 HSPF	Standard efficiency, ducted, ASHP, 7.7 HSPF	18	6.1%	$ 1.32		176	176	176
Cooling	NC, Reno, Repl	ASHP, Cooling, Tier 2	Replace existing electric ASHP cooling systemwith CEE Tier 2 unit 15SEER, 12.5EER	Standard efficiency, ducted, ASHP, 13 SEER, 11 EER	18	13.3%	$ 1.71		176	176	1005
Space Heating	NC, Reno, Repl	ASHP, Heat, Tier 2	Replace a standar efficiency electric ASHP with a CEE Tier 2 qualified unit	Standard efficiency, ducted, ASHP, 7.7 HSPF	18	9.0%	$ 1.71		176	176	176
Cooling	NC, Reno, Repl	Efficient fan motor -Cool	Efficient furnace fan motor (ECM or BPM) to replace standard efficiency (PSC) motors	standard efficiency permanent split capacitor (PSC) motor for central AC	18	50.0%	$ 1.12		176	168	176
Cooling	ret	Efficient fan motor -Cool	Efficient furnace fan motor (ECM or BPM) to replace standard efficiency (PSC) motors	standard efficiency permanent split capacitor (PSC) motor for central AC	18	50.0%	$ 1.12		176	168	176
Space Heating	NC, Reno, Repl	Efficient fan motor - Heat	Efficient furnace fan motor (ECM or BPM) to replace standard efficiency (PSC) motors	standard efficiency permanent split capacitor (PSC) motor for heating system	18	50.0%	$ 0.83		176	168	176
Space Heating	ret	Efficient fan motor - Heat	Efficient furnace fan motor (ECM or BPM) to replace standard efficiency (PSC) motors	standard efficiency permanent split capacitor (PSC) motor for heating system	18	50.0%	$ 0.83		176	168	176
Cooling	Ret	Duct Sealing -Cool	Air-seal duct work to reduce loss of conditioned air into unconditioned space, cooling only	Leaky ductwork within unconditioned space	20	5.0%	$ 1.83		176	176	127
Space Heating	Ret	Duct Sealing, Heat Pump -Heat	Air-seal duct work to reduce loss of conditioned air into unconditioned space, heat pump	Leaky ductwork within unconditioned space	20	33.0%	$ 0.50		168	168	127
Space Heating	NC, Reno, Repl	High performance window - ESH	an R-5 window in place of a standard window	standard double pane window with vinyl sash	25	59.2%	$ 0.41		168	176	176
Space Heating	NC, Reno, Repl	High performance window - HP	an R-5 window in place of a standard window	standard double pane window with vinyl sash	25	59.2%	$ 0.76		168	176	176
Cooling	NC, Reno, Repl	High performance window - Cool	an R-5 window in place of a standard window	standard double pane window with vinyl sash	25	39.6%	$ 0.95		168	176	176
Space Heating	NC, Reno, Repl	WiFi T-stats - Elec Resistance	An internet enabled programmable thermostat is installed	standard non-programmable thermostat	15	13.0%	$ 0.19		176	39	39
Space Heating	NC, Reno, Repl	WiFi T-stats - HP	An internet enabled programmable thermostat is installed	standard non-programmable thermostat	15	13.0%	$ 0.41		176	39	39
Plug Loads	NC, Reno, Repl	Controlled Power Strip	Controlled power strips eliminate standby loads by turning off devices connected to the same power strip as the controlling appliance	Power strip with no control	4	81.6%	$ 0.28		176	176	176

Primary Fuel End Use	Applicable Markets	Measure Name	Measure Description	Baseline Description	Life (yr)	% Savings	Incre-mental Cost/kWh Saved	Annual Fossil Fuel Savings (MMBtu per kWh saved)	Measure Life Source	Savings Data Sources	Costs Data Sources
Plug Loads	NC, Reno, Repl	Desktop Computer, Energy Star labeled	Advanced new power supply designs offer more than 80% efficiency across a wide range of load conditions and often need no cooling fan.	Standard efficiency power supply	4	50.1%	$ 0.06		127	127	127
Indoor Lighting	RET	CFL Direct Install	Blend of specialty and standard CFLs replaces a blended baseline of halogen and incandescent bulbs. Lamp is installed directly by a contractor	A blended average of incandescent and halogen general service lamp	6	64.2%	$ 0.12		176	127	127
Indoor Lighting	RET	LED Direct Install	Standard LED A lamp replaces a blended baseline of halogen and incandescent bulbs. Lamp is installed directly by a contractor	A blended average of incandescent and halogen general service lamp	20	75.0%	$ 0.22		176	127	127
Indoor Lighting	NC, Reno, Repl	CFL - spiral retail	A CFL replaces an incandescent or halogen general service lamp	A blended average of incandescent and halogen general service lamp	6	64.2%	$ 0.03		176	176	176
Indoor Lighting	NC, Reno, Repl	CFL - specialty retail	A specialty CFL replaces a specialty incandescent or halogen general service lamp	A blended average of incandescent and halogen specialty lamp	7	75.0%	$ 0.10		176	176	176
Indoor Lighting	NC, Reno, Repl	CFL fixture, hardwired, interior retail	A CFL fixture replaces an incandescent or halogen general service fixture	A blended average of incandescent and halogen general service lamp	3	64.2%	$ 0.82		176	176	176
Indoor Lighting	NC, Reno, Repl	SSL fixture	An SSL fixture replaces an incandescent or halogen general service lamp	A blended average of incandescent and halogen general service lamp	20	81.5%	$ 0.51		176	176	176
Indoor Lighting	NC, Reno, Repl	CFL fixture, hardwired, exterior	A CFL fixture replaces an incandescent or halogen general service fixture	A blended average of incandescent and halogen general service lamp	7	64.2%	$ 0.30		176	176	176
Indoor Lighting	NC, Reno, Repl	Exterior Motion Sensor	A motion sensor controlled exterior fixture replaces and uncontrolled fixture	an exterior fixture without motion sensor or any other controls	15	60.4%	$ 0.18		127	127	127
Indoor Lighting	NC, Reno, Repl	Exterior SSL 450 to 1600 lumens	An exterior SSL replaces an incandescent or halogen general service lamp	A blended average of incandescent and halogen general service lamp	20	75.0%	$ 0.18		127	127	127
Indoor Lighting	NC, Reno, Repl	Exterior SSL >1600 lumens	An exterior SSL replaces an incandescent or halogen general service lamp	A blended average of incandescent and halogen general service lamp	20	75.0%	$ 0.09		127	127	127
Water Heating	NC, Reno, Repl	Clothes Washer - Retail	An efficient clothes washer is purchased in place of a conventional clothes washer. Includes dryer savings for average dryer energy mix	a new conventional clothes washer	14	26.9%	$ 1.16	0.001	176	176	176
Kitchen/Laundry	NC, Reno, Repl	Tier 2 Clothes Washer - Elec	An efficient clothes washer is purchased in place of a conventional clothes washer. Includes dryer savings for average dryer energy mix	a new conventional clothes washer	14	29.8%	$ 1.21		176	176	176
Water Heating	Ret	Clothes Washer - Early Replacement	Removal of an existing inefficient clothes washer prior to its natural end of life and replacement with a new unit exceeding ENERGY STAR standards. Includes dryer savings for average dryer energy mix	an existing conventional clothes washer	14	45.4%	$ 2.51	0.001	176	176	176
Miscellaneous	NC, Reno, Repl	Pool Pump	the purchase of a multi speed swimming pool pump capable of running at 50% speed and being run twice as many hours to move the same amount of water through the filter.	Single speed pool pump	10	87.4%	$ 0.28		176	176	176
Indoor Lighting	NC, Reno, Repl	LED Screw Based Lamp retail <450 Lumens	A SSL replaces an incandescent or halogen general service lamp	A blended average of incandescent and halogen general service lamp	20	79.0%	$ 0.25		176	176	176
Indoor Lighting	NC, Reno, Repl	LED Screw Based Lamp retail 450 to 1600 Lumens	A SSL replaces an incandescent or halogen general service lamp	A blended average of incandescent and halogen general service lamp	20	75.0%	$ 0.14		176	176	176
Indoor Lighting	NC, Reno, Repl	LED Screw Based Lamp retail >1600 Lumens	A SSL replaces an incandescent or halogen general service lamp	A blended average of incandescent and halogen general service lamp	20	56.0%	$ 0.12		176	176	176
Elec Total	Ret	Enhanced Behavior based Efficiency initiative	Customer is provided with feedback and guidance to save energy at home.	No Initiative	1	2.0%	$ 0.07		175	175	175
Refrigeration	Ret	Refrigerator Retirement	An extra refrigerator is taken out of service	A homeowner has an extra refrigerator running (often in basement, garage or porch)	8	100.0%	$ 0.33		176	176	176
Refrigeration	Ret	Refrigerator Early Replacement	An aging refrigerator is replaced with a new, energy star model.	An older, inefficient refrigerator remains in use until it dies.	12	17.3%	$ 1.58		176	176	176

Primary Fuel End Use	Applicable Markets	Measure Name	Measure Description	Baseline Description	Life (yr)	% Savings	Incre-mental Cost/kWh Saved	Annual Fossil Fuel Savings (MMBtu per kWh saved)	Measure Life Source	Savings Data Sources	Costs Data Sources
Water Heating	NC, Reno, Repl	Electric Heat Pump Water Heater >55gal	High efficiency heat pump water heater replaces electric resistance water heater, COP>2.0 Measure null; April 2015	Standard efficiency electric resistance water heater, >55 gallons, .90 EF	10	48.0%	$ 0.53		168	168	168
Water Heating	NC, Reno, Repl	Electric Heat Pump Water Heater <55gal	High efficiency heat pump water heater replaces electric resistance water heater, COP>2.0	Standard efficiency electric resistance water heater, <55 gallons, .90 EF	10	48.0%	$ 0.53		168	168	168
Water Heating	NC, Reno, Repl	Tank wrap, electric water heater	Additional R-20 insulation blanket, 50 gal water heater	Uninsulated, 50 gal storage water heater	5	4.5%	$ 0.22		176	176	176
Water Heating	NC, Reno, Repl	Pipe insulation, electric water heater	Add R-3.5 insulation to uninsulated hot water pipes	Uninsulated hot water pipes	15	0.8%	$ 0.12		176	176	176
Water Heating	Ret	LF Showerhead - Elec	a conventional showerhead is replaced with a low-flow showerhead	a conventional 2.5 gpm showerhead	10	20.0%	$ 0.10		176	176	176
Water Heating	Ret	Faucet Aerator - Elec	a conventional 2.2 gpm faucet aerator is replaced with a low-flow aerator	a conventional faucet aerator	5	20.0%	$ 0.41		176	176	176
Kitchen/Laundry	NC, Reno, Repl	ESTAR Clothes Dryers - Elec	an Energy Star Clothes Dryer is purchased in place of a standard efficiency clothes dryer.	Standard efficiency Clothes Dryer	14	15.0%	$ 0.94		176	176	176
Kitchen/Laundry	NC, Reno, Repl	SEDI Clothes Dryers - Elec	an Energy Star Clothes Dryer is purchased in place of a standard efficiency clothes dryer.	Standard efficiency Clothes Dryer	14	26.0%	$ 1.44		176	176	176
Cooling	Ret	Air Sealing -Cool	Reduce air leakage in building shell using blower door guidance and durable materials	The building's air leakage before reduction	15	15.0%	$ 1.29		176	176	1005
Space Heating	Ret	Air Sealing, Heat Pump - Heat	Reduce air leakage in building shell using blower door guidance and durable materials	The building's air leakage before reduction	15	5.0%	$ 0.89		176	176	1005
Cooling	Ret	Insulation -Cool	Add R-19 insulation to attic	modestly insulated attic (R-25)	25	10.0%	$ 0.35		176	176	1005
Space Heating	Ret	Insulation, Heat Pump - Heat	Add R-19 insulation to attic	modestly insulated attic (R-25)	25	43.2%	$ 3.55		176	176	1005
Refrigeration	NC, Reno, Repl	Energy Star Freezer	Customer purchases an Energy Star Freezer instead of baseline	Customer purchases a baseline freezer	12	11.5%	$ 0.59		176	176	176
Refrigeration	Ret	Freezer early retirement	An extra freezer is taken out of service	A homeowner has an extra freezer running (often in basement, garage or porch)	8	100.0%	$ 0.26		127	127	127
Refrigeration	NC, Reno, Repl	Multi Family refrigerator	An CEE tier 2 listed refrigerator is purchased in place of a minimum federal standard efficiency unit	Federal standard efficiency refrigerator	17	25.0%	$ 0.72		127	127	127
Refrigeration	Ret	Multi Family refrigerator, early replace	A CEE tier 2 listed refrigerator replaces an existing, inefficient refrigerator	An inefficient refrigerator remains in use	17	34.6%	$ 2.00		127	127	127
Water Heating	NC, Reno, Repl	Multi Family in-unit clothes washer	An CEE tier 2 listed clothes washer is purchased in place of a minimum federal standard efficiency clothes washer	A baseline clothes washer	14	24.5%	$ 1.23		127	127	127
Water Heating	Ret	Multi Family clothes washer early replace	A CEE tier 2 listed clothes washer replaces an existing, inefficient clothes washer	Standard efficiency clothes washer	14	33.9%	$ 2.53		127	127	127
Space Heating	NC, Reno, Repl	Resistance to NG Fuel Switch	a customer replaces or supplements electric heat with hatural gas wall furnace	customer uses electric resistance space heat	25	100.0%	$ 0.06	(0.013)	176	168	168
Space Heating	NC, Reno, Repl	Resistance to Ductless mini split	a customer offsets electric resistance heat with a ductless heat pump	electric resistance heat	17	58.0%	$ 0.53		176	168	168
Water Heating	NC, Reno, Repl	Resistance to NG Fuel Switch	An electric resistance water heater is replaced by a Natural Gas fired water heater	electric resistance water heater	13	100.0%	$ 0.21	(0.018)	176	168	168

Residential Fossil Fuel Measures

Primary Fuel End Use	Applicable Markets	Measure Name	Measure Description	Baseline Description	Life (yr)	% Savings	Incre-mental Cost/kWh Saved	Annual Fossil Fuel Savings (kWh per MMBtu saved)	Data Sources: Measure Life Source	Data Sources: Savings Data Sources	Data Sources: Costs Data Sources
Space Heating	Ret	Duct Sealing, Fossil Fuel -Heat	Air-seal duct work to reduce loss of conditioned air into unconditioned space, NG	Leaky ductwork within unconditioned space	20	33.0%	$ 19.74		168	168	127
Space Heating	NC, Reno, Repl	Gas Boiler ESTAR	High efficiency gas boiler meeting Energy Star criteria (>85 AFUE)	Gas boiler meeting minimum federal standards (82 AFUE)	18	8.9%	$ 78.89		176	168	176
Space Heating	NC, Reno, Repl	Gas Furnace ESTAR	High efficiency gas furnace meeting Energy Star criteria (>90 AFUE)	Gas furnace meeting minimum federal standards (80 AFUE)	18	11.1%	$ 52.87		168	168	168
Space Heating	NC, Reno, Repl	Oil Furnace ESTAR	High efficiency oil furnace meeting Energy Star criteria (>85 AFUE)	oil furnace meeting minimum federal standards (83 AFUE)	18	2.4%	$ 258.71		168	168	168
Space Heating	NC, Reno, Repl	High performance window - NG	an R-5 window in place of a standard window	standard double pane window with vinyl sash	25	59.2%	$ 98.81		168	176	176
Space Heating	NC, Reno, Repl	WiFi T-stats - NG	An internet enabled programmable thermostat is installed	standard non-programmable thermostat	15	14.0%	$ 45.92		176	39	39
Water Heating	NC, Reno, Repl	Tier 2 Clothes Washer - Gas	An efficient clothes washer is purchased in place of a conventional clothes washer. Includes dryer savings for average dryer energy mix	a new conventional clothes washer	14	30.0%	$ 342.47		176	176	176
Fuel Total	Ret	Enhanced Behavior based Efficiency initiative - FF	Customer is provided with feedback and guidance to save energy at home.	No Initiative	1	1.3%	$ 5.00		175	175	175
Water Heating	NC, Reno, Repl	Condensing Gas Water Heater >55gal	High efficiency gas condensing storage or on demand water heater	Standard efficiency gas water heater, >55 gallons, .58 EF	13	29.9%	$ 193.79		176	176	176
Water Heating	NC, Reno, Repl	Condensing Gas Water Heater <55gal	High efficiency gas condensing storage or on demand water heater	Standard efficiency gas water heater, <55 gallons, .58 EF	13	29.9%	$ 193.79		176	176	176
Water Heating	NC, Reno, Repl	Tankless water heater	An Energy Star tankless water heater replaces a standard efficiency unit	Standard efficiency gas water heater, <55 gallons, .58 EF	13	30.0%	$ 118.97		176	176	176
Water Heating	NC, Reno, Repl	High efficiency gas storage water heater	A high efficiency gas water heater replaces a standard efficiency unit	Standard efficiency gas water heater, <55 gallons, .58 EF	13	14.0%	$ 58.49		176	176	176
Water Heating	Ret	LF Showerhead - NG	a conventional showerhead is replaced with a low-flow showerhead	a conventional 2.5 gpm showerhead	10	20.0%	$ 21.33		176	176	176
Water Heating	Ret	Faucet Aerator - NG	a conventional 2.2 gpm faucet aerator is replaced with a low-flow aerator	a conventional faucet aerator	5	20.0%	$ 93.75		176	176	176
Kitchen/Laundry	NC, Reno, Repl	ESTAR Clothes Dryers - Gas	an Energy Star Clothes Dryer is purchased in place of a standard efficiency clothes dryer.	Standard efficiency Clothes Dryer	14	15.0%	$ 277.78		176	176	176
Kitchen/Laundry	NC, Reno, Repl	SEDI Clothes Dryers - Gas	an Energy Star Clothes Dryer is purchased in place of a standard efficiency clothes dryer.	Standard efficiency Clothes Dryer	14	26.0%	$ 427.35		176	176	176
Space Heating	Ret	Air Sealing, Fossil Fuel - Heat	Reduce air leakage in building shell using blower door guidance and durable materials	The building's air leakage before reduction	15	5.0%	$ 68.90		176	176	1005
Space Heating	Ret	Insulation, Fossil Fuel - Heat	Add R-19 insulation to attic	modestly insulated attic (R-25)	25	10.0%	$ 210.34		176	176	1005
Water Heating	NC, Reno, Repl	Water Heating, petroleum fuels	High-efficiency water heating by petroleum fuels	Standard efficiency petroleum-fueled water heating	18	10.0%	$ 182.42		176	127	127
Water Heating	Ret	Pipe insulation, gas water heater	Add R-3.5 insulation to uninsulated hot water pipes	un-insulated pipes	15	0.8%	$ 19.61		176	127	127
Space Heating	NC, Reno, Repl	Fossil to ductless mini split	a customer offsets LP or oil heat with a ductless heat pump	oil or lp heat	17	100.0%	$ 73.26	($97.33)	176	168	168
Water Heating	NC, Reno, Repl	Oil to HP fuel Switch	An oil-fired stand alone DHW tank is replaced by a heat pump water heater	oil fired standalong DHW tank	20	100.0%	$ 46.68	($81.57)	176	168	168
Water Heating	NC, Reno, Repl	LP to HP Fuel Switch	An LP-fired stand alone DHW tank is replaced by a heat pump water heater	LP fired standalong DHW tank	20	100.0%	$ 46.68	($81.57)	176	168	168

APPENDIX J: BIBILOGRAPHY, UPDATED FROM PHASE 1

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APPENDIX K: OTHER ANALYSIS INPUTS AND ASSUPTIONS, UPDATED FROM PHASE 1

Screening Input	Value	Notes
Years of analysis	2014-2025	
Real Discount Rate (RDR)	3%	The U.S. Department of Energy recommendation for projects related to energy conservation, renewable energy, and water conservation is a real discount rate of 3%, as of 2010, consistent with the Federal Energy Management Program (FEMP) (see page 1 in http://www1.eere.energy.gov/femp/pdfs/ashb10.pdf).
Long Term Inflation	2%	
Electric Line Loss Factors – Energy, Capacity and Transmission & Distribution	7.87% of meter	EIA data: Average statewide line loss factors over the period 2001-2010 (see http://www.eia.gov/tools/faqs/faq.cfm?id=105&t=3)
Electric Emission Impact Factors (metric tons/MWh)		EPA, 2009 State Emissions and Inputs Emission Rates http://www.epa.gov/cleanenergy/documents/egridzips/eGRID2012V1_0_year09_SummaryTables.pdf
Carbon Dioxide (CO_2)	0.66160	
Nitrogen Oxide (NO_x)	0.00057	
Sulfur Dioxide (SO_2)	0.00335	
Natural Gas Emissions Factors (metric tons/MMBtu)		EPA Climate Leadership Emissions Factors http://www.epa.gov/climateleadership/documents/emission-factors.pdf
Carbon Dioxide (CO_2)	0.05302	
Nitrogen Oxide (NO_x)	0.000047	
Sulfur Dioxide (SO_2)	0.0000003	
Petroleum Fuels Emissions Factors (metric tons/MMBtu)		EPA Climate Leadership Emissions Factors http://www.epa.gov/climateleadership/documents/emission-factors.pdf
Carbon Dioxide (CO_2)	0.06759	
Nitrogen Oxide (NO_x)	0.000086	
Sulfur Dioxide (SO_2)	0.000054	

Net to Gross Ratio Assumptions

NTGR = Net-to-Gross Ratio

FR = free-ridership rate as a % of program participation

SO = spillover rate as a % of program participation

NTGR = 1 – FR + SO

Net_Savings = Gross_Savings X NTGR

Net-to-Gross Ratios were estimated based on review of free ridership and spillover assumptions in use by various applicable programs in other jurisdictions.

Net-to-Gross Ratios by Program

Program	Electric	Fossil Fuels
Residential New Construction	0.90	0.90
Home Energy Services	0.90	0.90
Multi-Family	0.65	0.75
Residential Products	0.90	0.90
Low Income Single Family	1.00	1.00
Residential Behavior	1.00	1.00
C&I Lost Opportunity	0.89	0.84
Small Business Retrofit	0.92	0.94
Large Business Retrofit	0.91	0.92

APPENDIX L: SALES FORECAST

Electric Forecast (Total) - MWh

	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Residential-SF	4,238,812	4,310,877	4,381,326	4,445,078	4,509,841	4,576,177	4,644,832	4,714,494	4,784,603	4,861,275	4,940,095	5,017,795
Residential-MF	270,787	275,391	279,892	283,964	288,102	292,339	296,725	301,175	305,654	310,552	315,587	320,551
Commercial	4,835,382	4,877,457	4,917,015	4,953,662	4,990,959	5,029,013	5,067,818	5,107,839	5,148,104	5,190,469	5,233,371	5,276,137
Industrial	2,735,062	2,753,885	2,767,582	2,775,759	2,787,096	2,800,786	2,808,763	2,814,973	2,821,500	2,819,529	2,814,307	2,809,874
Total	12,080,044	12,217,610	12,345,814	12,458,464	12,575,998	12,698,315	12,818,139	12,938,481	13,059,862	13,181,825	13,303,360	13,424,357
											Average Annual Growth:	1.01%
AVAILABLE EXISTING BUILDINGS (NOT including RENOVATION and Recent RENOVATION)												
Residential-SF	3,522,288	3,593,094	3,661,057	3,721,221	3,781,275	3,841,761	3,903,389	3,964,832	4,025,527	4,091,479	4,158,243	4,223,826
Residential-MF	240,369	244,920	249,316	253,237	257,175	261,166	265,255	269,358	273,439	277,883	282,409	286,859
Commercial	3,427,255	3,468,025	3,505,058	3,538,061	3,570,581	3,602,710	3,634,428	3,666,169	3,696,962	3,728,606	3,759,532	3,790,376
Industrial	1,938,576	1,956,815	1,969,507	1,976,432	1,986,174	1,997,855	2,003,589	2,007,379	2,011,301	2,006,804	1,999,236	1,993,192
NEW CONSTRUCTION												
Residential-SF	53,114	54,017	54,900	55,699	56,510	57,341	58,202	59,075	59,953	60,914	61,901	62,875
Residential-MF	1,777	1,807	1,836	1,863	1,890	1,918	1,947	1,976	2,005	2,038	2,071	2,103
Commercial	102,732	103,626	104,466	105,245	106,037	106,846	107,670	108,521	109,376	110,276	111,188	112,096
Industrial	58,109	58,509	58,800	58,974	59,214	59,505	59,675	59,807	59,945	59,903	59,792	59,698
UNAVAILABLE EXISTING BUILDINGS: Recent NEW CONSTRUCTION												
Residential-SF	478,027	478,027	478,930	480,716	483,300	486,696	490,924	496,011	501,972	508,811	516,610	524,495
Residential-MF	15,991	15,991	16,021	16,080	16,167	16,281	16,422	16,592	16,792	17,020	17,281	17,545
Commercial	924,588	924,588	925,482	927,217	929,730	933,035	937,149	942,087	947,876	954,520	962,064	969,626
Industrial	522,980	522,980	523,380	524,071	524,935	526,041	527,437	529,003	530,701	532,537	534,332	535,615
RENOVATION												
Residential-SF	18,538	18,894	19,237	19,543	19,850	20,161	20,479	20,797	21,113	21,458	21,808	22,152
Residential-MF	1,265	1,288	1,310	1,330	1,350	1,371	1,392	1,413	1,434	1,457	1,481	1,505
Commercial	38,081	38,492	38,871	39,212	39,552	39,891	40,230	40,572	40,909	41,257	41,601	41,944
Industrial	21,540	21,724	21,854	21,927	22,029	22,152	22,217	22,262	22,309	22,271	22,202	22,146
UNAVAILABLE EXISTING BUILDINGS: Recent RENOVATION												
Residential-SF	166,845	166,845	167,201	167,900	168,905	170,217	171,839	173,779	176,038	178,613	181,533	184,446
Residential-MF	11,386	11,386	11,409	11,454	11,519	11,604	11,710	11,836	11,984	12,153	12,346	12,539
Commercial	342,726	342,726	343,137	343,927	345,059	346,530	348,341	350,490	352,982	355,810	358,986	362,095
Industrial	193,858	193,858	194,042	194,356	194,744	195,233	195,846	196,523	197,245	198,013	198,745	199,222

Natural Gas Forecast (Total) - MMBtu

	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Residential-SF	10,171,857	10,324,594	10,469,277	10,609,183	10,564,004	10,523,441	10,484,860	10,441,842	10,383,700	10,314,301	10,240,364	10,163,815
Residential-MF	420,749	427,067	433,052	438,839	436,970	435,292	433,696	431,917	429,512	426,641	423,583	420,416
Commercial	9,738,866	9,997,966	10,129,110	10,246,696	10,257,381	10,297,402	10,343,914	10,412,291	10,481,112	10,555,292	10,646,920	10,763,321
Industrial	21,317,463	22,492,313	22,924,577	23,351,202	23,637,938	23,978,157	24,256,959	24,593,796	24,935,332	25,198,627	25,538,687	25,866,359
Total	41,648,935	43,241,940	43,956,016	44,645,919	44,896,292	45,234,292	45,519,428	45,879,846	46,229,655	46,494,861	46,849,555	47,213,911
											Average Annual Growth:	1.21%
AVAILABLE EXISTING BUILDINGS (NOT including RENOVATION and Recent RENOVATION)												
Residential-SF	8,452,417	8,602,485	8,741,983	8,874,278	8,822,304	8,775,681	8,731,734	8,684,122	8,622,418	8,550,683	8,475,711	8,402,126
Residential-MF	373,485	379,730	385,573	391,152	389,098	387,254	385,511	383,606	381,103	378,167	375,080	371,993
Commercial	6,902,781	7,153,840	7,272,929	7,374,892	7,369,732	7,392,776	7,420,985	7,469,068	7,515,600	7,565,347	7,629,873	7,723,737
Industrial	15,109,538	16,247,928	16,630,568	16,994,670	17,210,417	17,469,582	17,659,242	17,897,110	18,129,772	18,276,793	18,490,849	18,719,455
NEW CONSTRUCTION												
Residential-SF	127,458	129,371	131,184	132,938	132,371	131,863	131,380	130,841	130,112	129,243	128,316	127,357
Residential-MF	2,761	2,802	2,841	2,879	2,867	2,856	2,846	2,834	2,818	2,799	2,779	2,758
Commercial	206,911	212,416	215,202	217,700	217,927	218,778	219,766	221,219	222,681	224,257	226,203	228,676
Industrial	452,909	477,869	487,053	496,117	502,209	509,438	515,361	522,517	529,774	535,368	542,592	549,554
UNAVAILABLE EXISTING BUILDINGS: Recent NEW CONSTRUCTION												
Residential-SF	1,147,119	1,147,119	1,149,033	1,152,759	1,158,239	1,163,153	1,167,558	1,171,481	1,174,864	1,177,518	1,179,303	1,178,247
Residential-MF	24,846	24,846	24,887	24,968	25,087	25,193	25,289	25,374	25,447	25,504	25,543	25,520
Commercial	1,862,199	1,862,199	1,867,704	1,875,995	1,886,784	1,897,800	1,909,667	1,922,522	1,936,829	1,952,599	1,969,945	1,983,732
Industrial	4,076,178	4,076,178	4,101,139	4,135,284	4,178,492	4,227,793	4,284,322	4,346,774	4,416,383	4,493,247	4,575,706	4,640,429
RENOVATION												
Residential-SF	44,486	45,241	45,945	46,617	46,367	46,142	45,930	45,698	45,394	45,038	44,664	44,291
Residential-MF	1,966	1,997	2,027	2,055	2,045	2,036	2,028	2,019	2,006	1,992	1,976	1,961
Commercial	76,698	79,234	80,462	81,530	81,527	81,808	82,145	82,686	83,216	83,784	84,508	85,509
Industrial	167,884	179,383	183,364	187,198	189,572	192,409	194,573	197,245	199,892	201,700	204,204	206,764
UNAVAILABLE EXISTING BUILDINGS: Recent RENOVATION												
Residential-SF	400,378	400,378	401,132	402,591	404,722	406,602	408,258	409,701	410,912	411,820	412,371	411,794
Residential-MF	17,691	17,691	17,723	17,784	17,873	17,952	18,023	18,085	18,138	18,178	18,204	18,183
Commercial	690,278	690,278	692,814	696,579	701,411	706,240	711,351	716,798	722,786	729,304	736,391	741,665
Industrial	1,510,954	1,510,954	1,522,453	1,537,933	1,557,247	1,578,936	1,603,461	1,630,150	1,659,511	1,691,519	1,725,336	1,750,157

Petroleum Fuels Forecast (Total) - MMBtu

	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Residential-SF	6,173,655	6,066,890	5,957,825	5,845,717	5,736,844	5,636,496	5,544,879	5,454,721	5,365,376	5,278,028	5,193,654	5,110,823
Residential-MF	-	-	-	-	-	-	-	-	-	-	-	-
Commercial	2,054,172	2,134,828	2,132,268	2,121,181	2,107,643	2,100,319	2,090,311	2,082,079	2,072,676	2,063,661	2,054,769	2,047,120
Industrial	2,368,595	2,477,566	2,523,304	2,522,005	2,536,444	2,543,878	2,538,625	2,523,435	2,519,233	2,513,279	2,512,338	2,511,944
Total	10,596,422	10,679,284	10,613,397	10,488,903	10,380,931	10,280,694	10,173,815	10,060,236	9,957,285	9,854,968	9,760,762	9,669,887
											Average Annual Growth:	-0.79%
AVAILABLE EXISTING BUILDINGS (NOT including RENOVATION and Recent RENOVATION)												
Residential-SF	5,130,067	5,025,166	4,919,865	4,813,465	4,712,182	4,621,149	4,540,413	4,462,672	4,387,260	4,315,319	4,247,771	4,181,292
Residential-MF	-	-	-	-	-	-	-	-	-	-	-	-
Commercial	1,455,970	1,534,123	1,529,156	1,516,024	1,500,874	1,492,178	1,481,117	1,472,096	1,462,201	1,452,978	1,444,157	1,439,301
Industrial	1,678,829	1,784,419	1,825,378	1,819,375	1,828,693	1,830,812	1,820,444	1,800,646	1,792,000	1,781,819	1,776,710	1,775,550
NEW CONSTRUCTION												
Residential-SF	77,358	76,021	74,654	73,249	71,885	70,628	69,480	68,350	67,230	66,136	65,079	64,041
Residential-MF	-	-	-	-	-	-	-	-	-	-	-	-
Commercial	43,643	45,356	45,302	45,066	44,779	44,623	44,411	44,236	44,036	43,844	43,655	43,493
Industrial	50,323	52,638	53,610	53,582	53,889	54,047	53,935	53,613	53,523	53,397	53,377	53,369
UNAVAILABLE EXISTING BUILDINGS: Recent NEW CONSTRUCTION												
Residential-SF	696,226	696,226	694,889	692,184	688,075	682,601	675,871	667,992	658,983	648,855	637,633	626,691
Residential-MF	-	-	-	-	-	-	-	-	-	-	-	-
Commercial	392,785	392,785	394,498	396,157	397,581	398,717	399,698	400,465	401,058	401,451	401,653	399,952
Industrial	452,906	452,906	455,222	458,509	461,768	465,334	469,058	472,670	475,960	479,161	482,235	482,973
RENOVATION												
Residential-SF	27,000	26,473	25,941	25,401	24,884	24,416	23,998	23,592	23,196	22,815	22,455	22,100
Residential-MF	-	-	-	-	-	-	-	-	-	-	-	-
Commercial	16,177	16,967	16,925	16,800	16,653	16,570	16,462	16,374	16,276	16,184	16,095	16,037
Industrial	18,654	19,720	20,145	20,099	20,208	20,245	20,156	19,972	19,897	19,807	19,767	19,756
UNAVAILABLE EXISTING BUILDINGS: Recent RENOVATION												
Residential-SF	243,003	243,003	242,476	241,417	239,818	237,702	235,118	232,115	228,707	224,903	220,717	216,699
Residential-MF	-	-	-	-	-	-	-	-	-	-	-	-
Commercial	145,597	145,597	146,386	147,134	147,756	148,231	148,624	148,908	149,104	149,203	149,209	148,337
Industrial	167,883	167,883	168,949	170,441	171,886	173,440	175,032	176,534	177,852	179,096	180,249	180,297

APPENDIX M: AVOIDED COSTS

Avoided Electric Costs by Energy Period (2013$)

Year	Summer On-Peak $/kWh	Summer Off-Peak $/kWh	Winter On-Peak $/kWh	Winter Off-Peak $/kWh	Summer Capacity $/kWh-yr	T&D $/kW-yr
2014	0.111	0.034	0.104	0.041	65.0	88.0
2015	0.112	0.035	0.105	0.042	54.2	87.4
2016	0.122	0.038	0.114	0.045	47.9	87.0
2017	0.125	0.039	0.116	0.046	54.9	86.7
2018	0.131	0.040	0.122	0.048	54.7	86.3
2019	0.133	0.041	0.124	0.049	54.4	85.9
2020	0.134	0.042	0.125	0.050	54.3	85.6
2021	0.134	0.042	0.125	0.050	54.1	85.3
2022	0.138	0.043	0.129	0.051	54.0	85.1
2023	0.141	0.044	0.132	0.052	53.9	84.9
2024	0.145	0.045	0.135	0.053	53.8	84.8
2025	0.146	0.045	0.136	0.054	53.7	84.6
2026	0.152	0.047	0.142	0.056	53.6	84.4
2027	0.152	0.047	0.142	0.056	53.5	84.3
2028	0.155	0.048	0.145	0.057	53.4	84.1
2029	0.157	0.049	0.147	0.058	53.3	84.0
2030	0.160	0.049	0.149	0.059	53.3	83.9
2031	0.163	0.051	0.152	0.060	53.2	83.7
2032	0.165	0.051	0.154	0.061	53.1	83.6
2033	0.168	0.052	0.157	0.062	53.0	83.5
2034	0.173	0.054	0.162	0.064	52.9	83.4
2035	0.179	0.055	0.167	0.066	52.8	83.2
2036	0.187	0.058	0.175	0.069	52.7	83.1
2037	0.192	0.059	0.179	0.071	52.6	82.9
2038	0.192	0.059	0.179	0.071	52.6	82.9
2039	0.192	0.059	0.179	0.071	52.6	82.9
2040	0.192	0.059	0.179	0.071	52.6	82.9
2041	0.192	0.059	0.179	0.071	52.6	82.9
2042	0.192	0.059	0.179	0.071	52.6	82.9
2043	0.192	0.059	0.179	0.071	52.6	82.9
2044	0.192	0.059	0.179	0.071	52.6	82.9
2045	0.192	0.059	0.179	0.071	52.6	82.9
2046	0.192	0.059	0.179	0.071	52.6	82.9
2047	0.192	0.059	0.179	0.071	52.6	82.9
2048	0.192	0.059	0.179	0.071	52.6	82.9
2049	0.192	0.059	0.179	0.071	52.6	82.9
2050	0.192	0.059	0.179	0.071	52.6	82.9
2051	0.192	0.059	0.179	0.071	52.6	82.9
2052	0.192	0.059	0.179	0.071	52.6	82.9
2053	0.192	0.059	0.179	0.071	52.6	82.9
2054	0.192	0.059	0.179	0.071	52.6	82.9
2055	0.192	0.059	0.179	0.071	52.6	82.9
2056	0.192	0.059	0.179	0.071	52.6	82.9
2057	0.192	0.059	0.179	0.071	52.6	82.9
2058	0.192	0.059	0.179	0.071	52.6	82.9
2059	0.192	0.059	0.179	0.071	52.6	82.9
2060	0.192	0.059	0.179	0.071	52.6	82.9

Avoided Cost of Natural Gas and Petroleum Fuels (2013$/MMBtu)

	Natural Gas			Petroleum Fuels		
Year	Residential	Commercial	Industrial	Residential	Commercial	Industrial
2014	6.93	6.26	6.26	25.68	20.94	18.79
2015	6.93	6.26	6.26	25.07	20.41	18.36
2016	7.03	6.36	6.36	24.69	20.20	18.07
2017	7.30	6.57	6.57	24.32	19.89	17.85
2018	7.58	6.86	6.86	24.87	20.33	18.29
2019	7.90	7.22	7.22	25.17	20.57	18.70
2020	8.15	7.48	7.48	25.43	20.75	18.89
2021	8.30	7.62	7.62	25.60	20.87	19.10
2022	8.50	7.82	7.82	25.78	21.05	19.34
2023	8.62	7.95	7.95	26.04	21.22	19.57
2024	8.77	8.08	8.08	26.24	21.34	19.76
2025	8.94	8.27	8.27	26.48	21.52	19.95
2026	9.07	8.39	8.39	26.67	21.64	20.03
2027	9.19	8.51	8.51	26.94	21.85	20.30
2028	9.29	8.61	8.61	27.22	22.06	20.56
2029	9.44	8.76	8.76	27.51	22.26	20.82
2030	9.60	8.92	8.92	27.79	22.48	21.11
2031	9.76	9.08	9.08	28.08	22.69	21.38
2032	9.92	9.24	9.24	28.37	22.91	21.66
2033	10.08	9.40	9.40	28.66	23.12	21.94
2034	10.24	9.57	9.57	28.96	23.34	22.23
2035	10.41	9.74	9.74	29.26	23.56	22.51
2036	10.58	9.91	9.91	29.56	23.78	22.81
2037	10.75	10.09	10.09	29.87	24.01	23.11
2038	10.93	10.27	10.27	30.18	24.24	23.42
2039	11.11	10.45	10.45	30.49	24.47	23.73
2040	11.29	10.64	10.64	30.81	24.70	24.03
2041	11.47	10.82	10.82	31.13	24.94	24.35
2042	11.66	11.02	11.02	31.13	24.94	24.35
2043	11.85	11.21	11.21	31.13	24.94	24.35
2044	11.85	11.21	11.21	31.13	24.94	24.35
2045	11.85	11.21	11.21	31.13	24.94	24.35
2046	11.85	11.21	11.21	31.13	24.94	24.35
2047	11.85	11.21	11.21	31.13	24.94	24.35
2048	11.85	11.21	11.21	31.13	24.94	24.35
2049	11.85	11.21	11.21	31.13	24.94	24.35
2050	11.85	11.21	11.21	31.13	24.94	24.35
2051	11.85	11.21	11.21	31.13	24.94	24.35
2052	11.85	11.21	11.21	31.13	24.94	24.35
2053	11.85	11.21	11.21	31.13	24.94	24.35
2054	11.85	11.21	11.21	31.13	24.94	24.35
2055	11.85	11.21	11.21	31.13	24.94	24.35
2056	11.85	11.21	11.21	31.13	24.94	24.35
2057	11.85	11.21	11.21	31.13	24.94	24.35
2058	11.85	11.21	11.21	31.13	24.94	24.35
2059	11.85	11.21	11.21	31.13	24.94	24.35
2060	11.85	11.21	11.21	31.13	24.94	24.35

Retail Energy Rates (2013$)

	Electricity ($/kWh)			Natural Gas ($/MMBtu)			Petroleum Fuels ($/MMBtu)		
Year	Residential	Commercial	Industrial	Residential	Commercial	Industrial	Residential	Commercial	Industrial
2014	0.136	0.103	0.084	13.9	12.3	11.1	25.9	19.7	16.9
2015	0.137	0.103	0.084	13.6	12.0	11.2	25.5	19.3	16.6
2016	0.139	0.104	0.086	14.2	12.6	12.1	25.7	19.6	16.9
2017	0.140	0.104	0.086	14.5	12.9	12.5	26.4	20.3	17.3
2018	0.140	0.105	0.087	14.9	13.2	13.0	26.9	20.7	17.8
2019	0.140	0.104	0.087	15.1	13.4	13.2	27.3	21.2	18.1
2020	0.139	0.104	0.086	15.2	13.6	13.4	27.8	21.6	18.6
2021	0.139	0.103	0.086	15.4	13.8	13.6	28.1	22.0	18.9
2022	0.138	0.102	0.086	15.7	14.1	14.0	28.5	22.5	19.3
2023	0.138	0.102	0.087	16.0	14.4	14.4	28.9	22.9	19.7
2024	0.138	0.102	0.087	16.2	14.6	14.6	29.3	23.2	20.1
2025	0.137	0.101	0.087	16.4	14.7	14.7	29.6	23.6	20.4
2026	0.137	0.101	0.088	16.6	14.9	15.0	30.0	23.9	20.8
2027	0.137	0.101	0.088	16.7	15.0	15.1	30.3	24.2	21.1
2028	0.136	0.101	0.088	16.9	15.1	15.3	30.6	24.5	21.5
2029	0.136	0.101	0.088	17.1	15.3	15.5	30.9	24.8	21.8
2030	0.136	0.101	0.089	17.3	15.5	15.8	31.2	25.1	22.2
2031	0.136	0.101	0.089	17.6	15.7	16.1	31.5	25.4	22.3
2032	0.137	0.101	0.090	17.8	15.8	16.2	31.8	25.7	22.8
2033	0.137	0.102	0.091	18.0	16.0	16.5	32.1	26.0	23.2
2034	0.138	0.103	0.092	18.4	16.4	17.0	32.5	26.4	23.5
2035	0.140	0.105	0.094	18.8	16.7	17.5	32.9	26.9	24.0
2036	0.141	0.106	0.095	19.2	17.2	18.2	33.3	27.3	24.5
2037	0.142	0.108	0.097	19.6	17.7	18.8	33.8	27.8	25.0
2038	0.144	0.109	0.099	20.1	18.1	19.5	34.2	28.2	25.3
2039	0.145	0.111	0.100	20.3	18.3	19.7	34.6	28.6	25.9
2040	0.146	0.112	0.101	20.7	18.6	20.2	35.0	29.0	26.3
2041	0.146	0.112	0.101	20.7	18.6	20.2	35.0	29.0	26.3
2042	0.146	0.112	0.101	20.7	18.6	20.2	35.0	29.0	26.3
2043	0.146	0.112	0.101	20.7	18.6	20.2	35.0	29.0	26.3
2044	0.146	0.112	0.101	20.7	18.6	20.2	35.0	29.0	26.3
2045	0.146	0.112	0.101	20.7	18.6	20.2	35.0	29.0	26.3
2046	0.146	0.112	0.101	20.7	18.6	20.2	35.0	29.0	26.3
2047	0.146	0.112	0.101	20.7	18.6	20.2	35.0	29.0	26.3
2048	0.146	0.112	0.101	20.7	18.6	20.2	35.0	29.0	26.3
2049	0.146	0.112	0.101	20.7	18.6	20.2	35.0	29.0	26.3
2050	0.146	0.112	0.101	20.7	18.6	20.2	35.0	29.0	26.3
2051	0.146	0.112	0.101	20.7	18.6	20.2	35.0	29.0	26.3
2052	0.146	0.112	0.101	20.7	18.6	20.2	35.0	29.0	26.3
2053	0.146	0.112	0.101	20.7	18.6	20.2	35.0	29.0	26.3
2054	0.146	0.112	0.101	20.7	18.6	20.2	35.0	29.0	26.3
2055	0.146	0.112	0.101	20.7	18.6	20.2	35.0	29.0	26.3
2056	0.146	0.112	0.101	20.7	18.6	20.2	35.0	29.0	26.3
2057	0.146	0.112	0.101	20.7	18.6	20.2	35.0	29.0	26.3
2058	0.146	0.112	0.101	20.7	18.6	20.2	35.0	29.0	26.3
2059	0.146	0.112	0.101	20.7	18.6	20.2	35.0	29.0	26.3
2060	0.146	0.112	0.101	20.7	18.6	20.2	35.0	29.0	26.3

APPENDIX N: LOAD SHAPES

Load Shape Name (Read: BUILDING_Enduse)	**Summer On-peak**	**Summer Off-peak**	**Winter On-peak**	**Winter Off-peak**	**Summer Capacity**	**T&D**
COMMERCIAL LOAD SHAPES						
GROC_ElecTotl	12.8%	17.7%	28.2%	41.3%	69%	69%
GROC_ElecCook	11.0%	14.3%	32.7%	42.0%	54%	54%
GROC_Cool	30.8%	37.4%	17.4%	14.3%	61%	61%
GROC_ElecHeat	0.0%	0.0%	22.6%	77.4%	0%	0%
GROC_ElecDHW	11.1%	11.2%	38.9%	38.8%	53%	53%
GROC_InLight	11.9%	13.4%	34.8%	39.9%	67%	67%
GROC_ElecMisc	10.4%	14.9%	30.6%	44.2%	76%	76%
GROC_Office	10.5%	14.8%	30.8%	43.9%	77%	77%
GROC_Refrig	10.7%	16.3%	28.1%	44.9%	75%	75%
GROC_Vent	9.5%	15.7%	27.8%	47.1%	76%	76%
GROC_VentVFD	9.7%	16.0%	27.7%	46.6%	77%	77%
GROC_OutLight	3.7%	17.2%	16.2%	62.9%	4%	4%
HOSP_ElecTotl	15.0%	20.4%	26.7%	37.9%	62%	62%
HOSP_ElecCook	11.5%	13.7%	34.4%	40.4%	59%	59%
HOSP_Cool	27.2%	37.2%	17.6%	18.0%	59%	59%
HOSP_ElecHeat	2.4%	4.5%	24.2%	68.9%	8%	8%
HOSP_ElecDHW	9.9%	12.3%	34.9%	42.9%	47%	47%
HOSP_InLight	10.7%	14.5%	31.7%	43.1%	72%	72%
HOSP_ElecMisc	10.6%	14.6%	31.5%	43.4%	68%	68%
HOSP_Office	10.4%	14.8%	30.7%	44.1%	73%	73%
HOSP_Refrig	9.9%	15.3%	29.1%	45.7%	73%	73%
HOSP_Vent	9.4%	15.6%	27.8%	47.1%	59%	59%
HOSP_VentVFD	9.6%	15.9%	27.6%	46.8%	77%	77%
HOSP_OutLight	3.7%	17.2%	16.2%	62.9%	4%	4%
HOTEL_ElecTotl	17.6%	20.6%	25.2%	36.7%	55%	55%
HOTEL_ElecCook	12.9%	12.3%	37.8%	37.0%	70%	70%
HOTEL_Cool	39.3%	38.4%	14.3%	8.1%	62%	62%
HOTEL_ElecHeat	0.0%	0.0%	23.3%	76.7%	0%	0%
HOTEL_ElecDHW	10.1%	12.2%	34.7%	43.1%	56%	56%
HOTEL_InLight	10.6%	14.6%	30.8%	44.0%	58%	58%
HOTEL_ElecMisc	11.1%	14.1%	32.4%	42.4%	71%	71%
HOTEL_Office	10.1%	15.1%	29.6%	45.2%	76%	76%
HOTEL_Refrig	10.1%	15.1%	29.5%	45.3%	76%	76%
HOTEL_Vent	9.5%	15.7%	27.8%	47.1%	76%	76%
HOTEL_VentVFD	9.6%	15.8%	27.7%	46.9%	77%	77%
HOTEL_OutLight	3.7%	17.2%	16.2%	62.9%	4%	4%
OFFMD_ElecTotl	21.2%	10.4%	39.7%	28.6%	61%	61%
OFFMD_ElecCook	17.5%	7.7%	53.6%	21.2%	61%	61%
OFFMD_Cool	55.8%	14.8%	24.5%	4.8%	62%	62%
OFFMD_ElecHeat	0.0%	0.0%	58.5%	41.5%	0%	0%
OFFMD_ElecDHW	9.1%	13.1%	31.8%	46.0%	55%	55%
OFFMD_InLight	16.5%	8.7%	49.9%	24.9%	69%	69%
OFFMD_ElecMisc	13.8%	11.4%	41.4%	33.4%	70%	70%
OFFMD_Office	11.8%	13.4%	35.0%	39.8%	73%	73%
OFFMD_Refrig	10.0%	15.2%	29.2%	45.5%	72%	72%
OFFMD_Vent	11.2%	3.2%	37.5%	48.1%	75%	75%
OFFMD_VentVFD	8.2%	29.3%	17.3%	45.2%	21%	21%
OFFMD_OutLight	3.7%	17.2%	16.2%	62.9%	4%	4%
RETLG_ElecTotl	23.0%	16.9%	28.3%	31.8%	53%	53%
RETLG_ElecCook	14.8%	10.5%	43.7%	31.0%	74%	74%

Load Shape Name (Read: BUILDING_Enduse)	Summer On-peak	Summer Off-peak	Winter On-peak	Winter Off-peak	Summer Capacity	T&D
RETLG_Cool	49.4%	30.3%	13.0%	7.4%	60%	60%
RETLG_ElecHeat	0.0%	0.0%	49.9%	50.1%	0%	0%
RETLG_ElecDHW	12.3%	10.1%	43.1%	34.6%	55%	55%
RETLG_InLight	13.0%	12.3%	38.1%	36.6%	77%	77%
RETLG_ElecMisc	12.2%	13.0%	35.8%	39.0%	77%	77%
RETLG_Office	10.7%	14.5%	31.4%	43.4%	77%	77%
RETLG_Refrig	10.0%	15.2%	29.4%	45.4%	76%	76%
RETLG_Vent	11.4%	8.0%	33.9%	46.7%	76%	76%
RETLG_VentVFD	6.9%	28.2%	17.9%	47.1%	20%	20%
RETLG_OutLight	3.7%	17.2%	16.2%	62.9%	4%	4%
RST2_ElecTotl	14.7%	17.5%	30.0%	37.9%	67%	67%
RST2_ElecCook	15.0%	10.3%	44.3%	30.4%	72%	72%
RST2_Cool	35.3%	38.8%	15.2%	10.7%	61%	61%
RST2_ElecHeat	0.0%	0.0%	26.9%	73.1%	0%	0%
RST2_ElecDHW	13.3%	9.0%	45.7%	31.9%	53%	53%
RST2_InLight	14.1%	11.2%	41.3%	33.4%	77%	77%
RST2_ElecMisc	12.6%	12.7%	37.0%	37.8%	77%	77%
RST2_Office	11.2%	14.1%	32.7%	42.1%	77%	77%
RST2_Refrig	10.2%	15.0%	29.8%	45.0%	76%	76%
RST2_Vent	9.3%	15.4%	27.8%	47.5%	73%	73%
RST2_VentVFD	10.7%	17.7%	27.3%	44.3%	77%	77%
RST2_OutLight	3.7%	17.2%	16.2%	62.9%	4%	4%
WRHS_ElecTotl	11.4%	16.1%	29.2%	43.3%	72%	72%
WRHS_ElecCook	17.2%	8.0%	52.4%	22.4%	57%	57%
WRHS_Cool	44.1%	48.5%	4.8%	2.6%	62%	62%
WRHS_ElecHeat	0.0%	0.0%	29.6%	70.4%	0%	0%
WRHS_ElecDHW	12.6%	9.6%	44.8%	33.0%	54%	54%
WRHS_InLight	14.6%	10.6%	44.3%	30.5%	67%	67%
WRHS_ElecMisc	14.5%	10.7%	43.5%	31.3%	74%	74%
WRHS_Office	11.4%	13.8%	33.9%	40.8%	69%	69%
WRHS_Refrig	10.8%	16.4%	28.0%	44.8%	74%	74%
WRHS_Vent	9.4%	15.6%	27.8%	47.2%	76%	76%
WRHS_Vent	9.9%	16.3%	27.6%	46.2%	77%	77%
WRHS_OutLight	3.7%	17.2%	16.2%	62.9%	4%	4%
SCHL_ElecTotl	12.5%	8.1%	40.4%	39.0%	21%	21%
SCHL_ElecCook	5.5%	5.1%	52.6%	36.8%	7%	7%
SCHL_Cool	47.8%	18.5%	26.4%	7.3%	59%	59%
SCHL_ElecHeat	0.0%	0.0%	42.3%	57.7%	0%	0%
SCHL_ElecDHW	14.3%	8.4%	50.7%	26.6%	36%	36%
SCHL_InLight	5.0%	6.4%	49.0%	39.5%	10%	10%
SCHL_ElecMisc	4.0%	8.1%	43.0%	44.9%	5%	5%
SCHL_Office	3.9%	8.6%	41.3%	46.2%	10%	10%
SCHL_Refrig	10.2%	15.0%	29.8%	45.0%	76%	76%
SCHL_Vent	7.8%	3.3%	36.4%	52.4%	37%	37%
SCHL_VentVFD	11.5%	26.9%	20.0%	41.6%	59%	59%
SCHL_OutLight	3.7%	17.2%	16.2%	62.9%	4%	4%
OTHER_ElecTotl	17.7%	14.9%	30.7%	36.7%	50%	50%
OTHER_ElecCook	13.0%	12.2%	39.3%	35.6%	44%	44%
OTHER_Cool	49.2%	25.6%	16.4%	8.9%	60%	60%
OTHER_ElecHeat	0.0%	0.0%	47.9%	52.1%	0%	0%
OTHER_ElecDHW	10.8%	11.5%	37.8%	39.9%	47%	47%

Load Shape Name (Read: BUILDING_Enduse)	**Summer On-peak**	**Summer Off-peak**	**Winter On-peak**	**Winter Off-peak**	**Summer Capacity**	**T&D**
OTHER_InLight	11.9%	13.3%	35.6%	39.2%	51%	51%
OTHER_ElecMisc	11.3%	13.8%	33.7%	41.1%	54%	54%
OTHER_Office	10.5%	14.7%	30.9%	43.9%	63%	63%
OTHER_Refrig	9.9%	15.3%	29.0%	45.8%	72%	72%
OTHER_Vent	9.8%	5.3%	35.4%	49.5%	66%	66%
OTHER_Vent	9.4%	27.3%	19.3%	43.9%	34%	34%
OTHER_OutLight	3.7%	17.2%	16.2%	62.9%	4%	4%
Continuous	9.5%	15.7%	27.8%	47.0%	77%	77%
Streetlighting_OutLight	7.3%	17.9%	19.5%	55.3%	19%	19%
Data Center_InLight	9.5%	15.7%	27.8%	47.0%	19%	19%
Data Center_Cool	9.5%	15.7%	27.8%	47.0%	16%	16%
Data Center_ElecMisc	9.5%	15.7%	27.8%	47.0%	19%	19%
RESIDENTIAL LOAD SHAPES						
Res SF_ElecTotl	14.2%	18.0%	27.0%	40.9%	44%	44%
Res SF_ElecHeat	0.0%	0.0%	32.0%	68.0%	1%	1%
Res SF_Cool	44.0%	41.4%	5.6%	8.9%	70%	70%
Res SF_Refrig	10.6%	17.1%	27.1%	45.2%	87%	87%
Res SF_Freezer	11.0%	16.8%	28.0%	44.2%	97%	97%
Res SF_ElecCook	10.7%	10.6%	39.3%	39.4%	48%	48%
Res SF_Dishwash	11.0%	11.8%	36.8%	40.3%	34%	34%
Res SF_ElecMisc	9.2%	16.0%	26.8%	48.0%	85%	85%
Res SF_ElecDryr	11.4%	11.0%	39.1%	38.6%	45%	45%
Res SF_ElecDHW	7.8%	13.0%	30.0%	49.1%	31%	31%
Res SF_ClWash	9.2%	12.7%	33.4%	44.8%	40%	40%
Res SF_PoolSpa	12.0%	13.1%	34.7%	40.1%	70%	70%
Res SF_ColorTV	10.8%	14.4%	30.9%	43.9%	78%	78%
Res SF_InLight	7.7%	13.0%	30.8%	48.5%	12%	12%
Res SF_OutLight	7.7%	13.0%	30.8%	48.5%	12%	12%
Res MF_ElecTotl	13.4%	17.7%	27.4%	41.6%	69%	69%
Res MF_ElecHeat	0.0%	0.1%	34.2%	65.7%	2%	2%
Res MF_Cool	42.5%	41.5%	6.6%	9.3%	97%	97%
Res MF_Refrig	10.6%	17.1%	27.1%	45.2%	87%	87%
Res MF_Freezer	11.0%	16.8%	28.0%	44.2%	97%	97%
Res MF_ElecCook	10.9%	10.4%	40.3%	38.4%	48%	48%
Res MF_Dishwash	11.3%	11.5%	38.4%	38.8%	36%	36%
Res MF_ElecMisc	9.4%	15.8%	27.6%	47.2%	84%	84%
Res MF_ElecDryr	11.8%	10.6%	40.7%	36.9%	44%	44%
Res MF_ElecDHW	7.8%	13.1%	30.3%	48.9%	29%	29%
Res MF_ClWash	9.4%	12.4%	34.6%	43.6%	39%	39%
Res MF_PoolSpa	12.0%	13.1%	34.7%	40.1%	70%	70%
Res MF_ColorTV	10.4%	14.7%	30.1%	44.7%	81%	81%
Res MF_InLight	7.2%	13.7%	28.9%	50.3%	13%	13%
Res MF_OutLight	7.2%	13.7%	28.9%	50.3%	13%	13%
INDUSTRIAL LOADSHAPES						
Industrial_CompIndustrial	31.3%	2.1%	62.4%	4.2%	45%	45%
Industrial_InLight	29.0%	4.4%	57.8%	8.8%	73%	73%
Industrial_Cooling	46.0%	26.0%	18.0%	10.0%	81%	81%

APPENDIX O: RATE AND BILL IMPACTS MEMO

Optimal ENERGY Integrated Energy Resources

MEMORANDUM

To: DNREC
From: Optimal Energy
RE: Rate & Bill Analysis
Date: June 16, 2014

INTRODUCTION & SUMMARY OF RESULTS

Optimal Energy's recent study, *Study of Potential for Energy Savings in Delaware* ("the potential study") indicates that pursuing energy efficiency resources in Delaware would be highly cost-effective with a Total Resource benefit-cost ratio of 2.4, resulting in savings to the Delaware economy of $2.3 billion in present value net benefits, at an average levelized cost of $0.021/kWh and $2.80/MMBtu. This is approximately one-seventh of the cost of alternative supply-side energy resources.[1] As a result, capturing this energy resource will serve to significantly lower the overall costs of meeting Delaware's electricity and natural gas needs. That is, Delaware customers' *energy bills* will go down. As described in more detail later, electric and gas *rates* will increase slightly in the short term,[2] but these increases can easily be offset by participating in efficiency programs. For example, a typical residential customer only needs to install three CFLs to overcome the small electric rate increase.

The countervailing impacts of efficiency on Delaware's energy rates and bills result from two effects. First, the amount of energy consumed decreases as efficiency is improved. Because the utility industry is highly capital intensive, there are significant costs associated with the existing system infrastructure that are relatively fixed in the short term. Therefore, as energy consumption drops, these fixed costs must be recovered over a smaller volume of energy sales, leading to an increase in the per unit price. Second, and to a much lesser extent, the investment in the efficiency programs must also be recovered over this same reduced amount of energy sales. Offsetting these rate effects are savings that come from avoiding the variable costs of fuel and maintenance that would have been incurred to meet the higher energy loads in the absence of energy efficiency, and overall market clearing price reductions ("demand reduction induced price effects" or DRIPE) as demand is marginally lowered on the PJM electric grid.

This analysis considers the impacts on consumer retail rates and bills from Delaware pursuing the energy efficiency programs described in the potential study.[3] We separately analyze overall system impacts for all customers, the impacts for average customers who choose to participate in programs, and the impacts for those who choose not to participate or adopt any efficiency improvements ("non-participants"). Non-participants will experience modest short

[1] Delaware's residential Standard Offer Service - $0.159/kWh - is used as comparison

[2] "Short term" refers to 2014-2016 (the first three years of the analysis). "Long term" refers to 2014-2025 (the full study period). This language is used frequently throughout the document to refer to these time frames.

[3] The analysis covers both electric and gas, but not unregulated petroleum fuels.

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term increases in their rates and–because their energy usage is presumed to remain constant–energy bills). However, it is important to realize that a well-designed, comprehensive portfolio of programs such as the one described in the potential study typically enjoys high participation levels, with the majority of consumers adopting some efficiency measures. As a result, while rates will increase slightly, the majority of Delaware consumers will enjoy lower overall energy costs over the long term.

Results

The analysis compares the first three years (2014-2016) of efficiency program activity described in the potential study to a business-as-usual scenario with no energy efficiency programs or cost recovery on gas and electric rates. This methodology is necessary to isolate the impacts of the efficiency investments, which, unlike traditional supply side resources, are paid for up front but continue to "generate" energy over the course of their life. The results at the statewide level over both the short term and the long term (to account for the lifetime of the efficiency measures) are summarized in Figure 1 below.

Figure 1 | Summary of Statewide Bill Impacts Relative to Business-As-Usual

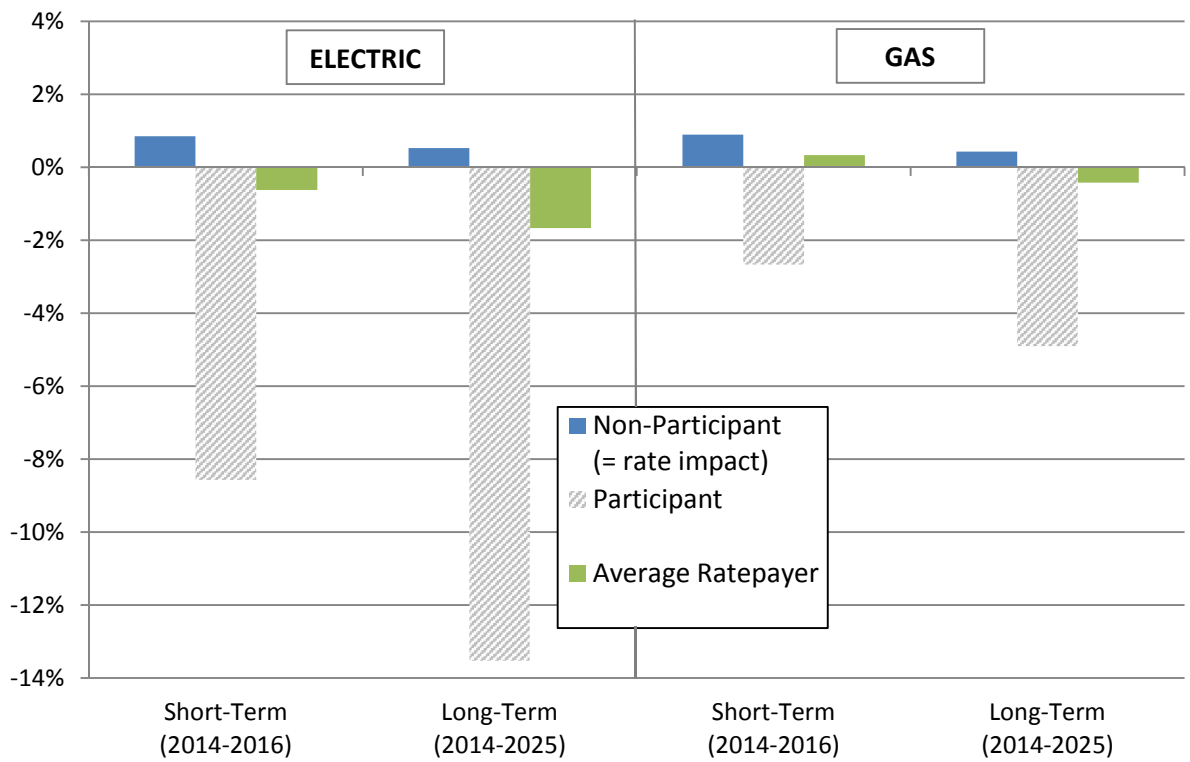


Figure 1 illustrates the concept described above of short term rate increases accompanied by participant bill reductions and long term system benefits. On both the gas and electric side, non-participants' bills increase by roughly 0.9% in the short term (equivalent to the rate increase). Meanwhile, program participants see net bill reductions ranging from 2% (gas) to 8% (electric),

even when incorporating the higher rates. Average ratepayers represent the net bill impact on the customer base as a whole. The impact on average ratepayers is calculated as the sum of bill impacts divided by the total number of customers. The fact that bill impacts on average ratepayers are positive (i.e. higher bills) in the short term indicates that the total cost associated with higher rates is greater than the sum of the bill reductions experienced by program participants.

Participant bill impacts improve (i.e., lower bills) over the long term because efficiency measures continue to save energy over the course of their measure life, accumulating savings each year compared to business-as-usual. Over the long term, participant bill savings range from 5% (gas) to 14% (electric). Long term bill impacts for average ratepayers are lower for the same reason; lifetime energy savings from program participants outweigh the total cost paid by all ratepayers to fund those efficiency measures. This is true for both the electric and gas sides, as shown in Figure 1. Rate impacts (i.e. non-participant bill impacts) appear smaller over the long term simply because the impact of cost recovery is averaged over a longer timeframe.

Scope, Assumptions, and Limitations

The scope of the analysis is constrained in several key ways which are summarized below:

- The analysis considers the rate impacts of cost recovery for the years 2014-2016 only. Due to the averaging of impacts over time, there is a natural tradeoff between the length of the study and the applicability of the results to any one year.[4] The 2014-2016 timeframe was chosen to give a reasonably accurate picture of the rate and bill impacts Delaware can expect in the near term.
- While the analysis only considers three years of costs, the study period extends many years longer. This methodology is necessary in order to capture the long term rate and bill impacts of the efficiency measures installed during those initial years. Unlike traditional supply side resources, efficiency resources are paid for up front but continue to impact rates and bills for the duration of the installed measures' lives.[5]
- The analysis considers only three generic customer classes – residential, commercial, and industrial. While this is a typical division that aligns with the potential study and other key data sources, it results in some significant generalizations. In actuality, the range of impacts will be much broader than those put forth in this memo, particularly for the commercial and industrial sectors, where individual usage can vary significantly from the average usage. For example, customers with consumption levels significantly

[4] For example, if the study had looked at the full ten years corresponding to the Potential Study, the average rate and bill impacts would be skewed toward the middle of the study period and would not be represent the impacts on ratepayers during the initial years of the program.

[5] For example, if a customer installs LED lighting in 2016, they will receive a rebate which was funded by the cost recovery rider. However, that customer will experience energy savings, and thus a bill reduction, throughout the life of the LED, which is approximately 10 years. Thus, because the timing of the costs and benefits of efficiency investments are not aligned, it is necessary to carefully account for the difference in timing between costs and benefits.

different from the average, and/or participants with savings levels considerably different from the average, will experience bill impacts that differ from those presented here.

We also note several key assumptions that affect the results of the analysis:

- The analysis includes the Demand Reduction Induced Price Effect (DRIPE).[6] The values are derived from a recent study of avoided costs in Maryland.[7]
- The rate classes that serve as the basis for the rate analysis are specific to Delmarva Power and Light (DPL). DPL covers roughly 38% of the statewide electric load.[8]
- The long term rate forecasts are rough estimates based on an average growth rate; they do not include any specific assumptions about the timing or outcomes of future rate cases.
- The analysis assumes the programs are mostly, but not entirely, funded through a cost recovery rider on customers' gas and electric bills. We assume 85% of the budget would be funded through ratepayers, while 15% of the funding could come from alternative sources, such as forward capacity market revenues and/or RGGI proceeds. Alternative funding to complement a cost recovery rider is common in other states with aggressive energy efficiency targets.

The many limitations resulting from the scope and assumptions mean these results should not be viewed as detailed predictions of the rate and bill impacts for any one customer in any one year. Rather, the findings are intended to be illustrative of the typical impacts that can be expected over the short and long term, both in aggregate for all customers within each sector and for typical customers. The findings from this analysis are consistent with those from similar analyses conducted in other states with aggressive energy efficiency programs.[9]

DETAILED RESULTS

Rate Impacts

We make the following observations from our analysis of how gas and electric rates are likely to change due to efficiency program activity:

- In the short term, while total costs of energy services in Delaware will decrease, rates will increase for all customer classes. The increase results from two components: 1) reduced

[6] Demand Reduction Induced Price Effect (DRIPE) refers to the reduction in prices in the wholesale markets for capacity and energy resulting from the reduction in quantities of capacity and of energy required from those markets due to the impact of efficiency and/or demand response programs. Thus DRIPE is a measure of the value of efficiency in terms of the reductions in wholesale prices seen by all retail customers in a given period.

[7] Exeter Associates, Inc. April, 2014. Avoided Energy Costs in Maryland – Assessment of the Costs Avoided through Energy Efficiency and Conservation Measures in Maryland.

[8] http://www.eia.gov/electricity/state/delaware/pdf/delaware.pdf

[9] http://www.narucmeetings.org/Presentations/Woolf-efficiency-bill-impacts.pdf

energy usage causing the utilities' fixed cost to be spread over less electricity sales; and 2) the cost recovery that provides program funding.

- In the long term, rate impacts are relatively minor as the avoided costs of capacity, transmission and distribution all reduce the utilities' expenses and therefore lower their revenue requirements, thus putting downward pressure on rates throughout the life of the installed measures. However, at the same time, reductions in electricity usage continue to exert upward pressure on rates to recover utility fixed costs.
- Price suppression from DRIPE puts downward pressure on rates in the medium term by reducing the cost of energy and capacity. That cost gets rolled into the "generation" component of rates.[10]
- Differences in rate impacts between sectors are due to differences in tariff structures as well as differences in savings and avoided costs that feed back into rates.

Bill Impacts

We make the following observations from our analysis of how electric bills are likely to change due to efficiency program activity:

- Participants in energy efficiency programs will experience bill reductions as the savings attributed to energy efficiency measures outweigh the additional cost associated with cost recovery.
- Non-participants will see bill increases roughly proportional to the rate increase due to the fact that all customers pay the cost recovery rider.
- Bill impacts are highly dependent on participation rates, which vary considerably by program. In the residential sector, for example, the behavior and lighting programs are expected to reach the vast majority of customers over the long term but will deliver a relatively small amount of savings to each customer. These 'broad' programs ensure that everyone benefits by maximizing participation. In contrast, some programs (e.g., home energy retrofit) will provide greater savings but for a smaller subset of customers. Customers who participate in these 'deep' programs achieve significant bill savings over time. The bill impacts identified in this analysis represent average customers participating in average programs, and thus should not be associated with a specific program.
- Differences between sectors are due to two factors: 1) the cost of saved energy, and 2) depth of savings. The cost of saved energy differs by sector because the programs, measures, and delivery mechanisms are different for different customer classes. For example, the process of working with a large industrial customer, including getting access to the facility and working with the building manager, are very different from a typical residential household. Similarly, the measures installed would be very different, resulting in different depths of savings.

[10] In DPL's tariffs the "generation" component is equivalent to the "Supply Capacity, Energy, and Ancillary" charge

Table 1 | Electric Participant Bill Impact Examples

Typical Building Type Average Annual Usage		Residential 10,100 kWh/yr		Commercial 86,400 kWh/yr		Industrial 2,954,300 kWh/yr	
Participation in Broad Programs	Savings (kWh/yr)	3 CFLs	105 kWh/yr	Retrofit 6 4-lamp T12 to super T8	1,313 kWh/yr	2% facility savings	59,086 kWh/yr
	Net Annual Bill Impact ($)		-$5		-$18		-$2,689
Participation in Deep Programs	Savings (kWh/yr)	Home retrofit with 15% Savings	1,568 kWh/yr	Complete Small Business Direct Install participation with 20% savings	17,280 kWh/yr	10% facility savings	296,899 kWh/yr
	Net Annual Bill Impact ($)		-$220		-$1,387		-$27,450

Table 1 shows some examples of typical participants in each sector and the bill impacts that would result from different depths of participation. While the participants in all the examples show net bill reductions, it is notable that, at least in the residential sector, it only takes a few CFL light bulbs to completely offset the rate increase and actually lower bills. It is expected that over the course of the potential study period (2014-2025) participation in the 'broad' programs will exceed 100% – that is, most ratepayers will participate at least once and many will participate more than once.[11] In the residential sector, these 'broad' programs correspond to lighting and behavior. In the commercial sector this role is fulfilled by the small business direct install (SBDI) program. The industrial sector, which is characterized by fewer customers with higher energy usage, generally already has high participation levels because they are good candidates for efficiency.. Furthermore, industrial customers tend to participate more than once, adding to their energy savings year after year and lowering their overall cost of energy services.

[11] A 2013 study by Synapse Energy Economics looked at efficiency program participation rates in Rhode Island. The analysis examined the utility's billing database and program records and concluded that, while rates differed between customer classes, over time most customers participate at least once and many participate more than once. Since Rhode Island has a similar population to Delaware, and runs aggressive efficiency programs like those proposed in the Potential Study, we assume Synapse's findings are broadly applicable to Delaware. http://aceee.org/files/pdf/conferences/eer/2013/5C-Woolf.pdf

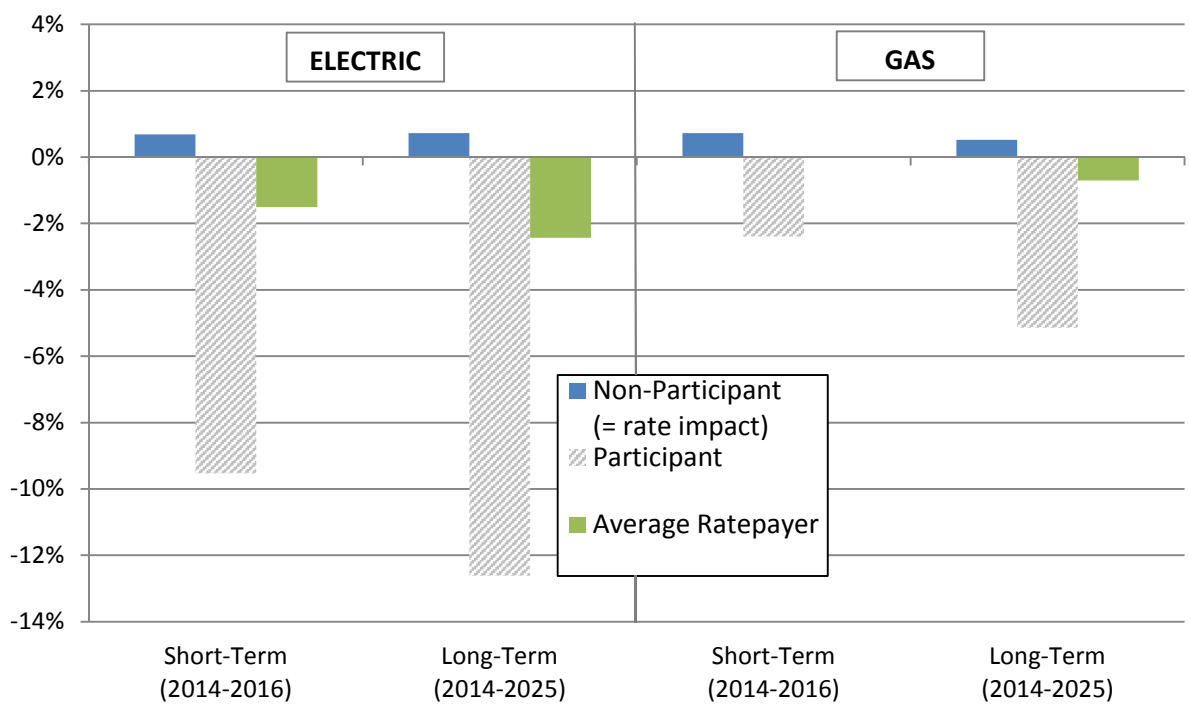
Table 2 | Gas Participant Bill Impact Examples

Typical Building Type		Residential		Commercial		Industrial	
Average Annual Usage		69 MMBtu/yr		740 MMBtu/yr		153,100 MMBtu/yr	
Participation in Broad Programs	Savings (MMBtu/yr)	2 faucet aerators and a low flow showerhead	1.03 MMBtu/yr	Programmable thermostat for 3,000 sq ft office	26 MMBtu/yr	1.5% full facility savings	2,297 MMBtu/yr
	Net Annual Bill Impact ($)		-$8		-$222		-$1,995
Participation in Deep Programs	Savings (MMBtu/yr)	Home retrofit with 15% Savings	10.37 MMBtu/yr	Heat and hot water project with 15% savings	148 MMBtu/yr	10% facility savings	15,310 MMBtu/yr
	Net Annual Bill Impact ($)		-$129		-$1,535		-$75,511

Table 2 shows similar examples of program participation, but for natural gas. Like the electric examples, the low participation scenario corresponds to 'broad' programs while the deep participation scenario corresponds to 'deep' programs. It is again notable that the installation of only a few measures, faucet aerators and a low flow showerhead in the residential case, is enough to offset the rate increase and result in a net bill reduction.

Figures 2, 3 and 4 compare short and long term bill impacts for each of the sectors analyzed.

Figure 2 | Residential Bill Impacts Summary



As would be expected, non-participants show a small bill increase which is due to the increase in rates associated with the cost recovery to fund the programs. Program participants, on the other hand, show a bill reduction due to lower energy use as a result of efficiency measures. The bill reduction is even larger over the long-term because efficiency measures continue to reduce consumption throughout their measure life. The average electric customer sees a slight bill reduction over both the short term and the long term, while the average gas customer sees a slight bill increase in the short term but a bill reduction in the long term. This finding indicates that the cumulative bill reduction of program participants is greater than the cumulative bill increases experienced by all ratepayers who pay for cost recovery.

Bill impacts in the commercial (Figure 3) and industrial (Figure 4) sectors exhibit similar patterns to the residential sector.

Figure 3 | Commercial Bill Impacts Summary

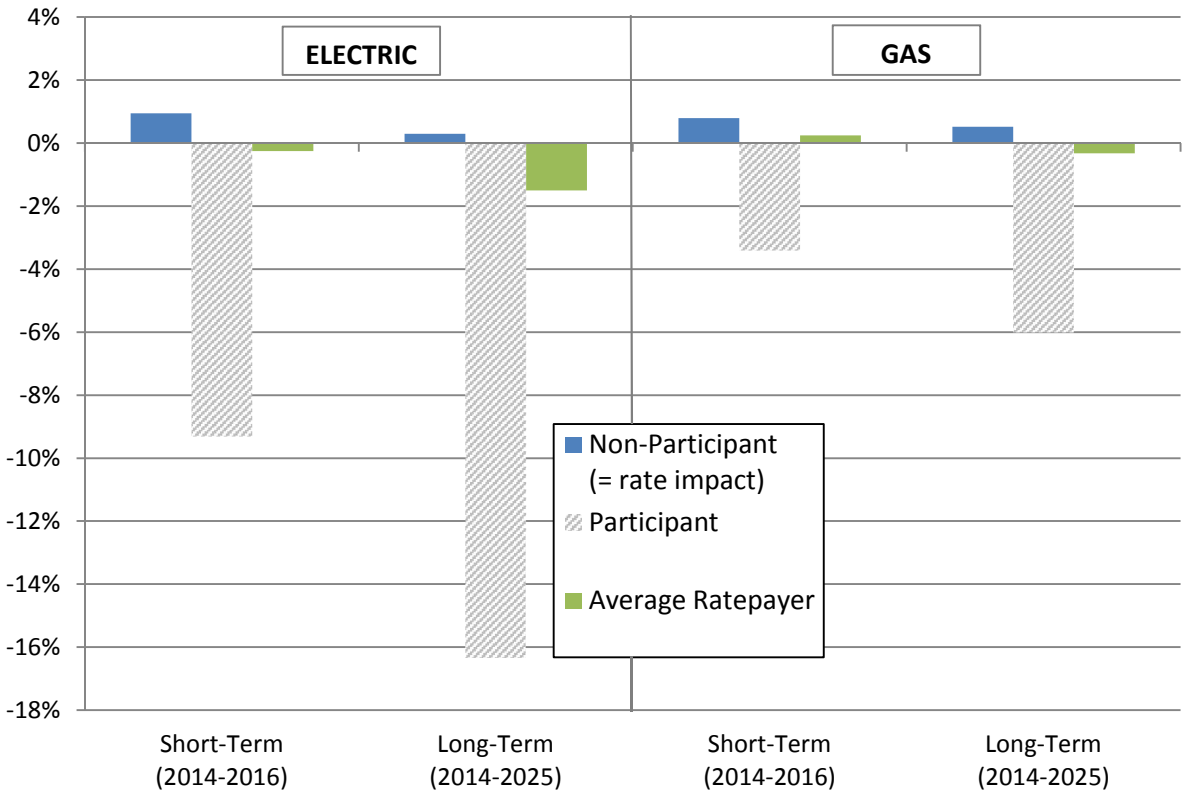
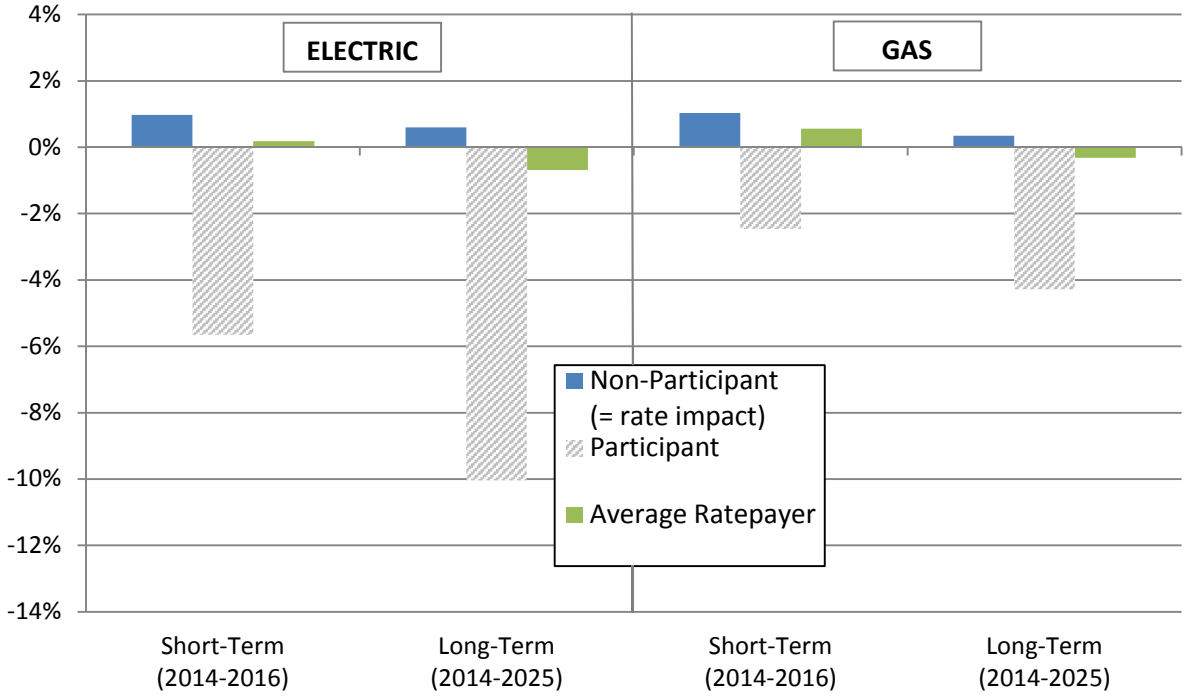


Figure 4 | Industrial Bill Impacts Summary



Additional Considerations

While this analysis is useful for broadly understanding the impact of efficiency program activity on the rates and bills of various classes of Delaware ratepayers, it does not capture several of the significant benefits of efficiency programs, including those listed below. For this reason, the results of this analysis should be viewed as a conservative estimate of the rate and bill impacts, meaning that actual benefits are likely to be higher.

- Environmental benefits due to the avoided emissions of CO_2, NO_X and SO_2.
- Economic benefits due to increased circulation of money in the local economy.
- Reduced volatility of electric rates due to reduced demand.
- Reduced risk to utility shareholders[12]

METHODOLOGY AND ASSUMPTIONS

The methodology for estimating rate and bill impacts from efficiency programs proceeded in the following manner:

1. Calculate the impact on the gas and electric sales.
2. Calculate the impact on gas and electric rates.

[12] http://www.ceres.org/resources/reports/practicing-risk-aware-electricity-regulation

3. Estimate the level of participation within each customer class.
4. Calculate the average impact on customer bills for participants, non-participants, and average customers.

The rest of this section provides additional detail on each step.

Sales Adjustments

The sales forecast is the basis for determining future rates, and thus adjustments to sales are the first step in a rate analysis. Energy efficiency programs reduce the energy and capacity forecast by promoting more efficient end use technology, practices and behavior that reduce consumption. The adjusted forecast is calculated by subtracting the forecasted energy and demand savings in the Report from the business-as-usual forecast. In the rate adjustment step, avoided costs and revenue requirements due to efficiency programs are divided by the adjusted forecast to determine how those impacts would be spread across the rate base.

Rate Adjustments

Energy efficiency programs impact gas and electric rates in a variety of ways. Some of the components of electric rates increase, while others decrease or are unaffected. These impacts are summarized below:

- *Additional charges* – includes transmission lost revenue recovery charge, distribution lost revenue recovery charge, and the cost recovery rider.
- *Charges lowered due to efficiency* – includes the transmission charge, the distribution charge, and the generation charge, which is due to avoided capacity and price suppression.
- *Charges that are not affected* – includes the customer charge, demand charge (only for C&I), and other charges such as the renewable energy and low income charge.

Changes to individual components are described in detail below:

- The **lost revenue recovery adjustment** includes the change to rates that will allow utilities to collect fixed costs that are "lost" as a result of reductions in sales from energy efficiency efforts. Utilities recover the distribution lost revenues through the decoupling mechanism in Delaware. Utilities recover the transmission lost revenues through periodic adjustments that are made to the PJM Regional Network Service charge. We assume that utilities collect both the transmission and distribution lost revenues through the average life of the energy efficiency savings.[13]
- The **cost recovery rider** is the additional charge levied on all customers' rates that provides the primary funding source for the programs. This charge is calculated by dividing the total budget for electric programs, as estimated in the Report, by the

[13] Over time we would expect these lost revenues to be less than what we have assumed because efficiency investments will help utilities reduce their fixed-cost investments.

statewide sales forecast, and then grossed up to account for the risk assumed by the utility.

- The **avoided transmission and distribution adjustments** include the reduction in rates due to reducing transmission and distribution costs over time. These rate adjustments are determined by multiplying avoided cost values by the net energy efficiency demand savings forecasted in the potential study. On the electric side the avoided costs of transmission and distribution were provided by DPL. On the gas side the avoided costs of distribution were calculated as the full avoided cost used in the potential study, minus the Gas Cost Rate component of each tariff. The rationale for this calculation is that the full avoided costs used in the potential study correspond to the costs of supply plus distribution, while the Gas Cost Rate corresponds to supply only, and thus the difference is roughly the avoided cost of distribution. Utilities experience these cost savings through the average life of the efficiency measures.
- The **avoided capacity adjustment** includes the reduction in rates as a result of reducing generation capacity requirements over time. The rate adjustments are calculated as the avoided capacity cost values provided by DPL multiplied by the net energy efficiency demand savings. Since the analysis of efficiency potential did not consider peak day gas savings, this component is ignored for the gas rate analysis.
- The **price suppression adjustment** includes the reduction in rates as a result of price suppression in the regional wholesale energy and capacity markets, also known as the demand reduction induced price effects (DRIPE). This calculation is based on estimates of price suppression effects in New England, as provided in the 2013 AESC study, and scaled to Delaware's load.[14] Price suppression effects are relatively short lived as the market adjusts to reduced demand, and thus these effects last for fewer years than the average life of the energy efficiency savings.

The adjustments described above are added up and combined with the business-as-usual rate to determine the total adjusted rate.

Participation Estimates

We estimated participation rates based on the programs and ramp-up schedules forecasted in the potential study. As is discussed earlier in this memo, participation rates vary considerably by program. Some programs reach many customers, but achieve a small amount of savings in each, while other programs reach comparatively few customers, but go 'deep' in each. Since this analysis was conducted at the sector level the participation rates represent an average depth of participation that accounts for the differences between programs and measures.

Over the course of the potential study period (2014-2025) we expect that the majority of customers will participate at least once, while many will participate multiple times, likely in

[14] http://www.synapse-energy.com/Downloads/SynapseReport.2013-07.AESC.AESC-2013.13-029-Report.pdf

multiple programs. This assumption is based on experience in other states with long-running aggressive efficiency programs, and is supported by evaluation studies.

Bill Impacts

Once the rate impacts are determined and participation levels are estimated, calculating the bill impacts is straightforward. For bill impacts, it is important to distinguish between the impacts on three different customer types: non-participants, participants, and the average customer.

Bill impacts are calculated in two steps. First, we estimate the amount by which a typical customer's consumption is reduced by participating in each program, based on typical customer consumption levels and average energy savings of participants by sector. Second, the adjusted consumption is multiplied by the adjusted rate to determine the net bill impact.

For **non-participants**, the bill impacts are identical to the rate impacts. For example, if rates are expected to increase by 1% on average over the long-term, then non-participant's bills will also increase by 1% on average over the long-term. In all scenarios, non-participant monthly savings are assumed to be zero; that is, we assume there are no impacts from market transformation on non-participants.

For **program participants**, the bill impacts are the combined effect of the rate impacts and the savings from efficiency measures. For example, if rates are expected to increase by 1% on average over the long term, and the customer participates in an efficiency program that is expected to reduce energy consumption by 7% on average over the long term, then the participants' bills will be reduced by 6% on average over the long- term.

For the **average customer**, the bill impacts represent a weighted average of the non-participant and participant bill impacts. The impact is calculated as the sum of rate impacts (total rate increase multiplied by the number of customers) minus the sum of participant savings (total energy savings), divided by the number of customers. Thus the average customer represents the impact of efficiency programs on the customer base as a whole.

APPENDIX P: JOB IMPACTS MEMO

Optimal ENERGY Integrated Energy Resources

MEMORANDUM

To: DNREC
From: Optimal Energy, Inc
Date: June 18, 2014
Subject: Job Impacts of Energy Efficiency Investments

INTRODUCTION

This memo presents our estimate of the job impacts of the energy efficiency investments proposed in Optimal Energy's recent study, *Study of Potential for Energy Savings in Delaware* ("the potential study"). Rather than conduct a traditional macroeconomic analysis, we have developed our estimate from a set of similar studies conducted in different states by different authors.

Investments in energy efficiency commensurate with the levels forecasted in the potential study will support between 3,000 and 4,800 job-years annually.[1] This estimate is derived from a meta-analysis of macroeconomic studies which quantified the net job impact from investments in energy efficiency.

In general, energy efficiency investments create net positive economic impacts in a given region.[2] In other words, usually more jobs are created through these projects than would have been created by the activities they displace, such as electric generation or the sale of fuel oil, or spending on other goods and services rather than paying more for efficient equipment. This net positive impact is due to the fact that participants save money on their energy bills, which adds to the local economy, and usually more of the dollars spent directly on energy efficiency remain in the local economy than dollars spent on "traditional" electric generation or fossil fuel purchases. Energy efficiency is also a more labor-intensive activity than typical generation or fuel sales, so for any given amount of efficiency spending, more local jobs are created than lost by reducing spending on electric generation.

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[1] One job-year is equivalent to one full time job for one year. The job-years created by one year of investment will extend over multiple years. For example, 6,000 job-years may be created as 600 jobs a year for 10 years. Furthermore, the number of job-years likely represents a mix of job impacts that are temporary (lasting from one to several years) or enduring (lasting for the majority of the analysis period).

[2] *Economic Impacts and Potential Air Emission Reductions from Renewable Generation & Efficiency Programs in New England,* prepared for the Regulatory Assistance Project by Synapse Energy Economics, April 2005.

SUMMARY OF FINDINGS

Estimate Based on ACEEE Job Impacts Methodology

As cited by the American Council for an Energy Efficiency Economy (ACEEE), $1 million spent in the U.S. economy supports 17 jobs on average.[3] These include direct, indirect, and induced jobs. Greater investment in certain industries may produce greater or fewer jobs than this average. Investments in energy efficiency will create net jobs in two ways. First, direct efficiency spending will provide opportunities in more labor intensive industries like construction. Second, because energy bill savings are invested in other areas of the economy, job impacts continue for the long term. Because energy savings from efficiency are many times greater than the initial investment, this effect is much larger than the effect from the initial investment.[4]

Using this methodology, energy efficiency in Delaware will support approximately 3,000 jobs annually. This is based on the program potential level spending forecast in the potential study. The steps involved in this calculation are described in more detail below.

The first step is to calculate the difference in net job creation from direct investment in efficiency programs compared to spending in other areas of the economy. The total direct spending on efficiency over the twelve year study period is equal to approximately $1.3 billion. Investments in efficiency spending yield 20 jobs per million compared to 17 jobs per million in the economy on average. Direct efficiency spending would create 26,000 gross jobs, whereas spending the same amount of money elsewhere in the economy would create 22,100 jobs. Therefore, the additional net jobs created through direct efficiency spending would be 3,900 (26,000 - 22,100).

The next step is to calculate the long-term effects of the investment. In the long-term, jobs that would have been created in the energy generation and distribution industries are shifted to other parts of the economy. Whereas energy industry investments yield 10 jobs per $million, investments in other areas of the economy yield 17 jobs per $million. Investments in efficiency at the level described in the potential study would provide approximately $4,560 million in utility bill savings to efficiency program participants over the 12 year study period. When this amount of money is spent in the economy as a whole, it creates 77,520 jobs versus 45,600 from spending on supply side energy resources. Therefore, the additional net jobs created through long-term impacts of efficiency investment would be 31,920 (77,520 – 45,600).

Taken together, the net jobs created through direct spending and long-term impacts would equal 35,820 from all 12 years of investment. Dividing the total net jobs by number by the years of investment suggests that approximately 3,000 jobs would be supported annually.

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[3] Casey Bell, American Council for an Energy-Efficient Economy, *Energy Efficiency Job Creation: Real Work Experiences*. October 15, 2012.

[4] Direct spending on efficiency creates 20 jobs per $1 million of spending as opposed to 17 jobs from spending in the overall economy, or a net gain of 3 jobs per $1 million. Spending on the energy industry supports just 10 jobs per $1 million, so redirecting the long-term savings from energy to other areas of the economy that support 17 jobs per $1 million on average results in an additional 7 net jobs per $1 million SAVED from efficiency.

Alternative Estimate of Job Impacts

We also derived an alternate job impact value from a meta-analysis of four other macroeconomic studies that estimated job impacts from energy efficiency programs. Each compares a scenario of modest to aggressive efficiency spending to a scenario of no efficiency investment. Two of the studies (New York and Wisconsin) are retroactive, looking back at prior investments that included program 'ramp up', while the other two (Vermont and New England) are forward looking, assessing the impact of efficiency investment commensurate with 'all cost-effective' policies. Moreover, each study looked at efficiency spending across multiple fuels (electric, natural gas, and oil), and relied on the same economic model (REMI).[5]

For all their similarities in scope, the studies also have differences that lend credibility to their findings – they were conducted by different authors for different regions that rely on different program administrators and implementation models. As the table below illustrates, the findings are remarkably consistent across studies:

State/Region	Year	Author	Job years / Million$
Vermont	2011	Synapse Energy Economics & Optimal Energy, Inc.	43
New York	2011	New York Energy Research and Development Authority	49
Wisconsin	2010	PA Consulting Group Inc.	37-60
New England	2008	Environment Northeast	46-66

A job-year represents one full time job for a period of one year. The metric *job-years per million dollar of efficiency spending* represents the net change in employment in a region due to the program's total spending. For the purposes of this analysis we conservatively assume 45 job-years per million dollars. The following table shows how positive employment impacts would accumulate over the next twelve years if Delaware were to follow the investment levels suggested in the potential study.

Program Year	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Efficiency Spending (Million$)	22	34	55	80	111	137	151	148	145	142	139	136
Net Job-Years / Million$	45	45	45	45	45	45	45	45	45	45	45	45
Net Incremental Job-Years Created	990	1,530	2,475	3,600	4,995	6,165	6,795	6,660	6,525	6,390	6,255	6,120
Net Cumulative Job-Years Created	990	2,520	4,995	8,595	13,590	19,755	26,550	33,210	39,735	46,125	52,380	58,500

[5] REMI = Regional Economic Models, Inc. This model is used throughout the US, including by many state and federal government agencies. The model is dynamic and sophisticated, capturing structural changes in the regional economy that result from a direct stimulus.

The calculation above demonstrates that over twelve years Delaware could create over 58,000 job-years through investments in energy efficiency. This is equal to roughly 4,875 job-years annually.

OVERVIEW OF ECONOMIC IMPACTS

The economic impacts of any new activity depend on the extent to which that new activity affects supporting industries in the region. Economic impacts emanate from:

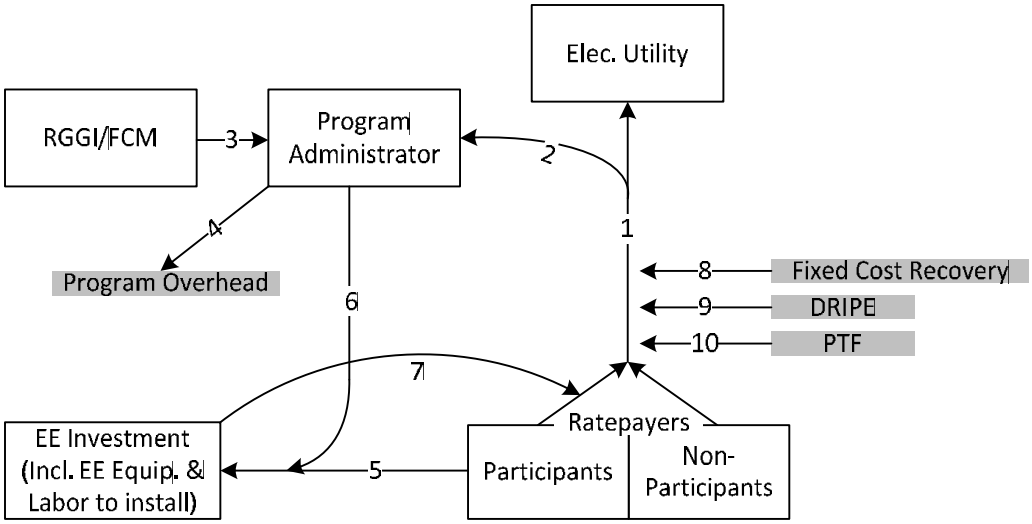
1. direct economic effects (e.g. spending on goods and services at a construction site or the purchase of a piece of new equipment), and
2. multiplier effects which include
    a. spending on supporting goods and services by the firms providing that direct activity ("indirect" impacts), and
    b. re-spending by workers of their wages or disposable income from savings to households ("induced" impacts).

Energy efficiency will generate economic activity throughout Delaware in the form of purchase and installation of energy efficiency goods and services, administration of the program itself, and net energy savings to ratepayers and participants. Households that participate in the program will save on energy costs and, therefore, can spend additional money in the local economy, spurring job growth. Businesses will have lower energy costs that improve their bottom-line, enabling them to be more competitive and to expand production and related employment. The investment in efficiency in itself also generates economic activity to the extent that the equipment is produced, sold, installed or maintained by Delaware businesses.

Efficiency investments also cost participants money for their part of the efficient equipment and installation costs. Further, all ratepayers participate in funding the program through a system benefit charge. These costs are taken into account in the reviewed studies in that participants are negatively affected through their additional spending on the energy efficiency goods and services (constricting their ability to spend elsewhere), and all ratepayers are negatively impacted by the inclusion of energy efficiency program costs on their energy bills. These negative impacts offset part of the positive impacts from savings and investment.

Energy efficiency investments are modeled as transfers of money from one party to another (from ratepayers to various industries in and out of state), whereas savings due to investments are modeled as increased discretionary spending for residents and lower energy costs for businesses that participate. Both are considered cash flows. To conceptualize the interactive effects of these cash flows (in the way that the REMI model does), it is useful to look at an illustration. The figure below (from the study for Vermont) represents the various cash flows and how they relate, with explanations provided below the figure.

Cash Flows captured in the REMI model



1. Payments by electric ratepayers via their electric bills.
2. The surcharge on electric bills collected to fund electric energy efficiency programs.
3. Allowance auction revenues from the Regional Greenhouse Gas Initiative (RGGI), and revenue provided from the Forward Capacity Market (FCM).
4. Payments to program administrators for general administration and planning, supporting services, and other non-incentive costs used to deliver the energy efficiency programs.
5. The incremental cost of energy efficient equipment, above the cost of baseline equipment, paid by those installing the efficient equipment due to the efficiency programs.
6. The incentive contributed toward efficient equipment and technical assistance to contractors. This activity reduces market barriers to energy efficiency investments such as first cost and lack of awareness.
7. The energy efficient equipment reduces the energy consumption of the end-user, resulting in lower utility bills.
8. Items 8, 9 and 10 all impact customer electric rates due to reduced electric consumption. Item 8 shows impacts in customer electric rates due to fixed cost recovery, since they are not supplying as much electricity.
9. Reductions in customer electric rates due to Demand Reduction Induced Price Effects (DRIPE).
10. Reductions in customer electric rates due to Delaware's reduced contributions to Pooled Transmission Facilities (PTF) and ancillary services provided by PJM.

CONCLUSIONS

The level of investment projected in the potential study could produce over 6,000 job-years per year of investment by the end of the study period. At the end of the 12 years of efficiency program investment, approximately 58,000 job-years would have been added to Delaware's economy compared to a scenario of no investment in energy efficiency.

In addition to net positive job impacts, the studies found that efficiency investments increase gross state product and bolster trade. These economic benefits derive from changes in the economy that occur as a result of increased spending on efficiency measures and decreased spending on energy. In short, efficiency programs exchange fossil fuel imports for local employment and economic growth. Neither the employment nor the gross state product impacts are captured in the Total Resource Cost test (i.e., the primary cost-benefit test in the potential study) since it is limited to the direct impacts of reduced energy use and bill savings.

If Delaware pursues the energy efficiency investment levels forecasted in the potential study the state will reduce emissions, lower energy bills, and arrest long-term load growth, thus creating a more sustainable energy sector. This study demonstrates that those efficiency investments will also deliver significant macroeconomic benefits in the process – benefits above and beyond those already captured in the potential study.

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