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ELECTRIC DEMAND SIDE MANAGEMENT: MARKET POTENTIAL STUDY AND ACTION PLAN

Volume 1: Executive Summary

Report Number 1432

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INTRODUCTION

Background

Energy efficiency (EE) efforts are increasing in magnitude and gaining traction in Indiana, building on the momentum of recently established statewide electric energy efficiency targets. Vectren Energy Delivery of Indiana (Vectren) is investigating the electric energy efficiency potential for their service territory. The findings of this investigation will lead directly into the development of a portfolio of energy efficiency programs to be delivered to customers over the time period 2015 to 2019.

Toward this end, Vectren has contracted with EnerNOC Utility Solutions (EnerNOC) to conduct a Market Potential Study and assemble an Action Plan that considers all metered electric customers in the residential, commercial, and industrial sectors for this time period.

EnerNOC conducted a detailed, bottom-up assessment of the Vectren market in the Evansville metropolitan area to deliver a projection of baseline electric energy use, forecasts of the energy savings achievable through efficiency measures, and program designs and strategies to optimally deliver those savings. This report describes the study approach and results.

Report Organization

This report is presented in 4 volumes as outlined below. This document is **Volume 1: Executive Summary**.

- Volume 1, Executive Summary
- Volume 2, Market Potential and Action Plan Report
- Volume 3, Detailed Appendices: Market Potential Study
- Volume 4, Detailed Appendices: Action Plan & Program Write-ups

Definitions of Potential

In this study, we estimate the potential for energy efficiency savings. The savings estimates represent net savings[1] developed into three types of potential: technical potential, economic potential, and achievable potential. Technical and economic potential are both theoretical limits to efficiency savings. Achievable potential embodies a set of assumptions about the decisions consumers make regarding the efficiency of the equipment they purchase, the maintenance activities they undertake, the controls they use for energy-consuming equipment, and the elements of building construction. Because estimating achievable potential involves the inherent uncertainty of predicting human behaviors and responses to market conditions, we developed low and high achievable potential as boundaries for a likely range. The various levels are described below.

- **Technical potential** is defined as the theoretical upper limit of energy efficiency potential. It assumes that customers adopt all feasible measures regardless of their cost. At the time of existing equipment failure, customers replace their equipment with the most efficient option available. In new construction, customers and developers also choose the most efficient

[1] Savings in "net" terms instead of "gross" means that the baseline forecast includes naturally occurring efficiency. In other words, the baseline assumes that natural early adopters continue to make purchases of equipment and measures at efficiency levels higher than the minimum standard.

equipment option. Examples of measures that make up technical potential for electricity in the residential sector include:

- Ductless mini-split air conditioners with variable refrigerant flow
- Ground source (or geothermal) heat pumps
- LED lighting

Technical potential also assumes the adoption of every other available measure, where applicable. For example, it includes installation of high-efficiency windows in all new construction opportunities and furnace maintenance in all existing buildings with furnace systems. These retrofit measures are phased in over a number of years, which is longer for higher-cost and complex measures.

- **Economic potential** represents the adoption of all ***cost-effective*** energy efficiency measures. In this analysis, the cost effectiveness is measured by the total resource cost (TRC) test, which compares lifetime energy and capacity benefits to the incremental cost of the measure. If the benefits outweigh the costs (that is, if the TRC ratio is greater than 1.0), a given measure is considered in the economic potential. Customers are then assumed to purchase the most cost-effective option applicable to them at any decision juncture.
- **Achievable High potential** estimates customer adoption of economic measures when delivered through efficiency programs under ideal market, implementation, and customer preference conditions. Information channels are assumed to be established and efficient for marketing, educating consumers, and coordinating with trade allies and delivery partners. Achievable High potential establishes a maximum target for the EE savings that an administrator can hope to achieve through its EE programs and involves incentives that represent a substantial portion of the incremental cost combined with high administrative and marketing costs.
- **Achievable Low potential** reflects expected program participation given significant barriers to customer acceptance, non-ideal implementation conditions, and limited program budgets. This represents a lower bound on achievable potential.

ANALYSIS APPROACH AND DATA DEVELOPMENT

This section describes the analysis approach taken for the study and the data sources used to develop the potential estimates.

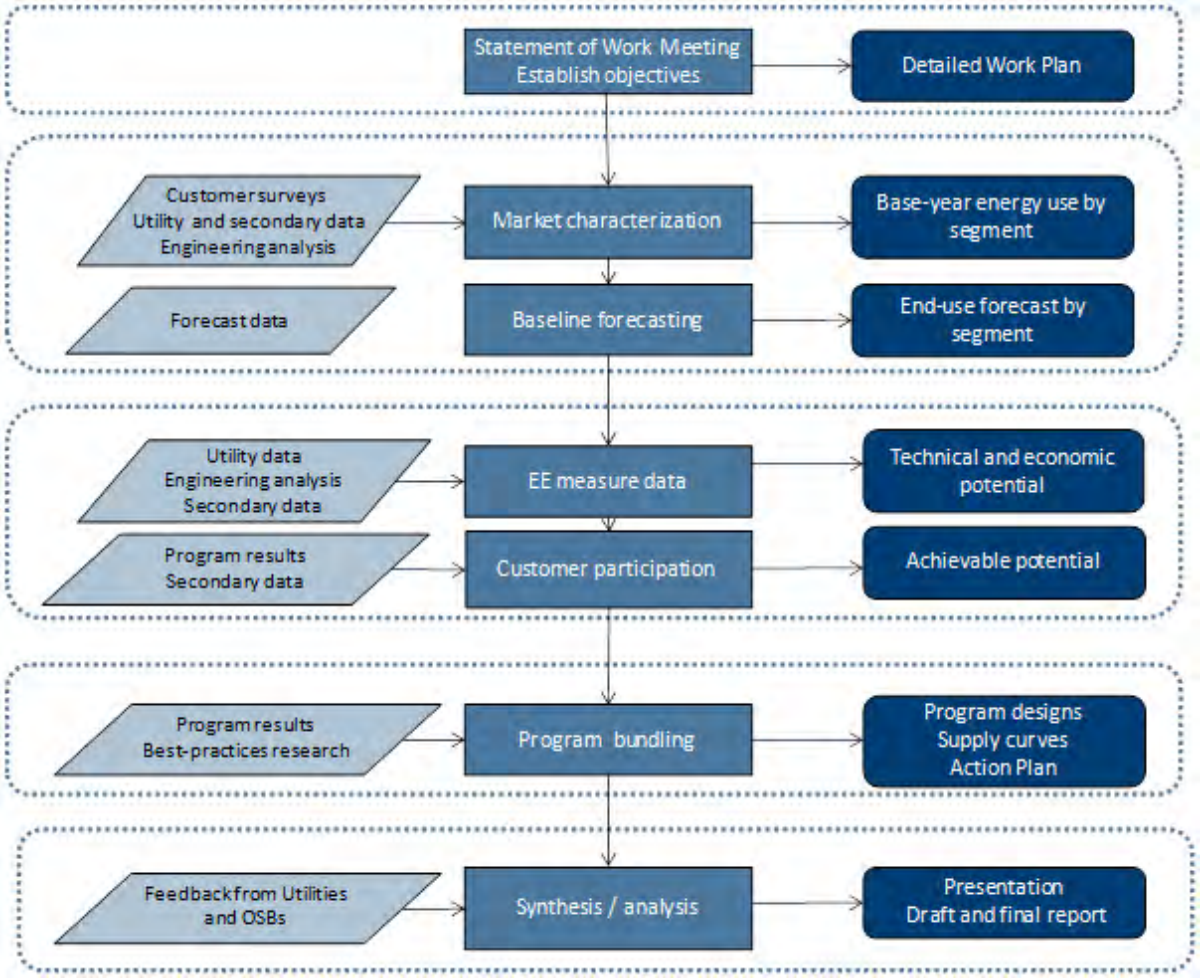
Analysis Approach

To perform the energy efficiency analysis, EnerNOC used a bottom-up analysis approach as shown in Figure 2-1. This involved the following steps.

1. Held a meeting with the client project team to refine the objectives of the project in detail. This resulted in a work plan for the study.
2. Conducted onsite energy consumption surveys with 30 of Vectren's largest commercial and industrial customers in order to provide data and guidance for these market sectors that had not formerly received focused DSM program efforts.
3. Performed a market characterization to describe sector-level electricity use for the residential, commercial, and industrial sectors for the base year, 2011. This included using existing information contained in prior Vectren and Indiana studies, new information from the aforementioned onsite surveys with large customers, EnerNOC's own databases and tools, and other secondary data sources such as the American Community Survey (ACS) and the Energy Information Administration (EIA).
4. Developed a baseline electricity forecast by sector, segment, and end use for 2011 through 2023. Results presented in this volume focus on the upcoming implementation years of 2015 through 2019. Results beyond 2019 are available in the Appendices.
5. Identified several hundred measures and estimated their effects in four tiers of measure-level energy efficiency potential: *Technical, Economic, Achievable High,* and *Achievable Low*.
6. Reviewed the current programs offered by Vectren in light of the study findings to make strategic program recommendations for achieving savings.
7. Created detailed program designs and action plans through 2019 representing the program potential for Vectren, basing them on the potential analysis and strategic recommendations developed in the previous steps.

The analysis approach for all these steps is described in further detail throughout the remainder of this chapter.

Figure 2-1 Overview of Analysis Approach



Data Development

A discussion of the data sources used in this study, as well as how they were applied, is found in Chapter 2 of the main body of the report. In general, data were used according to the hierarchy given below and adapted to local conditions whenever possible, for example, by using local sources for measure data and local weather for building simulations.

- Vectren and Indiana specific data first
- EnerNOC's databases and analysis tools
- Other secondary data and reports if necessary

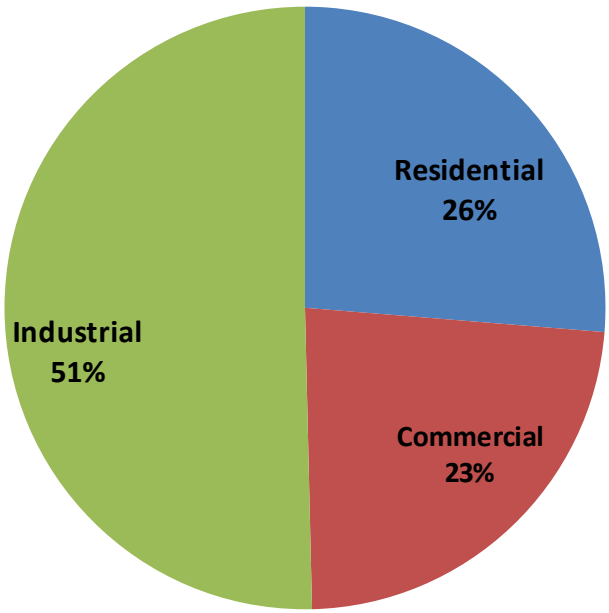
MARKET CHARACTERIZATION AND MARKET PROFILES

In this section, we describe how customers in the Vectren service territory use electricity in the base year of the study, 2011. It begins with a high-level summary of energy use by sector and then delves into each sector in detail.

Energy Use Summary

Total electricity use for the residential, commercial, and industrial sectors for Vectren in 2011 was 5,646 GWh. As shown in Figure 3-1, the largest sector is industrial, accounting for 51% of load at 2,845 GWh. The remaining use is in the residential and commercial sectors, at 1,483 GWh and 1,318 respectively.

Figure 3-1 Sector-Level Electricity Use, 2011



Residential Sector

The total number of households and electric sales for the service territory were obtained from Vectren's customer database. In 2011, there were 122,961 households in the Vectren territory that used a total of 1,483 GWh of electricity. We allocated these totals into the two residential segments based on the Vectren South 2010 baseline survey results.

Figure 3-2 shows the distribution of electric energy consumption by end use for all homes. Three main electricity end uses —appliances, space heating and cooling — account for over 50% of total use. The most energy allocated to any single category is 21% for cooling, which includes central AC, heat pumps, and room AC. Other categories with substantial energy use are space

heating and appliances. Appliances include refrigerators, freezers, stoves, clothes washers, clothes dryers, dishwashers, and microwaves. The remainder of the energy falls into the electronics, lighting, water heating and the miscellaneous category – which is comprised of furnace fans, pool pumps, and other "plug" loads (hair dryers, power tools, coffee makers, etc).

Figure 3-2 Residential Electricity by End Use (2011), All Homes

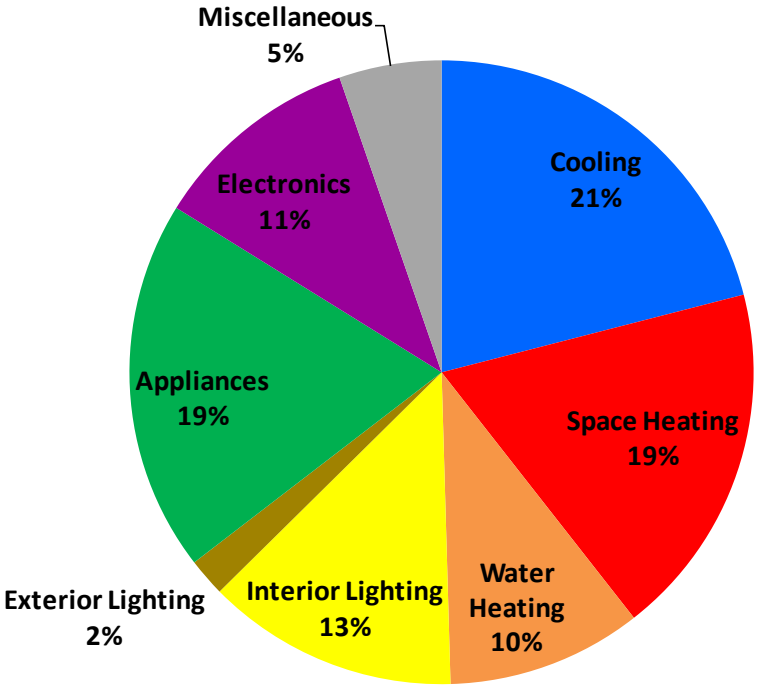
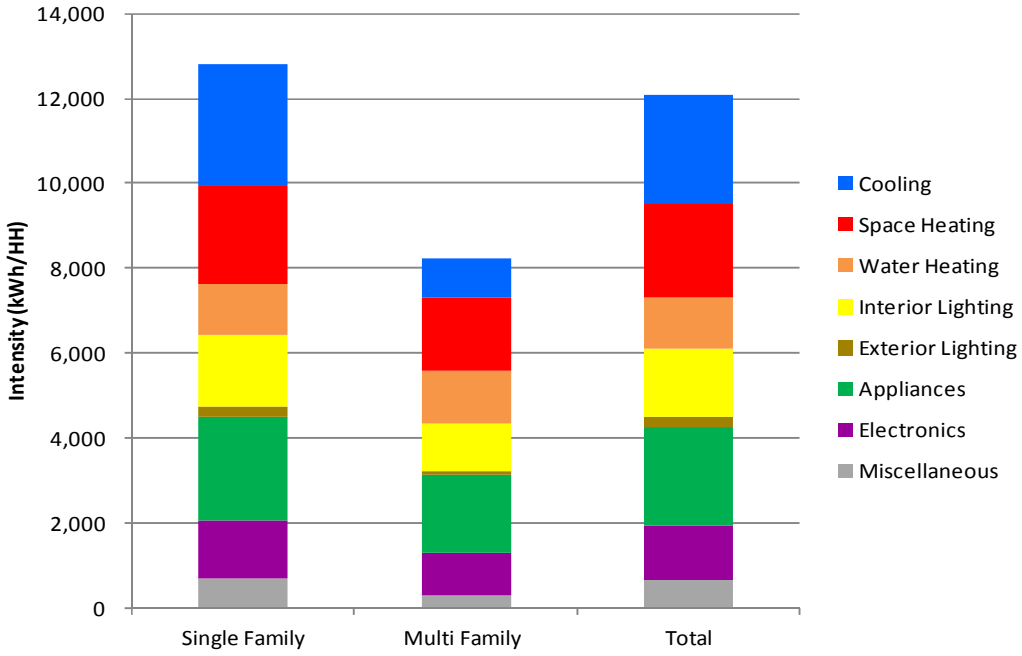


Figure 3-3 presents the electricity intensities by end-use and housing type, as well as all homes on average.

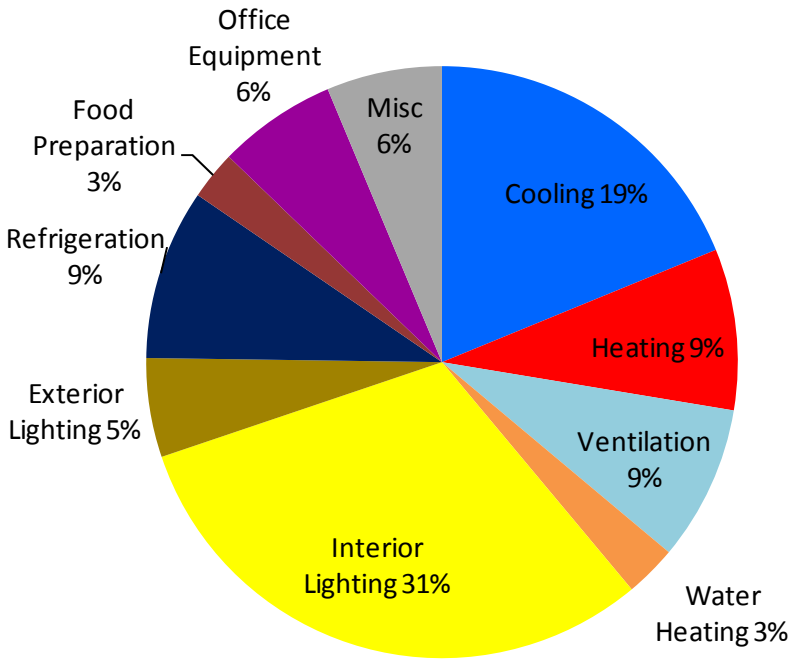
Figure 3-3 Residential Electricity Intensity by End Use and Segment (kWh/household, 2011)



Commercial Sector

The total electric energy consumed by commercial customers in Vectren's service area in 2011 was 1,318 GWh. Figure 3-4 shows the distribution of electricity consumption by end use for all commercial building types. Electric usage is dominated by lighting, with interior and exterior varieties accounting for over one third of consumption. After lighting, the largest end uses are cooling, heating, ventilation, and refrigeration. The remaining end uses comprise 6% or less of total usage: office equipment, miscellaneous, water heating, and food preparation.

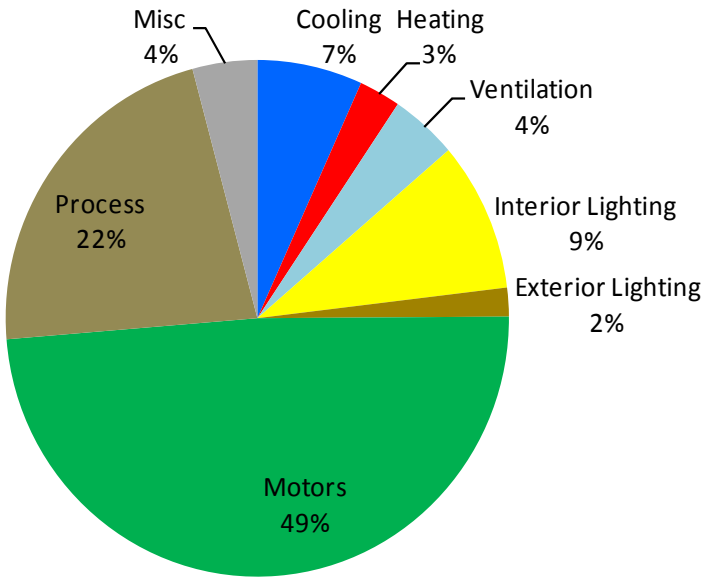
Figure 3-4 Commercial Electricity Consumption by End Use (2011), All Building Types



Industrial Sector

The total electric energy consumed by industrial customers in Vectren in 2011 was 2,845 GWh. Figure 3-5 shows the distribution of electricity energy consumption by end use for all industrial customers. Motors are clearly the largest overall end use for the industrial sector, accounting for 49% of energy use. Note that this end use includes a wide range of industrial equipment, such as air compressors and refrigeration compressors, pumps, conveyor motors, and fans. The process end use accounts for 22% of energy use, which includes heating, cooling, refrigeration, and electro-chemical processes. Lighting is the next highest, followed by cooling, ventilation, miscellaneous, and space heating.

Figure 3-5 Industrial Electricity Use by End Use (2011), All Industries



BASELINE FORECAST

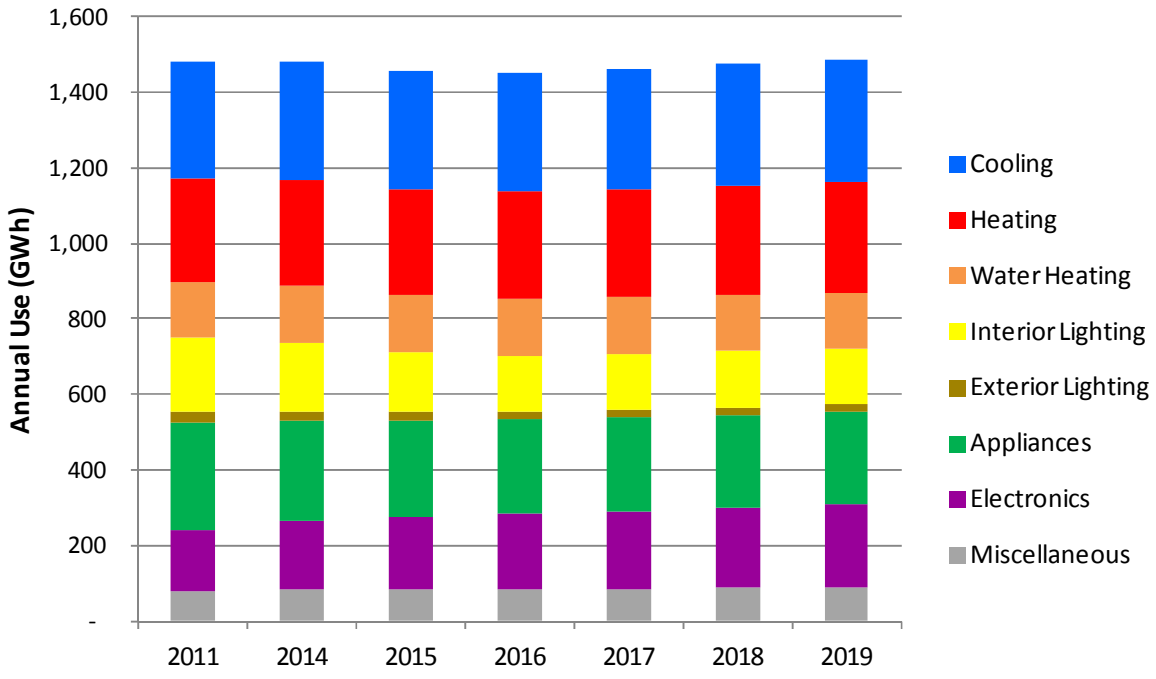
Prior to developing estimates of energy-efficiency potential, a baseline end-use forecast was developed to quantify what the consumption is likely to be in the future in absence of new efficiency programs and naturally occurring efficiency. The baseline forecast serves as the metric against which energy efficiency potentials are measured. This chapter presents the baseline forecast for electricity for each sector.

Residential Sector

The baseline forecast incorporates assumptions about economic growth, electricity prices, and appliance/equipment standards and building codes that are already mandated as described in Chapter 2 of the main report.

Figure 4-1 present the baseline forecast for electricity at the end-use level for the residential sector as a whole. Overall, residential use increases slightly from 1,483 GWh in 2011 to 1,488 GWh in 2019, an increase of only 0.3%, which is essentially a flat forecast year over year. This reflects the impact of the EISA lighting standard, additional appliance standards adopted in 2011, and modest customer growth.

Figure 4-1 Residential Electricity Baseline Forecast by End Use

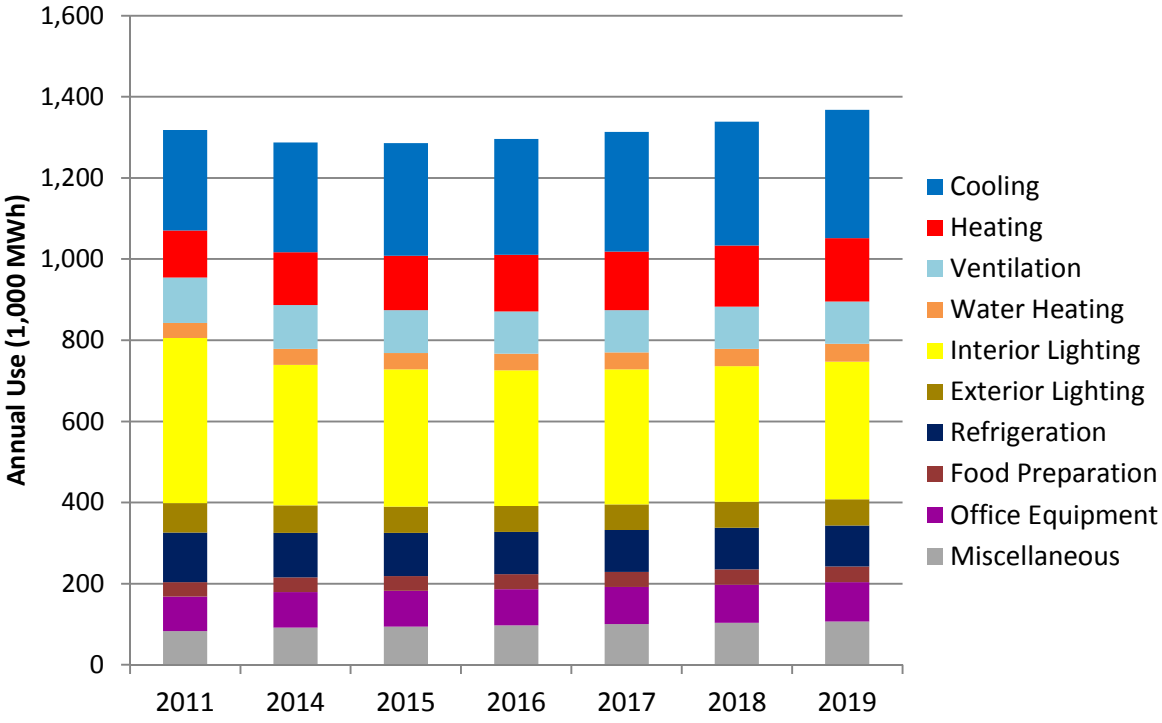


Commercial Sector

Electricity use in the commercial sector grows modestly during the overall forecast horizon, starting at 1,318 GWh in 2011, and increasing to 1,368 GWh in 2019.

Figure 4-2 present the electricity baseline forecast at the end-use level for the commercial sector as a whole. Usage is declining in the early years of the forecast, due largely to the phasing in of codes and standards such as the EISA 2007 lighting standards and EPACT 2005 refrigeration standards.

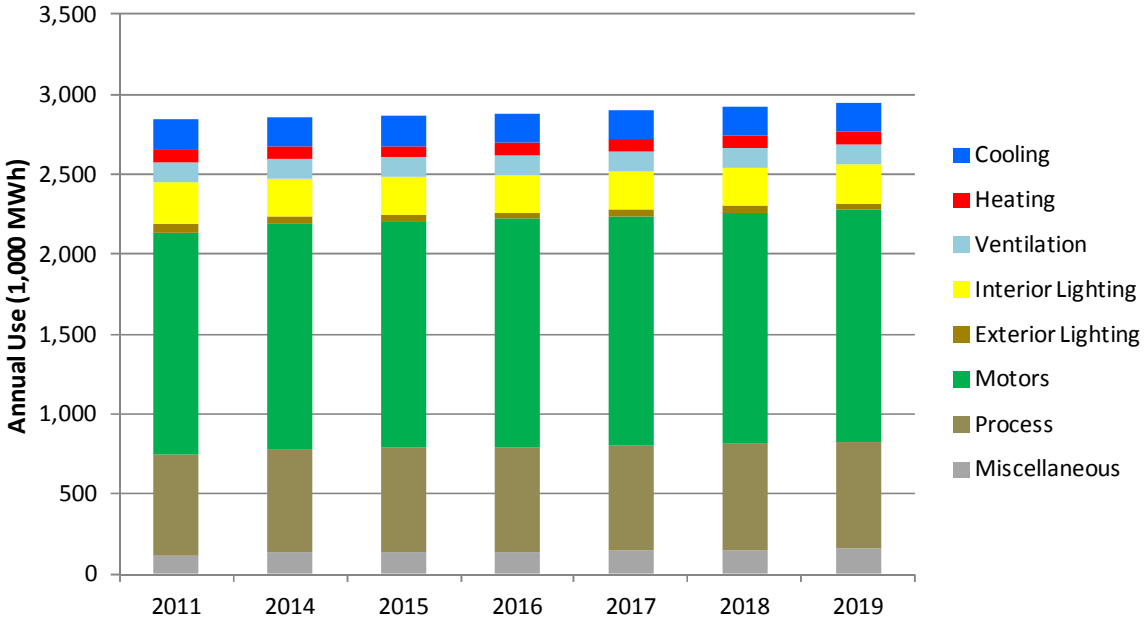
Figure 4-2 Commercial Electricity Baseline Forecast by End Use



Industrial Sector

Figure 4-3 present the electricity baseline forecast at the end-use level for the industrial sector. Overall, industrial annual electricity use increases modestly from 2,845 GWh in 2011 to 2,943 GWh in 2019. This comprises an overall increase of 3.5%, or 0.4% per year, which is colored by slow but recovering economy.

Figure 4-3 Industrial Electricity Baseline Forecast by End Use



Baseline Forecast Summary

Table 4-1 and Figure 4-4 provide a summary of the baseline forecast for electricity by sector for the entire Vectren service territory. Overall, the forecast shows only a slight incline in electricity use, driven primarily by oncoming codes and standards and a challenging macroeconomic environment.

Table 4-1 Electricity Baseline Forecast Summary (GWh)

Sector	2011	2014	2015	2016	2017	2018	2019	% Change	Avg. Growth Rate
Residential	1,483	1,482	1,459	1,453	1,463	1,476	1,488	0.3%	0.0%
Commercial	1,318	1,288	1,286	1,296	1,313	1,339	1,368	3.7%	0.5%
Industrial	2,845	2,861	2,863	2,877	2,896	2,922	2,943	3.5%	0.4%
Total	**5,646**	**5,630**	**5,608**	**5,626**	**5,673**	**5,738**	**5,799**	**2.7%**	**0.3%**

Figure 4-4 Electricity Baseline Forecast Summary (GWh)

ENERGY EFFICIENCY MEASURES

The energy efficiency measures and assumptions used in this analysis are detailed in Chapter 5 of the Volume 2 main report as well as Volume 3 appendices B, C, and D. Table 5-1 summarizes the number of equipment and non-equipment measures evaluated for each segment within each sector.

Table 5-1 Number of Measures Evaluated

	Residential	Commercial	Industrial	Total Number of Measures
Equipment Measures Evaluated	35	40	28	**103**
Non-Equipment Measures Evaluated	45	82	69	**196**
Total Measures Evaluated	**80**	**122**	**97**	**299**

CHAPTER | 6

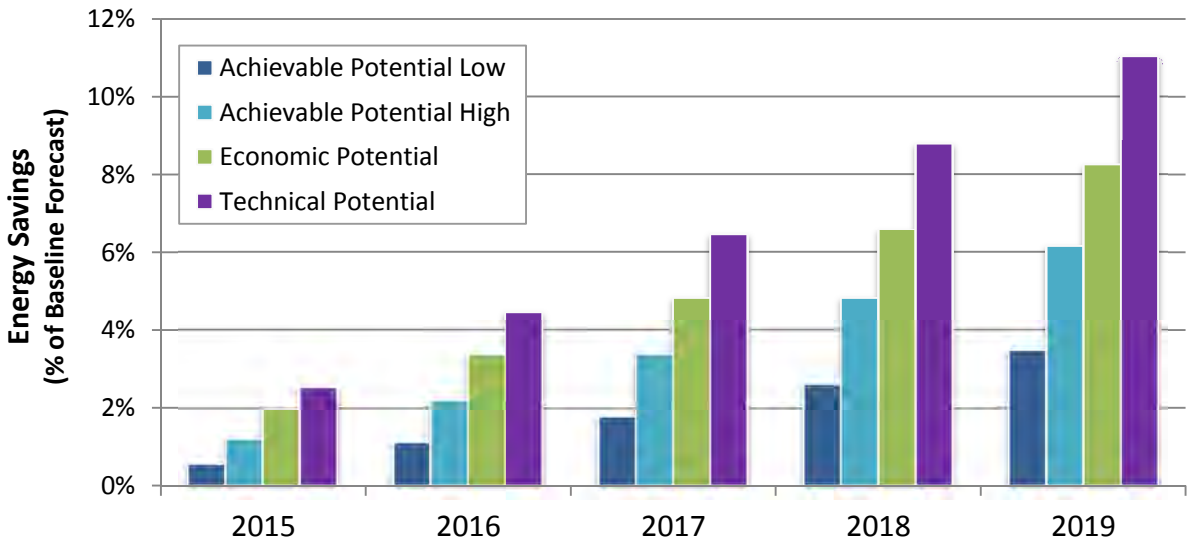
MEASURE-LEVEL ENERGY EFFICIENCY POTENTIAL

Table 6-1 and Figure 6-1 summarize the electric energy-efficiency savings for all measures at the different levels of potential relative to the baseline forecast. Note that the subsequent steps of measure bundling, program design and program delivery will hone and refine these results later in Chapter 8.[2]

Table 6-1 Overall Measure-Level Electricity Efficiency Potential

	2015	2016	2017	2018	2019
Baseline Forecast (GWh)	**5,608**	**5,626**	**5,673**	**5,738**	**5,799**
Cumulative Savings (GWh)					
Achievable Low Potential	32	63	100	151	203
Achievable High Potential	67	125	192	277	357
Economic Potential	112	191	274	377	478
Technical Potential	142	251	366	504	640
Energy Savings (% of Baseline)					
Achievable Low Potential	0.6%	1.0%	1.8%	2.6%	3.5%
Achievable High Potential	1.2%	2.2%	3.4%	4.8%	6.2%
Economic Potential	2.0%	3.4%	4.8%	6.6%	8.2%
Technical Potential	2.5%	4.5%	6.5%	8.8%	11.0%

Figure 6-1 Overall Measure-Level Electricity Efficiency Potential



[2] Utilities typically have a small subset of large commercial and industrial customers that comprise a disproportionate share of load and demand. In Vectren's case, there is one particular industrial customer that comprises a full 24% of the C&I load. If this customer were not to participate in EE programs, the savings potential would drop commensurately in the C&I sectors, which would remove approximately 15% from the overall savings potential in all sectors.

Overview of Measure-Level Energy Efficiency Potential by Sector

Table 6-2, summarize the range of electric achievable potential by sector. The commercial sector accounts for the largest portion of the savings, followed by residential, and then industrial.

Table 6-2 Electric Achievable Potential by Sector (GWh)

	2015	2016	2017	2018	2019
Achievable Low Cumulative Savings (GWh)					
Residential	9.4	15.7	22.1	32.4	43.4
Commercial	12.1	22.8	36.0	53.0	71.8
Industrial	10.7	24.3	42.2	65.4	87.4
Total	**32.2**	**62.7**	**100.3**	**150.9**	**202.6**
Achievable High Cumulative Savings (GWh)					
Residential	20.4	32.0	43.8	60.9	76.8
Commercial	25.3	45.7	69.2	97.9	127.1
Industrial	21.7	47.2	79.4	118.7	152.7
Total	**67.3**	**124.9**	**192.5**	**277.4**	**356.7**

MEASURE-LEVEL ENERGY EFFICIENCY POTENTIAL BY SECTOR

This chapter presents the results of the energy efficiency analysis for all measures at the sector level. First, the residential potential is presented, followed by the commercial, and lastly, industrial. Note that the subsequent steps of measure bundling, program design and program delivery will hone and refine these results later in Chapter 8.

Residential Electricity Potential

Figure 7-1 depicts the residential electricity potential energy savings estimates graphically.

Figure 7-1 Residential Electric Energy Efficiency Potential Savings

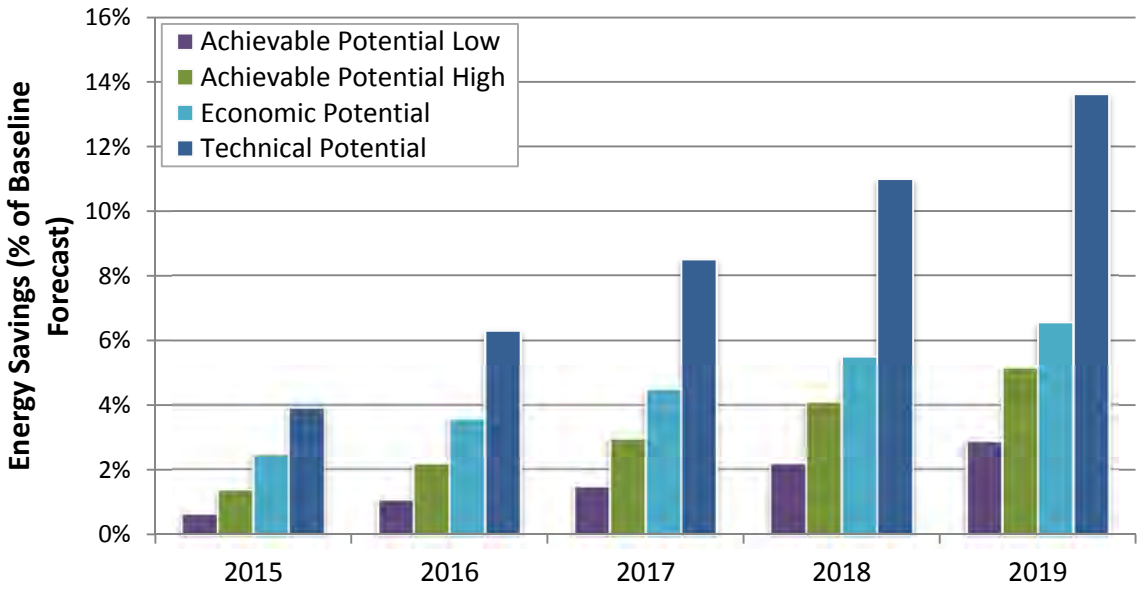
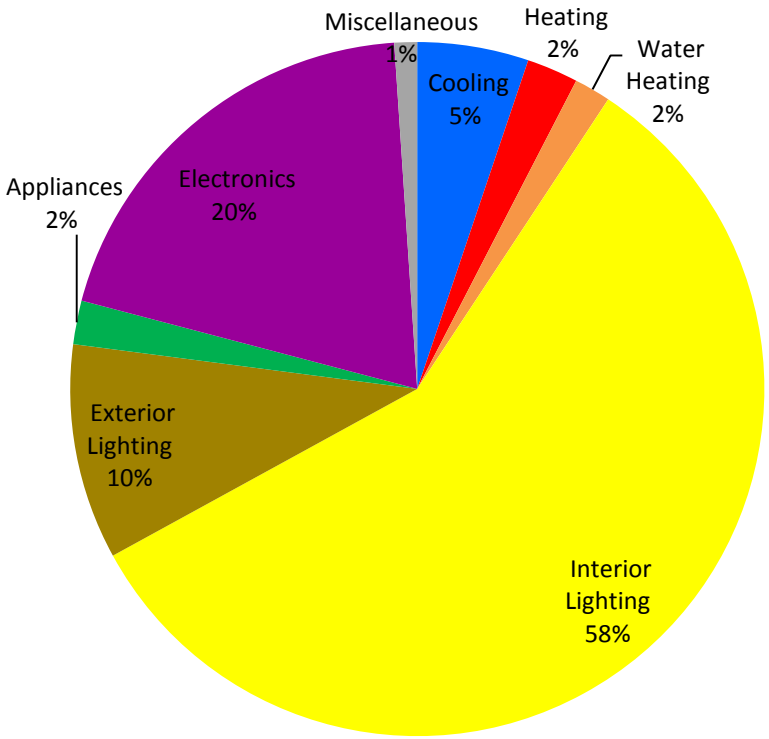


Figure 7-2 focuses on the residential achievable low potential in 2017. Lighting equipment replacement accounts for the highest portion of the savings in the near term as a result of the efficiency gap between CFL lamps and advanced incandescent lamps, even those that will meet the EISA 2007 standard. Electronics, cooling, and appliances also contribute significantly to the savings. Detailed measure information is available in Volume 3 Appendices. The key measures comprising the potential are listed below:

- Lighting: mostly CFL lamps and specialty bulbs
- Electronics (reduce standby wattage, televisions, set top boxes, PCs)
- Second refrigerator/ freezer removal
- HVAC: Removal of second room AC unit, efficient air conditioners, ducting repair/sealing, insulation, home energy management system and programmable thermostats

Figure 7-2 Residential Electric Achievable Low Potential by End Use in 2017



Commercial Electricity Potential

Figure 7-3 depicts these potential energy savings estimates graphically.

Figure 7-3 Commercial Energy Efficiency Potential Savings

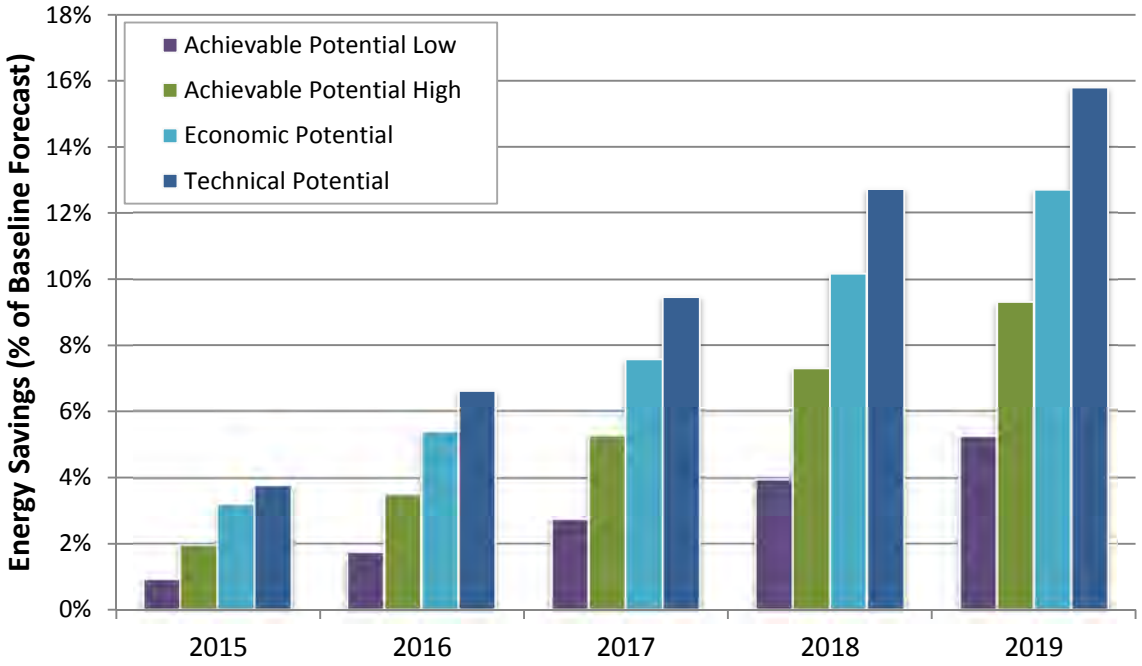
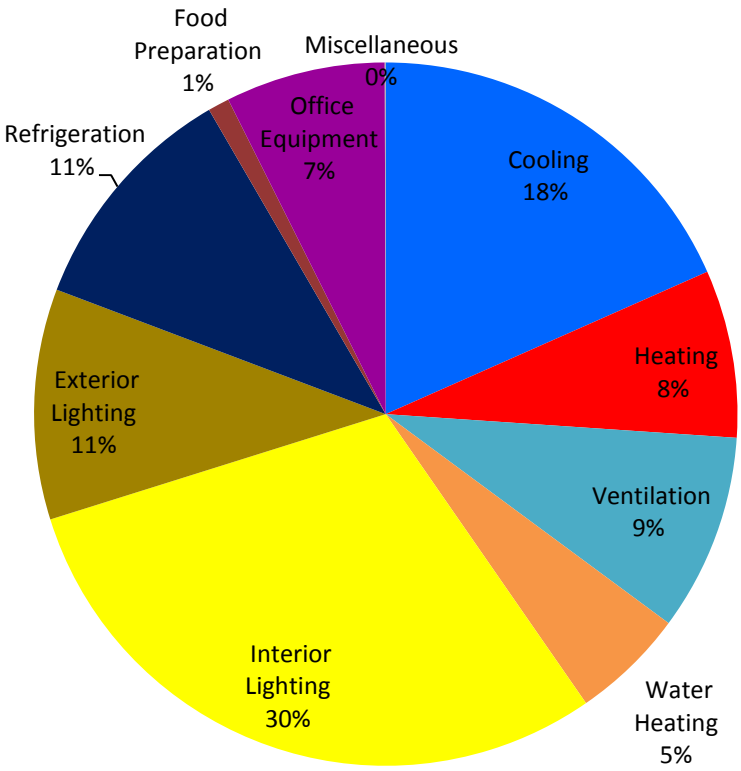


Figure 7-4 focuses on achievable potential savings by end use. Not surprisingly, interior lighting delivers the highest achievable savings throughout the study period. In 2017, Cooling is second, and exterior lighting is third. Regarding refrigeration, it is interesting to point out a relatively new control and sensing technology that vendors such as "eCube" are using to regulate the system energy. The technology consists of a solid, waxy food simulant that is fitted around a thermostat sensor that would otherwise measure air temperature. The refrigeration controls therefore attempt to regulate the temperature of food, which changes more slowly and gradually than air, thereby reducing the frequency of refrigeration on/off cycles. Refrigeration energy savings are then followed in descending order by cooling, ventilation, office equipment, and small amounts of the other end uses.
Detailed measure information is available in the Volume 3 Appendices. The key measures comprising the potential are listed below:

- Lighting – CFLs, LED lamps, linear fluorescent, daylighting controls, occupancy sensors, and HID lamps for exterior lighting
- Energy management systems & programmable thermostats
- Ventilation – variable speed control
- Refrigeration – efficient equipment, control systems, decommissioning
- Efficient office equipment – computers, servers

Figure 7-4 Commercial Achievable Low Potential Electricity Savings by End Use in 2017



Industrial Electricity Potential

The Vectren industrial sector accounts for 51% of total energy consumption, making for prime efficiency opportunities. Figure 7-5 present the savings for the various types of potential considered in this study.

Figure 7-5 Industrial Electric Potential Savings

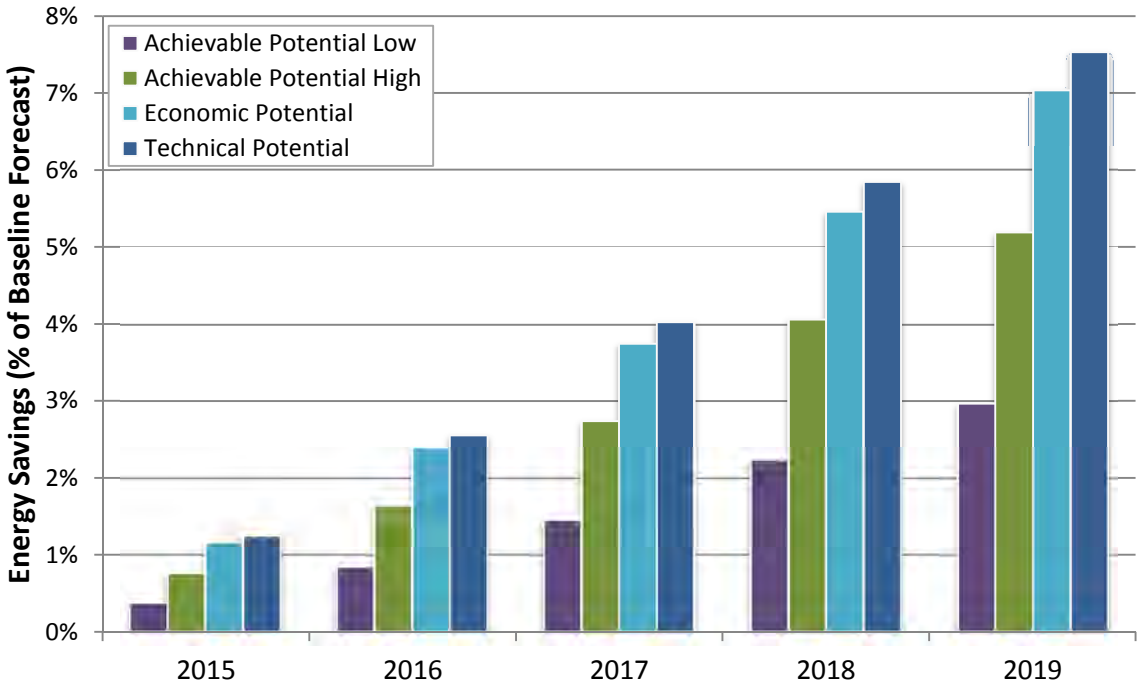
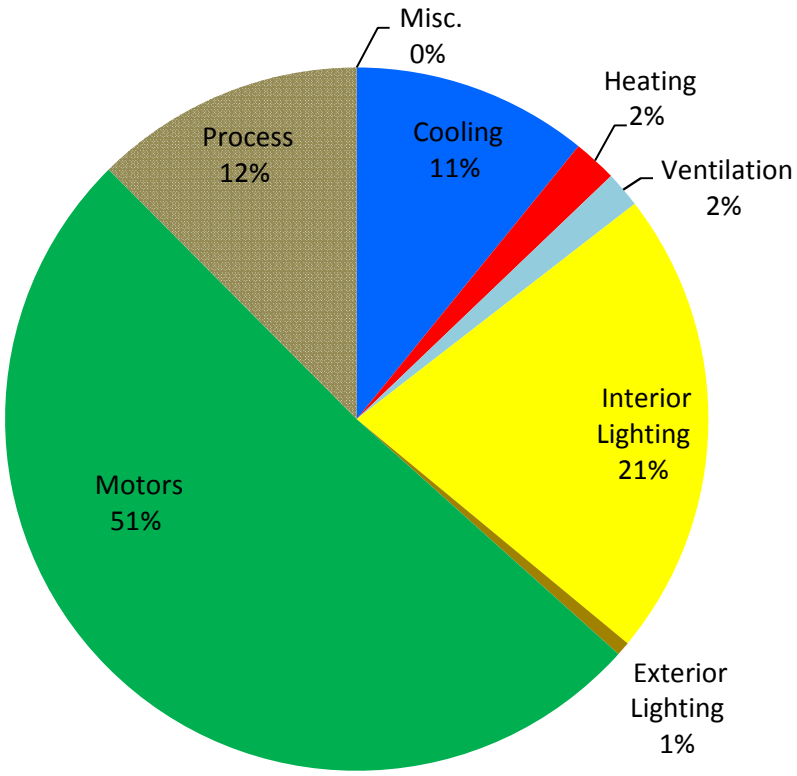


Figure 7-6 illustrates the achievable potential savings by electric end use in 2017 for the industrial sector. The largest shares of savings opportunities are in the motors and machine drives. Potential savings for straight motor equipment change-outs are being eliminated due to the National Electrical Manufacturer's Association (NEMA) standards, which now make premium efficiency motors the baseline efficiency level. As a result, potential savings are incrementally small to upgrade to even more efficient levels. All the savings opportunities in this end use come from controls, timers, and variable speed drives, which improve system efficiencies where motors are utilized. These system-level measures and upgrades are also applicable to a large swath of applications for heating, cooling, and electrochemical processes. Since the plastics industry is so prominent in the Vectren service territory, measures such as injection molding barrel insulation are very promising sources of potential savings.

Beyond motors and processes, there are large opportunities for savings in lighting and cooling; and smaller opportunities in ventilation and space heating. Detailed measure information is available in the Volume 3 Appendices. The key measures comprising the potential are listed below:

- Motors – drives and controls
- Process – timers and controls
- Application optimization and control – fans, pumps, compressed air
- Efficient high bay lighting
- Efficient ventilation systems
- Energy management systems & programmable thermostats

Figure 7-6 Industrial Achievable Low Electricity Potential Savings by End Use in 2017



CHAPTER | 8

PROGRAM POTENTIAL AND ACTION PLAN

The Action Plan is the heart of the study. This is where the multitude of energy efficiency measures covered in previous chapters get bundled into delivery mechanisms to take on the form of specific energy efficiency programs. Several changes and adjustments occur in the translation from the market potential assessment to the program designs in the Action Plan, as the measure mix may change due to program delivery considerations. Table 8-1 below lists the distinct programs that emerge from this exercise to deliver an effective and balanced portfolio of energy savings opportunities across all customer segments.

Table 8-1 Portfolio of Energy Efficiency Programs Included in Action Plan

Residential Programs	Commercial & Industrial Programs
Lighting	Prescriptive
Efficient Products	Custom Incentives
Income Qualified Weatherization (IQW)	Schools Program
IQW Plus	Strategic Energy Management (SEM)
New Construction	Business & Multi Family New Construction
Multi Family Direct Install	Small Business Direct Install
Home Energy Assessment	
School Kit	
Whole House Plus	
Appliance Recycling	
Behavioral Feedback Tools	

Programmatic Framework

Each program contemplates and outlines a programmatic framework for administrators and implementers. The items considered and developed for this framework include those listed below. Detailed write-ups delve into the specific recommendations for each program in Volume 4 of this report.

- Target market
- Implementation strategy, including delivery channels, marketing, education and outreach
- Program issues, risks and risk management strategies
- Eligible measures and incentives
- Evaluation, measurement and verification requirements and guidance
- Administrative requirements
- Estimated participation
- Program budget
- Program energy savings and demand reduction
- Cost effectiveness

The state of Indiana has mandated efficiency targets for regulated electric utilities, specifying that they reach certain levels of savings by implementing a required set of programs, known as Core programs, and that they should make up any shortfall between the targets and the Core program savings with a flexible or optional set of Core Plus programs, which can be designed to suit each utility. The Residential Lighting, Income Qualified Weatherization, Home Energy Assessment, School Kit, and Business Prescriptive programs are Core programs; and the remainder are Core Plus. These distinctions are outlined later in the program highlights and descriptions.

The total amount of energy efficiency savings required by the state targets, in gross incremental savings per year, is shown as a percent of the baseline forecast in Table 8-2 below.

Table 8-2 Indiana State Goals, Gross Incremental Electricity Savings as % of Baseline

2015	2016	2017	2018	2019
1.30%	1.50%	1.70%	1.90%	2.00%

Using Achievable High and Achievable Low as Guidelines

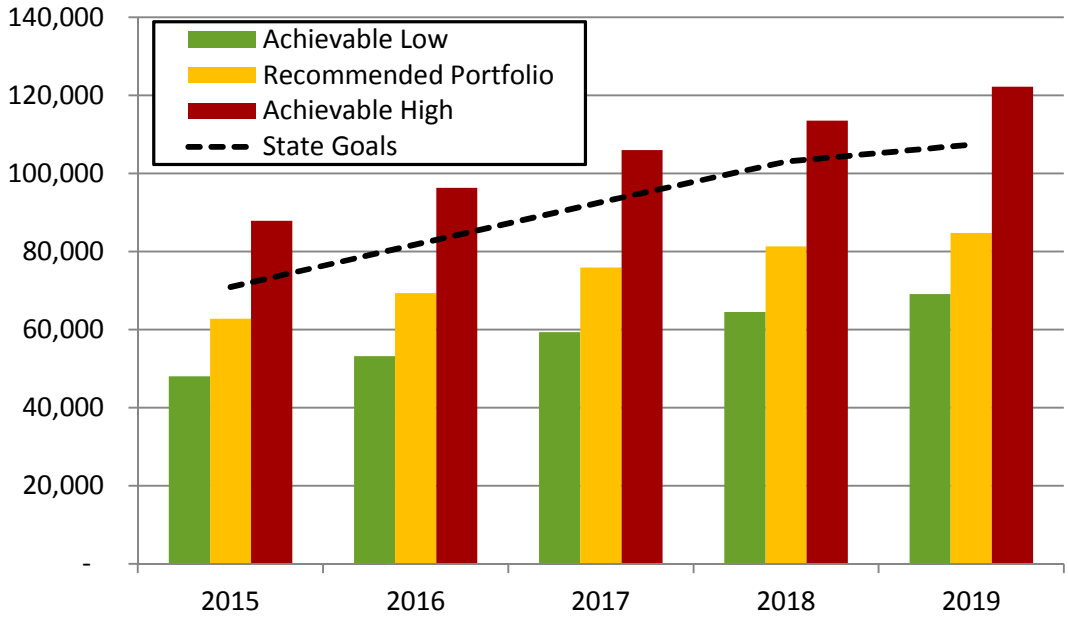
The first step toward creating the recommended Action Plan was to create two separate scenarios that corresponded to the measure-level energy efficiency potentials assessed in the previous chapter: Achievable Low and Achievable High. After applying all the delivery and cost structures, each of the Low and High portfolios resulted in a set of program potential savings and estimated budgets.

These portfolios provided guidelines, allowing us create the Recommended Action Plan by interpolating between Low and High, optimizing to consider the Indiana state goals, past program experience, industry benchmarks, and feedback from Vectren and Stakeholders.

Figure 8-1 below shows the resulting Gross MWh savings per year for the three separate portfolios, along with a black, dotted line indicating the level of the state goals. Note that the recommended portfolio is not able to meet the state goals in any year. Note also that the savings on this chart are in terms of Gross incremental savings since the Indiana goals are expressed as such, and that all other potential savings in this report are given in terms of Net incremental or Net cumulative savings.[3]

[3] Utilities typically have a small subset of large commercial and industrial customers that comprise a disproportionate share of load and demand. In Vectren's case, there is one particular industrial customer that comprises a full 24% of the C&I load. If this customer were not to participate in EE programs, the savings potential would drop commensurately in the C&I sectors, which would remove approximately 15% from the overall savings potential in all sectors.

Figure 8-1 Gross Incremental Electricity Savings (MWh)



The remainder of this report focuses on the delivery of the Recommended Portfolio specifically, and further details of the Achievable Low and Achievable High program portfolios are available in the analysis workpapers.

Recommended Program Action Plan

While the economic potential shown in the Action Plan meets the aggressive Indiana state goals, the recommended program Action Plan falls short. Figure 8-2 shows the net incremental energy savings in each year of the study by program. Figure 8-3 shows the annual budgets for the portfolio. Note again that the savings presented here are Net, and not Gross.

Figure 8-2 Recommended Action Plan - Net Incremental Energy Savings (MWh)

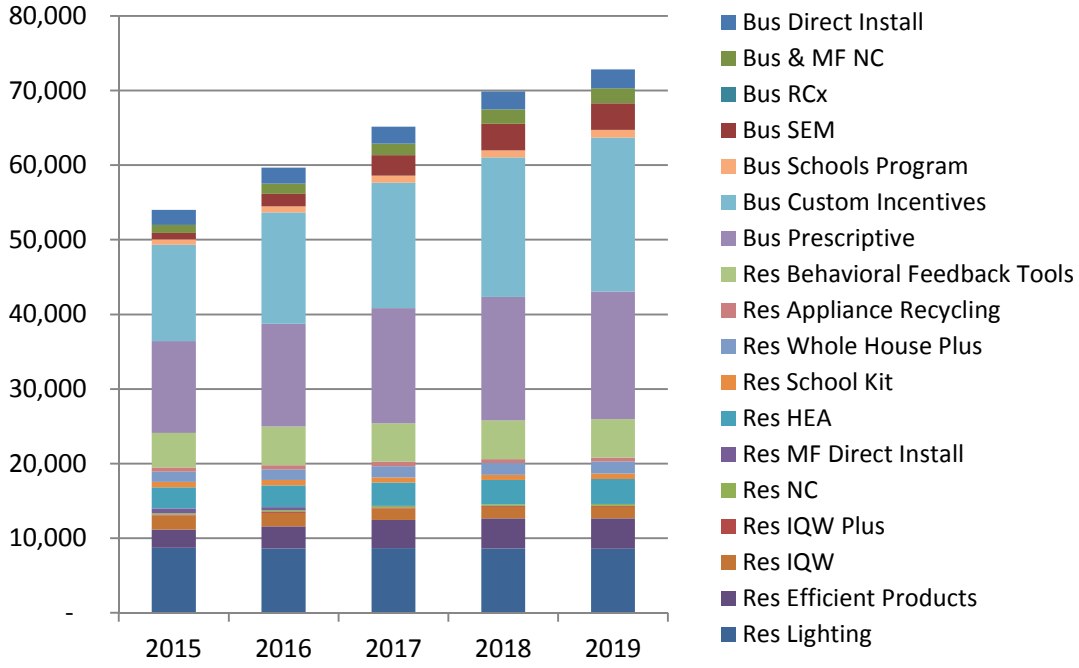


Figure 8-3 Recommended Action Plan - Annual Utility Budgets

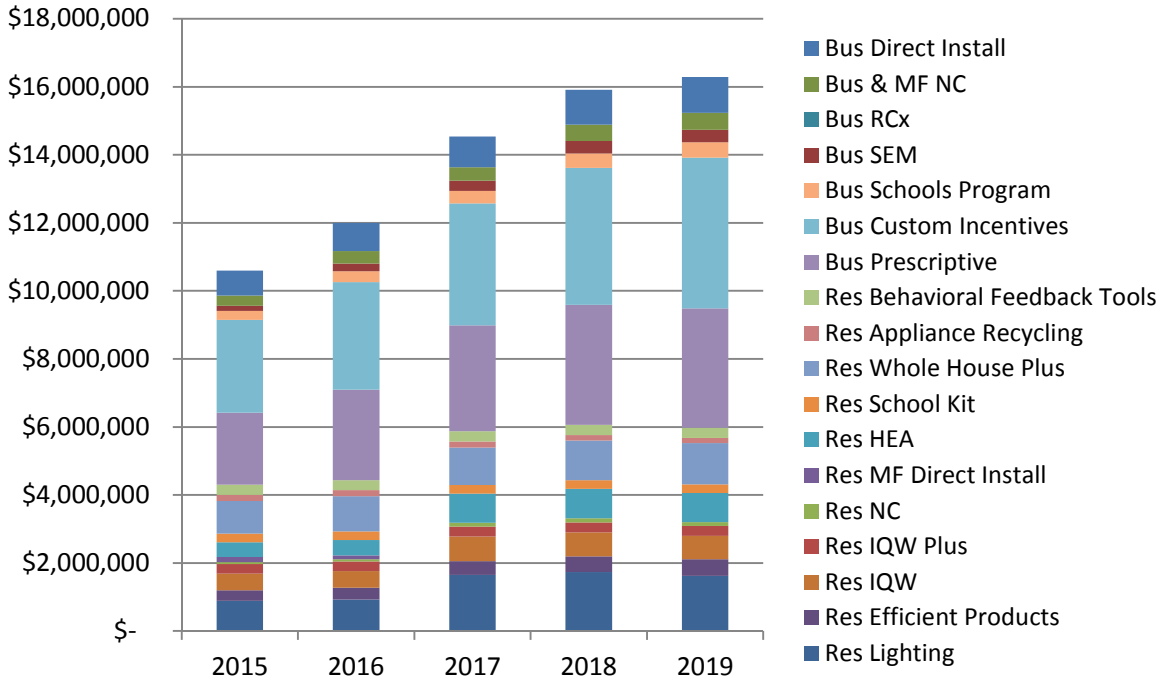


Table 8-3 below shows the detailed annual savings and budgets for the recommended portfolio.

Table 8-3 Vectren Recommended Electric Energy Efficiency Portfolio Summary

Program	Total Utility Costs (000$)					Total Net Incremental Energy Savings (MWh)					Total Net Incremental Demand Savings (kW)				
	2015	2016	2017	2018	2019	2015	2016	2017	2018	2019	2015	2016	2017	2018	2019
Res Lighting	891	924	1,648	1,737	1,619	8,738	8,642	8,696	8,621	8,590	525	520	523	518	516
Res Efficient Products	309	349	406	455	496	2,425	2,957	3,773	4,061	4,096	259	310	385	420	438
Res IQW	491	491	728	712	680	1,876	1,799	1,527	1,517	1,518	116	112	95	94	94
Res IQW Plus	282	282	291	291	291	142	141	144	143	142	88	87	87	86	86
Res NC	57	64	107	116	119	193	193	220	236	248	24	26	29	32	35
Res MF Direct Install	146	115	-	-	-	610	448	-	-	-	44	32	-	-	-
Res HEA	434	452	861	872	855	2,846	2,911	3,092	3,218	3,354	138	140	149	155	161
Res School Kit	252	252	252	252	252	741	726	721	715	711	132	131	130	130	130
Res Whole House Plus	966	1,037	1,105	1,163	1,213	1,343	1,426	1,507	1,579	1,646	936	994	1,049	1,100	1,146
Res Appliance Recycling	174	174	174	165	155	561	561	561	528	495	143	143	143	135	126
Res Behavioral Feedback Tools	300	300	300	300	300	4,659	5,177	5,177	5,177	5,177	1,299	1,443	1,443	1,443	1,443
Bus Prescriptive	2,120	2,660	3,119	3,527	3,510	12,310	13,774	15,438	16,535	17,112	8,088	9,683	11,231	14,842	13,627
Bus Custom Incentives	2,725	3,157	3,578	4,025	4,426	12,906	14,891	16,801	18,698	20,595	8,027	9,329	10,587	11,946	13,206
Bus Schools Program	268	324	372	422	454	719	839	919	938	1,027	110	135	155	174	192
Bus SEM	150	225	298	373	373	832	1,663	2,757	3,589	3,589	141	281	495	635	635
Bus & MF NC	298	364	395	479	493	1,109	1,386	1,530	1,902	2,009	587	725	749	960	939
Bus Direct Install	737	826	908	1,025	1,056	1,977	2,134	2,278	2,399	2,526	648	720	797	925	982
Residential Total:	4,301	4,440	5,872	6,062	5,979	24,134	24,981	25,418	25,795	25,977	3,704	3,938	4,034	4,113	4,175
Business Total:	6,298	7,557	8,669	9,851	10,311	29,851	34,686	39,723	44,060	46,857	17,602	20,873	24,013	29,482	29,581
Portfolio Total:	**10,599**	**11,996**	**14,542**	**15,913**	**16,290**	**53,986**	**59,667**	**65,140**	**69,855**	**72,834**	**21,306**	**24,811**	**28,047**	**33,596**	**33,757**

Cost Effectiveness

With the program savings and budgets, we perform the industry standard cost-effectiveness tests to gauge the economic merits of the portfolio. Each test compares the benefits of the EE programs to their costs – using its own unique perspectives and definitions – all defined in terms of net present value of future cash flows. The definitions for the four standard tests most commonly used in EE program design are described below.

- **Total Resource Cost test (TRC).** The benefits in this test are the lifetime avoided energy costs and avoided capacity costs. The costs in this test are the incremental measure costs plus all administrative costs spent by the program administrator.
- **Utility Cost Test (UCT).** The benefits in this test are the lifetime avoided energy costs and avoided capacity costs, the same as the TRC benefits. The costs in this test are the program administrator's incentive costs and administrative costs.
- **Participant Cost Test (PCT).** The benefits in this test are the lifetime value of retail rate savings (which is another way of saying "lost utility revenues"). The costs in this test are those seen by the participant; in other words: the incremental measure costs minus the value of incentives paid out.
- **Rate Impact Measure test (RIM).** The benefits of the RIM test are the same as the TRC benefits. The RIM costs are the same as the UCT, except for the addition of lost revenue. This test attempts to show the effects that EE programs will have on rates, which is almost always to raise them on a per unit basis. Thus, costs typically outweigh benefits from the point of view of this test, but the assumption is that absolute energy use decreases to a greater extent than per-unit rates are increased — resulting in lower average utility bills.

The cost effectiveness results for the Vectren Recommended Portfolio are shown in Table 8-4, sporting lifetime TRC benefits of $177 million dollars and costs of $92 million dollars for a robust TRC ratio of 1.92.

Table 8-4 Vectren Recommended Action Plan Cost Effectiveness summary

	TRC Ratio	TRC Benefits	TRC Costs	UCT Ratio	PCT Ratio	RIM Ratio
Res Lighting	1.47	$12,729,504	$8,638,583	2.33	7.39	0.44
Res Efficient Products	2.31	$5,767,547	$2,494,058	3.55	11.18	0.51
Res IQW	0.99	$2,475,435	$2,503,149	0.99	-	0.35
Res IQW Plus	0.56	$650,864	$1,166,742	0.56	-	0.35
Res NC	1.02	$453,989	$443,548	1.23	9.82	0.42
Res MF Direct Install	1.47	$383,335	$260,561	1.69	20.72	0.41
Res HEA	1.90	$5,286,017	$2,783,242	1.90	-	0.42
Res School Kit	1.14	$1,165,755	$1,024,230	1.14	-	0.38
Res Whole House Plus	1.07	$8,212,627	$7,653,155	1.85	2.47	0.66
Res Appliance Recycling	1.05	$723,032	$686,727	1.05	-	0.40
Res Behavioral Feedback Tools	1.18	$1,442,788	$1,220,290	1.18	-	0.42
Bus Prescriptive	2.06	$50,575,254	$24,584,518	4.21	3.91	0.83
Bus Custom Incentives	2.52	$70,292,200	$27,918,583	4.87	5.25	0.82
Bus Schools Program	0.69	$2,168,631	$3,155,364	1.46	1.96	0.45
Bus SEM	1.61	$1,821,203	$1,133,881	1.61	-	0.43
Bus & MF NC	2.06	$5,972,921	$2,896,189	3.66	5.04	0.75
Bus Direct Install	1.85	$6,808,569	$3,675,085	1.85	-	0.56
Residential Total:	1.36	$39,290,894	$28,874,285	1.83	8.54	0.47
Business Total:	2.17	$137,638,778	$63,363,620	4.00	4.87	0.78
Portfolio Total:	**1.92**	**$176,929,672**	**$92,237,905**	**3.17**	**5.61**	**0.68**

CONCLUSIONS AND RECOMMENDATIONS

The results of this study reveal that significant energy efficiency opportunities exist for Vectren in Southern Indiana, despite aggressive appliance and efficiency standards and a challenging macroeconomic environment.

Our program analysis shows that Vectren can achieve Net incremental electric energy savings of 53,986 MWh in 2015, increasing to 72,834 MWh in 2019. This equates to Gross incremental savings of 62,818 MWh in 2015 and 84,809 MWh in 2019, all by implementing the programs and measures presented in this report.

Vectren's energy-efficiency programs are relatively young compared to other programs in the nation, but have made significant impacts already and are building appreciable market momentum. Based on our market potential assessment and program design analysis, EnerNOC provides the following high-level recommendations for the portfolio. We fully expect that Vectren, the stakeholders, and the implementers will consider the plans and recommendations in this report now, at the outset of the forthcoming implementation cycle; and that they will adopt the elements that are appropriate, adjust the elements that fit differently when translated into the trenches and front lines of program delivery, and continue to revisit the report as a reference throughout the next years as situations and markets continue to change and evolve.

General Recommendations

- **Increase focus on non-residential programs:** Our study shows that a large portion of the program savings from energy efficiency efforts will come from the commercial and industrial sectors. Vectren has already begun to shift budget and focus toward the C&I sectors, as evidenced by budgeting trends in 2013 and 2014 as well as the primary market research conducted on large C&I customers as part of this study. Increasing program efforts in the C&I sectors will not only lead to harvesting larger EE savings, but to increased business competitiveness and decreased operating costs for customers. Additionally, these sectors offer larger projects, which can be attained and bundled more readily and efficiently.
- **Continued collaboration among stakeholders:** The discourse and information sharing between stakeholders, utilities, and EnerNOC on this study has been effective and transparent. Continuing this trend is of paramount importance to the future success of programs. It is essential to cultivate a mutual understanding of the dynamic nature of the energy efficiency industry due to its intrinsic linkage with human behavior and the customer mind. Ongoing interactions should be marked by an understanding of collaboration, flexibility, and continuous improvement.
- **Deliver electric and natural gas programs jointly when possible:** Vectren also has a broad array of natural gas energy efficiency programs to help its natural gas customers save on their gas bills. Administrative efficiencies and economies of scale can be reached with dual fuel program offerings in applicable programs like HEA and IQW, where both electric and gas savings can be obtained without creating duplicative, administrative cost structures. Further, Indiana's concept of a statewide Therm Bank provides an excellent platform to deliver joint electric and natural gas programs on a straightforward and highly cost-effective basis. In this paradigm, if it proves feasible and appropriate to management and to stakeholders, Vectren could share costs across its electric and gas programs to extend their reach and effectiveness.

Residential Recommendations

- **Focus on lighting:** The largest share of achievable energy efficiency potential in the residential sector continues to come from CFLs. This is in spite of the forthcoming EISA standards that will reduce their per-unit savings compared to the new baseline. Also, Vectren should focus strong attention on specialty lamps, as they are not affected by the EISA standard, and prepare for the entrance of LED lamps into their programs in the later years of the portfolio.
- **Implement and monitor behavioral feedback programs:** The behavioral modification program to be implemented by OPower is shown in the program plans to comprise a significant amount of Vectren's portfolio savings. This initiative was added at the program design stage, and was not included in our bottom-up, measure level potential analysis. This is due to the fact that it is not a specific action or piece of equipment, per se, as well as the fact that it does not go through the typical customer-adoption model that other measures encounter. The program is simply delivered to as many participants as the planners deem appropriate, and produces a statistically measured energy reduction effect in a treatment group (vs. a control group that does not receive the program treatment). It should be monitored carefully, however, as it is a new and emerging opportunity. Relatively little is known about the specific actions that customers perform to reduce their energy usage in this program, and it may undergo meaningful change in customer responsiveness and evaluation paradigms in the coming years. Additionally, savings under this program will not persist after the program is ended, and must be continually renewed each year with additional cost and effort, whereas the savings from a capital equipment measure can last 10 to 20 years.
- **Develop deeper, follow-on measures in existing programs:** Some current Vectren program delivery structures are pursuing low-cost measures through rapid customer touches with direct-install components only. We have recommended the addition of more deep, involved measures to capitalize on customer touches as much as possible. While you are in the home of a customer, it makes better sense to cross-sell these other measures and harvest as many energy savings as you can. This would include major equipment replacements and shell measures such as duct sealing and insulation.
- **Consider social media avenues for targeted program delivery:** As internet social media paradigms become the norm in today's wired society, companies like Groupon, Amazon Local Deals, and Living Social have assembled a nationwide network of businesses into a well-oiled, rebate-issuing machine. Vectren should consider if there are opportunities to link their energy efficiency trade ally network to one of these companies to facilitate the target marketing, processing, and delivery of rebates. These vendors have sophisticated tracking systems and databases that may facilitate EM&V reporting on the back end as well.

Commercial & Industrial Recommendations

- **Aggressively pursue lighting savings:** The commercial sector in particular has significant savings potential in lighting equipment, both interior and exterior. Notably, LED lamps are showing as cost effective in the commercial sector due to aggressive forecasts of cost reductions, as well as higher hours of operation than their non-economic counterparts in residential settings. Savings are also available through occupancy sensors, timers, and energy management systems. Vectren should strongly pursue lighting savings to accelerate the phase out of T12 fluorescent lighting. In particular, program efforts can help intercept building operators before they make purchase and stocking decisions that could lead to the hoarding of T12 lamps.
- **Focus industrial program efforts on motor controls and system optimizations**: The savings for the industrial sector are all about control and optimization of motors and processes. Low-cost retrofits can often have significant energy impacts with minimal disruption of (and often times improvement of) business processes.

- **Target niches with segment specific programs**: There are specific business segments that offer considerable savings potential, but will not typically be reached by standard rebates and generic business programs. Consider initiating specifically targeted sub-programs within business standard and custom for areas such as: hotels and lodging, food preparation equipment in restaurants, and refrigeration equipment in grocery stores.
- **Implement new programs:** We have identified additional programs that show promise to expand Vectren's portfolio of programs to address Indiana's aggressive statewide savings goals. These programs are as follows:
    1. *Strategic Energy Management*. For large customers, SEM initiatives can deliver substantial savings over long time horizons. This means coming alongside the larger customers to create a customized, multi-year plan, identify metrics, set goals, and provide technical assistance and attention from dedicated account executives or energy coaches.
    2. *Business and Multifamily New Construction*. A program to encourage more rapid adoption of efficient building design practices is a very relevant addition to the Vectren portfolio.

About EnerNOC

EnerNOC's Utility Solutions Consulting team is part of EnerNOC's Utility Solutions, which provides a comprehensive suite of demand-side management (DSM) services to utilities and grid operators worldwide. Hundreds of utilities have leveraged our technology, our people, and our proven processes to make their energy efficiency (EE) and demand response (DR) initiatives a success. Utilities trust EnerNOC to work with them at every stage of the DSM program lifecycle – assessing market potential, designing effective programs, implementing those programs, and measuring program results.

EnerNOC's Utility Solutions deliver value to our utility clients through two separate practice areas – Implementation and Consulting.

- Our Implementation team leverages EnerNOC's deep "behind-the-meter expertise" and world-class technology platform to help utilities create and manage DR and EE programs that deliver reliable and cost-effective energy savings. We focus exclusively on the commercial and industrial (C&I) customer segments, with a track record of successful partnerships that spans more than a decade. Through a focus on high quality, measurable savings, EnerNOC has successfully delivered hundreds of thousands of MWh of energy efficiency for our utility clients, and we have thousands of MW of demand response capacity under management.
- The Consulting team provides expertise and analysis to support a broad range of utility DSM activities, including: potential assessments; end-use forecasts; integrated resource planning; EE, DR, and smart grid pilot and program design and administration; load research; technology assessments and demonstrations; evaluation, measurement and verification; and regulatory support.

The team has decades of combined experience in the utility DSM industry. The staff is comprised of professional electrical, mechanical, chemical, civil, industrial, and environmental engineers as well as economists, business planners, project managers, market researchers, load research professionals, and statisticians. Utilities view EnerNOC's experts as trusted advisors, and we work together collaboratively to make any DSM initiative a success.

ELECTRIC DEMAND SIDE MANAGEMENT: MARKET POTENTIAL STUDY AND ACTION PLAN

Volume 2: Report

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INTRODUCTION

Background

Energy efficiency (EE) efforts are increasing in magnitude and gaining traction in Indiana, building on the momentum of recently established statewide electric energy efficiency targets. Vectren Energy Delivery of Indiana (Vectren) is investigating the electric energy efficiency potential for their service territory. The findings of this investigation will lead directly into the development of a portfolio of energy efficiency programs to be delivered to customers over the time period 2015 to 2019.

Toward this end, Vectren has contracted with EnerNOC Utility Solutions (EnerNOC) to conduct a Market Potential Study and assemble an Action Plan that considers all metered electric customers in the residential, commercial, and industrial sectors for this time period.

EnerNOC conducted a detailed, bottom-up assessment of the Vectren market in the Evansville metropolitan area to deliver forecasts of electric energy use, forecasts of the energy savings achievable through efficiency measures, and program designs and strategies to optimally deliver those savings. This report describes the study approach and results.

Report Organization

This report is presented in 4 volumes as outlined below. This document is **Volume 2: Market Potential and Action Plan Report**.

- Volume 1, Executive Summary
- Volume 2, Market Potential and Action Plan Report
- Volume 3, Detailed Appendices: Market Potential Study
- Volume 4, Detailed Appendices: Action Plan & Program Write-ups

Definitions of Potential

In this study, we estimate the potential for energy efficiency savings. The savings estimates represent net savings[1] developed into three types of potential: technical potential, economic potential, and achievable potential. Technical and economic potential are both theoretical limits to efficiency savings. Achievable potential embodies a set of assumptions about the decisions consumers make regarding the efficiency of the equipment they purchase, the maintenance activities they undertake, the controls they use for energy-consuming equipment, and the elements of building construction. Because estimating achievable potential involves the inherent uncertainty of predicting human behaviors and responses to market conditions, we developed low and high achievable potential as boundaries for a likely range. The various levels are described below.

- **Technical potential** is defined as the theoretical upper limit of energy efficiency potential. It assumes that customers adopt all feasible measures regardless of their cost. At the time of existing equipment failure, customers replace their equipment with the most efficient option available. In new construction, customers and developers also choose the most efficient

[1] Savings in "net" terms instead of "gross" means that the baseline forecast includes naturally occurring efficiency. In other words, the baseline assumes that natural early adopters continue to make purchases of equipment and measures at efficiency levels higher than the minimum standard.

equipment option. Examples of measures that make up technical potential for electricity in the residential sector include:

- Ductless mini-split air conditioners with variable refrigerant flow
- Ground source (or geothermal) heat pumps
- LED lighting

Technical potential also assumes the adoption of every other available measure, where applicable. For example, it includes installation of high-efficiency windows in all new construction opportunities and furnace maintenance in all existing buildings with furnace systems. These retrofit measures are phased in over a number of years, which is longer for higher-cost and complex measures.

- **Economic potential** represents the adoption of all ***cost-effective*** energy efficiency measures. In this analysis, the cost effectiveness is measured by the total resource cost (TRC) test, which compares lifetime energy and capacity benefits to the incremental cost of the measure. If the benefits outweigh the costs (that is, if the TRC ratio is greater than 1.0), a given measure is considered in the economic potential. Customers are then assumed to purchase the most cost-effective option applicable to them at any decision juncture.
- **Achievable High potential** estimates customer adoption of economic measures when delivered through efficiency programs under ideal market, implementation, and customer preference conditions. Information channels are assumed to be established and efficient for marketing, educating consumers, and coordinating with trade allies and delivery partners. Achievable High potential establishes a maximum target for the EE savings that an administrator can hope to achieve through its EE programs and involves incentives that represent a substantial portion of the incremental cost combined with high administrative and marketing costs.
- **Achievable Low potential** reflects expected program participation given significant barriers to customer acceptance, non-ideal implementation conditions, and limited program budgets. This represents a lower bound on achievable potential.

Abbreviations and Acronyms

Throughout the report we use several abbreviations and acronyms. Table 1-1 shows the abbreviation or acronym, along with an explanation.

Table 1-1 Explanation of Abbreviations and Acronyms

Acronym	Explanation
ACS	American Community Survey
AEO	Annual Energy Outlook forecast developed annual by the Energy Information Administration of the DOE
AHAM	Association of Home Appliance Manufacturers
B/C Ratio	Benefit to cost ratio
BEST	EnerNOC's Building Energy Simulation Tool
CAC	Central air conditioning
C&I	Commercial and industrial
CFL	Compact fluorescent lamp
DEEM	EnerNOC's Database of Energy Efficiency Measures
DEER	State of California Database for Energy-Efficient Resources
DSM	Demand side management
DR	Demand response
EE	Energy efficiency
EIA	Energy Information Administration
EISA	Energy Efficiency and Security Act of 2007
EPACT	Energy Policy Act of 2005
EPRI	Electric Power Research Institute
EUEA	Efficient Use of Energy Act
EUI	Energy-use index
HH	Household
HID	High intensity discharge lamps
HPWH	Heat pump water heater
IURC	Indiana Utility Regulatory Commission
LED	Light emitting diode lamp
LoadMAP	EnerNOC's Load Management Analysis and Planning™ tool
OUCC	Indiana Office of Utility Consumer Counselor
NWPCC	Northwest Power and Conservation Council
RTU	Roof top unit
Sq. ft.	Square feet
TRC	Total resource cost
UEC	Unit energy consumption

ANALYSIS APPROACH AND DATA DEVELOPMENT

This section describes the analysis approach taken for the study and the data sources used to develop the potential estimates.

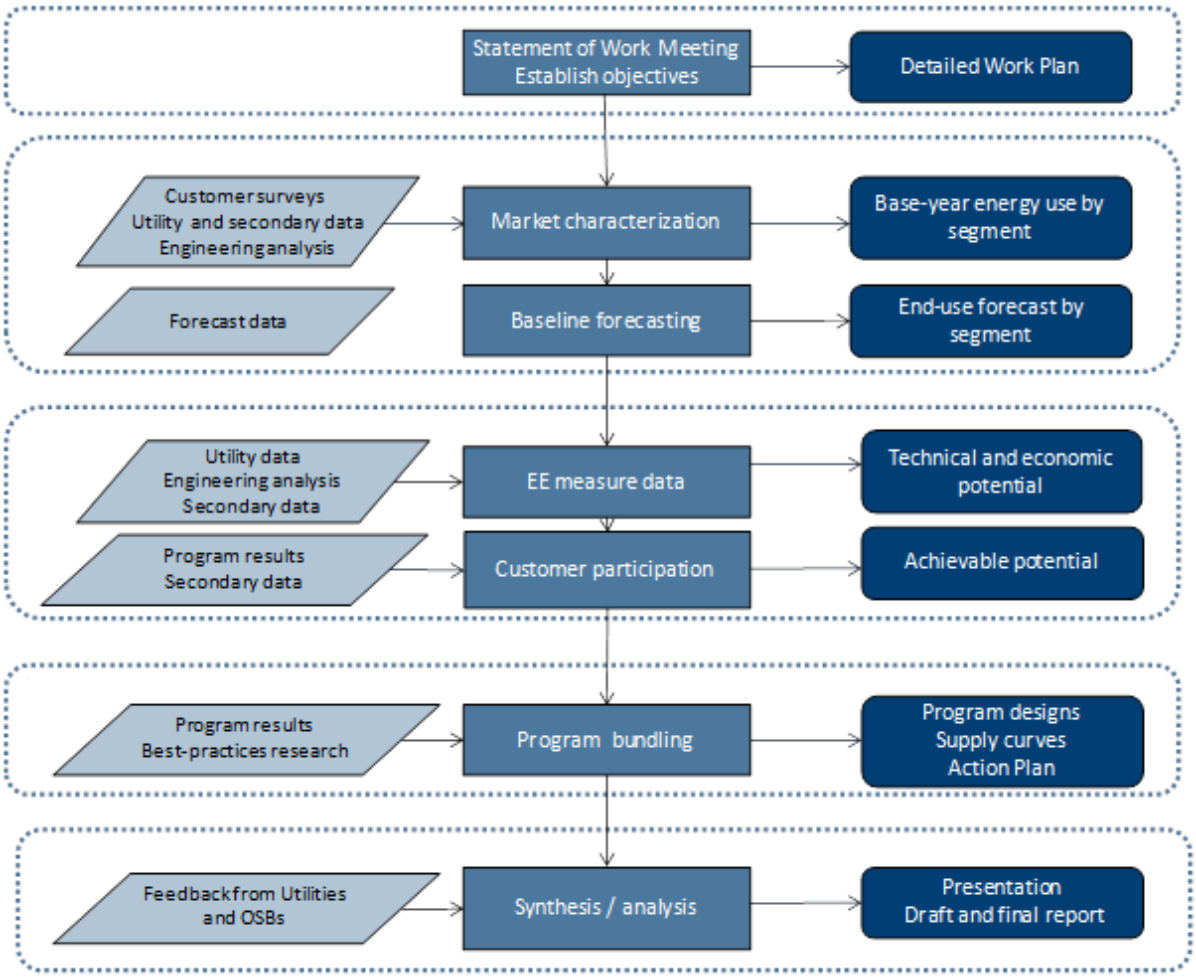
Analysis Approach

To perform the energy efficiency analysis, EnerNOC used a bottom-up analysis approach as shown in Figure 2-1. This involved the following steps.

1. Held a meeting with the client project team to refine the objectives of the project in detail. This resulted in a work plan for the study.
2. Conducted onsite energy consumption surveys with 30 of Vectren's largest commercial and industrial customers in order to provide data and guidance for these market sectors that had not formerly received focused DSM program efforts.
3. Performed a market characterization to describe sector-level electricity use for the residential, commercial, and industrial sectors for the base year, 2011. This included using existing information contained in prior Vectren and Indiana studies, new information from the aforementioned onsite surveys with large customers, EnerNOC's own databases and tools, and other secondary data sources such as the American Community Survey (ACS) and the Energy Information Administration (EIA).
4. Developed a baseline electricity forecast by sector, segment, and end use for 2011 through 2023. Results presented in this volume focus on the upcoming implementation years of 2015 through 2019. Results beyond 2019 are available in the Appendices.
5. Identified several hundred measures and estimated their effects in four tiers of measure-level energy efficiency potential: *Technical, Economic, Achievable High,* and *Achievable Low*.
6. Reviewed the current programs offered by Vectren in light of the study findings to make strategic program recommendations for achieving savings.
7. Created detailed program designs and action plans through 2019 representing the program potential for Vectren, basing them on the potential analysis and strategic recommendations developed in the previous steps.

The analysis approach for all these steps is described in further detail throughout the remainder of this chapter.

Figure 2-1 Overview of Analysis Approach



LoadMAP Model

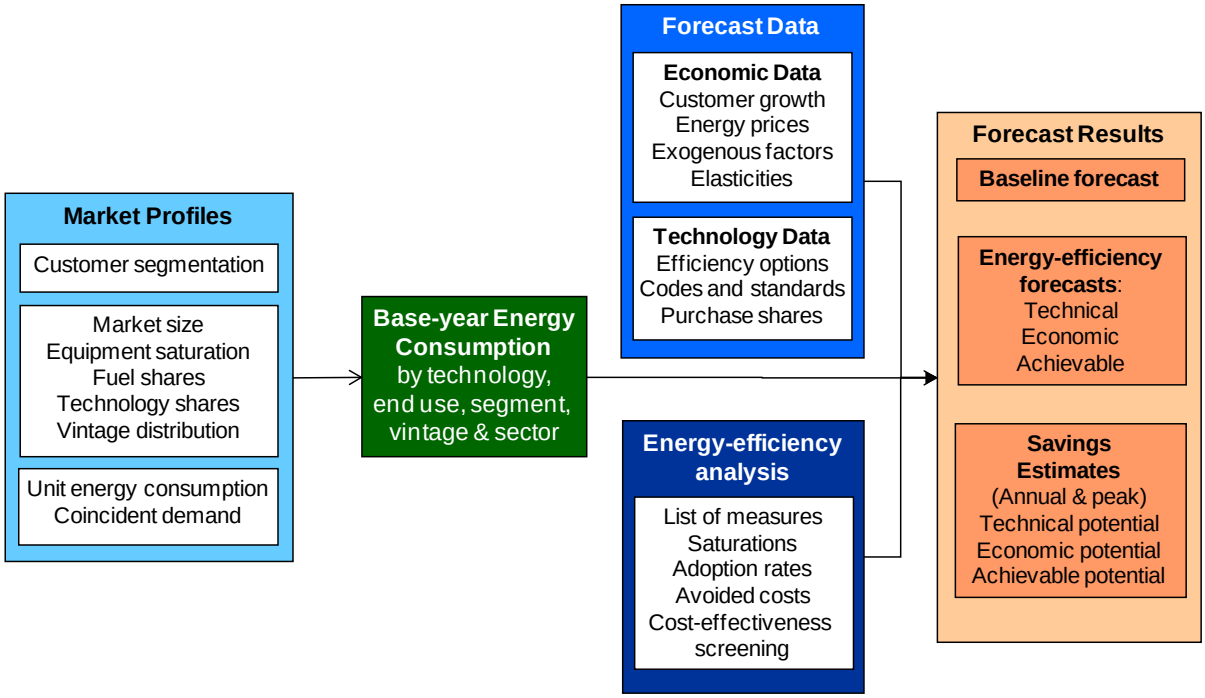
We used EnerNOC's Load Management Analysis and Planning tool (LoadMAP™) version 3.0 to develop both the baseline forecast and the estimates of energy efficiency potential. EnerNOC developed LoadMAP in 2007 and has enhanced it over time, using it for the EPRI National Potential Study and numerous utility-specific forecasting and potential studies. Built in Excel, the LoadMAP framework (see Figure 2-1) is both accessible and transparent and has the following key features.

- Embodies the basic principles of rigorous end-use models (such as EPRI's REEPS and COMMEND) but in a more simplified, accessible form.
- Includes stock-accounting algorithms that treat older, less efficient appliance/equipment stock separately from newer, more efficient equipment. Equipment is replaced according to the measure life and appliance vintage distributions defined by the user.
- Balances the competing needs of simplicity and robustness by incorporating important modeling details related to equipment saturations, efficiencies, vintage, and the like, where market data are available, and treats end uses separately to account for varying importance and availability of data resources.
- Isolates new construction from existing equipment and buildings and treats purchase decisions for new construction and existing buildings separately.

- Uses a simple logic for appliance and equipment decisions. Other models available for this purpose embody complex decision choice algorithms or diffusion assumptions, and the model parameters tend to be difficult to estimate or observe and sometimes produce anomalous results that require calibration or even overriding. The LoadMAP approach allows the user to drive the appliance and equipment choices year by year directly in the model. This flexible approach allows users to import the results from diffusion models or to input individual assumptions. The framework also facilitates sensitivity analysis.
- Includes appliance and equipment models customized by end use. For example, the logic for lighting is distinct from refrigerators and freezers.
- Can accommodate various levels of segmentation. Analysis can be performed at the sector level (e.g., total residential) or for customized segments within sectors (e.g., housing type or income level).

Consistent with the segmentation scheme and the market profiles we describe below, the LoadMAP model provides forecasts of baseline energy use by sector, segment, end use, and technology for existing and new buildings. It also provides forecasts of total energy use and energy-efficiency savings associated with the four types of potential.[2]

Figure 2-2 LoadMAP Analysis Framework



Market Characterization

In order to estimate the savings potential from energy-efficient measures, it is necessary to understand how much energy is used today and what equipment is currently being used. This characterization begins with a segmentation of Vectren's energy footprint to quantify energy use by sector, segment, fuel, end-use application, and the current set of technologies used. We incorporate information from the secondary research sources to advise the market characterization.

[2] The model computes energy and peak-demand forecasts for each type of potential for each end use as an intermediate calculation. Annual-energy and peak-demand savings are calculated as the difference between the value in the baseline forecast and the value in the potential forecast (e.g., the technical potential forecast).

Segmentation for Modeling Purposes

The market assessment first defined the market segments (building types, end uses and other dimensions) that are relevant in the Vectren service territory. The segmentation scheme for this project is presented in Table 2-1.

Table 2-1 Overview of Segmentation Scheme for Potentials Modeling

Market Dimension	Segmentation Variable	Dimension Examples
1	Sector	Residential, commercial, industrial
2	Building type	Residential (single family, multi family) Commercial (office, restaurant, retail, etc.) Industrial (plastics, chemicals, transportation , and other)
3	Vintage	Existing and new construction
4	Fuel	Electricity
5	End uses	Cooling, lighting, water heat, motors, etc. (as appropriate by sector)
6	Appliances/end uses and technologies	Technologies such as lamp type, air conditioning equipment, motors by application, etc.
7	Equipment efficiency levels for new purchases	Baseline and higher-efficiency options as appropriate for each technology

Following this scheme, the residential sector was segmented as described below, starting with customer segments by building type:

- Single family
- Multi family

In addition to segmentation by housing type, we identified the set of end uses and technologies that are appropriate for Vectren. These are shown in Table 2-2 and Table 2-3

Table 2-2 Residential Electric End Uses and Technologies

End Use	Technology
Cooling	Central Air Conditioning (CAC)
Cooling	Room Air Conditioning (RAC)
Cooling/Heating	Air-Source Heat Pump
Cooling/Heating	Geothermal Heat Pump
Space Heating	Electric Resistance
Space Heating	Electric Furnace
Water Heating	Water Heater <= 55 gal
Water Heating	Water Heater > 55 gal
Interior Lighting	Screw-in Lamps
Interior Lighting	Linear Fluorescent Lamps
Interior Lighting	Specialty
Exterior Lighting	Screw-in Lamps
Appliances	Clothes Washer
Appliances	Clothes Dryer
Appliances	Dishwasher
Appliances	Refrigerator
Appliances	Freezer
Appliances	Second Refrigerator
Appliances	Stove
Appliances	Microwaves
Electronics	Personal Computers
Electronics	Monitor
Electronics	Laptops
Electronics	TVs
Electronics	Printer/Fax/Copier
Electronics	Set-top Boxes/DVR
Electronics	Devices and Gadgets
Miscellaneous	Pool Pump
Miscellaneous	Pool Heater
Miscellaneous	Hot Tub / Spa
Miscellaneous	Well Pump
Miscellaneous	Furnace Fan
Miscellaneous	Miscellaneous

For the commercial sector, it is useful to analyze the segments based on the unique characteristics of the building type. For this study, we used the following segments.

- Small Office—all types of offices, including medical/dental offices
- Large Office—all types of offices, including large government facilities
- Restaurant—fast-food, sit-down and cafeteria-style restaurants
- Retail—retail establishments such as small boutiques, and large box retailers
- Grocery—convenience stores, small markets, and supermarkets
- College—colleges, universities and technical colleges
- School—primary and secondary schools
- Health—hospitals and nursing homes
- Lodging—motels, hotels, resorts and small inns
- Warehouse—storage facilities, refrigerated and unrefrigerated

- Miscellaneous—all remaining building types, such as police stations, parking garages, public assembly, amusement parks, etc.
- Traffic Signals—encompasses traffic lights and crosswalk lights.

In addition to segmentation by building type, we identified the set of end uses and technologies that are appropriate for Vectren. Table 2-3 lists the end uses and technologies used in this study.

Table 2-3 Commercial Electric End Uses and Technologies

End Use	Technology
Cooling	Air-Cooled Chiller
Cooling	Water-Cooled Chiller
Cooling	Roof top AC
Cooling	Other Cooling
Cooling/Heating	Air-Source Heat Pump
Cooling/Heating	Geothermal Heat Pump
Heating	Electric Room Heat
Heating	Electric Furnace
Ventilation	Ventilation
Water Heating	Water Heater
Interior Lighting	Screw-in
Interior Lighting	High-Bay Fixtures
Interior Lighting	Linear Fluorescent
Exterior Lighting	Screw-in
Exterior Lighting	HID
Exterior Lighting	Linear Fluorescent
Exterior Lighting	Traffic Lights
Exterior Lighting	Crosswalk Lights
Refrigeration	Walk-in Refrigerator
Refrigeration	Reach-in Refrigerator
Refrigeration	Glass Door Display
Refrigeration	Open Display Case
Refrigeration	Icemaker
Refrigeration	Vending Machine
Food Preparation	Oven
Food Preparation	Fryer
Food Preparation	Dishwasher
Food Preparation	Hot Food Container
Office Equipment	Desktop Computer
Office Equipment	Laptop
Office Equipment	Server
Office Equipment	Monitor
Office Equipment	Printer/Copier/Fax
Office Equipment	POS Terminal
Miscellaneous	Non-HVAC Motors
Miscellaneous	Pool Pump
Miscellaneous	Pool Heater
Miscellaneous	Miscellaneous

For the industrial sector, the study isolated the top three industries in Vectren by energy consumption, which accounted for 71% of the total 2011 industrial load. The remaining group of industrial customers is considered in aggregate as “other industrial.” While the commercial sector has a relatively small set of building types that have relatively uniform characteristics, the sheer

number of unique industry types makes it infeasible to perform a deep dive into all but the largest ones. This results in a larger “other” or “miscellaneous” segment than that which exists in the commercial sector. Nonetheless, these “other” industries typically have energy use characteristics that are similar enough to perform an accurate potential assessment.

The resulting segmentation is as follows:

- Chemical
- Plastics
- Transportation
- Other Industrial

In addition to segmentation by industry, we identified the set of end uses and technologies that are appropriate for Vectren. These are shown in Table 2-4.

Table 2-4 Industrial Electric End Uses and Technologies

End Use	Technology
Cooling	Air-Cooled Chiller
Cooling	Water-Cooled Chiller
Cooling	Roof top AC
Cooling	Other Cooling
Cooling/Heating	Air-Source Heat Pump
Cooling/Heating	Geothermal Heat Pump
Heating	Electric Room Heat
Heating	Electric Furnace
Ventilation	Ventilation
Interior Lighting	Screw-in
Interior Lighting	High-Bay Fixtures
Interior Lighting	Linear Fluorescent
Exterior Lighting	Screw-in
Exterior Lighting	HID
Exterior Lighting	Linear Fluorescent
Motors	Pumps
Motors	Fans & Blowers
Motors	Compressed Air
Motors	Material Handling
Motors	Material Processing
Motors	Other Motors
Process	Process Heating
Process	Process Cooling and Refrigeration
Process	Electro-Chemical Processes
Process	Other Process
Miscellaneous	Miscellaneous

With the segmentation scheme defined, we then performed a high-level market characterization of electricity sales in the base year to allocate sales to each customer segment. We used various data sources to identify the annual sales in each customer segment, as well as the market size for each segment. This information provided control totals at a sector level for calibrating the LoadMAP model to known data for the base-year.

Market Profiles

The next step was to develop market profiles for each sector, customer segment, end use, and technology. A market profile includes the following elements:

- **Market size** is a representation of the number of customers in the segment. For the residential sector, it is number of households. In the commercial sector, it is floor space measured in square feet. For the industrial sector, it is number of employees.
- **Saturations** define the fraction of homes and square feet with the various technologies. (e.g., homes with electric space heating).
- **UEC (unit energy consumption) or EUI (energy-use index)** describes the amount of energy consumed in 2011 by a specific technology in buildings that have the technology. For electricity, UECs are expressed in kWh/household for the residential sector, and EUIs are expressed in kWh/square foot or kWh/employee for the commercial and industrial sectors, respectively.
- **Intensity** for the residential sector represents the average energy use for the technology across all homes in 2011. It is computed as the product of the saturation and the UEC and is defined as kWh/household for electricity. For the commercial and industrial sectors, intensity, computed as the product of the saturation and the EUI, represents the average use for the technology across all floor space or all employees in 2011.
- **Usage** is the annual energy use by an end use technology in the segment. It is the product of the market size and intensity and is quantified in GWh. The market assessment results and the market profiles are presented in Chapter 3.

Baseline Forecast

The next step was to develop the baseline forecast of annual electricity usage for 2011 through 2017 by customer segment and end use without new utility programs or naturally occurring efficiency. The end-use forecast does include the relatively certain impacts of codes and standards that will unfold over the study timeframe. All such mandates that were defined as of January 2012 are included in the baseline. The baseline forecast is the foundation for the analysis of savings from future EE efforts as well as the metric against which potential savings are measured.

Inputs to the baseline forecast include:

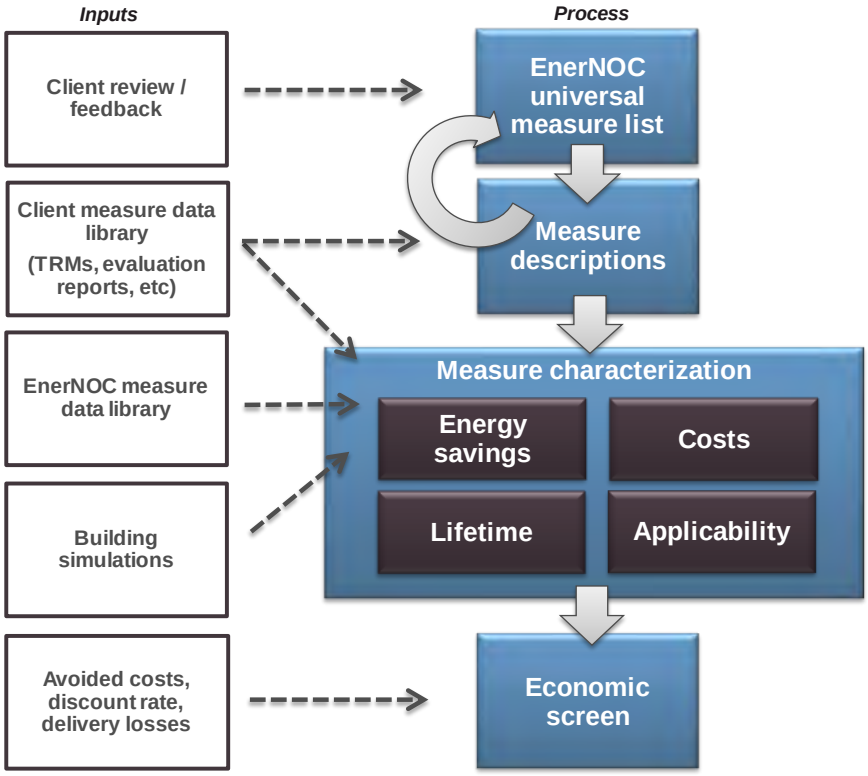
- Current economic growth forecasts (i.e., customer growth, income growth)
- Electricity price forecasts
- Trends in fuel shares and equipment saturations
- Existing and approved changes to building codes and equipment standards

We present the results of the baseline forecast development in Chapter 4.

Energy Efficiency Measure Analysis

This section describes the framework used to assess the savings, costs, and other attributes of energy-efficiency measures. These characteristics form the basis for measure-level cost-effectiveness analyses as well as for determining measure-level savings. For all measures, EnerNOC assembled information to reflect equipment performance, incremental costs, and equipment lifetimes. We used this information, along with Vectren's avoided costs data, in the economic screen to determine economically feasible measures. Figure 2-3 outlines the framework for measure analysis.

Figure 2-3 Approach for Measure Assessment



The framework for assessing savings, costs, and other attributes of energy efficiency measures involves identifying the list of energy efficiency measures to include in the analysis, determining their applicability to each market sector and segment, fully characterizing each measure, and performing cost-effectiveness screening.

We compiled a robust list of energy efficiency measures for each customer sector, drawing upon the Vectren program experience and protocols, EnerNOC's own measure databases and building simulation models, and secondary sources. This universal list of EE measures covers all major types of end-use equipment, as well as devices and actions to reduce energy consumption. If considered today, some of these measures would not pass the economic screens initially, but may pass in future years as a result of lower projected equipment costs or higher avoided costs.

The selected measures are categorized into two types according to the LoadMAP taxonomy: equipment measures and non-equipment measures.

- **Equipment measures** are efficient energy-consuming pieces of equipment that save energy by providing the same service with a lower energy requirement than a standard unit. An example is an ENERGY STAR refrigerator that replaces a standard efficiency refrigerator. For equipment measures, many efficiency levels may be available for a given technology, ranging from the baseline unit (often determined by code or standard) up to the most efficient product commercially available. For instance, in the case of central air conditioners, this list begins with the current federal standard SEER 13 unit and spans a broad spectrum up to a maximum efficiency of a SEER 21 unit.
- **Non-equipment measures** save energy by reducing the need for delivered energy, but do not involve replacement or purchase of major end-use equipment (such as a refrigerator or air conditioner). An example would be a programmable thermostat that is pre-set to run heating and cooling systems only when people are home. Non-equipment measures can apply to more than one end use. For instance, addition of wall insulation will affect the

energy use of both space heating and cooling. Non-equipment measures typically fall into one of the following categories:

- Building shell (windows, insulation, roofing material)
- Equipment controls (thermostat, energy management system)
- Equipment maintenance (cleaning filters, changing setpoints)
- Whole-building design (building orientation, passive solar lighting)
- Lighting retrofits (included as a non-equipment measure because retrofits are performed prior to the equipment's normal end of life)
- Displacement measures (ceiling fan to reduce use of central air conditioners)
- Commissioning and retrocommissioning

We developed a preliminary list of EE measures, which was distributed to Vectren for review. The list was finalized after incorporating comments, and can be found in Chapter 5 of this report.

Once we assembled the list of EE measures, the project team assessed their energy-saving characteristics. For each measure we also characterized incremental cost, service life, and other performance factors. Following the measure characterization, we performed an economic screening of each measure, which serves as the basis for developing the economic and achievable potential.

Representative Measure Data Inputs

To provide an example of the measure data, Table 2-5 and Table 2-6 present examples of the detailed data inputs behind both equipment and non-equipment measures, respectively, for the case of residential CAC in single-family homes. Table 2-5 displays the various efficiency levels available as equipment measures, as well as the corresponding useful life, energy usage, and cost estimates. The columns labeled On Market and Off Market reflect equipment availability due to codes and standards or the entry of new products to the market.

Table 2-5 Example Equipment Measures for Central Air Conditioning – Single Family Home

Efficiency Level	Useful Life	Equipment Cost	Energy Usage(kWh/yr)	On Market	Off Market
SEER 13	15	$ 2,778	2,841	2011	n/a
SEER 14 (ENERGY STAR)	15	$ 3,205	2,605	2011	n/a
SEER 15 (CEE Tier 2)	15	$ 3,846	2,507	2011	n/a
SEER 16 (CEE Tier 3)	15	$ 3,900	2,424	2011	n/a
SEER 17 (Ductless Mini-split)	15	$ 6,544	2,353	2011	n/a
SEER 21	15	$ 6,410	1,905	2011	n/a

Table 2-6 lists some of the non-equipment measures applicable to CAC in an existing single-family home. All measures are evaluated for cost effectiveness based on the lifetime benefits relative to the cost of the measure. The total savings and costs are calculated for each year of the study and depend on the base year saturation of the measure, the applicability[3] of the measure, and the savings as a percentage of the relevant energy end uses.

[3] The applicability factors take into account whether the measure is applicable to a particular building type and whether it is feasible to install the measure. For instance, attic fans are not applicable to homes where there is insufficient space in the attic or there is no attic at all.

Table 2-6 Example Non-Equipment Measures – Single Family Home, Existing

End Use	Measure	Saturation in 2011[4]	Applica-bility	Lifetime (yrs)	Measure Installed Cost	Energy Savings (%)
Cooling	Central AC - Maintenance	15%	100%	2	$175	10.1%
Cooling	Repair and Sealing – Ducting	12%	50%	18	$500	11.0%
Cooling	Insulation - Ceiling	16%	38%	20	$375	4.0%
Cooling	Windows – Install Reflective Film	5%	45%	10	$1025	33.3%
Cooling	Windows - ENERGY STAR	24%	90%	20	$7200	32.0%
Cooling	Thermostat - Clock/Programmable	46%	56%	5	$30	9.7%

Screening Measures for Cost-Effectiveness

Only measures that are cost-effective are included in economic and achievable potential. Therefore, for each individual measure, LoadMAP performs an economic screen. This study uses the TRC test that compares the lifetime energy benefits (and peak demand for electricity) of each applicable measure with its incremental installed cost, including material and labor. There is no program administration cost considered in this analysis, and therefore, no specific program delivery methods or mechanisms are assumed. The lifetime benefits are calculated by multiplying the annual energy and demand savings for each measure by all appropriate avoided costs for each year, and discounting the dollar savings to the present value equivalent. The analysis uses each measure's values for savings, costs, and lifetimes that were developed as part of the measure characterization process described above.

The LoadMAP model performs this screening dynamically, taking into account changing savings and cost data over time. Thus, some measures pass the economic screen for some — but not all — of the years in the forecast.

It is important to note the following about the economic screen:

- The economic evaluation of every measure in the screen is conducted relative to a baseline condition. For instance, in order to determine the kilowatt-hour (kWh) savings potential of a measure, kWh consumption with the measure applied must be compared to the kWh consumption of a baseline condition.
- The economic screening was conducted only for measures that are applicable to each building type and vintage; thus if a measure is deemed to be irrelevant to a particular building type and vintage, it is excluded from the respective economic screen.

Table 2-7 shows the results of the economic screen, highlighting the economic unit for a central air-source heat pump and select other measures. In 2014, the federal minimum standard efficiency for heat pumps changes from SEER 13 to SEER 14. Before this change, the cost is prohibitive to improve from a SEER 13 baseline. After 2014, however, the incremental cost to go from a SEER 14 to a SEER 15 is proportionally less, thereby making this measure cost-effective. For pool heaters, a heat pump unit is cost effective in all years. For refrigerators, the AHAM federal efficiency standards cause existing Energy Star units to become obsolete in 2014. Units compliant with AHAM 2014 thus become the new minimum efficiency baseline. Since there is not a more efficient, cost-effective unit available, they become both the baseline unit and the economic unit by default. If the measure passes the screen (has a B/C ratio greater than or equal to 1), the measure is included in economic potential. Otherwise, it is screened out for that

[4] Note that saturation levels reflected for the base year change over time as more measures are adopted.

year. If multiple equipment measures have B/C ratios greater than or equal to 1.0, the most efficient technology is selected by the economic screen.

Table 2-7 Economic Screen Results for Selected Residential Equipment Measures

Technology	2013	2014	2015	2016	2017	2018	2019
Air Source Heat Pump	SEER 13	SEER 13	SEER 15	SEER 15	SEER 15	SEER 15	SEER 15
Pool Heater	Heat Pump (COP = 5.0)	Heat Pump (COP = 5.0)	Heat Pump (COP = 5.0)	Heat Pump (COP = 5.0)	Heat Pump (COP = 5.0)	Heat Pump (COP = 5.0)	Heat Pump (COP = 5.0)
Refrigerator	Energy Star	AHAM (2014)	AHAM (2014)	AHAM (2014)	AHAM (2014)	AHAM (2014)	AHAM (2014)

Energy-Efficiency Potential

The approach we used for this study adheres to the approaches and conventions outlined in the National Action Plan for Energy-Efficiency (NAPEE) Guide for Conducting Potential Studies (November 2007).[5] The NAPEE Guide represents the most credible and comprehensive industry practice for specifying energy-efficiency potential. As described in Chapter 1, four types of potentials were developed as part of this effort: Technical potential, Economic potential, Achievable High potential and Achievable Low potential.

The calculation of Technical and Economic potential is a straightforward algorithm. To develop estimates for **Achievable potential**, we develop market adoption rates for each measure that specify the percentage of customers that will select the highest–efficiency economic option. The Achievable High adoption rates are based on the ramp rates from the Northwest Power & Conservation Council's Sixth Plan as a starting point. The NWPCC has been running programs in the Pacific Northwest for many years, and the portfolio of programs reflects a similar profile of market maturity. The ramp rates are then adjusted downward by 10% to account for a generally younger program history and then adjusted specifically as needed based on information from program evaluations. The Achievable Low adoption rates start with the Achievable High rates and decrement them by 40% to 60% based on where measures lie in the time horizon of the study or whether they are already familiar inclusions in existing programs. Finally, reasonableness checks are applied by comparing the adoption rates to those from other relevant potential studies and market research.

The overall energy efficiency potential results are available in Chapter 6, and the results by sector are given in Chapter 7.

Program Action Plan

We then developed energy efficiency action plans where we map the cost effective measures into a specific set of programs. We describe the programs in terms of costs, savings, strategy, and delivery mechanism. Incentive strategies are set and quantified in terms of the appropriate portion of incremental measure costs. In turn, the various program costs (implementation, marketing & education, evaluation, and administration) are added to the incentive budget using best practice research, industry benchmarks, and market trends.

We first created a separate Vectren portfolio action plan that corresponded with both of the measure-level potential estimates: Achievable Low and Achievable High. Then, considering the Indiana state goals, industry benchmarks, and feedback from Vectren and stakeholders, we made a set of recommendations between those two guideposts to ultimately arrive at the recommended portfolio of programs. The resulting action plan is described in detail in Chapter 8, with supporting documentation and a deep-dive into each program in the Volume 4 appendix.

[5] National Action Plan for Energy Efficiency (2007). *National Action Plan for Energy Efficiency Vision for 2025: Developing a Framework for Change*. www.epa.gov/eeactionplan.

Conclusions and Recommendations

In this final step, we review the action plan and potential estimates from a high level to develop a set of overarching conclusions and recommendations to guide program efforts toward optimal attainment of the energy efficiency savings. This is presented in Chapter 9.

Data Development

This section details the data sources used in this study, followed by a discussion of how these sources were applied. In general, data were adapted to local conditions, for example, by using local sources for measure data and local weather for building simulations.

Data Sources

The data sources are organized into the following categories:

- Vectren and Indiana-specific data
- EnerNOC's databases and analysis tools
- Other secondary data and reports

Indiana Data

Our highest priority data sources for this study were those that were specific to Vectren.

- **Vectren customer data:** Vectren provided number of customers and total electric usage by sector from the customer billing database. Vectren also had a recent residential and commercial saturation survey that was leveraged heavily. Finally, primary onsite research was conducted with 30 of Vectren's largest C&I customers to obtain energy usage characteristics in this segment that had not been covered as well by prior market research efforts.
- **Vectren program implementation and evaluation data**: Program reports that outline the details of energy efficiency programs, program goals and achievements to date.
- **Residential Energy Consumption Survey (RECS).** In the most recent RECS survey conducted by the U.S. DOE, Indiana data was combined with Ohio data in a sample indicative of the two Midwest states. We used these data extensively to develop residential market profiles as described below. http://www.eia.gov/consumption/residential/data/2009/
- **Commercial Buildings Energy Consumption Survey (CBECS).** We used state and regional data extensively to develop commercial market profiles.
- **Manufacturing Energy Consumption Survey (MECS).** We used state and regional data extensively to develop industrial market profiles.
- **American Community Survey:** The US Census American Community Survey is an ongoing survey that provides data every year on household characteristics. Data for Vectren were available for this study. http://www.census.gov/acs/www/
- **Indiana Weather Data:** Weather from NOAA's National Climatic Data Center for Indiana was used as the basis for building simulations.

EnerNOC Databases, Analysis Tools, and Reports

EnerNOC maintains several databases and modeling tools that we use for forecasting and potential studies.

- **EnerNOC Energy Market Profiles**: For more than 10 years, EnerNOC staff have maintained profiles of end-use consumption for the residential, commercial, and industrial sectors. These profiles include market size, fuel shares, unit consumption estimates, and annual energy use by fuel (electricity and natural gas), customer segment and end use for 10 regions in the U.S. The Energy Information Administration surveys (RECS, CBECS and MECS)

as well as state-level statistics and local customer research provide the foundation for these regional profiles.

- **Building Energy Simulation Tool (BEST)**. EnerNOC's BEST is a derivative of the DOE 2.2 building simulation model, used to estimate base-year UECs and EUIs, as well as measure savings for the HVAC-related measures.
- **EnerNOC's EnergyShape™:** This database of load shapes includes the following: Residential – electric load shapes for 10 regions, 3 housing types, 13 end uses; Commercial – electric load shapes for 9 regions, 54 building types, 10 end uses; Industrial – electric load shapes, whole facility only, 19 2-digit SIC codes, as well as various 3-digit and 4-digit SIC codes
- **EnerNOC's Database of Energy Efficiency Measures (DEEM):** EnerNOC maintains an extensive database of measure data for our studies. Our database draws upon reliable sources including the California Database for Energy Efficient Resources (DEER), the EIA Technology Forecast Updates – Residential and Commercial Building Technologies – Reference Case, RS Means cost data, and Grainger Catalog Cost data.
- **Recent studies**. EnerNOC has conducted numerous studies of EE potential in the last five years. We checked our input assumptions and analysis results against the results from these other studies, which include Indianapolis Power & Light, Tennessee Valley Authority, Ameren Illinois, Ameren Missouri, Los Angeles Department of Water and Power, Consolidated Edison of New York, Avista Utilities, the State of New Mexico, and Seattle City Light. In addition, we used the information about impacts of building codes and appliance standards from a recent report for the Institute for Energy Efficiency.[6]

Other Secondary Data and Reports

Finally, a variety of secondary data sources and reports were used for this study. The main sources are identified below.

- **Indiana and regional data from past EnerNOC projects:** EnerNOC referenced data from our project with MISO, as well as regional data from similar studies for Indianapolis Power & Light, Ameren Illinois, and Ameren Missouri.
- **California Statewide Surveys**. The Residential Appliance Saturation Survey (RASS) and the Commercial End Use Survey (CEUS) are comprehensive market research studies conducted by the California Energy Commission. These databases provide a wealth of information on appliance use in homes and businesses. RASS is based on information from almost 25,000 homes and CEUS is based on information from a stratified random sample of almost 3,000 businesses in California.
- **Annual Energy Outlook**. The Annual Energy Outlook (AEO), conducted each year by the U.S. Energy Information Administration (EIA), presents yearly projections and analysis of energy topics. For this study, we used data from the 2011 AEO.
- **Electric Power Research Institute – Assessment of Achievable Potential from Energy Efficiency and Demand Response Programs in the U.S.**, also known as the EPRI National Potential Study (2009). In 2009, EPRI hired EnerNOC to conduct an assessment of the national potential for energy efficiency, with estimates derived for the four DOE regions.
- **EPRI End-Use Models (REEPS and COMMEND)**. These models provide the elasticities we apply to electricity prices, household income, home size and heating and cooling.

[6] "Assessment of Electricity Savings in the U.S. Achievable through New Appliance/Equipment Efficiency Standards and Building Efficiency Codes (2010 – 2025)." Global Energy Partners, LLC for the Institute for Electric Efficiency, May 2011. http://www.edisonfoundation.net/iee/reports/IEE_CodesandStandardsAssessment_2010-2025_UPDATE.pdf

- **Database for Energy Efficient Resources (DEER).** The California Energy Commission and California Public Utilities Commission (CPUC) sponsor this database, which is designed to provide well-documented estimates of energy and peak demand savings values, measure costs, and effective useful life (EUL) for the state of California. We used the DEER database to cross check the measure savings we developed using BEST and DEEM.
- **Northwest Power and Conservation Council Sixth Plan workbooks.** To develop its Power Plan, the Council maintains workbooks with detailed information about measures.
- **Other relevant regional sources:** These include reports from the Consortium for Energy Efficiency, the EPA, and the American Council for an Energy-Efficient Economy.

Data Application

We now discuss how the data sources described above were used for each step of the study.

Data Application for Market Characterization

To construct the high-level market characterization of electricity use and households/floor space for the residential, commercial, and industrial sectors, we applied the following data sources:

- Vectren internal data, RECS 2009 and the American Community Survey to allocate residential customers by housing type
- Vectren internal data, EIA, AEO 2011 and our Energy Market Profiles Database to allocate sales and square footage by building type for the commercial sector
- Vectren internal data, EIA data on energy use by industry type, Bureau of Labor Statistics and AEO 2011 data to allocate sales and employment for the industrial sector

Data Application for Market Profiles

The specific data elements for the market profiles, together with the key data sources, are shown in Table 2-8. To develop the market profiles for each segment, we used the following approach:

1. Developed control totals for each segment. These include market size, segment-level annual electricity use, and annual intensity.
2. Used Vectren saturation surveys, RECS 2009, and the American Housing Survey to incorporate information on existing appliance saturations, appliance and equipment characteristics, and building characteristics.
3. Incorporated secondary data sources to supplement and corroborate the data from items 1 and 2 above.
4. Compared and cross-checked with regional data obtained as part of the EPRI National Potential Study and with the Energy Market Profiles Database.
5. Ensured calibration to control totals for annual electricity sales in each sector and segment.
6. Worked with Vectren staff to vet the data against their knowledge and experience.

Table 2-8 Data Applied for the Market Profiles

Model Inputs	Description	Key Sources
Market size	Base-year residential dwellings commercial floor space, and industrial employment	Vectren customer data American Community Survey Energy Market Profiles AEO
Annual intensity	Residential: Annual energy use (kWh/household) Commercial: Annual energy use (kWh/sq ft) Industrial: Annual energy use (kWh/employee)	Energy Market Profiles AEO Previous studies
Appliance/equipment saturations	Fraction of dwellings with an appliance/technology Percentage of C&I floor space/employment with equipment/technology	Vectren survey data RECS 2009 Energy Market Profiles
UEC/EUI for each end-use technology	UEC: Annual electricity use for a technology in dwellings that have the technology EUI: Annual electricity use per square foot/employee for a technology in floor space that has the technology	HVAC uses: BEST simulations using prototypes developed for Indiana Engineering analysis DEEM Previous EnerNOC studies California RASS and CEUS
Appliance/equipment vintage distribution	Age distribution for each technology	RECS 2009 Previous EnerNOC studies
Efficiency options for each technology	List of available efficiency options and annual energy use for each technology	DEEM DEER NWPCC workbooks Annual Energy Outlook Previous studies
Peak factors	Share of technology energy use that occurs during the peak hour	EnergyShape database

Data Application for Baseline Forecast

Table 2-9 summarizes the LoadMAP model inputs required for the baseline forecast. These inputs are required for each segment within each sector, as well as for new construction and existing dwellings/buildings.

Table 2-9 Data Needs for the Baseline Forecast and Potentials Estimation in LoadMAP

Model Inputs	Description	Key Sources
Customer growth forecasts	Forecasts of new construction in residential and C&I sectors	AEO 2011 growth forecast US BLS
Equipment purchase shares for baseline forecast	For each equipment/technology, purchase shares for each efficiency level; specified separately for existing equipment replacement and new construction	Shipments data from AEO AEO 2011 regional forecast assumptions[7] Appliance/efficiency standards analysis Vectren program results and evaluation reports
Electricity prices	Forecast of average energy and capacity avoided costs and retail prices	Vectren projections AEO 2011
Utilization model parameters	Price elasticities, elasticities for other variables (income, weather)	EPRI's REEPS and COMMEND models AEO 2011 NOAA data for normal cooling & heating degree days for Indiana.

In addition, we implemented assumptions for known future equipment standards as of January, 2012, as shown in the tables below.

[7] We developed baseline purchase decisions using the Energy Information Agency's *Annual Energy Outlook* report (2011), which utilizes the National Energy Modeling System (NEMS) to produce a self-consistent supply and demand economic model. We calibrated equipment purchase options to match manufacturer shipment data for recent years and then held values constant for the study period. This removes any effects of naturally occurring conservation or effects of future DSM programs that may be embedded in the AEO forecasts.

Table 2-10 Residential Electric Equipment Standards Applicable to Indiana

Today's Efficiency or Standard Assumption
1st Standard (relative to today's standard)
2nd Standard (relative to today's standard)

End Use	Technology	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Cooling	Central AC	SEER 13														
	Room AC	EER 9.8				EER 11.0										
	Evaporative Central AC	Conventional														
	Evaporative Room AC	Conventional														
Cooling/Heating	Heat Pump	SEER 13.0/HSPF 7.7				SEER 14.0/HSPF 8.0										
Space Heating	Electric Resistance	Electric Resistance														
Water Heating	Water Heater (<=55 gallons)	EF 0.90				EF 0.95										
	Water Heater (>55 gallons)	EF 0.90				Heat Pump Water Heater										
Lighting	Screw-in/Pin Lamps	Incandescent				Advanced Incandescent - tier 1					Advanced Incandescent - tier 2					
	Linear Fluorescent	T8														
Appliances	Refrigerator/2nd Refrigerator	NAECA Standard				25% more efficient										
	Freezer	NAECA Standard				25% more efficient										
	Dishwasher	Conventional (355			14% more efficient (307 kWh/yr)											
	Clothes Washer	Conventional (MEF 1.26 for top loader)				MEF 1.72 for top loader			MEF 2.0 for top loader							
	Clothes Dryer	Conventional (EF 3.01)				5% more efficient (EF 3.17)										
	Range/Oven	Conventional														
	Microwave	Conventional														
Electronics	Personal Computer	Conventional/Energy Star														
	Monitor	Conventional														
	Laptop Computer	Conventional/Energy Star														
	TV	Conventional/Energy Star														
	Copier/Printer/Fax	Conventional														
	DVD/VCR/Audio	Conventional														
	Devices and Gadgets	Conventional														
Miscellaneous	Pool Pump	Conventional														
	Well Pump	Conventional														
	Furnace Fan	Conventional														

Table 2-11 Commercial Electric Equipment Standards Applicable to Indiana

Today's Efficiency or Standard Assumption
1st Standard (relative to today's standard)
2nd Standard (relative to today's standard)

End Use	Technology	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Cooling	Chillers	2007 ASHRAE 90.1														
	Roof Top Units	EER 11.0/11.2														
	Packaged Terminal AC/HP	EER 9.8	EER 11.0													
Cooling/Heating	Heat Pump	EER 11.0/COP 3.3														
Space Heating	Electric Resistance	Electric Resistance														
	Electric Furnace	Electric Furnace														
Ventilation	Ventilation	Constant Air Volume/Variable Air Volume														
Lighting	Screw-in/Pin Lamps	Incandescent			Advanced Incandescent - tier 1						Advanced Incandescent - tier 2					
	Linear Fluorescent	T12	T8													
	High Intensity Discharge	Metal Halide														
Water Heating	Water Heater	EF 0.97														
Refrigeration	Walk-in Refrigerator/Freezer	EISA 2007 Standard														
	Reach-in Refrigerator	EPACT 2005 Standard														
	Glass Door Display	EPACT 2005 Standard	42% more efficient													
	Open Display Case	EPACT 2005 Standard	18% more efficient													
	Vending Machines	EPACT 2005 Standard	33% more efficient													
	Icemaker	2010 Standard														
Office Equipment	Desktop Computer	Conventional/Energy Star														
	Laptop Computer	Conventional/Energy Star														
Miscellaneous	Non-HVAC Motors	62.3% Efficiency				70% Efficiency										
	Commercial Laundry	MEF 1.26		MEF 1.6												

Energy Efficiency Measure Data Application

Table 2-12 details the data sources used for measure characterization.

Table 2-12 Data Needs for the Measure Characteristics in LoadMAP

Model Inputs	Description	Key Sources
Energy Impacts	The annual reduction in consumption attributable to each specific measure. Savings were developed as a percentage of the energy end use that the measure affects.	Vectren program results and evaluation reports BEST DEEM DEER NWPCC workbooks Other secondary sources
Peak Demand Impacts	Savings during the peak demand periods are specified for each electric measure. These impacts relate to the energy savings and depend on the extent to which each measure is coincident with the system peak.	Vectren program results and evaluation reports BEST EnergyShape
Costs	Equipment Measures: Includes the full cost of purchasing and installing the equipment on a per-household, per-square-foot, or per employee basis for the residential, commercial, and industrial sectors, respectively. Non-equipment measures: Existing buildings – full installed cost. New Construction - the costs may be either the full cost of the measure, or as appropriate, it may be the incremental cost of upgrading from a standard level to a higher efficiency level.	Vectren program results and evaluation reports DEEM DEER NWPCC workbooks RS Means Other secondary sources
Measure Lifetimes	Estimates derived from the technical data and secondary data sources that support the measure demand and energy savings analysis.	Vectren program results and evaluation reports DEEM DEER NWPCC workbooks Other secondary sources
Applicability	Estimate of the percentage of either dwellings in the residential sector or square feet/employment in the C&I sectors where the measure is applicable and where it is technically feasible to implement.	DEEM DEER NWPCC workbooks Other secondary sources
On Market and Off Market Availability	Expressed as years for equipment measures to reflect when the equipment technology is available or no longer available in the market.	EnerNOC appliance standards and building codes analysis

Data Application for Cost-effectiveness Screening

To perform the cost-effectiveness screening, a number of economic assumptions were needed. All cost and benefit values were analyzed as real 2011 dollars. A discount rate of 7.29% in nominal terms was used, as provided by Vectren. This is equivalent to a 4.25% discount rate in real terms when adjusting for 2.92% inflation.[8] Avoided costs were provided by Vectren. Also, energy savings at the meter reduce system needs by that amount plus the avoided line losses, so benefits are increased by a factor equivalent to Vectren's average electric delivery losses, or 5.0%.

[8] Inflation adjuster of 2.92% based on the average annual growth forecast in US Consumer Price Index from the 2012 Annual Energy Outlook for 2010-2035.

Achievable Potential Estimation

To estimate achievable potentials, three sets of parameters were required to account for the decision making behavior of humans in the efficiency marketplace.

- **Adoption curves for non-equipment measures**. Equipment measures are installed when existing units fail. Non-equipment measures do not have this natural periodicity, so rather than installing all available non-equipment measures in the first year of the forecast (instantaneous potential), they are phased in according to adoption schedules that vary based on cost and complexity. The adoption rates used in this analysis take several factors into account to determine how quickly the market can absorb these measures. Typically, measures that cause disruption to the building, such as wall insulation in existing buildings, receive longer adoption curves, while those with drop-in installations, such as programmable thermostats in new buildings, receive shorter ones. High capital cost measures will also receive longer adoption curves than ones with low capital cost. These adoption rates are used within LoadMAP to generate the Technical and Economic potentials. In general, the rates align with the diffusion of similar equipment measures.
- **Achievable High adoption rates**. These factors are applied to Economic potential to estimate the upper bound: Achievable High. These estimate customer adoption of economic measures when delivered through efficiency programs under ideal market, implementation, and customer preference conditions. Information channels are assumed to be established and efficient for marketing, educating consumers, and coordinating with trade allies and delivery partners. The Achievable High adoption rates are based on the ramp rates from the Northwest Power & Conservation Council's Sixth Plan as a starting point. The NWPCC has been running programs in the Pacific Northwest for many years, so the portfolio of programs reflects a more mature profile of market maturity. Because of this, the ramp rates are adjusted downward by 10%, and then further adjusted with actual Vectren program history and information from program evaluations. Achievable High potential establishes a maximum target for the EE savings that an administrator can hope to achieve through its EE programs and involves incentives that represent a substantial portion of the incremental cost combined with high administrative and marketing costs.
- **Achievable Low adoption rates**. These factors are applied to Achievable High potential to calculate Achievable Low potential, decrementing them by a range of 40% to 75% based on where measures lie in the time horizon of the study or whether they are already familiar inclusions in existing programs. These rates reflect expected program participation given significant barriers to customer acceptance, non-ideal implementation conditions, and limited program budgets. This represents a lower bound on achievable potential.

Achievable Low and Achievable High adoption rates are presented in Volume 3, Appendix E.

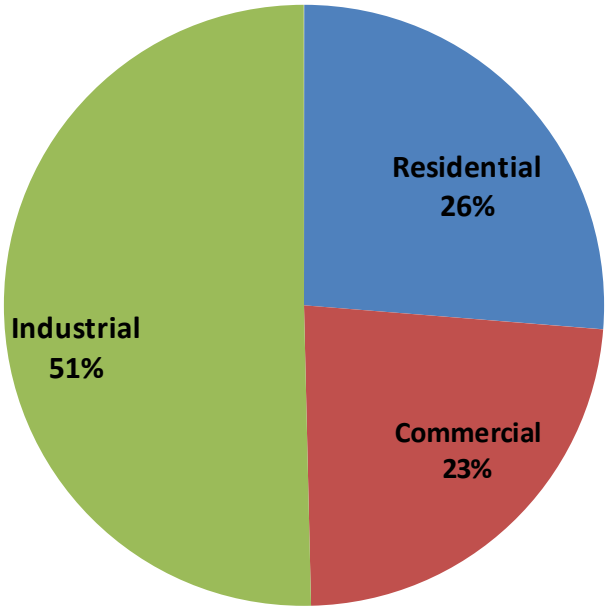
MARKET CHARACTERIZATION AND MARKET PROFILES

In this section, we describe how customers in the Vectren service territory use electricity in the base year of the study, 2011. It begins with a high-level summary of energy use by sector and then delves into each sector in detail.

Energy Use Summary

Total electricity use for the residential, commercial, and industrial sectors for Vectren in 2011 was 5,646 GWh. As shown in Figure 4-1, the largest sector is industrial, accounting for 51% of load at 2,845 GWh. The remaining use is in the residential and commercial sectors, at 1,483 GWh and 1,318 respectively.

Figure 4-1 Sector-Level Electricity Use, 2011



Residential Sector

The total number of households and electric sales for the service territory were obtained from Vectren's customer database. In 2011, there were 122,961 households in the Vectren territory that used a total of 1,483 GWh of electricity. We allocated these totals into the two residential segments based on the Vectren South 2010 baseline survey results. The values are shown in Table 4-1 below, and referred to throughout the study as the *control totals* to which all energy usage is calibrated in the base year of the study.

Table 4-1 Residential Sector Energy Usage and Intensity by Segment Type, 2011

Segment	No. of Households	Intensity (kWh/HH)	2011 Electricity Use (GWh)
Single Family	103,287	12,792	1,321
Multi Family	19,674	8,246	162
Total	**122,961**	**12,065**	**1,483**

Composite Electric Profile

As we describe in the previous chapter, the market profiles provide the foundation upon which we develop the baseline forecast. The average market profile for the residential sector is presented in Table 4-2. Segment specific market profiles are presented in Volume 3, Appendix A.

Table 4-2 Average Electric Market Profile for the Residential Sector, 2011

Residential : Total
Total Households: 122,961
GWh: 1,483

Average Market Profiles - Electricity

End Use	Technology	Saturation	UEC (kWh)	Intensity (kWh/HH)	Usage (GWh)
Cooling	Central AC	80.2%	2,764	2,218	272.7
Cooling	Room AC	9.0%	1,049	95	11.6
Cooling	Air-Source Heat Pump	10.0%	2,179	219	26.9
Cooling	Geothermal Heat Pump	0.1%	1,921	2	0.2
Cooling	Evaporative AC	0.0%	0	0	0.0
Space Heating	Electric Resistance	8.6%	6,528	558	68.6
Space Heating	Electric Furnace	15.4%	7,109	1,094	134.5
Space Heating	Air-Source Heat Pump	10.0%	5,673	569	70.0
Space Heating	Geothermal Heat Pump	0.1%	3,311	3	0.4
Water Heating	Water Heater <= 55 gal	37.8%	2,883	1,090	134.0
Water Heating	Water Heater > 55 gal	4.2%	3,073	129	15.9
Interior Lighting	Screw-in	100.0%	1,010	1,010	124.2
Interior Lighting	Linear Fluorescent	100.0%	120	120	14.8
Interior Lighting	Specialty	100.0%	445	445	54.7
Exterior Lighting	Screw-in	100.0%	237	237	29.1
Appliances	Clothes Washer	89.0%	69	61	7.5
Appliances	Clothes Dryer	84.0%	532	447	55.0
Appliances	Dishwasher	68.0%	291	198	24.4
Appliances	Refrigerator	100.0%	756	756	93.0
Appliances	Freezer	34.4%	602	207	25.5
Appliances	Second Refrigerator	27.4%	787	216	26.5
Appliances	Stove	71.0%	470	334	41.0
Appliances	Microwave	95.0%	112	107	13.1
Electronics	Personal Computers	69.0%	262	181	22.3
Electronics	Monitor	69.0%	52	36	4.4
Electronics	Laptops	57.0%	113	64	7.9
Electronics	TVs	268.8%	213	573	70.5
Electronics	Printer/Fax/Copier	92.0%	40	37	4.5
Electronics	Set-top Boxes/DVR	268.8%	135	364	44.8
Electronics	Devices and Gadgets	100.0%	55	55	6.8
Miscellaneous	Pool Pump	9.0%	1,500	135	16.6
Miscellaneous	Pool Heater	1.0%	4,981	50	6.1
Miscellaneous	Hot Tub / Spa	4.3%	950	41	5.0
Miscellaneous	Well Pump	5.0%	561	28	3.4
Miscellaneous	Furnace Fan	73.5%	486	357	43.9
Miscellaneous	Miscellaneous	100.0%	28	28	3.5
Total				**12,065**	**1,483.5**

Figure 4-2 shows the distribution of electric energy consumption by end use for all homes. Three main electricity end uses —appliances, space heating and cooling — account for over 50% of total use. The most energy allocated to any single category is 21% for cooling, which includes central AC, heat pumps, and room AC. Other categories with substantial energy use are space heating and appliances. Appliances include refrigerators, freezers, stoves, clothes washers, clothes dryers, dishwashers, and microwaves. The remainder of the energy falls into the electronics, lighting, water heating and the miscellaneous category – which is comprised of furnace fans, pool pumps, and other "plug" loads (hair dryers, power tools, coffee makers, etc).

Figure 4-2 Residential Electricity by End Use (2011), All Homes

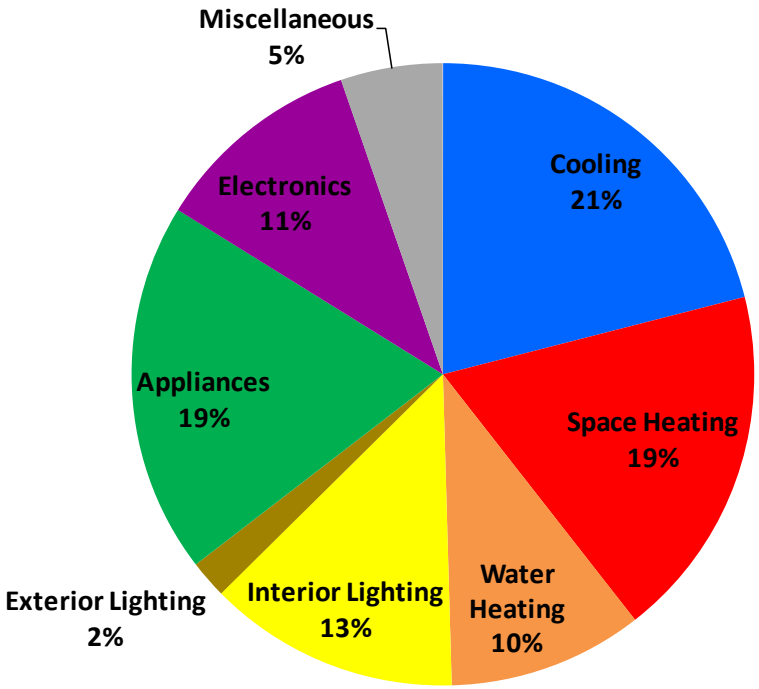


Figure 4-3 and Table 4-3 present the electricity intensities by end-use and housing type, as well as all homes on average. Figure 4-4 shows the same data as a percentage of total energy use.

Figure 4-3 Residential Electricity Intensity by End Use and Segment (kWh/household, 2011)

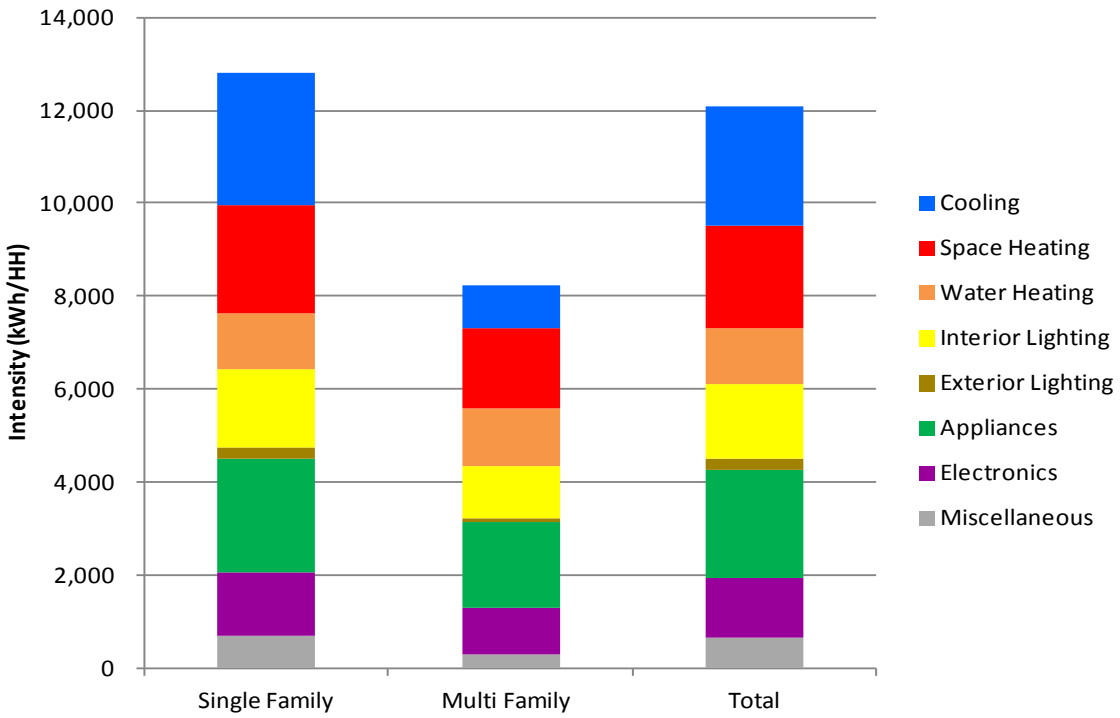
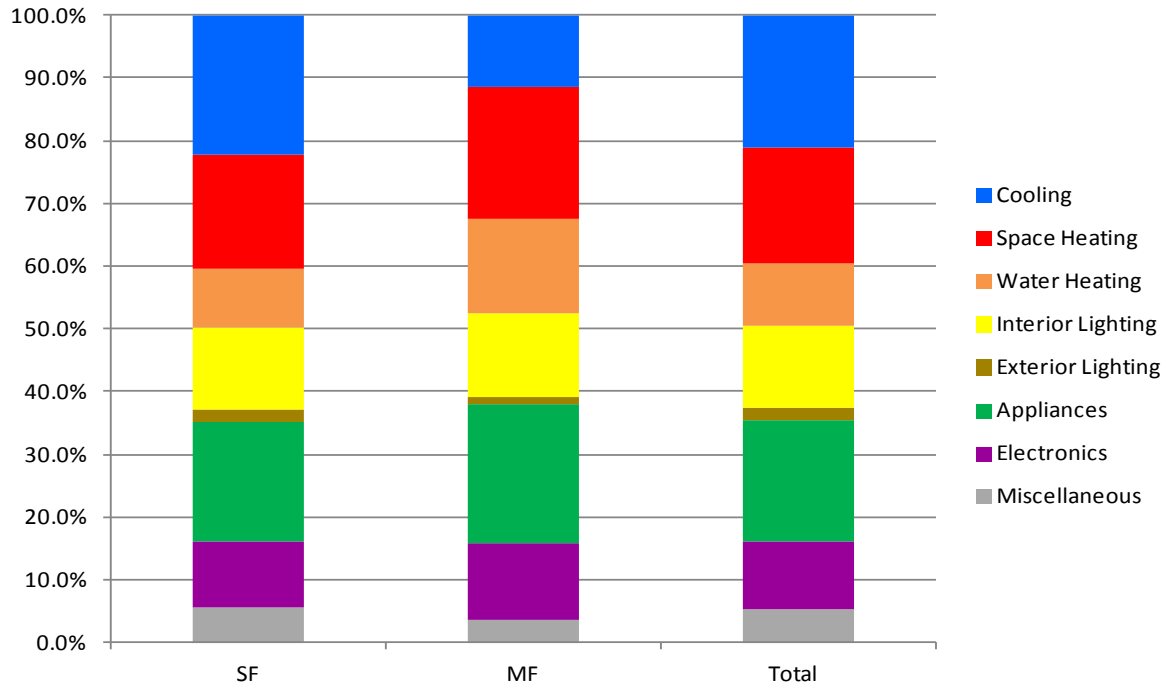


Table 4-3 Residential Electricity Use by End Use and Segment (kWh/HH/year, 2011)

End Use	Single Family	Multi Family	Total
Cooling	2,838	934	2,533
Space Heating	2,318	1,733	2,225
Water Heating	1,214	1,244	1,219
Interior Lighting	1,666	1,099	1,575
Exterior Lighting	260	113	238
Appliances	2,423	1,817	2,326
Electronics	1,369	1,006	1,311
Misc.	704	299	639
Total	**13,070**	**7,552**	**12,065**

Figure 4-4 Percentage of Residential Electricity Use by End Use and Segment (2011)



Commercial Sector

To develop a Baseline Forecast for Vectren's commercial sector, the first step was to determine the characteristics of energy use in the study's base year, 2011, for eleven building-type segments agreed upon for the study: Small Office, Large Office, Restaurant, Retail, Grocery, College, School, Health, Lodging, Warehouse, and Miscellaneous.

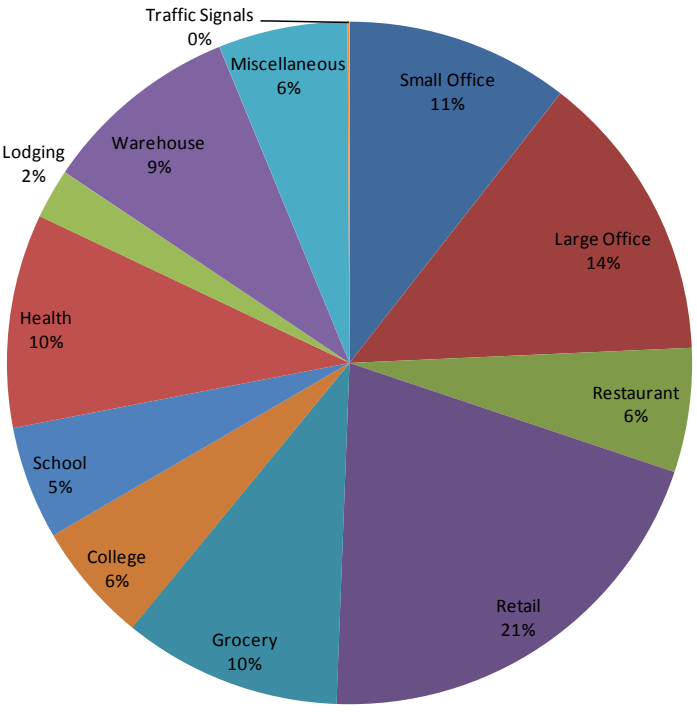
The total electric energy consumed by commercial customers in Vectren's service area in 2011 was 1,318 GWh. We used our internal database of Energy Market Profiles for both Central Industrial and Upper Southeast regions and consumption data from Vectren's customer database to allocate energy usage to building types and to develop estimates of energy intensity (annual kWh/square foot). Using the electricity use and intensity estimates, we infer floor space which is the unit of analysis in LoadMAP for the commercial sector. The values are shown in Table 4-4 below, and referred to throughout the study as the *control totals* to which all energy usage is calibrated in the base year of the study.

Table 4-4 Commercial Electricity Use by End Use and Segment (kWh/SqFt/year, 2011)

Segment	Electricity Use (GWh)	Intensity (kWh/SqFt)	Floor Space (million SqFt)
Small Office	139	16.66	8
Large Office	181	19.22	9
Restaurant	78	40.88	2
Retail	269	15.15	18
Grocery	136	50.80	3
College	75	13.04	6
School	71	8.56	8
Health	133	25.74	5
Lodging	31	14.95	2
Warehouse	124	6.85	18
Miscellaneous	81	8.16	10
Traffic Signals	1	n/a	n/a
Total	**1,318**	**14.75**	**89**

Figure 4-5 shows the size of each of the building-types as a percentage of commercial sector energy sales.

Figure 4-5 Commercial Market Segmentation by Building Type – Percentage of Electricity Use



Composite Electric Profile

Table 4-5 shows the average market profile for electricity of the commercial sector as a whole, representing a composite of all the building types. Market profiles for each building type are presented in Volume 3, Appendix A.

Table 4-5 Average Electric Market Profile for the Commercial Sector, 2011

Average Market Profiles - Electricity

End Use	Technology	Saturation	EUI (kWh)	Intensity (kWh/Sqft)	Usage (GWh)
Cooling	Air-Cooled Chiller	4.5%	3.95	0.18	16
Cooling	Water-Cooled Chiller	10.5%	3.61	0.38	34
Cooling	Roof top AC	45.7%	4.23	1.93	173
Cooling	Air-Source Heat Pump	2.9%	4.10	0.12	11
Cooling	Geothermal Heat Pump	0.7%	2.73	0.02	2
Cooling	Other Cooling	5.4%	2.74	0.15	13
Heating	Air-Source Heat Pump	2.9%	4.60	0.13	12
Heating	Geothermal Heat Pump	0.7%	3.07	0.02	2
Heating	Electric Room Heat	1.7%	6.17	0.10	9
Heating	Electric Furnace	19.3%	5.38	1.04	93
Ventilation	Ventilation	100.0%	1.25	1.25	112
Water Heating	Water Heating	40.2%	1.04	0.42	37
Interior Lighting	Screw-in	100.0%	1.83	1.83	163
Interior Lighting	High-Bay Fixtures	100.0%	0.40	0.40	36
Interior Lighting	Linear Fluorescent	100.0%	2.33	2.33	208
Exterior Lighting	Screw-in	100.0%	0.20	0.20	18
Exterior Lighting	HID	100.0%	0.55	0.55	49
Exterior Lighting	Linear Fluorescent	100.0%	0.04	0.04	4
Refrigeration	Walk-in Refrigerator	51.6%	0.84	0.43	38
Refrigeration	Reach-in Refrigerator	51.6%	0.08	0.04	4
Refrigeration	Glass Door Display	51.6%	0.97	0.50	45
Refrigeration	Open Display Case	51.6%	0.44	0.23	20
Refrigeration	Icemaker	51.6%	0.17	0.09	8
Refrigeration	Vending Machine	51.6%	0.17	0.09	8
Food Preparation	Oven	21.4%	0.40	0.09	8
Food Preparation	Fryer	21.4%	0.58	0.12	11
Food Preparation	Dishwasher	21.4%	0.66	0.14	13
Food Preparation	Hot Food Container	21.4%	0.19	0.04	4
Office Equipment	Desktop Computer	100.0%	0.48	0.48	43
Office Equipment	Laptop	100.0%	0.07	0.07	7
Office Equipment	Server	100.0%	0.22	0.22	20
Office Equipment	Monitor	100.0%	0.09	0.09	8
Office Equipment	Printer/Copier/Fax	100.0%	0.07	0.07	6
Office Equipment	POS Terminal	46.9%	0.04	0.02	2
Misc	Non-HVAC Motors	53.0%	0.40	0.21	19
Misc	Pool Pump	1.6%	0.01	0.00	0
Misc	Pool Heater	0.4%	0.02	0.00	0
Misc	Misc	100.0%	0.72	0.72	65
Total				**14.75**	**1,318**

Commercial Electricity Consumption

Figure 4-6 shows the distribution of electricity consumption by end use for all commercial building types. Electric usage is dominated by lighting, with interior and exterior varieties accounting for over one third of consumption. After lighting, the largest end uses are cooling, heating, ventilation, and refrigeration. The remaining end uses comprise 6% or less of total usage: office equipment, miscellaneous, water heating, and food preparation.

Figure 4-6 Commercial Electricity Consumption by End Use (2011), All Building Types

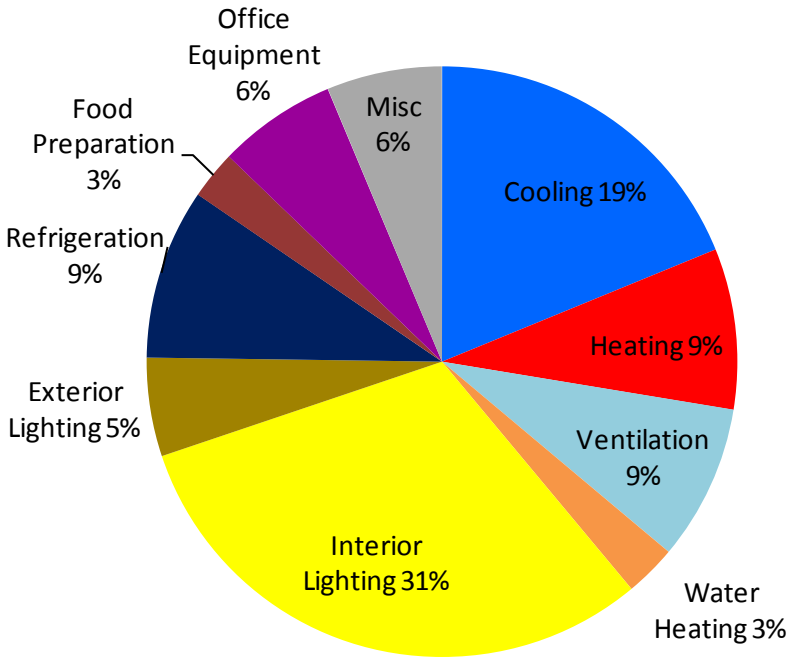


Figure 4-7 shows the electricity intensity by end use and building type in terms of kWh per square foot of building floor space. Figure 4-8 and Table 4-6 present the electricity usage in GWh by end use and building type. Figure 4-9 shows the same data as a percentage of total energy use for each segment.

Figure 4-7 Commercial Electricity Intensity by End Use and Segment (kWh/SqFt, 2011)

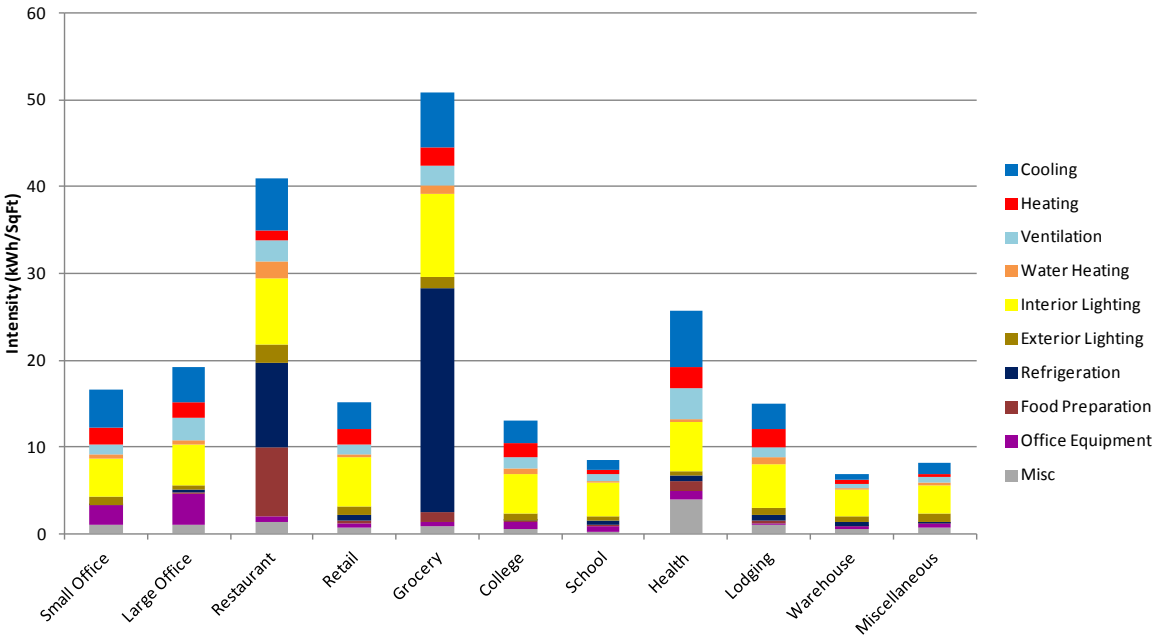


Figure 4-8 Commercial Electricity Usage by End Use Segment (GWh, 2011)

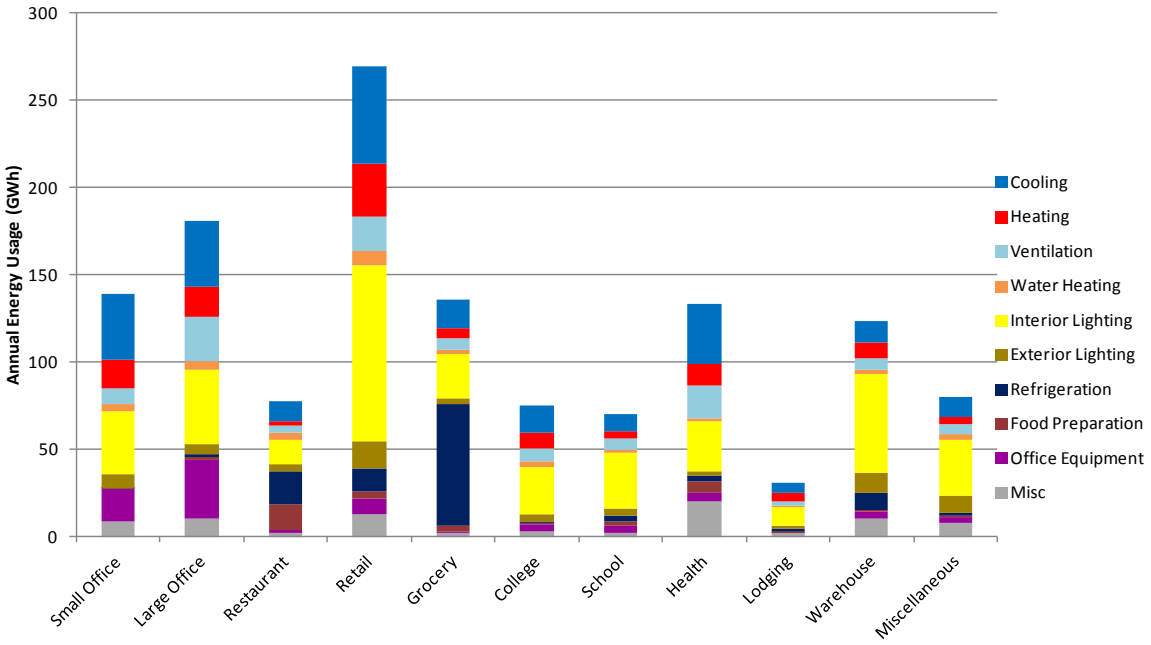
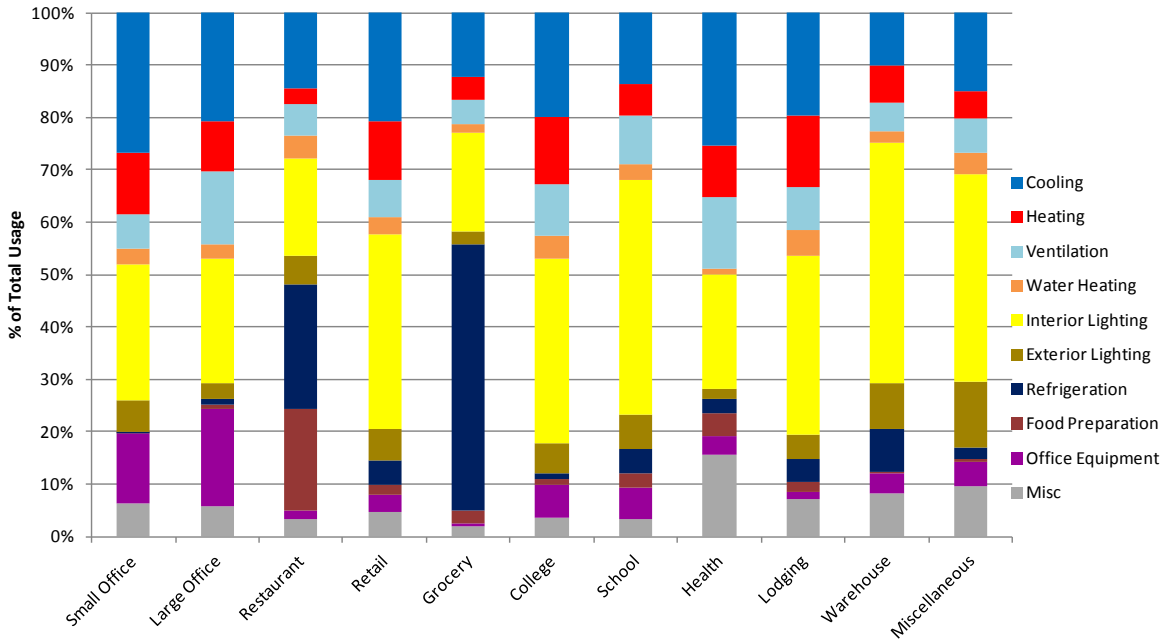


Table 4-6 Commercial Electricity Consumption by End Use (GWh, 2011)

Enduse	Small Office	Large Office	Restaurant	Retail	Grocery	College	School	Health	Lodging	Warehouse	Misc	Total
Cooling	37	38	11	56	17	15	10	34	6	12	12	248
Heating	16	17	2	30	6	10	4	13	4	9	4	116
Ventilation	9	25	5	20	6	7	7	18	3	7	5	112
Water Heating	4	5	3	8	2	3	2	1	1	3	3	37
Interior Lighting	36	43	14	101	26	26	32	29	11	57	32	407
Exterior Lighting	8	5	4	16	3	4	5	3	1	11	10	71
Refrigeration	0	2	18	12	69	1	3	3	1	10	2	123
Food Preparation	0	1	15	5	3	1	2	6	1	0	1	35
Office Equipment	18	34	1	9	1	5	4	5	0	5	4	85
Misc	9	10	3	13	2	3	2	21	2	10	9[9]	84
Total	**139**	**181**	**78**	**269**	**136**	**75**	**71**	**133**	**31**	**124**	**82**	**1,318**

Figure 4-9 Commercial Electricity Use by End Use and Segment (2011)



[9] 1 GWh of consumption for traffic signals has been rolled up into the Miscellaneous end use of the Miscellaneous segment in this table.

Industrial Sector

To develop a Baseline Forecast for Vectren's industrial sector, the first step was to determine the characteristics of energy use in the study's base year, 2011. We agreed upon a segmentation strategy for the study that would highlight the top few industries in Vectren by energy consumption. After reviewing the billing data by NAICS code and conducting market research with Vectren's largest customers, we determined that there were three key segments to highlight: Chemicals, Plastics, and Transportation; with the remaining customers classified as "Other Industrial". These "other" industries typically have energy use characteristics that are similar enough that further granularity does not meaningfully affect the study results.

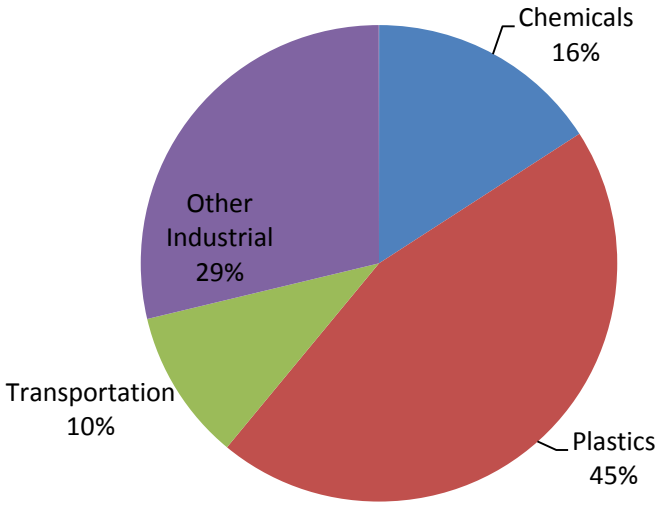
The total electric energy consumed by industrial customers in Vectren in 2011 was 2,845 GWh. To allocate this energy usage to the various industry types, we used data from our internal database of Energy Market Profiles for the Central Industrial region, consumption data from Vectren's customer database, and data from primary market research surveys administered onsite at 30 of Vectren's largest energy using customers. The energy usage is mapped to an estimated number of employees in each industry, based on data from the U.S. Economic Census, to enable benchmarking and expression of data in terms of energy per employee, which is the unit used in our LoadMAP modeling. The resulting allocations are shown in Table 4-7, and referred to throughout the study as the *control totals* to which all energy usage is calibrated in the base year of the study.

Table 4-7 Industrial Market Segmentation by Industry Type, Base Year 2011

Segment	Electricity Use (GWh)	Number of Employees
Chemicals	451	3,230
Plastics	1,284	12,939
Transportation	291	6,633
Other Industrial	818	21,091
Total	**2,845**	**43,894**

Figure 4-10 shows the size of each of the segments as a percentage of industrial sector electricity use.

Figure 4-10 Industrial Market Segmentation – Percentage of Electricity Use



Composite Electric Profile

As with the residential and commercial sectors, the industrial market profiles characterize electricity use in terms of end use and technology for the base year 2011. Table 4-8 shows the composite market profile for the industrial sector.

Table 4-8 Average Electric Market Profile for the Industrial Sector, 2011

	Total
Employees:	43,894
Control Total (GWh):	2,844.5
Intensity (kWh/employee):	64,805

Average Market Profiles

End Use	Technology	Saturation	EUI (kWh)	Intensity (kWh/Employee)	Usage (GWh)
Cooling	Air-Cooled Chiller	2.5%	17,863	447	19.6
Cooling	Water-Cooled Chiller	2.6%	17,133	451	19.8
Cooling	Roof top AC	12.1%	27,476	3,318	145.6
Cooling	Air Source Heat Pump	0.1%	27,770	40	1.7
Cooling	Geothermal Heat Pump	0.0%	18,522	7	0.3
Cooling	Other Cooling	0.7%	18,136	119	5.2
Heating	Air Source Heat Pump	0.1%	69,380	99	4.4
Heating	Geothermal Heat Pump	0.0%	46,276	17	0.7
Heating	Electric Room Heat	0.2%	72,596	168	7.4
Heating	Electric Furnace	1.9%	76,226	1,448	63.6
Ventilation	Ventilation	100.0%	2,785	2,785	122.2
Interior Lighting	Screw-in	100.0%	1,471	1,471	64.6
Interior Lighting	High-Bay Fixtures	100.0%	313	313	13.7
Interior Lighting	Linear Fluorescent	100.0%	4,286	4,286	188.1
Exterior Lighting	Screw-in	100.0%	3	3	0.1
Exterior Lighting	HID	100.0%	1,159	1,159	50.9
Exterior Lighting	Linear Fluorescent	100.0%	0	0	0.0
Motors	Pumps	100.0%	6,687	6,687	293.5
Motors	Fans & Blowers	100.0%	3,241	3,241	142.3
Motors	Compressed Air	100.0%	5,090	5,090	223.4
Motors	Matl Handling	100.0%	2,793	2,793	122.6
Motors	Matl Processing	100.0%	12,798	12,798	561.8
Motors	Other Motors	100.0%	1,020	1,020	44.8
Process	Process Heating	100.0%	8,134	8,134	357.0
Process	Process Cooling and Refrigeration	100.0%	4,852	4,852	213.0
Process	Electro-Chemical Processes	100.0%	635	635	27.9
Process	Other Process	100.0%	732	732	32.1
Misc	Misc	100.0%	2,691	2,691	118.1
	Total			**64,805**	**2,844.5**

Figure 4-11 shows the distribution of electricity energy consumption by end use for all industrial customers. Motors are clearly the largest overall end use for the industrial sector, accounting for 49% of energy use. Note that this end use includes a wide range of industrial equipment, such as air compressors and refrigeration compressors, pumps, conveyor motors, and fans. The process end use accounts for 22% of energy use, which includes heating, cooling, refrigeration, and electro-chemical processes. Lighting is the next highest, followed by cooling, ventilation, miscellaneous, and space heating.

Figure 4-11 Industrial Electricity Use by End Use (2011), All Industries

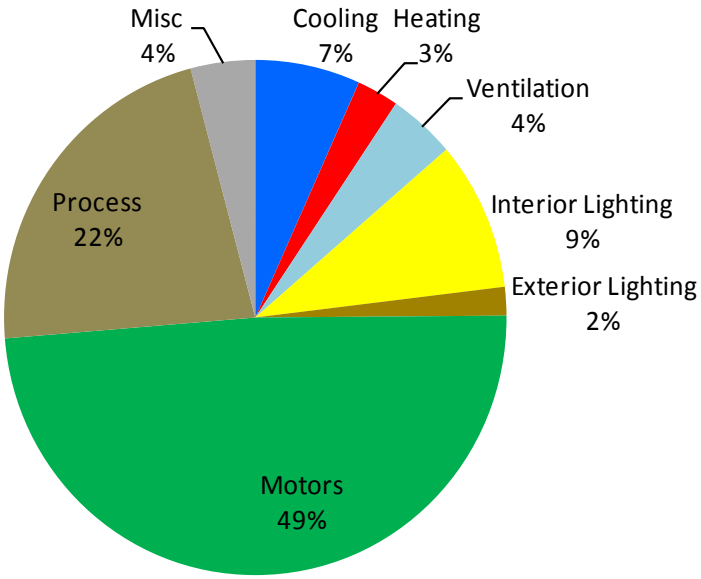


Figure 4-12 presents the electricity consumption by end-use and industry type. Figure 4-13 shows the same data as a percentage of total energy use for each segment.

Figure 4-12 Industrial Electricity Consumption by End Use and Segment (GWh, 2011)

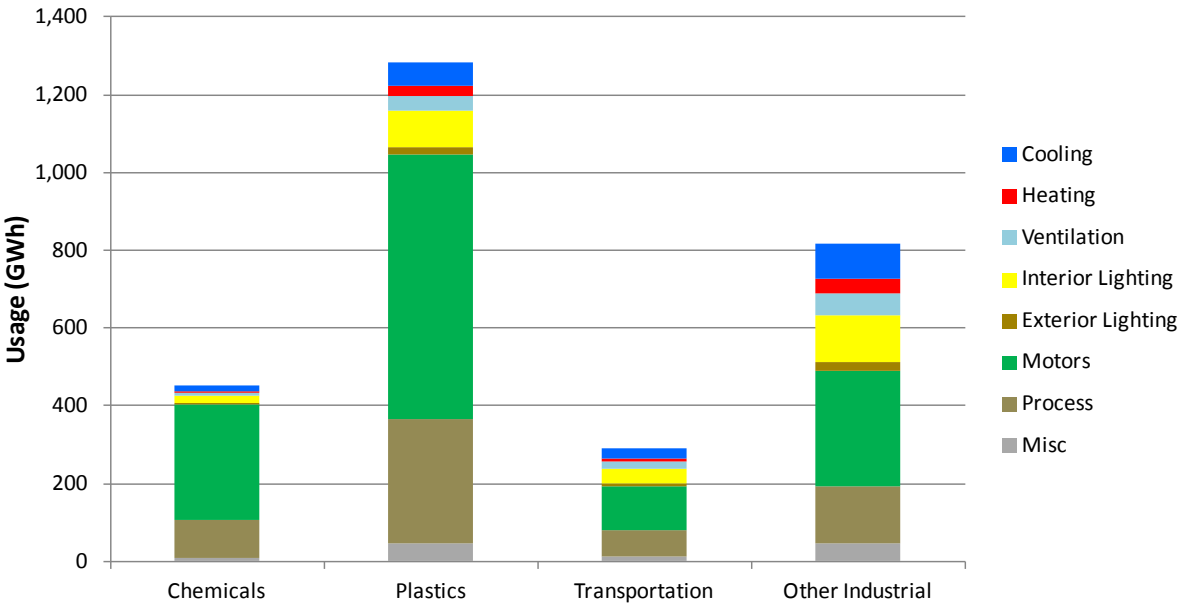
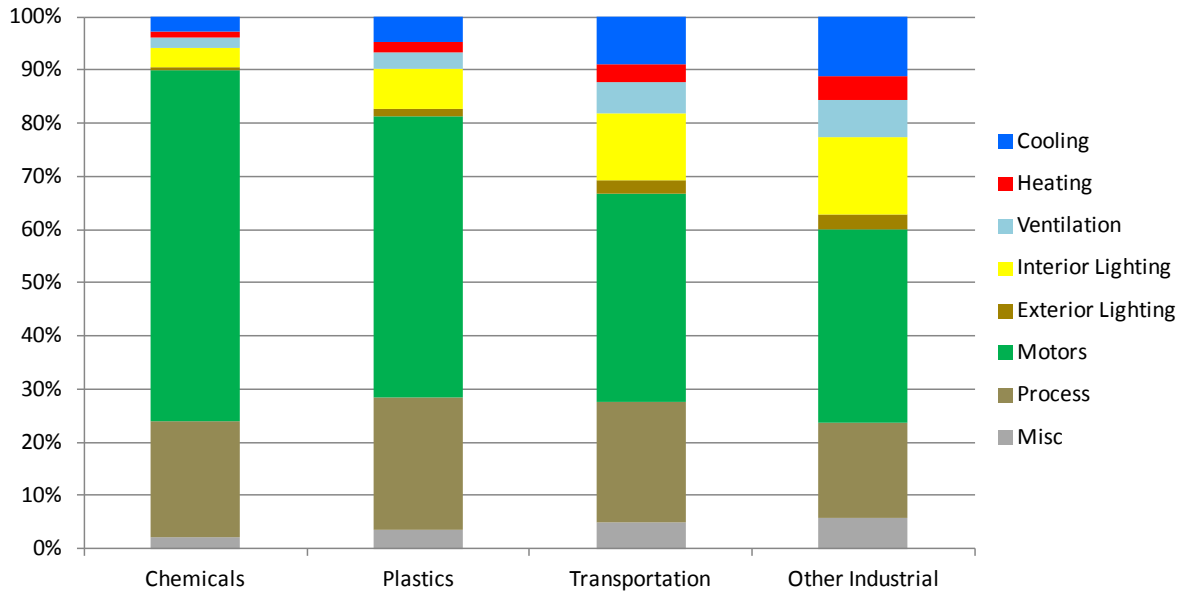


Table 4-9 Industrial Electricity Use by End Use and Segment (GWh, 2011)

End Use	Chemicals	Plastics	Transportation	Other Industrial	Total
Cooling	13.0	62.1	25.9	91.2	192.3
Heating	5.2	24.6	10.2	36.1	76.0
Ventilation	8.3	39.5	16.5	58.0	122.2
Interior Lighting	16.3	94.6	37.0	118.5	266.5
Exterior Lighting	3.1	18.1	7.1	22.7	51.0
Motors	297.2	679.4	114.3	297.4	1,388.3
Process	98.0	318.6	66.0	147.5	630.0
Misc.	10.1	47.1	14.4	46.6	118.1
Total	**451.1**	**1,284.0**	**291.4**	**818.0**	**2,844.5**

Figure 4-13 Percentage of Industrial Electricity Use by End Use and Segment (2011)



BASELINE FORECAST

Prior to developing estimates of energy-efficiency potential, a baseline end-use forecast was developed to quantify what the consumption is likely to be in the future in absence of new efficiency programs and naturally occurring efficiency. The baseline forecast serves as the metric against which energy efficiency potentials are measured. This chapter presents the baseline forecast for electricity for each sector.

Residential Sector

The baseline forecast incorporates assumptions about economic growth, electricity prices, and appliance/equipment standards and building codes that are already mandated as described in Chapter 2.

Table 5-1 and Figure 5-1 present the baseline forecast for electricity at the end-use level for the residential sector as a whole. Overall, residential use increases slightly from 1,483 GWh in 2011 to 1,488 GWh in 2019, an increase of only 0.3%, which is essentially a flat forecast year over year. This reflects the impact of the EISA lighting standard, additional appliance standards adopted in 2011, and modest customer growth. Figure 5-2 presents the forecast of use per household. Most noticeable is that lighting use decreases significantly throughout the time period as the lighting efficiency standards from EISA come into effect.

Table 5-1 Residential Electricity Consumption by End Use (GWh)

End Use	2011	2014	2015	2016	2017	2018	2019	% Change	Avg. Growth Rate
Cooling	311	315	315	316	319	322	325	4%	0.5%
Heating	274	281	282	284	288	291	294	7%	0.9%
Water Heating	150	151	150	150	150	150	149	0%	0.0%
Int. Lighting	194	179	159	149	148	149	147	-24%	-3.4%
Ext. Lighting	29	25	21	19	19	19	19	-35%	-5.3%
Appliances	286	264	257	252	248	245	242	-15%	-2.1%
Electronics	161	185	191	199	207	215	224	39%	4.1%
Miscellaneous	79	82	83	84	85	87	88	12%	1.4%
Total	**1,483**	**1,482**	**1,459**	**1,453**	**1,476**	**1,476**	**1,488**	**0.3%**	**0.04%**

Figure 5-1 Residential Electricity Baseline Forecast by End Use

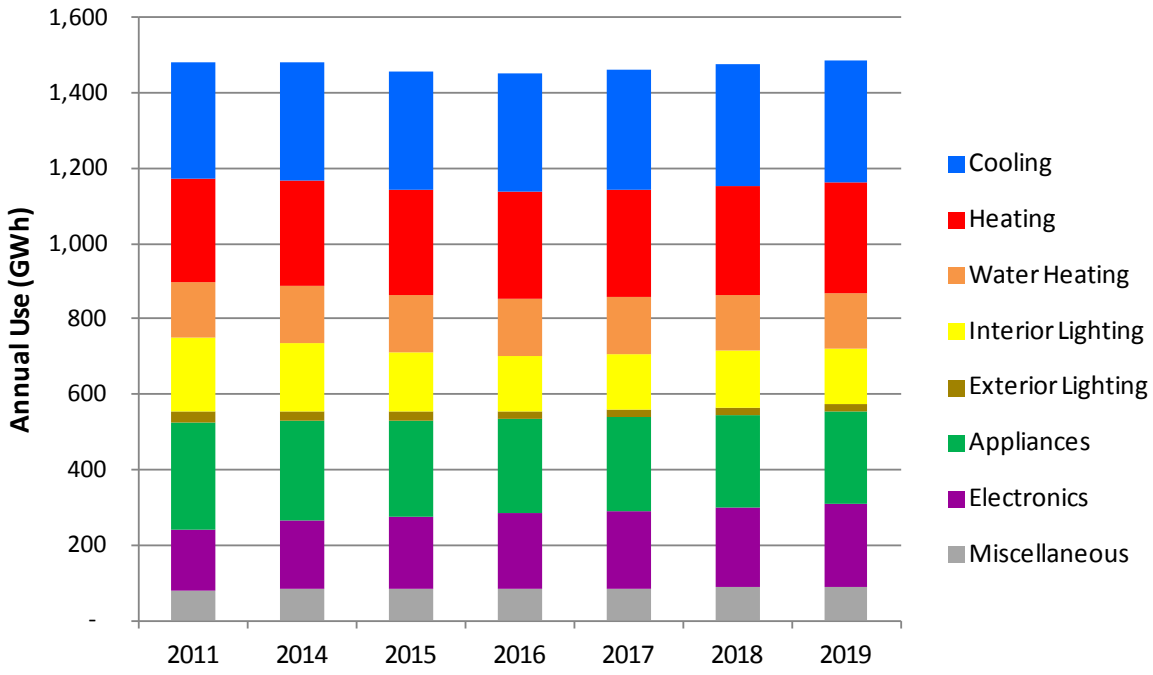


Figure 5-2 Residential Baseline Electricity Use per Household by End Use

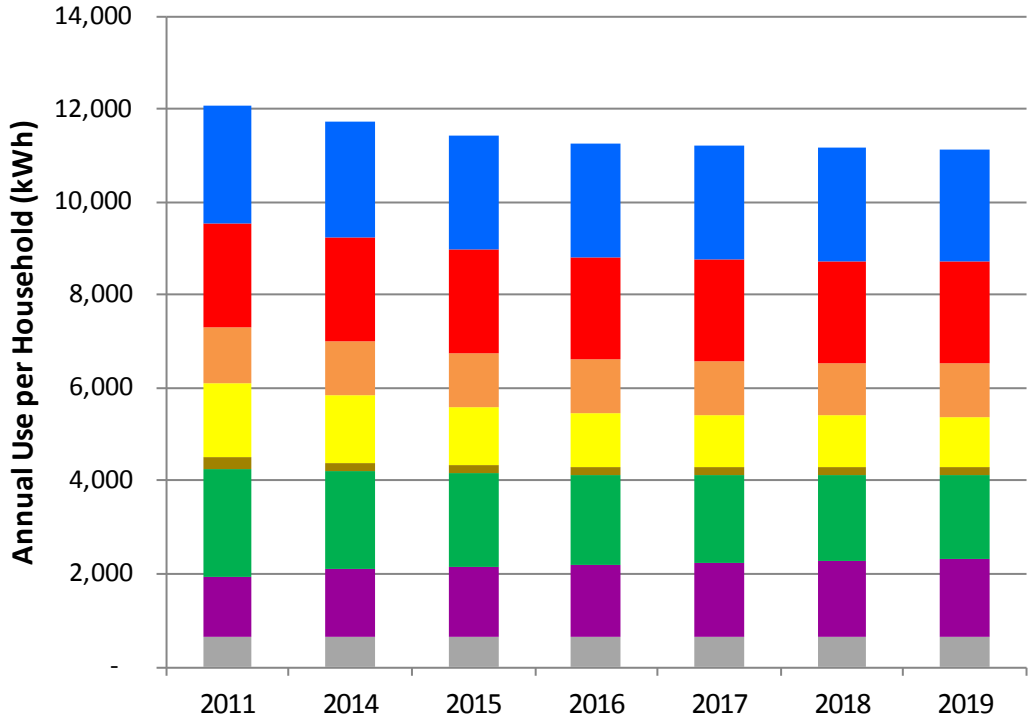


Table 5-2 shows the end-use forecast at the technology level for select years. Specific observations include:

1. The primary reason for the reduction in the baseline forecast beginning in 2012 is the federal lighting standards. The standard phases general service incandescent lamps out of the market over a three-year period, causing a decline in interior screw-in lighting use by 44.5% over the forecast period.
2. Appliance energy use decreases markedly, reflecting efficiency gains from standards.
3. Growth in use in electronics is substantial and reflects an increase in the saturation of electronics and the trend toward higher-powered computers.
4. Growth in miscellaneous use is also substantial. This use includes various plug loads not elsewhere classified (e.g., hair dryers, power tools, coffee makers, etc.). This end use has grown consistently in the past and we incorporate future growth assumptions that are consistent with the Annual Energy Outlook.

Table 5-2 Residential Electricity Baseline Forecast by End Use and Technology (GWh)

End Use	Technology	2011	2014	2015	2017	2019	% Change	Avg. Growth Rate
Cooling	Central AC	273	276	276	280	285	4.6%	0.6%
	Room AC	12	11	11	11	11	-4.9%	-0.6%
	Air-Source Heat Pump	27	27	27	27	28	5.0%	0.6%
	Geothermal Heat Pump	0	0	0	0	0	5.0%	0.6%
Heating	Furnace	135	140	141	143	146	8.5%	1.0%
	Air-Source Heat Pump	70	69	70	71	73	4.2%	0.5%
	Geothermal Heat Pump	0	0	0	0	0	9.1%	1.1%
	Electric Resistance	69	71	72	73	75	8.6%	1.0%
Water Heating	Water Heater > 55 gal	16	16	16	15	14	-14.8%	-2.0%
	Water Heater <= 55 gal	134	135	134	135	136	1.4%	0.2%
Interior Lighting	Screw-in	124	105	84	71	69	-44.5%	-7.4%
	Linear Fluorescent	15	16	16	16	17	12.9%	1.5%
	Specialty	55	59	59	60	62	12.8%	1.5%
Exterior Lighting	Screw-in	29	25	21	19	19	-34.7%	-5.3%
Appliances	Clothes Washer	8	7	6	6	5	-30.9%	-4.6%
	Clothes Dryer	55	51	50	48	47	-14.3%	-1.9%
	Dishwasher	24	21	20	19	18	-25.6%	-3.7%
	Refrigerator	93	84	80	75	71	-23.7%	-3.4%
	Freezer	25	22	21	20	19	-25.0%	-3.6%
	Second Refrigerator	27	23	23	21	21	-21.7%	-3.1%
	Stove	41	43	44	45	47	14.0%	1.6%
	Microwave	13	14	14	14	14	9.3%	1.1%
Electronics	Personal Computers	22	25	26	27	29	31.9%	3.5%
	Monitor	4	5	5	5	6	26.9%	3.0%
	Laptops	8	9	9	10	10	31.8%	3.5%
	TVs	70	82	85	93	101	42.9%	4.5%
	Printer/Fax/Copier	5	5	5	5	5	2.1%	0.3%
	Set-top Boxes/DVR	45	52	54	59	64	41.9%	4.4%
	Devices and Gadgets	7	8	8	9	9	37.9%	4.0%
Miscellaneous	Pool Pump	17	17	18	18	18	10.8%	1.3%
	Pool Heater	6	6	6	6	6	3.0%	0.4%
	Hot Tub / Spa	5	5	5	5	6	11.0%	1.3%
	Well Pump	3	4	4	4	4	11.1%	1.3%
	Furnace Fan	44	46	46	48	49	11.1%	1.3%
	Miscellaneous	3	4	4	5	5	43.2%	4.5%
Total		**1,483**	**1,482**	**1,459**	**1,463**	**1,488**	0.3%	0.0%

Commercial Sector

Electricity use in the commercial sector grows modestly during the overall forecast horizon, starting at 1,318 GWh in 2011, and increasing to 1,368 GWh in 2019. Table 5-3 and Figure 5-3 present the electricity baseline forecast at the end-use level for the commercial sector as a whole. Usage is declining in the early years of the forecast, due largely to the phasing in of codes and standards such as the EISA 2007 lighting standards and EPACT 2005 refrigeration standards.

Table 5-3 Commercial Electricity Consumption by End Use (GWh)

End Use	2011	2014	2015	2016	2017	2018	2019	% Change	Avg. Growth Rate
Cooling	248	271	277	285	295	305	316	28%	3.0%
Heating	116	131	135	139	145	151	156	35%	3.7%
Ventilation	112	108	106	104	104	104	104	-7%	-0.9%
Water Heating	37	39	40	41	42	43	44	17%	2.0%
Interior Lighting	407	347	338	334	333	335	339	-17%	-2.3%
Ext. Lighting	72	67	65	64	63	64	64	-11%	-1.5%
Refrigeration	123	110	107	105	103	102	101	-17%	-2.4%
Food Prep	35	36	36	37	37	38	39	11%	1.3%
Office Equip	85	88	88	90	92	94	96	13%	1.5%
Miscellaneous	83	92	94	97	100	104	107	29%	3.2%
Total	**1,318**	**1,288**	**1,286**	**1,296**	**1,313**	**1,339**	**1,368**	**4%**	**0.5%**

Figure 5-3 Commercial Electricity Baseline Forecast by End Use

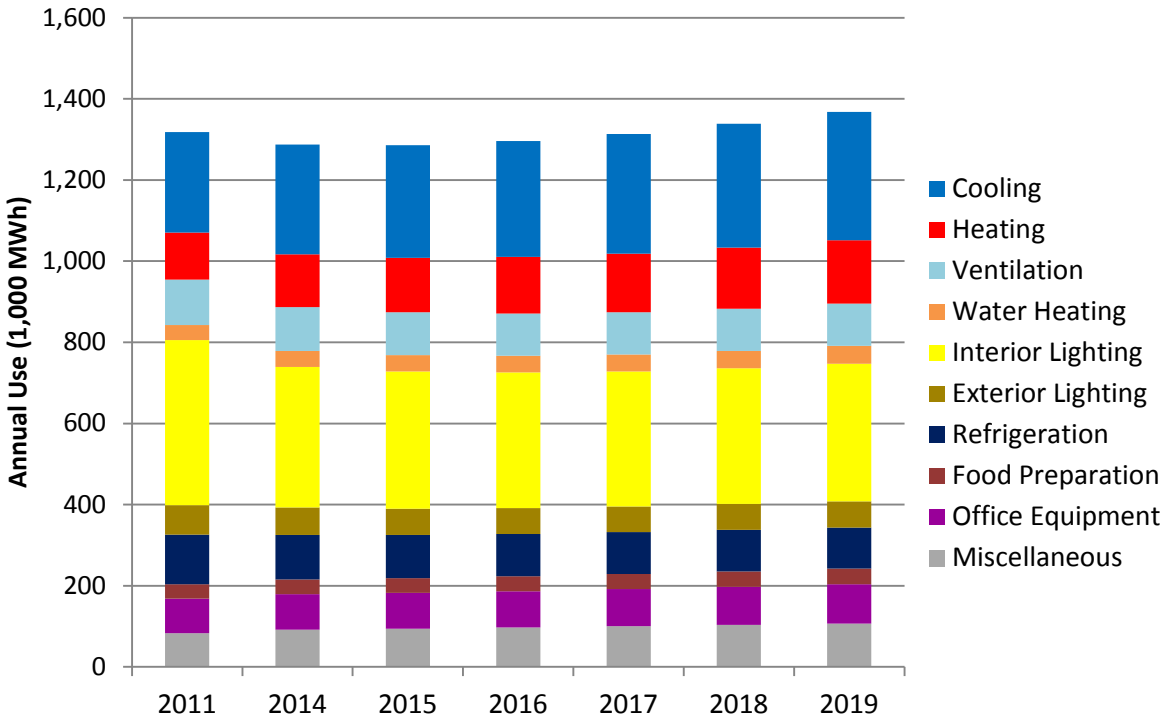


Table 5-4 presents the commercial sector electricity forecast by technology for select years. Interior screw-in lighting and refrigeration decrease significantly over the forecast period as a result of efficiency standards.

Table 5-4 Commercial Baseline Electricity Forecast by End Use and Technology (GWh)

End Use	Technology	2011	2014	2015	2017	2019	% Change	Avg. Growth Rate
Cooling	Air-Cooled Chiller	16	20	22	25	28	77.5%	7.2%
	Water-Cooled Chiller	34	38	39	42	45	33.6%	3.6%
	Roof top AC	173	175	175	177	182	5.3%	0.6%
	Geothermal Heat Pump	2	5	7	9	12	585.8%	24.1%
	Other Cooling	13	17	18	21	24	84.4%	7.6%
	Air Source Heat Pump	11	16	17	21	25	133.2%	10.6%
Heating	Geothermal Heat Pump	2	7	8	12	16	690.9%	25.8%
	Electric Room Heat	9	9	9	9	10	5.6%	0.7%
	Electric Furnace	93	95	95	96	98	5.6%	0.7%
	Air Source Heat Pump	12	19	22	27	33	179.9%	12.9%
Ventilation	Ventilation	112	108	106	104	104	-6.8%	-0.9%
Water Heating	Water Heating	37	39	40	42	44	17.4%	2.0%
Interior Lighting	Screw-in	163	110	104	99	103	-37.1%	-5.8%
	High-Bay Fixtures	36	27	25	23	22	-37.3%	-5.8%
	Linear Fluorescent	208	210	209	211	214	3.2%	0.4%
Exterior Lighting	Screw-in	18	18	17	16	17	-6.7%	-0.9%
	HID	49	45	43	42	42	-14.3%	-1.9%
	Linear Fluorescent	4	4	4	4	5	28.0%	3.1%
	Traffic Lights	1	1	0	0	0	-61.2%	-11.8%
	Crosswalk Lights	0	0	0	0	0	-73.0%	-16.3%
Refrigeration	Walk-in Refrigerator	38	32	30	29	28	-26.8%	-3.9%
	Reach-in Refrigerator	4	3	3	3	3	-30.3%	-4.5%
	Glass Door Display	45	40	39	37	36	-19.7%	-2.7%
	Open Display Case	20	20	21	21	21	5.1%	0.6%
	Icemaker	8	8	8	8	8	3.0%	0.4%
	Vending Machine	8	7	7	6	5	-31.0%	-4.6%
Food Preparation	Oven	8	8	8	9	9	22.4%	2.5%
	Fryer	11	12	12	13	13	19.6%	2.2%
	Dishwasher	13	12	12	12	12	-3.3%	-0.4%
	Hot Food Container	4	4	4	4	4	10.7%	1.3%
Office Equipment	Desktop Computer	43	45	45	46	49	13.0%	1.5%
	Laptop	7	7	7	8	8	24.3%	2.7%
	Server	20	20	20	21	23	12.9%	1.5%
	Monitor	8	8	8	9	9	14.8%	1.7%
	Printer/Copier/Fax	6	6	6	6	6	0.0%	0.0%
	POS Terminal	2	2	2	2	2	-7.5%	-1.0%
Miscellaneous	Non-HVAC Motors	19	19	19	20	20	5.2%	0.6%
	Pool Pump	0	0	0	0	0	9.9%	1.2%
	Pool Heater	0	0	0	0	0	13.2%	1.6%
	Miscellaneous	64	73	75	81	87	35.8%	3.8%
Total		**1,318**	**1,288**	**1,286**	**1,313**	**1,368**	**3.7%**	**0.5%**

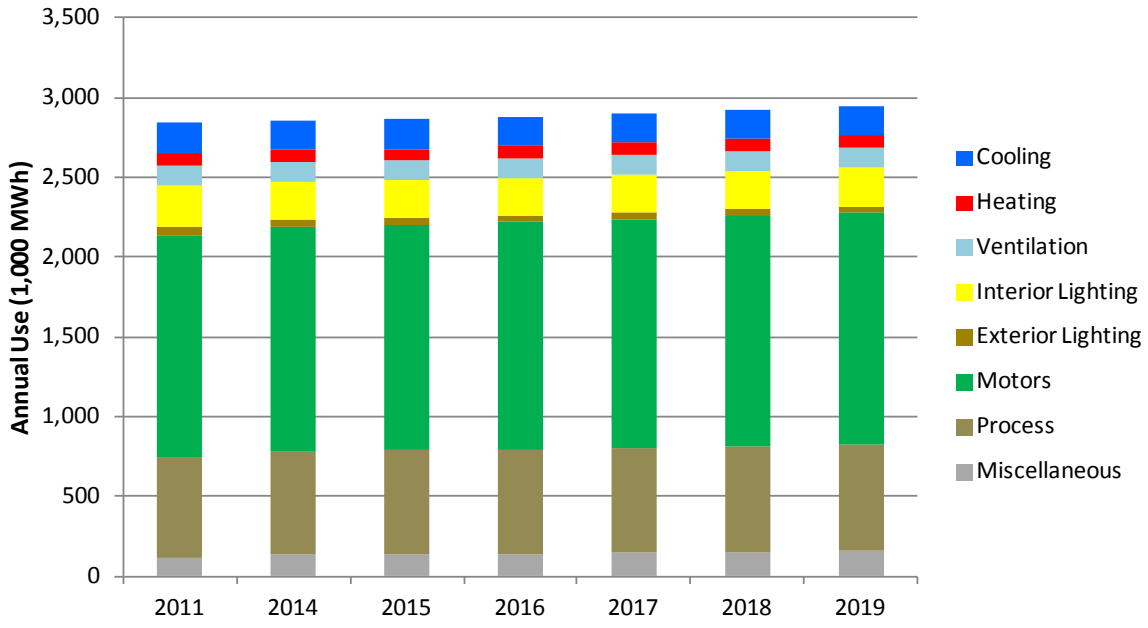
Industrial Sector

Table 5-5 and Figure 5-4 present the electricity baseline forecast at the end-use level for the industrial sector. Overall, industrial annual electricity use increases modestly from 2,845 GWh in 2011 to 2,943 GWh in 2019. This comprises an overall increase of 3.5%, or 0.4% per year, which is colored by slow but recovering economy.

Table 5-5 Industrial Electricity Consumption by End Use (GWh)

End Use	2011	2014	2015	2016	2017	2018	2019	% Change	Avg. Growth Rate
Cooling	192	186	184	182	182	181	181	-6%	-0.8%
Heating	76	78	78	78	79	79	80	5%	0.6%
Ventilation	122	121	119	119	118	118	118	-4%	-0.5%
Int. Lighting	266	245	240	240	241	246	249	-6%	-0.8%
Ext. Lighting	51	38	37	38	38	38	38	-25%	-3.6%
Motors	1,388	1,416	1,420	1,427	1,436	1,448	1,456	5%	0.6%
Process	630	646	649	653	657	663	667	6%	0.7%
Miscellaneous	118	132	136	140	145	150	154	31%	3.4%
Total	**2,845**	**2,861**	**2,863**	**2,877**	**2,896**	**2,922**	**2,943**	**3.5%**	**0.4%**

Figure 5-4 Industrial Electricity Baseline Forecast by End Use



Baseline Forecast Summary

Table 5-6 and Figure 5-5 provide a summary of the baseline forecast for electricity by sector for the entire Vectren service territory. Overall, the forecast shows only a slight incline in electricity use, driven primarily by oncoming codes and standards and a challenging macroeconomic environment.

Table 5-6 Electricity Baseline Forecast Summary (GWh)

Sector	2011	2014	2015	2016	2017	2018	2019	% Change	Avg. Growth Rate
Residential	1,483	1,482	1,459	1,453	1,463	1,476	1,488	0.3%	0.0%
Commercial	1,318	1,288	1,286	1,296	1,313	1,339	1,368	3.7%	0.5%
Industrial	2,845	2,861	2,863	2,877	2,896	2,922	2,943	3.5%	0.4%
Total	**5,646**	**5,630**	**5,608**	**5,626**	**5,673**	**5,738**	**5,799**	**2.7%**	**0.3%**

Figure 5-5 Electricity Baseline Forecast Summary (GWh)

ENERGY EFFICIENCY MEASURES

List of Energy Efficiency Measures

The first step of the energy efficiency measure analysis is to identify the list of all relevant energy efficiency measures that should be considered for the Vectren potential assessment.

For this study, EnerNOC prepared a preliminary list of measures for Vectren staff and stakeholders to review. After incorporating feedback, we populated the full databases for the three sectors.

Sources for the measure assumptions were drawn from past Vectren program and evaluation experience, EnerNOC's building simulation tool (BEST), EnerNOC's measure database (DEEM), TRM's from neighboring states of Illinois and Ohio, the California DEER, NWPCC workbooks, other secondary sources, and other data from EnerNOC's previous studies and program work.[10]

- **Residential Measures**. The residential measures span all end uses and vary significantly in the manner in which they impact energy consumption. All residential measures considered for this study are listed and described in Volume 3 Appendix B.
- **Commercial Measures**. All commercial measures considered for this study are listed and described in Volume 3 Appendix C.
- **Industrial Measures**. All industrial measures considered for this study are listed and described in Volume 3 Appendix D.

Results of the Economic Screen

Table 6-1 summarizes the number of equipment and non-equipment measures evaluated for each segment within each sector.

Table 6-1 Number of Measures Evaluated

	Residential	Commercial	Industrial	Total Number of Measures
Equipment Measures Evaluated	35	40	28	**103**
Non-Equipment Measures Evaluated	45	82	69	**196**
Total Measures Evaluated	**80**	**122**	**97**	**299**

The Volume 3 Appendices mentioned above give results for the economic screening process by segment, vintage, end use and measure for all sectors.

[10] The Indiana TRM being developed by the Indiana DSMCC EM&V subcommittee was not finalized and available at the time this study was being performed.

CHAPTER | 6

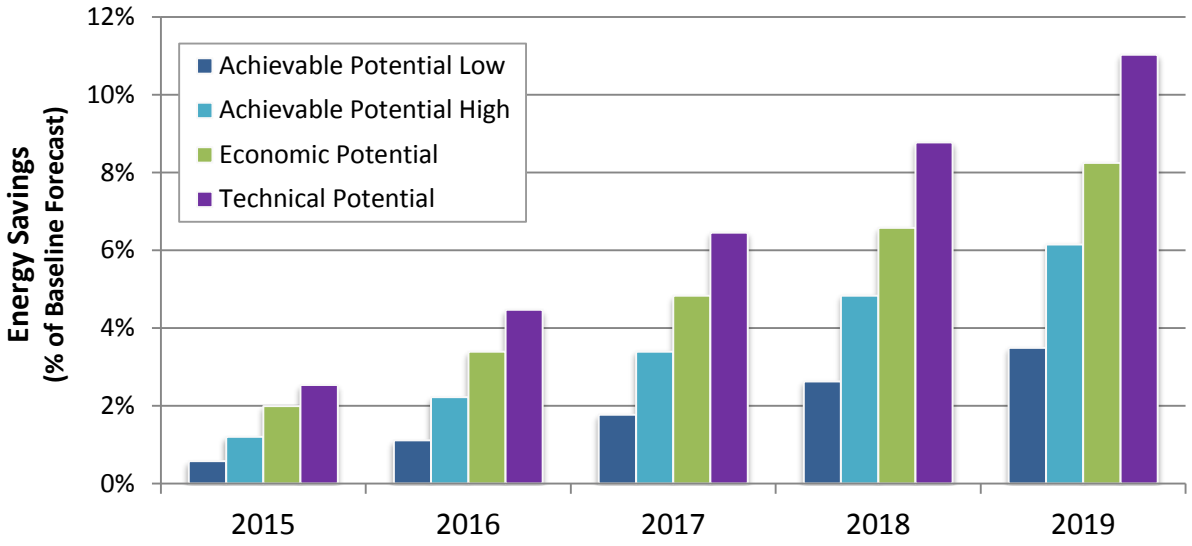
MEASURE-LEVEL ENERGY EFFICIENCY POTENTIAL

Table 7-1 and Figure 7-1 summarize the electric energy-efficiency savings for all measures at the different levels of potential relative to the baseline forecast. Figure 7-2 displays the electric energy-efficiency forecasts. Note that the subsequent steps of measure bundling, program design, and program delivery will hone and refine these results later in Chapter 8.[11]

Table 7-1 Overall Measure-Level Electricity Efficiency Potential

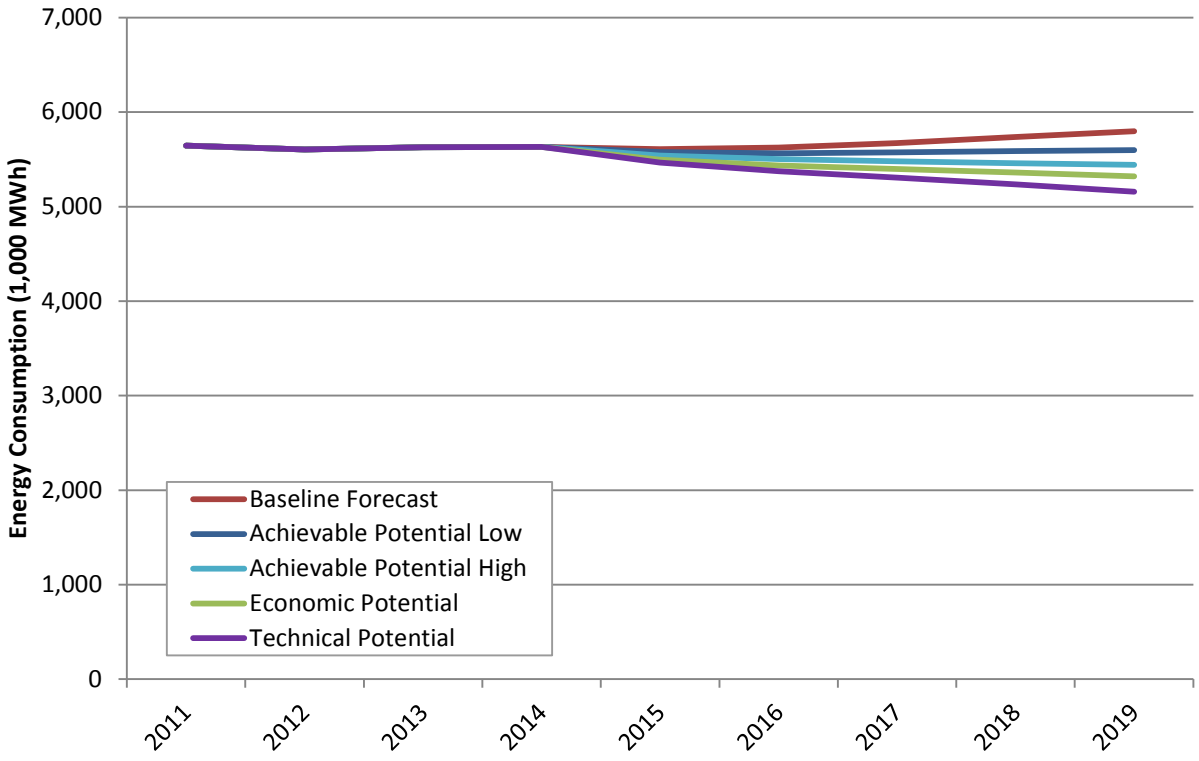
	2015	2016	2017	2018	2019
Baseline Forecast (GWh)	**5,608**	**5,626**	**5,673**	**5,738**	**5,799**
Cumulative Savings (GWh)					
Achievable Low Potential	32	63	100	151	203
Achievable High Potential	67	125	192	277	357
Economic Potential	112	191	274	377	478
Technical Potential	142	251	366	504	640
Energy Savings (% of Baseline)					
Achievable Low Potential	0.6%	1.0%	1.8%	2.6%	3.5%
Achievable High Potential	1.2%	2.2%	3.4%	4.8%	6.2%
Economic Potential	2.0%	3.4%	4.8%	6.6%	8.2%
Technical Potential	2.5%	4.5%	6.5%	8.8%	11.0%

Figure 7-1 Overall Measure-Level Electricity Efficiency Potential



[11] Utilities typically have a small subset of large commercial and industrial customers that comprise a disproportionate share of load and demand. In Vectren's case, there is one particular industrial customer that comprises a full 24% of the C&I load. If this customer were not to participate in EE programs, the savings potential would drop commensurately in the C&I sectors, which would remove approximately 15% from the overall savings potential in all sectors.

Figure 7-2 Overall Measure-Level Electricity Potentials Forecasts (GWh)



Overview of Measure-Level Energy Efficiency Potential by Sector

Table 7-2, Figure 7-3, and Figure 7-4 summarize the range of electric achievable potential by sector. The commercial sector accounts for the largest portion of the savings, followed by residential, and then industrial.

Table 7-2 Electric Achievable Potential by Sector (GWh)

	2015	2016	2017	2018	2019
Achievable Low Cumulative Savings (GWh)					
Residential	9.4	15.7	22.1	32.4	43.4
Commercial	12.1	22.8	36.0	53.0	71.8
Industrial	10.7	24.3	42.2	65.4	87.4
Total	**32.2**	**62.7**	**100.3**	**150.9**	**202.6**
Achievable High Cumulative Savings (GWh)					
Residential	20.4	32.0	43.8	60.9	76.8
Commercial	25.3	45.7	69.2	97.9	127.1
Industrial	21.7	47.2	79.4	118.7	152.7
Total	**67.3**	**124.9**	**192.5**	**277.4**	**356.7**

Figure 7-3 Achievable Low Electric Potential by Sector (GWh)

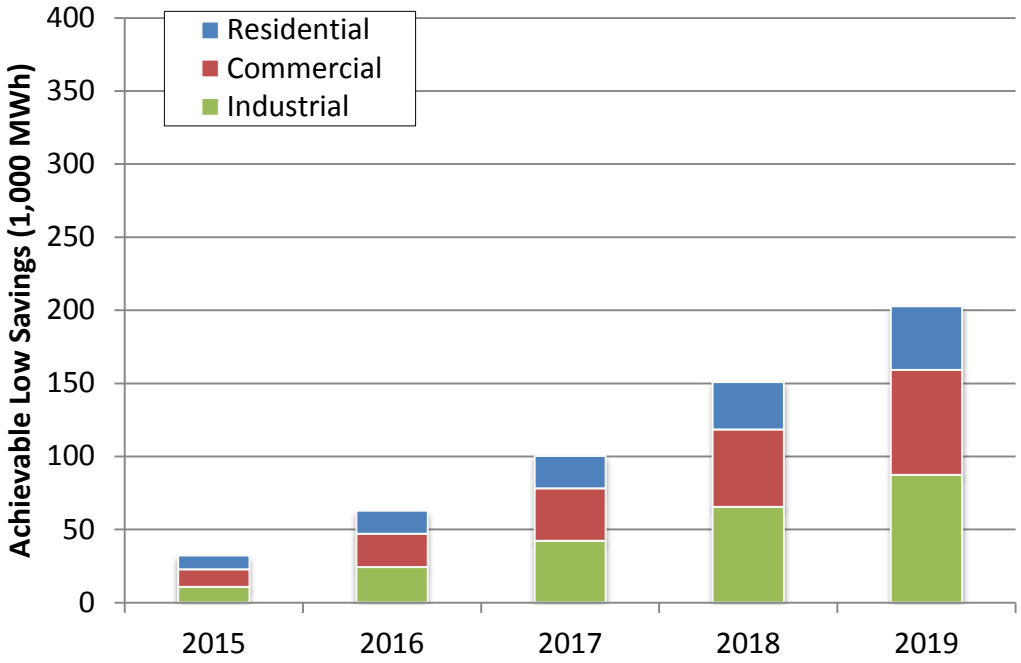
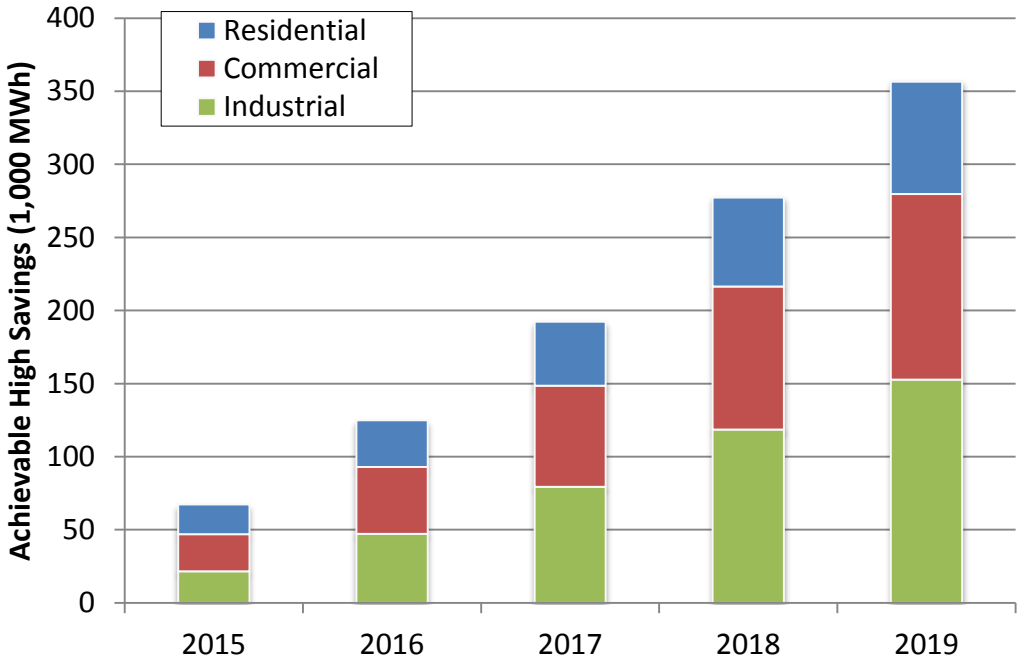


Figure 7-4 Achievable High Electric Potential by Sector (GWh)



Details for each sector are presented in the following chapter.

MEASURE-LEVEL ENERGY EFFICIENCY POTENTIAL BY SECTOR

This chapter presents the results of the energy efficiency analysis for all measures at the sector level. First, the residential potential is presented, followed by the commercial, and lastly, industrial. Note that the subsequent steps of measure bundling, program design, and program delivery will hone and refine these results later in Chapter 8.

Residential Electricity Potential

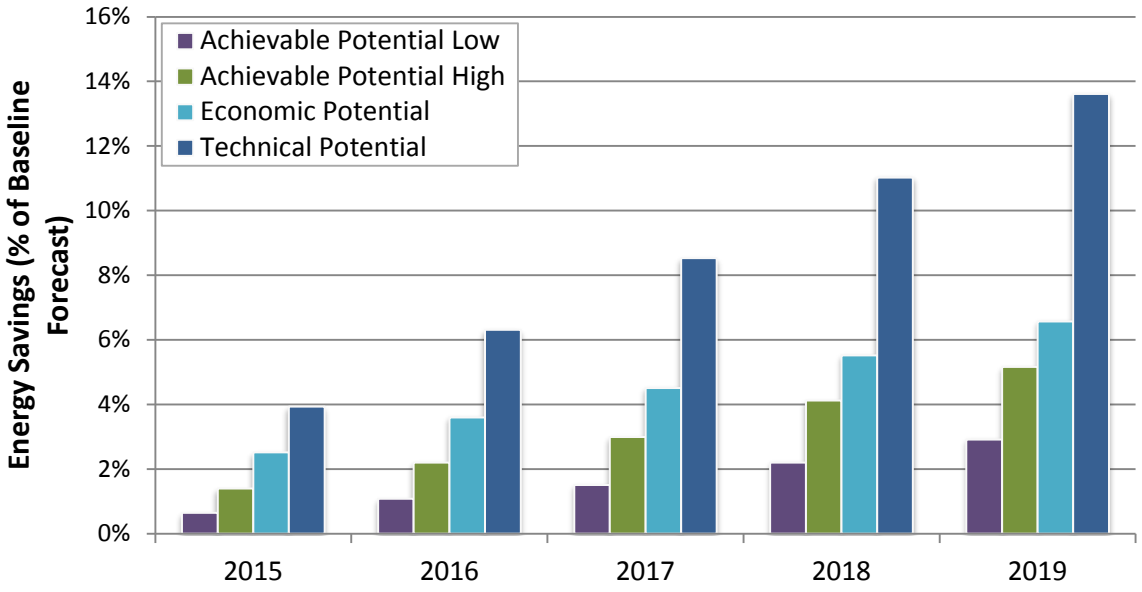
Table 7-1 presents estimates for the four types of potential for the residential electricity sector. Figure 7-1 depicts these potential energy savings estimates graphically.

- **Achievable Low potential** projects 9 GWh of energy savings in 2015, 0.6% of the baseline forecast. This increases to 43 GWh, 2.9% of the baseline forecast, in 2019.
- **Achievable High potential** is 20 GWh in 2015, which represents 1.4% of the baseline forecast. By 2019, the cumulative energy savings are 77 GWh, 5.2% of the baseline forecast.
- **Economic potential,** which reflects a theoretical limit to savings when all cost-effective measures are taken, is 37 GWh in 2015. This represents 2.5% of the baseline energy forecast. By 2019, economic potential reaches 98 GWh, 6.6% of the baseline energy forecast.
- **Technical potential,** which reflects the adoption of all energy efficiency measures regardless of cost, is a theoretical upper bound on savings. In 2015, energy savings are 57 GWh, or 3.9% of the baseline energy forecast. By 2019, technical potential reaches 203 GWh, 13.6% of the baseline energy forecast.

Table 7-1 Electricity Energy Efficiency Potential for the Residential Sector

	2015	2016	2017	2018	2019
Baseline Forecast (GWh)	**1,459**	**1,453**	**1,463**	**1,476**	**1,488**
Cumulative Savings (GWh)					
Achievable Low Potential	9	16	22	32	43
Achievable High Potential	20	32	44	61	77
Economic Potential	37	52	66	81	98
Technical Potential	57	92	125	163	203
Energy Savings (% of Baseline)					
Achievable Low Potential	0.6%	1.1%	1.5%	2.2%	2.9%
Achievable High Potential	1.4%	2.2%	3.0%	4.1%	5.2%
Economic Potential	2.5%	3.6%	4.5%	5.5%	6.6%
Technical Potential	3.9%	6.3%	8.5%	11.0%	13.6%

Figure 7-1 Residential Electric Energy Efficiency Potential Savings



Residential Electric Potential by Market Segment

Single-family homes in Vectren account for the majority of this sector's total sales in the base year and throughout the forecast. Similarly, single-family homes account for the largest share of potential savings by segment, as displayed in Table 7-2, which shows results for 2017.

Table 7-2 Residential Electric Potential by Market Segment, 2017

	Single Family	Multi Family
Baseline Forecast (GWh)	**1,299**	**165**
Energy Savings (GWh)		
Achievable Low Potential	19	3
Achievable High Potential	39	5
Economic Potential	59	7
Technical Potential	111	14
Energy Savings as % of Baseline		
Achievable Low Potential	1.5%	1.6%
Achievable High Potential	3.0%	3.2%
Economic Potential	4.5%	4.3%
Technical Potential	8.6%	8.3%

Table 7-3 shows the Achievable Low savings by end use and market segment in 2017. Single-family homes have more exterior lighting and so have more savings potential for this end use.

Table 7-3 Residential Electric Achievable Low Potential by End Use and Market Segment, 2017 (GWh)

End Use	Single Family	Multi Family
Cooling	1.1	0.0
Heating	0.5	0.0
Water Heating	0.3	0.1
Interior Lighting	11.3	1.5
Exterior Lighting	1.8	0.4
Appliances	0.4	0.0
Electronics	3.9	0.5
Miscellaneous	0.2	-
Total	**19.5**	**2.7**

Residential Electric Potential by End Use

Table 7-4 provides estimates of savings for each end use and type of potential. The most significant savings opportunities come from the lighting end use.

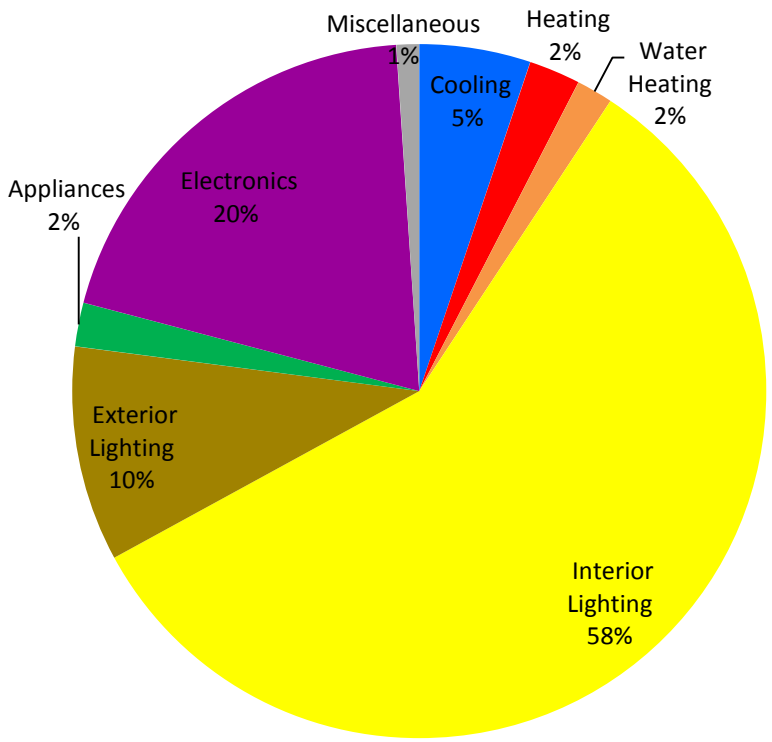
Table 7-4 Residential Electric Savings by End Use and Potential Type (GWh)

End Use	Case	2015	2017	2019
Cooling	Achievable Potential Low	0.23	1.15	3.59
	Achievable Potential High	0.47	2.25	6.67
	Economic Potential	1.13	5.00	12.55
	Technical Potential	8.82	28.79	53.69
Heating	Achievable Potential Low	0.09	0.53	1.72
	Achievable Potential High	0.20	1.08	3.28
	Economic Potential	0.62	2.70	6.69
	Technical Potential	1.20	4.91	11.68
Water Heating	Achievable Potential Low	0.10	0.38	0.95
	Achievable Potential High	0.21	0.76	1.78
	Economic Potential	0.23	0.98	2.39
	Technical Potential	3.97	13.09	24.61
Interior Lighting	Achievable Potential Low	6.34	12.77	21.27
	Achievable Potential High	13.77	25.32	36.26
	Economic Potential	24.05	32.01	31.16
	Technical Potential	27.90	38.81	40.09
Exterior Lighting	Achievable Potential Low	1.44	2.22	3.71
	Achievable Potential High	3.13	4.38	5.97
	Economic Potential	4.33	4.10	4.68
	Technical Potential	5.40	5.42	5.47
Appliances	Achievable Potential Low	0.22	0.45	0.74
	Achievable Potential High	0.34	0.50	0.75
	Economic Potential	0.08	0.36	0.78
	Technical Potential	2.66	8.29	14.26
Electronics	Achievable Potential Low	0.96	4.39	10.97
	Achievable Potential High	2.09	9.05	21.16
	Economic Potential	5.68	19.11	36.86
	Technical Potential	5.81	20.78	45.31
Miscellaneous	Achievable Potential Low	0.07	0.23	0.47
	Achievable Potential High	0.14	0.49	0.93
	Economic Potential	0.59	1.63	2.62
	Technical Potential	1.63	4.66	7.41
Total	**Achievable Potential Low**	**9.44**	**22.11**	**43.42**
	Achievable Potential High	**20.35**	**43.82**	**76.80**
	Economic Potential	**36.72**	**65.90**	**97.74**
	Technical Potential	**57.39**	**124.75**	**202.53**

Figure 7-2 focuses on the residential achievable low potential in 2017. Lighting equipment replacement accounts for the highest portion of the savings in the near term as a result of the efficiency gap between CFL lamps and advanced incandescent lamps, even those that will meet the EISA 2007 standard. Electronics, cooling, and appliances also contribute significantly to the savings. Detailed measure information is available in Volume 3 Appendices. The key measures comprising the potential are listed below:

- Lighting: mostly CFL lamps and specialty bulbs
- Electronics (reduce standby wattage, televisions, set top boxes, PCs)
- Second refrigerator/ freezer removal
- HVAC: Removal of second room AC unit, efficient air conditioners, ducting repair/sealing, insulation, home energy management system and programmable thermostats

Figure 7-2 Residential Electric Achievable Low Potential by End Use in 2017



Commercial Electricity Potential

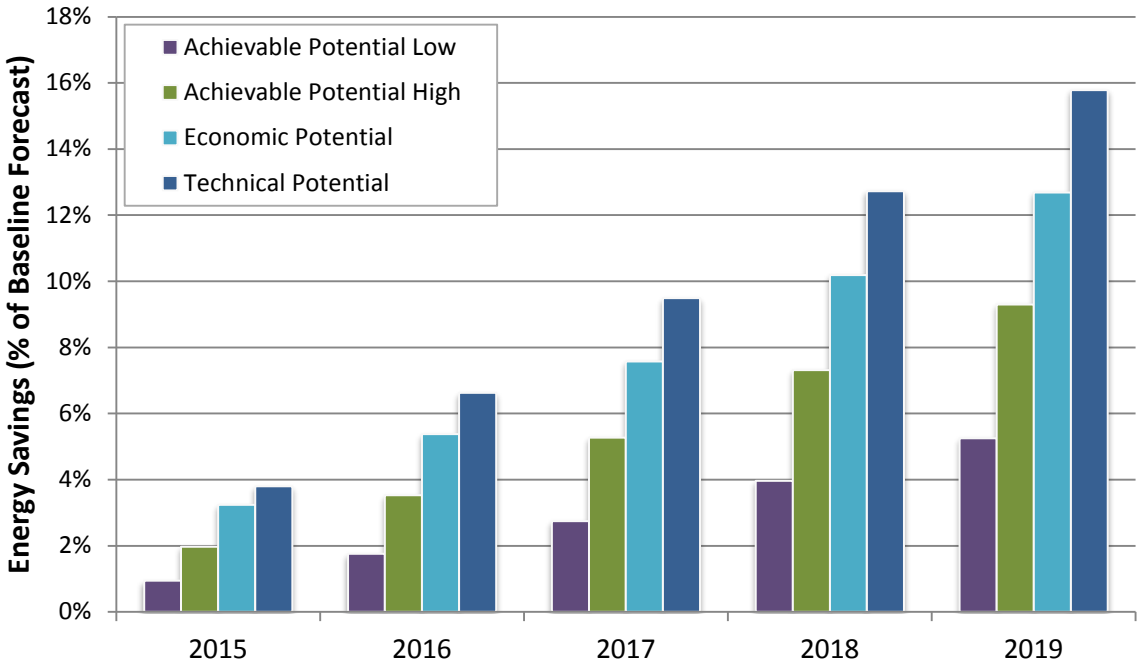
The baseline forecast for the commercial sector only grows slightly, which reflects the sluggish near-term economy and forthcoming codes and standards. Nevertheless, the opportunity for energy-efficiency savings is still significant for the commercial sector. Table 7-5 presents estimates for the four types of potential for the residential electricity sector. Figure 8-3 depicts these potential energy savings estimates graphically.

- **Achievable Low potential** projects 12 GWh of energy savings in 2015, 0.9% of the baseline forecast. The cumulative savings increase to 72 GWh, 5.3% of the baseline forecast, in 2019.
- **Achievable High potential** is 25 GWh in 2015, which represents 2.0% of the baseline forecast. By 2019, the cumulative energy savings are 127 GWh, 9.3% of the baseline forecast.
- **Economic potential,** which reflects a theoretical limit to savings when all cost-effective measures are taken, is 42 GWh in 2015. This represents 3.2% of the baseline energy forecast. By 2019, cumulative economic potential reaches 173 GWh, 12.7% of the baseline energy forecast.
- **Technical potential,** which reflects the adoption of all energy efficiency measures regardless of cost, is a theoretical upper bound on savings. In 2015, energy savings are 49 GWh, or 3.8% of the baseline energy forecast. By 2019, technical potential reaches 216 GWh, 15.8% of the baseline energy forecast.

Table 7-5 Electricity Efficiency Potential for the Commercial Sector

	2015	2016	2017	2018	2019
Baseline Forecast (GWh)	**1,286**	**1,296**	**1,313**	**1,339**	**1,368**
Cumulative Savings (GWh)					
Achievable Low Potential	12	23	36	53	72
Achievable High Potential	25	46	69	98	127
Economic Potential	42	70	99	136	173
Technical Potential	49	86	125	170	216
Savings (% of Baseline)					
Achievable Low Potential	0.9%	1.8%	2.7%	4.0%	5.3%
Achievable High Potential	2.0%	3.5%	5.3%	7.3%	9.3%
Economic Potential	3.2%	5.4%	7.6%	10.2%	12.7%
Technical Potential	3.8%	6.6%	9.5%	12.7%	15.8%

Figure 7-3 Commercial Energy Efficiency Potential Savings



Commercial Electric Potential by Market Segment

Table 7-6 shows potential estimates by building type segment in 2017. Retail has the largest Achievable Low savings potential in 2017, followed by warehouse, grocery, and offices. Table 7-7 summarizes achievable potential for each segment and end use.

Table 7-6 Commercial Electric Potential by Market Segment, 2017

	Small Office	Large Office	Restaurant	Retail	Grocery	College
Baseline Forecast	**145**	**188**	**70**	**254**	**124**	**78**
Energy Savings (GWh)						
Achievable Low Potential	3	4	2	7	4	2
Achievable High Potential	7	8	4	13	8	4
Economic Potential	10	12	5	19	12	6
Technical Potential	14	16	6	25	14	7
Energy Savings (% of Baseline)						
Achievable Low Potential	2.35%	2.25%	2.84%	2.65%	3.63%	2.61%
Achievable High Potential	4.58%	4.40%	5.46%	5.11%	6.87%	5.06%
Economic Potential	7.09%	6.37%	7.71%	7.41%	9.56%	7.33%
Technical Potential	9.39%	8.44%	9.09%	9.70%	11.24%	9.19%
	School	**Health**	**Lodging**	**Warehouse**	**Misc.**	**TOTAL**
Baseline Forecast	**71**	**143**	**29**	**134**	**77**	**1,313**
Energy Savings (GWh)						
Achievable Low Potential	2	3	1	4	3	**36**
Achievable High Potential	4	7	1	8	5	**69**
Economic Potential	5	9	2	13	7	**100**
Technical Potential	7	11	2	15	8	**125**
Energy Savings (% of Baseline)						
Achievable Low Potential	2.79%	2.38%	2.50%	3.31%	3.30%	**2.74%**
Achievable High Potential	5.42%	4.56%	4.77%	6.34%	6.33%	**5.28%**
Economic Potential	7.02%	6.46%	5.68%	9.43%	9.31%	**7.60%**
Technical Potential	9.54%	7.87%	7.34%	11.18%	10.58%	**9.51%**

Table 7-7 Commercial Electric Achievable Low Potential by End Use and Market Segment, 2017 (GWh)

Segment	Cooling	Space Heating	Ventilation	Water Heat	Int. Lighting	Ext. Lighting	Food Prep	Refrigeration	Office Equip	Misc	Total
Small Office	1.1	0.2	0.2	0.2	0.7	0.5	0.0	0.0	0.6	0.0	3.4
Large Office	0.9	0.2	0.6	0.2	1.1	0.2	0.0	0.0	1.1	0.0	4.2
Restaurant	0.3	0.0	0.2	0.2	0.2	0.2	0.2	0.6	0.0	0.0	2.0
Retail	1.3	0.7	0.5	0.4	2.2	1.0	0.1	0.3	0.3	0.0	6.7
Grocery	0.6	0.4	0.2	0.1	0.6	0.2	0.5	1.9	0.0	0.0	4.5
College	0.4	0.1	0.2	0.2	0.8	0.2	0.0	0.0	0.1	0.0	2.0
School	0.1	0.1	0.2	0.1	1.0	0.2	0.0	0.1	0.1	0.0	2.0
Health	0.1	0.1	0.1	0.1	0.6	0.1	0.0	0.1	0.1	0.0	1.3
Lodging	0.3	0.5	0.2	0.1	1.5	0.1	0.0	0.2	0.0	0.0	3.0
Warehouse	0.5	0.2	0.2	0.1	1.1	0.7	0.1	0.0	0.2	0.0	3.1
Misc.	1.0	0.4	0.7	0.1	0.9	0.4	0.0	0.1	0.1	0.0	3.7
Traffic Signals	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	**6.6**	**2.8**	**3.3**	**1.9**	**10.7**	**3.8**	**0.9**	**3.3**	**2.6**	**0.0**	**36.0**

Commercial Electric Potential by End Use

Table 7-8 presents the commercial sector savings by end use and potential type. The end uses with the highest technical and economic potential are lighting, cooling, ventilation, and refrigeration.

Figure 7-4 focuses on achievable potential savings by end use. Not surprisingly, interior lighting delivers the highest achievable savings throughout the study period. In 2017, Cooling is second, and exterior lighting is third. Regarding refrigeration, it is interesting to point out a relatively new control and sensing technology that vendors such as “eCube” are using to regulate the system energy. The technology consists of a solid, waxy food simulant that is fitted around a thermostat sensor that would otherwise measure air temperature. The refrigeration controls therefore attempt to regulate the temperature of food, which changes more slowly and gradually than air, thereby reducing the frequency of refrigeration on/off cycles. Refrigeration energy savings are then followed in descending order by cooling, ventilation, office equipment, and small amounts of the other end uses.

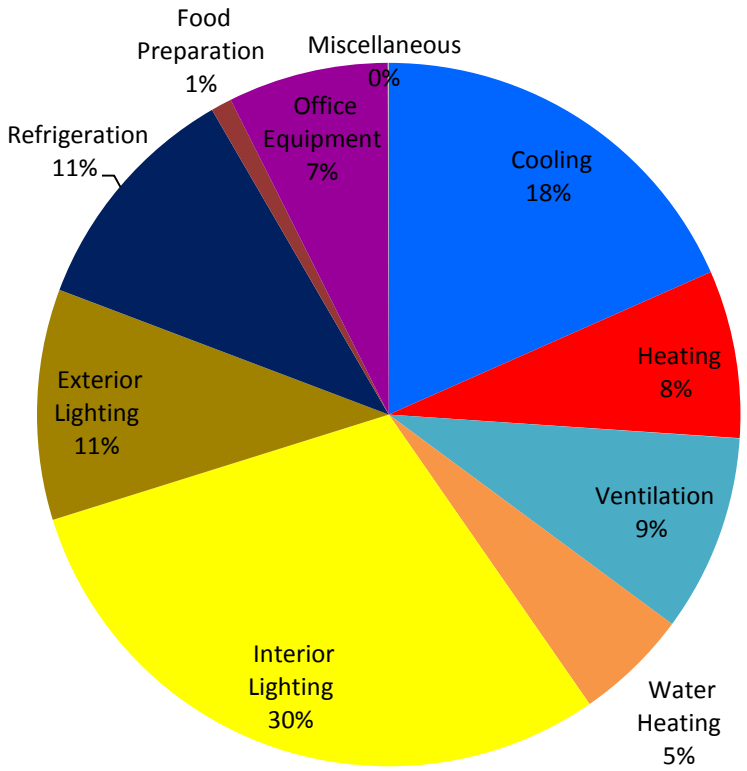
Detailed measure information is available in the Volume 3 Appendices. The key measures comprising the potential are listed below:

- Lighting – CFLs, LED lamps, linear fluorescent, daylighting controls, occupancy sensors, and HID lamps for exterior lighting
- Energy management systems & programmable thermostats
- Ventilation – variable speed control
- Refrigeration – efficient equipment, control systems, decommissioning
- Efficient office equipment – computers, servers

Table 7-8 Commercial Potential by End Use and Potential Type (GWh)

End Use	Case	2015	2017	2019
Cooling	Achievable Potential Low	1	7	13
	Achievable Potential High	3	13	23
	Economic Potential	6	20	36
	Technical Potential	9	32	56
Heating	Achievable Potential Low	0	0	0
	Achievable Potential High	0	0	0
	Economic Potential	1	3	6
	Technical Potential	1	6	11
Ventilation	Achievable Potential Low	3	10	17
	Achievable Potential High	4	13	21
	Economic Potential	1	3	5
	Technical Potential	1	3	5
Water Heating	Achievable Potential Low	1	4	8
	Achievable Potential High	2	8	14
	Economic Potential	4	13	22
	Technical Potential	4	14	24
Interior Lighting	Achievable Potential Low	4	7	15
	Achievable Potential High	10	14	28
	Economic Potential	16	21	36
	Technical Potential	16	21	36
Exterior Lighting	Achievable Potential Low	2	4	7
	Achievable Potential High	4	8	10
	Economic Potential	4	6	6
	Technical Potential	4	6	6
Refrigeration	Achievable Potential Low	1	4	9
	Achievable Potential High	2	8	16
	Economic Potential	3	10	17
	Technical Potential	4	16	29
Food Preparation	Achievable Potential Low	0	0	1
	Achievable Potential High	0	1	1
	Economic Potential	0	1	2
	Technical Potential	0	1	2
Office Equipment	Achievable Potential Low	1	2	2
	Achievable Potential High	2	4	4
	Economic Potential	3	7	8
	Technical Potential	4	8	10
Miscellaneous	Achievable Potential Low	0	1	3
	Achievable Potential High	1	3	5
	Economic Potential	0	0	0
	Technical Potential	0	0	0
Total	**Achievable Potential Low**	**14**	**40**	**75**
	Achievable Potential High	**26**	**71**	**124**
	Economic Potential	**38**	**84**	**139**
	Technical Potential	**44**	**108**	**179**

Figure 7-4 Commercial Achievable Low Potential Electricity Savings by End Use in 2017



Industrial Electricity Potential

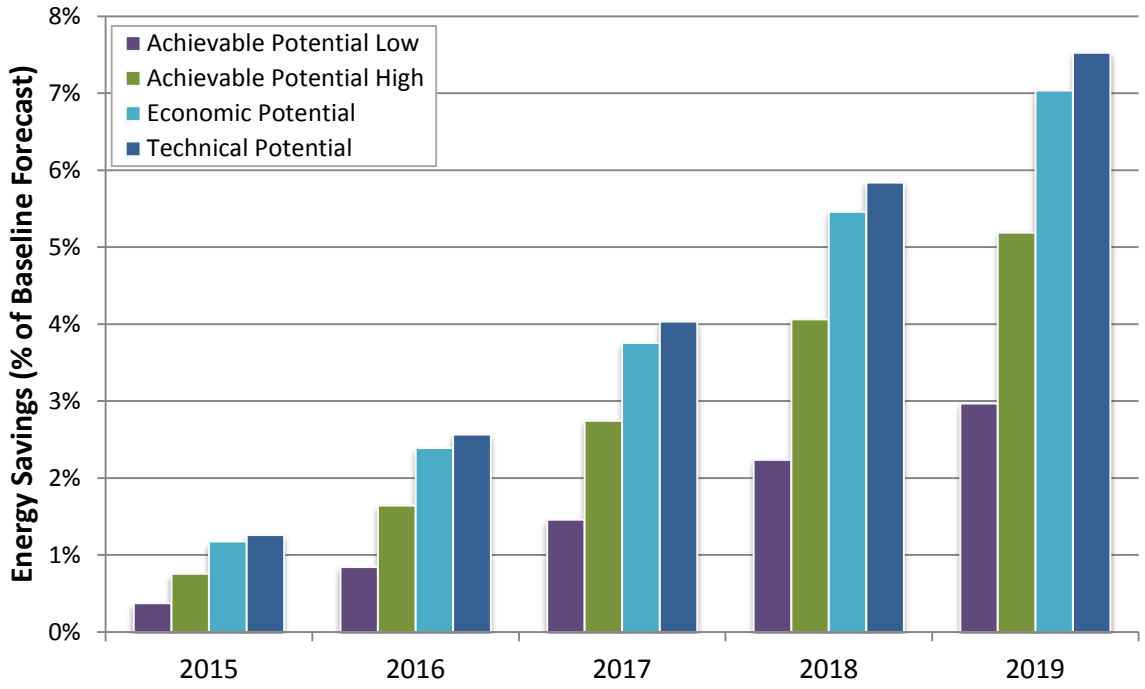
The Vectren industrial sector accounts for 51% of total energy consumption, making for prime efficiency opportunities. Table 7-9 and Figure 7-5 present the savings for the various types of potential considered in this study.

- **Achievable Low potential** projects 11 GWh of energy savings in 2015 and 87 GWh in 2019. This corresponds to 0.4% of the baseline forecast in 2015 and 3.0% in 2019.
- **Achievable High potential** is 22 GWh in 2015, which represents 0.8% of the baseline forecast. By 2019, the cumulative energy savings are 153 GWh, 5.2% of the baseline forecast.
- **Economic potential**, which reflects the savings when all cost-effective measures are taken, is 34 GWh in 2015. This represents 1.2% of the baseline energy forecast. By 2019, economic potential reaches 207 GWh, 7.0% of the baseline energy forecast.
- **Technical potential,** which reflects the adoption of all energy efficiency measures regardless of cost, is a theoretical upper bound on savings. In 2015, energy savings are 36 GWh, or 1.3% of the baseline energy forecast. By 2019, technical potential reaches 221 GWh, 7.5% of the baseline energy forecast.

Table 7-9 Electric Efficiency Potential for the Industrial Sector

	2015	2016	2017	2018	2019
Energy Forecasts (GWh)	**2,863**	**2,877**	**2,896**	**2,922**	**2,943**
Cumulative Energy Savings (GWh)					
Achievable Low Potential	11	24	42	65	87
Achievable High Potential	22	47	79	119	153
Economic Potential	34	69	109	160	207
Technical Potential	36	74	117	171	221
Energy Savings (% of Baseline Forecast)					
Achievable Low Potential	0.4%	0.8%	1.5%	2.2%	3.0%
Achievable High Potential	0.8%	1.6%	2.7%	4.1%	5.2%
Economic Potential	1.2%	2.4%	3.8%	5.5%	7.0%
Technical Potential	1.3%	2.6%	4.0%	5.8%	7.5%

Figure 7-5 Industrial Electric Potential Savings



Industrial Electric Potential by Market Segment

Table 7-10 shows electric energy efficiency potential for the four industrial segments in 2017. Table 7-11 shows the Achievable Low savings by end use and market segment in 2017.

Table 7-10 Industrial Electric Potential by Market Segment, 2017

	Transportation	Other Industrial	Chemicals	Plastics	Total
Baseline Forecast (GWh)	**294**	**822**	**465**	**1,314**	**2,896**
Cumulative Savings (GWh)					
Achievable Low Potential	4	13	7	19	**42**
Achievable High Potential	7	25	13	35	**79**
Economic Potential	10	35	16	48	**109**
Technical Potential	11	38	17	51	**117**
Savings as % of Baseline					
Achievable Low Potential	1.27%	1.60%	1.43%	1.42%	1.46%
Achievable High Potential	2.40%	3.02%	2.69%	2.66%	2.74%
Economic Potential	3.37%	4.22%	3.51%	3.63%	3.75%
Technical Potential	3.69%	4.57%	3.71%	3.89%	4.03%

Table 7-11 Industrial Electric Achievable Potential Low by End Use and Market Segment, 2017

End Use	Transportation	Other Industrial	Chemicals	Plastics	Total
Cooling	0.62	2.18	0.31	1.48	4.58
Heating	0.11	0.40	0.06	0.27	0.84
Ventilation	0.09	0.33	0.05	0.23	0.70
Int. Lighting	1.26	4.04	0.55	3.22	9.08
Ext. Lighting	0.04	0.12	0.02	0.10	0.27
Motors	1.27	5.27	5.06	9.88	21.49
Process	0.35	0.82	0.61	3.48	5.26
Miscellaneous	-	-	-	-	-
Grand Total	**3.74**	**13.17**	**6.66**	**18.66**	**42.23**

Industrial Electric Potential by End Use

Table 7-12 provides estimates of savings for each end use and type of potential. Not surprisingly, the largest savings opportunities are found in motors and drives.

Table 7-12 Industrial Electric Potential by End Use and Potential Type (GWh)

End Use	Potential	2015	2017	2019
Cooling	Achievable Low Potential	1.13	4.58	8.52
	Achievable High Potential	2.28	8.65	14.96
	Economic Potential	3.77	12.04	20.83
	Technical Potential	3.96	12.70	21.87
Heating	Achievable Low Potential	0.20	0.84	1.76
	Achievable High Potential	0.40	1.59	3.09
	Economic Potential	0.53	1.88	3.70
	Technical Potential	0.61	2.16	4.08
Ventilation	Achievable Low Potential	0.19	0.70	1.35
	Achievable High Potential	0.42	1.45	2.67
	Economic Potential	2.31	6.41	10.02
	Technical Potential	2.44	6.89	10.93
Interior Lighting	Achievable Low Potential	2.59	9.08	23.59
	Achievable High Potential	5.32	17.11	41.13
	Economic Potential	8.58	22.04	46.85
	Technical Potential	9.06	24.03	50.62
Exterior Lighting	Achievable Low Potential	0.11	0.27	0.44
	Achievable High Potential	0.22	0.54	0.84
	Economic Potential	0.31	0.71	1.12
	Technical Potential	0.54	1.67	3.22
Motors	Achievable Low Potential	5.09	21.49	42.38
	Achievable High Potential	10.23	40.37	73.95
	Economic Potential	14.69	53.68	103.18
	Technical Potential	14.94	54.07	103.20
Process	Achievable Low Potential	1.41	5.26	9.34
	Achievable High Potential	2.78	9.74	16.08
	Economic Potential	3.52	11.89	21.27
	Technical Potential	4.11	13.83	24.63
Miscellaneous	Achievable Low Potential	-	-	-
	Achievable High Potential	-	-	-
	Economic Potential	-	-	-
	Technical Potential	-	-	-
Total	Achievable Low Potential	**10.72**	**42.23**	**87.38**
	Achievable High Potential	**21.66**	**79.44**	**152.72**
	Economic Potential	**33.71**	**108.65**	**206.97**
	Technical Potential	**35.66**	**115.35**	**218.55**

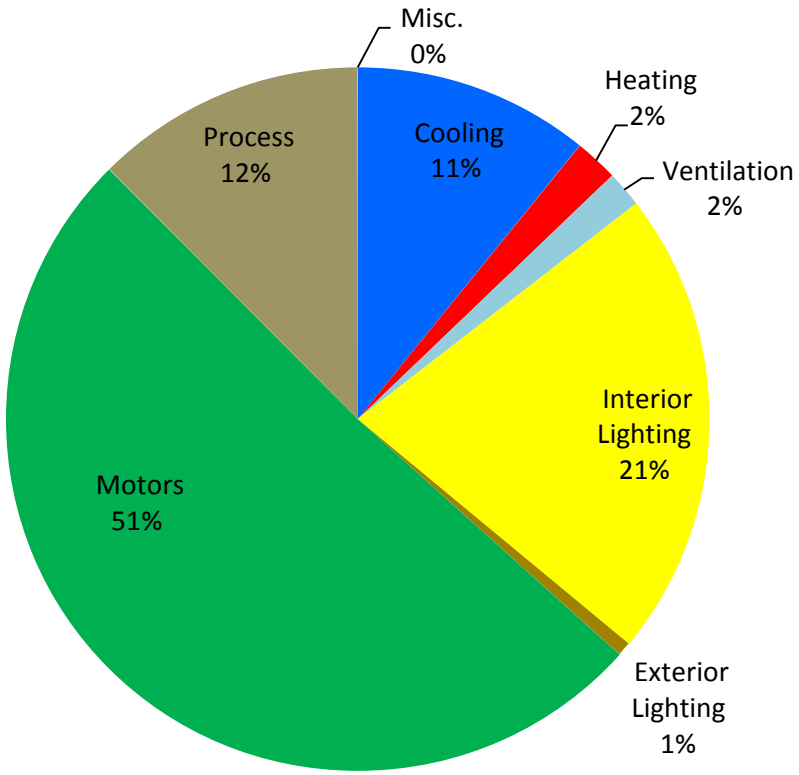
Figure 7-6 illustrates the achievable potential savings by electric end use in 2017 for the industrial sector. The largest shares of savings opportunities are in the motors and machine drives. Potential savings for straight motor equipment change-outs are being eliminated due to the National Electrical Manufacturer's Association (NEMA) standards, which now make premium efficiency motors the baseline efficiency level. As a result, potential savings are incrementally small to upgrade to even more efficient levels. All the savings opportunities in this end use come from controls, timers, and variable speed drives, which improve system efficiencies where motors

are utilized. These system-level measures and upgrades are also applicable to a large swath of applications for heating, cooling, and electrochemical processes. Since the plastics industry is so prominent in the Vectren service territory, measures such as injection molding barrel insulation are very promising sources of potential savings.

Beyond motors and processes, there are large opportunities for savings in lighting and cooling; and smaller opportunities in ventilation and space heating. Detailed measure information is available in the Volume 3 Appendices. The key measures comprising the potential are listed below:

- Motors – drives and controls
- Process – timers and controls
- Application optimization and control – fans, pumps, compressed air
- Efficient high bay lighting
- Efficient ventilation systems
- Energy management systems & programmable thermostats

Figure 7-6 Industrial Achievable Low Electricity Potential Savings by End Use in 2017



PROGRAM POTENTIAL AND ACTION PLAN

The Action Plan is the heart of the study. This is where the multitude of energy efficiency measures covered in previous chapters get bundled into delivery mechanisms to take on the form of specific energy efficiency programs. Several changes and adjustments occur in the translation from the market potential assessment to the program designs in the Action Plan, as the measure mix may change due to program delivery considerations. Table 8-1 below lists the distinct programs that emerge from this exercise to deliver an effective and balanced portfolio of energy savings opportunities across all customer segments.

Table 8-1 Portfolio of Energy Efficiency Programs Included in Action Plan

Residential Programs	Commercial & Industrial Programs
Lighting	Prescriptive
Efficient Products	Custom Incentives
Income Qualified Weatherization (IQW)	Schools Program
IQW Plus	Strategic Energy Management (SEM)
New Construction	Business & Multi Family New Construction
Multi Family Direct Install	Small Business Direct Install
Home Energy Assessment	
School Kit	
Whole House Plus	
Appliance Recycling	
Behavioral Feedback Tools	

Programmatic Framework

Each program contemplates and outlines a programmatic framework for administrators and implementers. The items considered and developed for this framework include those listed below. Detailed write-ups delve into the specific recommendations for each program in Volume 4 of this report.

- Target market
- Implementation strategy, including delivery channels, marketing, education and outreach
- Program issues, risks and risk management strategies
- Eligible measures and incentives
- Evaluation, measurement and verification requirements and guidance
- Administrative requirements
- Estimated participation
- Program budget
- Program energy savings and demand reduction
- Cost effectiveness

The state of Indiana has mandated efficiency targets for regulated electric utilities, specifying that they reach certain levels of savings by implementing a required set of programs, known as Core programs, and that they should make up any shortfall between the targets and the Core program savings with a flexible or optional set of Core Plus programs, which can be designed to suit each utility. The Residential Lighting, Income Qualified Weatherization, Home Energy Assessment, School Kit, and Business Prescriptive programs are Core programs; and the remainder are Core Plus. These distinctions are outlined later in the program highlights and descriptions.

The total amount of energy efficiency savings required by the state targets, in gross incremental savings per year, is shown as a percent of the baseline forecast in Table 8-2 below.

Table 8-2 Indiana State Goals, Gross Incremental Electricity Savings as % of Baseline

2015	2016	2017	2018	2019
1.30%	1.50%	1.70%	1.90%	2.00%

Using Achievable High and Achievable Low as Guidelines

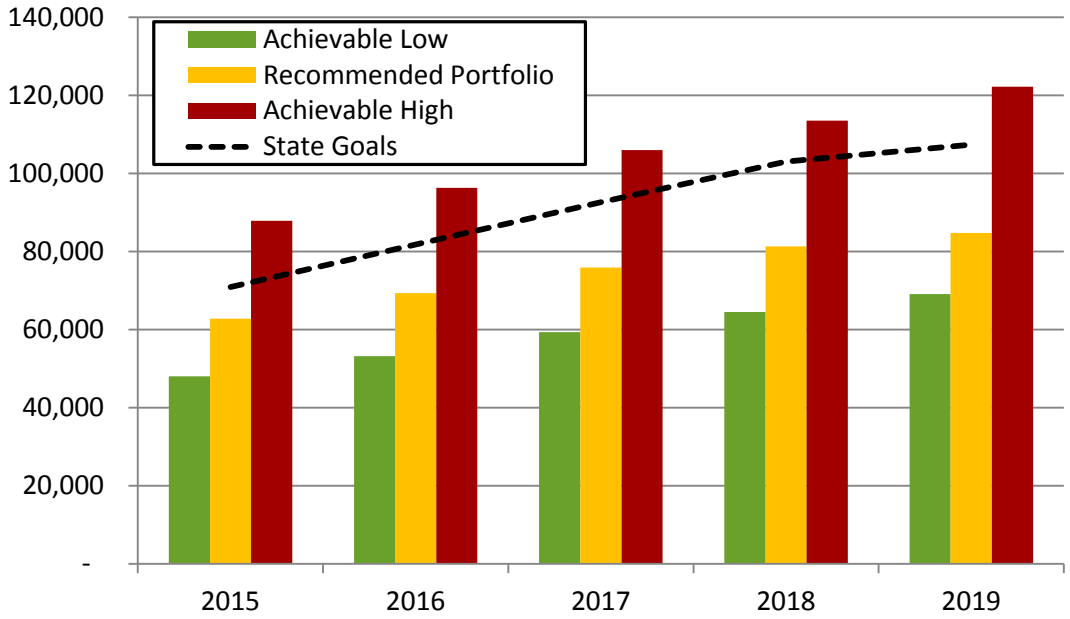
The first step toward creating the recommended Action Plan was to create two separate scenarios that corresponded to the measure-level energy efficiency potentials assessed in the previous chapter: Achievable Low and Achievable High. After applying all the delivery and cost structures, each of the Low and High portfolios resulted in a set of program potential savings and estimated budgets.

These portfolios provided guidelines, allowing us create the Recommended Action Plan by interpolating between Low and High, optimizing to consider the Indiana state goals, past program experience, industry benchmarks, and feedback from Vectren and Stakeholders.

Figure 8-1 below shows the resulting Gross MWh savings per year for the three separate portfolios, along with a black, dotted line indicating the level of the state goals. Note that the recommended portfolio is not able to meet the state goals in any year. Note also that the savings on this chart are in terms of Gross incremental savings since the Indiana goals are expressed as such, and that all other potential savings in this report are given in terms of Net incremental or Net cumulative savings.[12]

[12] Utilities typically have a small subset of large commercial and industrial customers that comprise a disproportionate share of load and demand. In Vectren's case, there is one particular industrial customer that comprises a full 24% of the C&I load. If this customer were not to participate in EE programs, the savings potential would drop commensurately in the C&I sectors, which would remove approximately 15% from the overall savings potential in all sectors.

Figure 8-1 Gross Incremental Electricity Savings (MWh)



To provide an indication of the relative level of program effort between the three portfolios and how the recommended portfolio was reached, key indicators are provided in Table 8-3 below. The remainder of this report focuses on the delivery of the Recommended Portfolio specifically, and further details of the Achievable Low and Achievable High program portfolios are available in the analysis workpapers.

Table 8-3 Recommended Portfolio, Key Indicators Compared to Achievable Low and High

	RECOMMENDED	Achievable Low	Achievable High
Res Lighting	**$7M spend 2015-2019**	$5M spend 2015-2019	$10M spend 2015-2019
Res Efficient Products	**$2M spend 2015-2019**	$1M spend 2015-2019	$2M spend 2015-2019
Res IQW	**5,000 HH, 2015-2019**	4,000 HH, 2015-2019	5,000 HH, 2015-2019
Res IQW Plus	**$1M spend 2015-2019**	$1M spend 2015-2019	$2M spend 2015-2019
Res NC	**$0.5M spend 2015-2019**	$1M spend 2015-2019	$2M spend 2015-2019
Res MF Direct Install	**1,400 HH 2015-2016**	1,250 HH 2015-2016	1,400 HH 2015-2016
Res HEA	**23,000 HH 2015-2019**	20,000 HH 2015-2019	26,000 HH 2015-2019
Res School Kit	**3,000 kits/year**	2,000 kits/year	3,500 kits/year
Res Whole House Plus	**$5M spend 2015-2019**	$3M spend 2015-2019	$6M spend 2015-2019
Res Appliance Recycling	**~1200 units/year (fridges + freezers)**	~1400 units/year	~2800 units/year
Res Behav Feedback	**25,000 All-Electric HH/yr**	25,000 All-Electric HH/yr	75,000 HH/yr
Bus Prescriptive	**$15M spend 2015-2019**	$9M spend 2015-2019	$24M spend 2015-2019
Bus Custom Incentives	**$18M spend 2015-2019**	$18M spend 2015-2019	$43M spend 2015-2019
Bus Schools Program	**$2M spend 2015-2019**	$1M spend 2015-2019	$3M spend 2015-2019
Bus SEM	**$1M spend 2015-2019**	$2M spend 2015-2019	$2M spend 2015-2019
Bus Retrocomissioning	**Removed, not recommended for area**	<$1M spend 2015-2019	$1M spend 2015-2019
Bus & MF NC	**$2M spend 2015-2019**	$1M spend 2015-2019	$3M spend 2015-2019
Bus Direct Install	**Boosted to $5M spend 2015-2019**	$2M spend 2015-2019	$3M spend 2015-2019

Recommended Program Action Plan

While the economic potential shown in the Action Plan meets the aggressive Indiana state goals, the recommended program Action Plan falls short. Figure 8-2 shows the net incremental energy savings in each year of the study by program. Figure 8-3 shows the annual budgets for the portfolio. Note again that the savings presented here are Net, and not Gross.

Figure 8-2 Recommended Action Plan - Net Incremental Energy Savings (MWh)

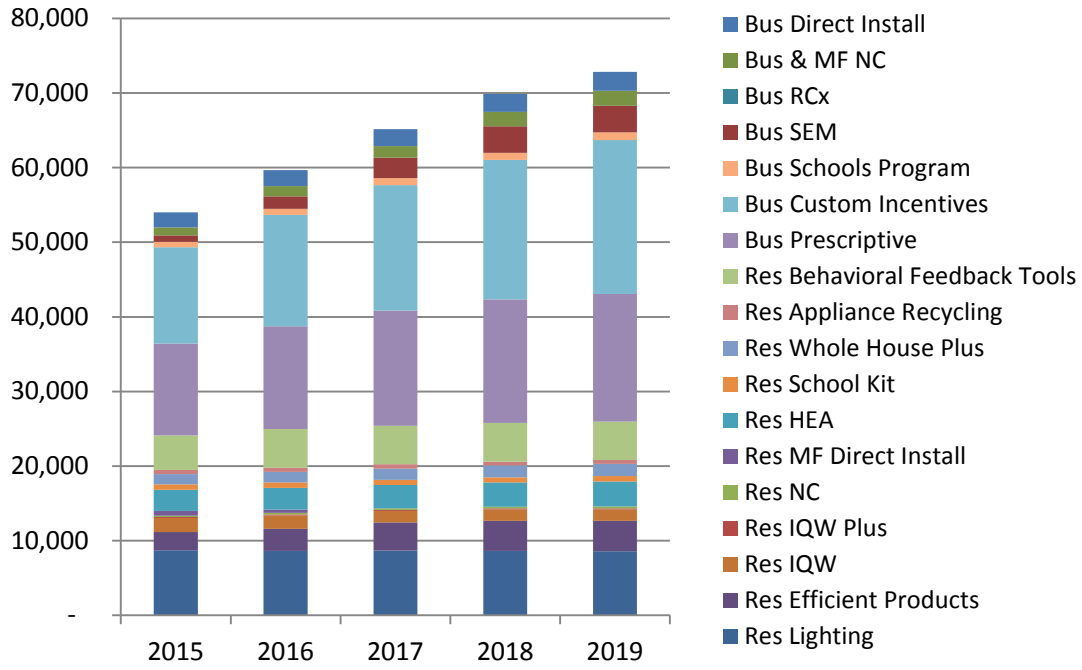


Figure 8-3 Recommended Action Plan - Annual Utility Budgets

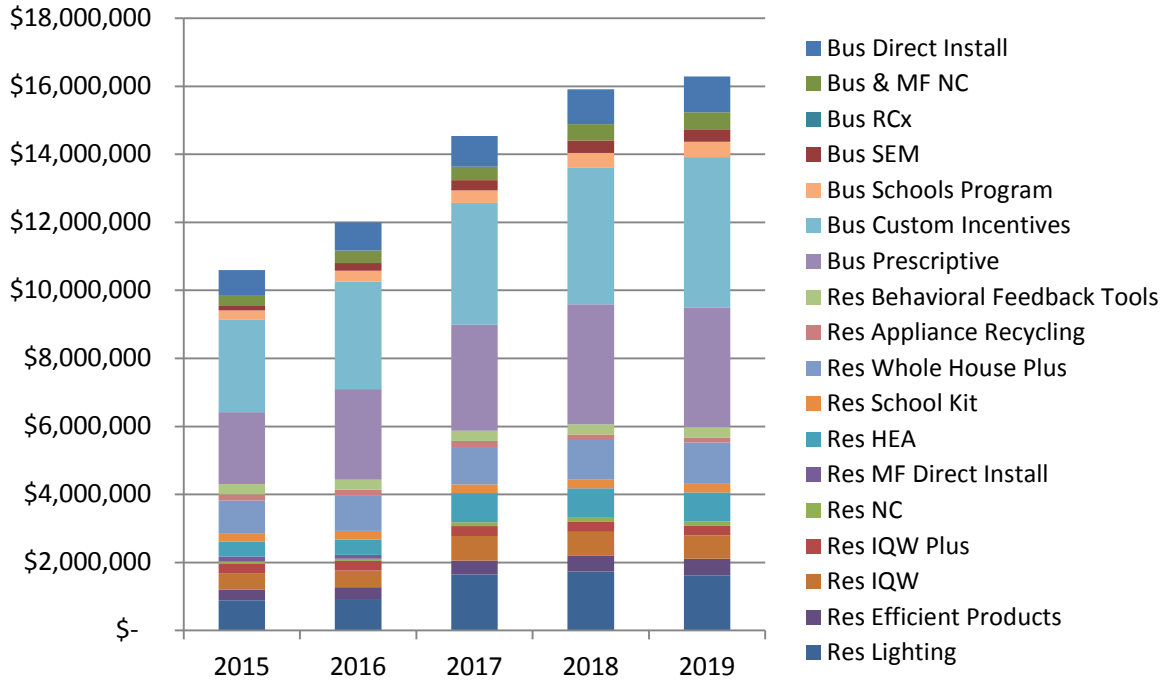


Table 8-4 below shows the detailed annual savings and budgets for the recommended portfolio.

Table 8-4 Vectren Recommended Electric Energy Efficiency Portfolio Summary

Program	Total Utility Costs (000$)					Total Net Incremental Energy Savings (MWh)					Total Net Incremental Demand Savings (kW)				
	2015	2016	2017	2018	2019	2015	2016	2017	2018	2019	2015	2016	2017	2018	2019
Res Lighting	891	924	1,648	1,737	1,619	8,738	8,642	8,696	8,621	8,590	525	520	523	518	516
Res Efficient Products	309	349	406	455	496	2,425	2,957	3,773	4,061	4,096	259	310	385	420	438
Res IQW	491	491	728	712	680	1,876	1,799	1,527	1,517	1,518	116	112	95	94	94
Res IQW Plus	282	282	291	291	291	142	141	144	143	142	88	87	87	86	86
Res NC	57	64	107	116	119	193	193	220	236	248	24	26	29	32	35
Res MF Direct Install	146	115	-	-	-	610	448	-	-	-	44	32	-	-	-
Res HEA	434	452	861	872	855	2,846	2,911	3,092	3,218	3,354	138	140	149	155	161
Res School Kit	252	252	252	252	252	741	726	721	715	711	132	131	130	130	130
Res Whole House Plus	966	1,037	1,105	1,163	1,213	1,343	1,426	1,507	1,579	1,646	936	994	1,049	1,100	1,146
Res Appliance Recycling	174	174	174	165	155	561	561	561	528	495	143	143	143	135	126
Res Behavioral Feedback Tools	300	300	300	300	300	4,659	5,177	5,177	5,177	5,177	1,299	1,443	1,443	1,443	1,443
Bus Prescriptive	2,120	2,660	3,119	3,527	3,510	12,310	13,774	15,438	16,535	17,112	8,088	9,683	11,231	14,842	13,627
Bus Custom Incentives	2,725	3,157	3,578	4,025	4,426	12,906	14,891	16,801	18,698	20,595	8,027	9,329	10,587	11,946	13,206
Bus Schools Program	268	324	372	422	454	719	839	919	938	1,027	110	135	155	174	192
Bus SEM	150	225	298	373	373	832	1,663	2,757	3,589	3,589	141	281	495	635	635
Bus & MF NC	298	364	395	479	493	1,109	1,386	1,530	1,902	2,009	587	725	749	960	939
Bus Direct Install	737	826	908	1,025	1,056	1,977	2,134	2,278	2,399	2,526	648	720	797	925	982
Residential Total:	4,301	4,440	5,872	6,062	5,979	24,134	24,981	25,418	25,795	25,977	3,704	3,938	4,034	4,113	4,175
Business Total:	6,298	7,557	8,669	9,851	10,311	29,851	34,686	39,723	44,060	46,857	17,602	20,873	24,013	29,482	29,581
Portfolio Total:	**10,599**	**11,996**	**14,542**	**15,913**	**16,290**	**53,986**	**59,667**	**65,140**	**69,855**	**72,834**	**21,306**	**24,811**	**28,047**	**33,596**	**33,757**

Below are summary highlights of the programs we recommend for delivery. As mentioned above, detailed write-ups are available in Volume 4 of this report.

Residential Programs

- **Res Lighting**

  This program emphasizes standardized rebates, and upstream buydowns, with a market transformation focus. The concentration will mainly be on CFL lighting. It should be noted that the number of general purpose bulbs decreases over the timeframe due to lower savings, the increasing efficiency of the baseline technology due to the EISA 2007 legislation, and increased market transformation. Meanwhile, the number of specialty bulbs delivered by the program increases over the same period, as these are not "general service bulbs" to which the EISA legislation is limited.

  Another highlight is the emergence of LED lighting as a cost-effective measure in certain residential applications, such as outdoor lighting where there are longer hours of operation that allow a more rapid payback. LED technology costs are declining very quickly, and they become cost effective in 2017 for the residential sector in our models.

  The lighting portion of this program is a Core program, required by the Indiana Utility Regulatory Commission (IURC) generic order.

- **Res Efficient Products**

  This program emphasizes standardized rebates, and upstream buydowns, with a market transformation focus. We recommend this as a new, Core Plus program in 2015 to expand the current measure offerings in an attempt to meet aggressive savings targets.

  The measure list includes an electronics program, computers, TV's, set-top boxes, ceiling fans, and Energy Star room air conditioners and dehumidifiers.

  This is a Core Plus program

- **Income Qualified Weatherization**

  This program provides education and a suite of electric efficiency measures to help income qualified customers reduce their energy bills. These customers are defined as those living in geographic census blocks with an average household income at or below 200% of the federal poverty level.

  Full installation of direct-install measures is subsidized and provided to the residents, therefore full measure costs are used in the analysis rather than incremental measure costs. Coverage is targeted at 1,000 households per year.

  Measures in this program are primarily CFLs and low-flow water fixtures.

  This particular program is not highly cost-effective, but consensus agreement around the nation is that this is OK for income-limited populations, as long as the overall portfolio is still cost-effective.

  This is a Core program required by the IURC generic order.

- **Income Qualified Weatherization Plus**

  This program is a set of expanded, highly-subsidized, follow-on measures available to customers qualifying for the IQW Core program that wish to expand their energy savings beyond the set of Core measures. This will capitalize on the customer touches garnered by the Core program and attempt to achieve higher savings.

  Measures in this program are building shell infiltration control, insulation, programmable thermostats, duct repair & sealing, smart power strips, and whole-house fans.

This particular program is not highly cost-effective, but consensus agreement around the nation is that this is OK for income-limited populations, as long as the overall portfolio is still cost-effective.

This is a Core Plus program.

- **Residential New Construction**

  This program, starting in 2015, is designed to accelerate the incorporation of energy efficient design, construction, and operation in new residential buildings. It provides education and incentive payments to upstream designer-builders and owner-builders for installing high efficiency end-use equipment and building envelope measures. Under it, different “tiers” or “packages” of building performance receive tiered incentives.

  This is a Core Plus program.

- **Multi Family Direct Install**

  This program provides targeted, highly cost-effective measures to multifamily households in a quickly deployable program delivery mechanism. These are often rental units with split-landlord-and-renter barrier, i.e., the owner of the equipment does not pay the energy bills. It is therefore typically an underserved market with respect to energy efficiency programs and an important program to include in the portfolio.

  Current measures in this program are primarily CFLs and low-flow water fixtures. Full installation of these direct-install measures is provided, therefore full measure costs are used rather than incremental measure costs. We recommend offering an expanded set of measures in 2015 and beyond include insulation, programmable thermostats, duct repair & sealing, etc. delivered in follow-up touches by a network of qualified trade allies and contractors. These expanded measures would not be fully paid for, like the direct install measures, by the program.

  The target participation in this program will be 800 households in 2015 and decreasing to 600 in 2016. After 2016, it is anticipated that the market for additional multifamily units will be exhausted, and therefore we recommend that this program be shuttered in 2017 and beyond, pending market conditions as that time gets closer.

  This is a Core Plus program.

- **Home Energy Assessment**

  This program provides education and a suite of electric efficiency measures to help single family customers reduce their energy bills.

  Current measures in this program are direct installations of CFLs and low-flow water fixtures. The initial target is 4,200 households in 2015, ramping up gradually to 5,000 households in 2019.

  This program is a prime candidate for cross-selling into other programs and measures, chiefly the Whole House Plus Program.

  This is a Core program required by the IURC generic order.

- **School Kit**

  Under this program, an educational module is provided to 5th graders, along with a take-home kit of energy efficiency measures (CFLs, low-flow water fixtures, an air filter alarm, and an LED nightlight). It is a program goal that education and awareness permeates into the home through the children and effects the behaviors and purchase decisions of their parents, as well as those of the children in the future. 3,000 kits will be distributed each year.

  This is a Core program required by the IURC generic order.

- **Whole House Plus**

  This is a new program we recommend which offers an expanded set of whole house measures delivered primarily by contractors and trade allies in 2015 and beyond. Measures include efficient air conditioning equipment, insulation, programmable thermostats, duct repair & sealing, etc.

  Stringent codes and standards make the cost-effectiveness of this program challenging. It is not cost-effective on a standalone basis, and must be included in the portfolio view to merit its inclusion. Having an expanded program like this is a key strategy to reach deeper savings for the strong subset of customers that would want to pursue additional savings after participating in other Vectren programs such as the Efficient Products or the Home Energy Assessment programs.

  This is a Core Plus program.

- **Appliance Recycling**

  This program pursues energy savings by offering a bounty payment to customers to remove their old, inefficient appliances from the grid and recycle them. It has the potential to deliver large savings available from two cost-effective measures: secondary refrigerators and freezers.

  One concern with this program is the possibility that after program pick-up of their secondary refrigerator, residents might simply buy a new unit and move their former primary unit into the garage or basement to replace it. This is why the program is penalized with a challenging net-to-gross ratio.

  This is a Core Plus program.

- **Behavioral Feedback Tools**

  This program uses energy reports sent periodically to customers to give them self-awareness and a peer comparison of their energy usage. Social competitiveness effects increase efficient behaviors to reduce energy consumption. This produces a statistically measurable energy reduction effect in a treatment group (vs. a control group that does not receive the reports).

  Our modeling assumes 0.9% electric savings for single family households in 2015, rising to 1.0% savings in 2016 through 2019 to account for increased awareness and engagement with the program.

  It is important to note that this initiative was added at the program design stage, and was not included in our bottom-up, measure level potential analysis from Chapters 6 and 7. This is due to the fact that it is not a specific action or piece of equipment, per se, as well as the fact that it does not go through the typical customer-adoption modeling that other measures encounter. The program is simply delivered to as many participants as is deemed feasible by the planners.

  This program should be monitored carefully, as it is a new and emerging opportunity. Relatively little is known about the specific actions that customers perform to reduce their energy usage in this program, and it may undergo meaningful change in customer responsiveness and evaluation paradigms in the coming years.

  Measure life and persistence is also a key issue: behavioral effects only continue while the reports are being provided, and measured effects decay over a period of several months after the reports stop coming. Therefore, savings must be continually renewed each year with additional cost and effort, whereas the savings from a capital equipment measure can last 10 to 20 years once initially installed. This makes for relatively low-cost energy savings when considered on a first-year basis, but relatively high-cost energy savings on a lifetime or levelized cost basis.

The recommended portfolio action plan calls for participation of 25,000 customers encompassing only those households with electric heat and water heat and thereby capturing a larger electricity consumption base and larger energy savings. There are approximately 75,000 customers available for participation, but the relatively low levels of engagement and behavior modifications to-date have made cost-effectiveness challenging. Removal of the program was contemplated, but it provides a relatively large amount of incremental or first-year savings. Given the very aggressive state goals, we recommend that the program continue in one form or another if cost-effectiveness can be achieved. Our analysis shows the TRC ratio for the program in this configuration as 1.18. It is also an excellent platform to educate and engage customers and cross-sell other portfolio offerings.

This is a Core Plus program.

Commercial & Industrial Programs

- **Prescriptive Rebate**

  This program is designed to help non-residential customers save energy through a broad range of EE options that address all major end uses and processes. It offers incentives to customers and engages equipment suppliers and contractors to promote the incentive-eligible equipment, focusing on standardized rebates, upstream buydowns, and market transformation.

  Together with Bus Custom Incentives, this is where a bulk of program savings and dollars are focused. Business energy efficiency efforts are very project-centric, with many large projects participating in a hybrid of standard, prescriptive rebates and custom project incentives. Thus, delivery is integrated in many ways between the two programs.

  It is worth noting that LED lighting is already a cost-effective measure in many non-residential applications due to the typically longer hours of operation that allow a more rapid payback. LED technology costs are declining very quickly, and will become a larger and larger part of the business programs in the coming years.

  This is a Core program required by the IURC generic order.

- **Custom Incentives**

  This program is designed to help non-residential customers save energy through customizable projects that are too complex to fit in standard rebate offering.

  Together with Bus Prescriptive, this is where a bulk of program savings and dollars are focused. Business energy efficiency efforts are very project-centric, with many large projects participating in a hybrid of standard, prescriptive rebates and custom project incentives. Thus, delivery is integrated in many ways between the two programs.

  This is a Core Plus program.

- **Schools Program**

  This program is essentially a combination of the Business Prescriptive and Custom Incentives programs that is targeted toward public schools. It offers an audit and assessment, followed by the opportunity to install efficiency measures for school buildings. It also includes some direct install measures during the audit such as lighting, maintenance, and programmable thermostat.

  This program does not pass the TRC in our analysis, but is a a Core program required by the IURC generic order and has only a minor effect on the overall portfolio TRC, so it is still included in the recommended action plan.

- **Strategic Energy Management**

  Strategic Energy Management (or SEM) involves energy education, advising, and coaching for non-residential customers to drive behavioral change and transformation of company culture toward improved energy efficiency and utilization. This means the appointment of energy liaisons and teams within participating organizations who will regularly correspond with program representatives. Institutionalizing internal policies and practices this way creates longer-lasting behavioral-based savings than residential behavioral programs.

  This program is a new recommendation, and is therefore planned to begin in 2015 to allow time to ramp up and conduct more detailed program planning.

  This is a Core Plus program.

- **Business & Multi Family New Construction**

  This program, starting in 2015, is designed to accelerate the incorporation of energy efficient design, construction, and operation in new business and multi family residential buildings. It provides education and incentive payments to upstream designer-builders and owner-builders for installing high efficiency end-use equipment and building envelope measures. Under it, different “tiers” or “packages” of building performance receive tiered incentives.

  The multifamily component of this program is mean to specifically address the hybrid nature of this market, which contains many aspects of both residential and commercial construction. Such a specialized program would target the particular needs of these customers.

  This is a Core Plus program.

- **Small Business Direct Install**

  This program provides targeted, highly cost-effective measures to small business customers in a quickly deployable program delivery mechanism to help them reduce their energy bills and foster awareness and cross-selling of other efficiency portfolio efforts.

  Measures include lighting replacements, pre-rinse sprayers, programmable thermostats, pipe wrap, vending machine controls, smart power strips, etc. The program goal is to deploy a network of qualified trade allies and contractors that can install these measures quickly and free of charge to participants. The program aims to perform a site assessment and implementation of measures on the same day.

  Special outreach and program focus is given to not-for-profit businesses. They will be provided with enhanced education and training and more attractive rebate rates for follow-on measures.

  This is a Core Plus program.

Omitted Programs

- **Retrocommissioning**

  This program involves the initial, periodic, or continual monitoring and commissioning of building energy systems such as heating, cooling, ventilation, and lighting in order to optimize energy consumption relative to actual building usage.

  This program is not cost-effective in our analysis. The Vectren service territory does not contain a heavy concentration of the customer types that are prime candidates for a program such as this: office buildings, hospitals, universities, etc. It is our recommendation that if singular retrocommissioning projects are attractive with particular customers that they can be run through the Business Custom program.

Cost Effectiveness

With the program savings and budgets, we perform the industry standard cost-effectiveness tests to gauge the economic merits of the portfolio. Each test compares the benefits of the EE programs to their costs – using its own unique perspectives and definitions – all defined in terms of net present value of future cash flows. The definitions for the four standard tests most commonly used in EE program design are described below.

- **Total Resource Cost test (TRC).** The benefits in this test are the lifetime avoided energy costs and avoided capacity costs. The costs in this test are the incremental measure costs plus all administrative costs spent by the program administrator.
- **Utility Cost Test (UCT).** The benefits in this test are the lifetime avoided energy costs and avoided capacity costs, the same as the TRC benefits. The costs in this test are the program administrator's incentive costs and administrative costs.
- **Participant Cost Test (PCT).** The benefits in this test are the lifetime value of retail rate savings (which is another way of saying "lost utility revenues"). The costs in this test are those seen by the participant; in other words: the incremental measure costs minus the value of incentives paid out.
- **Rate Impact Measure test (RIM).** The benefits of the RIM test are the same as the TRC benefits. The RIM costs are the same as the UCT, except for the addition of lost revenue. This test attempts to show the effects that EE programs will have on rates, which is almost always to raise them on a per unit basis. Thus, costs typically outweigh benefits from the point of view of this test, but the assumption is that absolute energy use decreases to a greater extent than per-unit rates are increased — resulting in lower average utility bills.

The cost effectiveness results for the Vectren Recommended Portfolio are shown in Table 8-5, sporting lifetime TRC benefits of $177 million dollars and costs of $92 million dollars for a robust TRC ratio of 1.92.

Table 8-5 Vectren Recommended Action Plan Cost Effectiveness summary

	TRC Ratio	TRC Benefits	TRC Costs	UCT Ratio	PCT Ratio	RIM Ratio
Res Lighting	1.47	$12,729,504	$8,638,583	2.33	7.39	0.44
Res Efficient Products	2.31	$5,767,547	$2,494,058	3.55	11.18	0.51
Res IQW	0.99	$2,475,435	$2,503,149	0.99	-	0.35
Res IQW Plus	0.56	$650,864	$1,166,742	0.56	-	0.35
Res NC	1.02	$453,989	$443,548	1.23	9.82	0.42
Res MF Direct Install	1.47	$383,335	$260,561	1.69	20.72	0.41
Res HEA	1.90	$5,286,017	$2,783,242	1.90	-	0.42
Res School Kit	1.14	$1,165,755	$1,024,230	1.14	-	0.38
Res Whole House Plus	1.07	$8,212,627	$7,653,155	1.85	2.47	0.66
Res Appliance Recycling	1.05	$723,032	$686,727	1.05	-	0.40
Res Behavioral Feedback Tools	1.18	$1,442,788	$1,220,290	1.18	-	0.42
Bus Prescriptive	2.06	$50,575,254	$24,584,518	4.21	3.91	0.83
Bus Custom Incentives	2.52	$70,292,200	$27,918,583	4.87	5.25	0.82
Bus Schools Program	0.69	$2,168,631	$3,155,364	1.46	1.96	0.45
Bus SEM	1.61	$1,821,203	$1,133,881	1.61	-	0.43
Bus & MF NC	2.06	$5,972,921	$2,896,189	3.66	5.04	0.75
Bus Direct Install	1.85	$6,808,569	$3,675,085	1.85	-	0.56
Residential Total:	1.36	$39,290,894	$28,874,285	1.83	8.54	0.47
Business Total:	2.17	$137,638,778	$63,363,620	4.00	4.87	0.78
Portfolio Total:	**1.92**	**$176,929,672**	**$92,237,905**	**3.17**	**5.61**	**0.68**

CONCLUSIONS AND RECOMMENDATIONS

The results of this study reveal that significant energy efficiency opportunities exist for Vectren in Southern Indiana, despite aggressive appliance and efficiency standards and a challenging macroeconomic environment.

Our program analysis shows that Vectren can achieve Net incremental electric energy savings of 53,986 MWh in 2015, increasing to 72,834 MWh in 2019. This equates to Gross incremental savings of 62,818 MWh in 2015 and 84,809 MWh in 2019, all by implementing the programs and measures presented in this report.

Vectren's energy-efficiency programs are relatively young compared to other programs in the nation, but have made significant impacts already and are building appreciable market momentum. Based on our market potential assessment and program design analysis, EnerNOC provides the following high-level recommendations for the portfolio. We fully expect that Vectren, the stakeholders, and the implementers will consider the plans and recommendations in this report now, at the outset of the forthcoming implementation cycle; and that they will adopt the elements that are appropriate, adjust the elements that fit differently when translated into the trenches and front lines of program delivery, and continue to revisit the report as a reference throughout the next years as situations and markets continue to change and evolve.

General Recommendations

- **Increase focus on non-residential programs:** Our study shows that a large portion of the program savings from energy efficiency efforts will come from the commercial and industrial sectors. Vectren has already begun to shift budget and focus toward the C&I sectors, as evidenced by budgeting trends in 2013 and 2014 as well as the primary market research conducted on large C&I customers as part of this study. Increasing program efforts in the C&I sectors will not only lead to harvesting larger EE savings, but to increased business competitiveness and decreased operating costs for customers. Additionally, these sectors offer larger projects, which can be attained and bundled more readily and efficiently.
- **Continued collaboration among stakeholders:** The discourse and information sharing between stakeholders, utilities, and EnerNOC on this study has been effective and transparent. Continuing this trend is of paramount importance to the future success of programs. It is essential to cultivate a mutual understanding of the dynamic nature of the energy efficiency industry due to its intrinsic linkage with human behavior and the customer mind. Ongoing interactions should be marked by an understanding of collaboration, flexibility, and continuous improvement.
- **Deliver electric and natural gas programs jointly when possible:** Vectren also has a broad array of natural gas energy efficiency programs to help its natural gas customers save on their gas bills. Administrative efficiencies and economies of scale can be reached with dual fuel program offerings in applicable programs like HEA and IQW, where both electric and gas savings can be obtained without creating duplicative, administrative cost structures. Further, Indiana's concept of a statewide Therm Bank provides an excellent platform to deliver joint electric and natural gas programs on a straightforward and highly cost-effective basis. In this paradigm, if it proves feasible and appropriate to management and to stakeholders, Vectren could share costs across its electric and gas programs to extend their reach and effectiveness.

Residential Recommendations

- **Focus on lighting:** The largest share of achievable energy efficiency potential in the residential sector continues to come from CFLs. This is in spite of the forthcoming EISA standards that will reduce their per-unit savings compared to the new baseline. Also, Vectren should focus strong attention on specialty lamps, as they are not affected by the EISA standard, and prepare for the entrance of LED lamps into their programs in the later years of the portfolio.
- **Implement and monitor behavioral feedback programs:** The behavioral modification program to be implemented by OPower is shown in the program plans to comprise a significant amount of Vectren's portfolio savings. This initiative was added at the program design stage, and was not included in our bottom-up, measure level potential analysis. This is due to the fact that it is not a specific action or piece of equipment, per se, as well as the fact that it does not go through the typical customer-adoption model that other measures encounter. The program is simply delivered to as many participants as the planners deem appropriate, and produces a statistically measured energy reduction effect in a treatment group (vs. a control group that does not receive the program treatment). It should be monitored carefully, however, as it is a new and emerging opportunity. Relatively little is known about the specific actions that customers perform to reduce their energy usage in this program, and it may undergo meaningful change in customer responsiveness and evaluation paradigms in the coming years. Additionally, savings under this program will not persist after the program is ended, and must be continually renewed each year with additional cost and effort, whereas the savings from a capital equipment measure can last 10 to 20 years.
- **Develop deeper, follow-on measures in existing programs:** Some current Vectren program delivery structures are pursuing low-cost measures through rapid customer touches with direct-install components only. We have recommended the addition of more deep, involved measures to capitalize on customer touches as much as possible. While you are in the home of a customer, it makes better sense to cross-sell these other measures and harvest as many energy savings as you can. This would include major equipment replacements and shell measures such as duct sealing and insulation.
- **Consider social media avenues for targeted program delivery:** As internet social media paradigms become the norm in today's wired society, companies like Groupon, Amazon Local Deals, and Living Social have assembled a nationwide network of businesses into a well-oiled, rebate-issuing machine. Vectren should consider if there are opportunities to link their energy efficiency trade ally network to one of these companies to facilitate the target marketing, processing, and delivery of rebates. These vendors have sophisticated tracking systems and databases that may facilitate EM&V reporting on the back end as well.

Commercial & Industrial Recommendations

- **Aggressively pursue lighting savings:** The commercial sector in particular has significant savings potential in lighting equipment, both interior and exterior. Notably, LED lamps are showing as cost effective in the commercial sector due to aggressive forecasts of cost reductions, as well as higher hours of operation than their non-economic counterparts in residential settings. Savings are also available through occupancy sensors, timers, and energy management systems. Vectren should strongly pursue lighting savings to accelerate the phase out of T12 fluorescent lighting. In particular, program efforts can help intercept building operators before they make purchase and stocking decisions that could lead to the hoarding of T12 lamps.
- **Focus industrial program efforts on motor controls and system optimizations**: The savings for the industrial sector are all about control and optimization of motors and processes. Low-cost retrofits can often have significant energy impacts with minimal disruption of (and often times improvement of) business processes.

- **Target niches with segment specific programs**: There are specific business segments that offer considerable savings potential, but will not typically be reached by standard rebates and generic business programs. Consider initiating specifically targeted sub-programs within business standard and custom for areas such as: hotels and lodging, food preparation equipment in restaurants, and refrigeration equipment in grocery stores.
- **Implement new programs:** We have identified additional programs that show promise to expand Vectren's portfolio of programs to address Indiana's aggressive statewide savings goals. These programs are as follows:
    1. *Strategic Energy Management*. For large customers, SEM initiatives can deliver substantial savings over long time horizons. This means coming alongside the larger customers to create a customized, multi-year plan, identify metrics, set goals, and provide technical assistance and attention from dedicated account executives or energy coaches.
    2. *Business and Multifamily New Construction*. A program to encourage more rapid adoption of efficient building design practices is a very relevant addition to the Vectren portfolio.

About EnerNOC

EnerNOC's Utility Solutions Consulting team is part of EnerNOC's Utility Solutions, which provides a comprehensive suite of demand-side management (DSM) services to utilities and grid operators worldwide. Hundreds of utilities have leveraged our technology, our people, and our proven processes to make their energy efficiency (EE) and demand response (DR) initiatives a success. Utilities trust EnerNOC to work with them at every stage of the DSM program lifecycle – assessing market potential, designing effective programs, implementing those programs, and measuring program results.

EnerNOC's Utility Solutions deliver value to our utility clients through two separate practice areas – Implementation and Consulting.

- Our Implementation team leverages EnerNOC's deep "behind-the-meter expertise" and world-class technology platform to help utilities create and manage DR and EE programs that deliver reliable and cost-effective energy savings. We focus exclusively on the commercial and industrial (C&I) customer segments, with a track record of successful partnerships that spans more than a decade. Through a focus on high quality, measurable savings, EnerNOC has successfully delivered hundreds of thousands of MWh of energy efficiency for our utility clients, and we have thousands of MW of demand response capacity under management.
- The Consulting team provides expertise and analysis to support a broad range of utility DSM activities, including: potential assessments; end-use forecasts; integrated resource planning; EE, DR, and smart grid pilot and program design and administration; load research; technology assessments and demonstrations; evaluation, measurement and verification; and regulatory support.

The team has decades of combined experience in the utility DSM industry. The staff is comprised of professional electrical, mechanical, chemical, civil, industrial, and environmental engineers as well as economists, business planners, project managers, market researchers, load research professionals, and statisticians. Utilities view EnerNOC's experts as trusted advisors, and we work together collaboratively to make any DSM initiative a success.

ELECTRIC DEMAND SIDE MANAGEMENT: MARKET POTENTIAL STUDY AND ACTION PLAN

Volume 3: Detailed Appendices: Market Potential Study

Report Number 1432

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MARKET PROFILES

Market profiles describe electricity use by sector, segment, end use and technology in the base year of the study (2011). The market profiles are given for average buildings and new vintages.

As explained in Chapter 2, a market profile includes the following elements:

- **Market size** is a representation of the number of customers in the segment. For the residential sector, it is number of households. In the commercial sector, it is floor space measured in square feet. For the industrial sector, it is number of employees.
- **Saturations** define the fraction of buildings with the specific technologies. (e.g., homes with electric space heating)
- **UEC (unit energy consumption) or EUI (energy-use index)** describes the amount of energy consumed in the base year by a specific technology in buildings that have the technology. We use UECs expressed in kWh/household for the residential sector, and EUIs expressed in kWh/square foot or kWh/employee for the commercial and industrial sectors respectively.
- **Intensity** for the residential sector represents the average energy use for the technology across all households in the base year. It is computed as the product of the saturation and the UEC and is defined as kWh/household for electricity. For the commercial and industrial sectors, intensity, computed as the product of the saturation and the EUI, represents the average use for the technology across all floor space or all employees in the base year.
- **Usage** is the annual energy use by a technology/end use in the segment. It is the product of the market size and intensity and is quantified in GWh for electricity.

This appendix presents the following market profiles:

- Residential market profiles by segment (Table A-1 through Table A-2)
- Commercial market profiles by building type (Table A-3 through Table A-13)
- Industrial market profiles (Table A-15 through Table A-18)

Table A-1 Single Family Electric Market Profile, 2011

		Average Market Profile				New Units			
End Use	**Technology**	**Saturation**	**UEC (kWh)**	**Intensity (kWh/HH)**	**Usage (GWh)**	**Saturation**	**UEC (kWh)**	**Intensity (kWh/HH)**	**Compared to Average**
Cooling	Central AC	80.6%	3,082.1	2,485.05	256.7	85.5%	2,335	1,995.68	-24%
Cooling	Room AC	9.1%	1,162.4	105.43	10.9	9.3%	998	92.36	-14%
Cooling	Air-Source Heat Pump	10.1%	2,431.3	245.04	25.3	11.1%	1,738	192.69	-29%
Cooling	Geothermal Heat Pump	0.1%	2,158.6	2.16	0.2	0.1%	2,028	2.03	-6%
Heating	Electric Resistance	6.4%	8,724.4	560.05	57.8	6.4%	6,548	420.33	-25%
Heating	Furnace	12.3%	9,160.6	1,127.06	116.4	12.3%	6,875	845.90	-25%
Heating	Air-Source Heat Pump	10.1%	9,226.5	627.54	64.8	11.1%	4,199	465.47	-33%
Heating	Geothermal Heat Pump	0.1%	3,559.1	3.56	0.4	0.1%	3,359	3.36	-6%
Water Heating	Water Heater <=55 gal	34.5%	2,144.3	1,085.47	112.1	36.2%	2,878	1,043.13	-8%
Water Heating	Water Heater > 55 gal	3.8%	3,351.6	128.56	13.3	4.0%	3,068	123.55	-8%
Interior Lighting	Screw-in	100.0%	1,068.7	1068.66	110.4	100.0%	1,149	1,148.56	7&
Interior Lighting	Linear Fluorescent	100.0%	123.6	123.60	12.8	100.0%	140	140.22	13%
Interior Lighting	Specialty	100.0%	473.9	473.94	49.0	100.0%	551	551.38	16%
Exterior Lighting	Screw-in	100.0%	260.3	260.30	26.9	100.0%	278	277.87	7%
Appliances	Clothes Washer	95.0%	70.0	66.48	6.9	96.9%	47	45.57	-33%
Appliances	Clothes Dryer	89.6%	538.3	482.41	49.8	92.3%	373	344.04	-31%
Appliances	Dishwasher	71.1%	291.3	207.02	21.4	73.2%	200	146.36	-31%
Appliances	Refrigerator	100.0%	756.1	756.10	78.1	100.0%	526	526.33	-30%
Appliances	Freezer	38.6%	602.3	232.33	24.0	39.7%	418	166.06	-31%
Appliances	Second Refrigerator	31.6%	792.6	250.19	25.8	32.5%	519	168.60	-35%
Appliances	Stove	67.9%	473.2	321.13	33.2	69.9%	473	330.81	0%
Appliances	Microwave	95.4%	112.1	106.91	11.0	97.3%	112	109.04	0%
Electronics	Personal Computers	71.2%	262.3	186.79	19.3	73.3%	270	197.81	3%
Electronics	Monitor	71.2%	52.2	37.17	3.8	73.3%	270	197.81	-3%
Electronics	Laptops	57.3%	113.0	64.79	6.7	59.1%	116	68.65	3%
Electronics	TVs	281.1%	213.3	599.45	61.9	289.5%	220	636.97	3%
Electronics	Printer/Fax/Copier	99.7%	40.2	40.07	4.1	102.7%	39	40.19	-3%
Electronics	Set-top Boxes/DVR	281.1%	135.5	308.81	39.3	289.5%	135	391.37	0%
Electronics	Devices and Gadgets	100.0%	60.0	60.00	6.2	103.0%	60	61.80	0%
Miscellaneous	Pool Pump	10.7%	1,500.0	160.71	16.6	10.7%	1,500	160.71	0%
Miscellaneous	Pool Heater	1.2%	4,981.0	59.30	6.1	1.2%	4,583	54.55	-8%
Miscellaneous	Hot Tub / Spa	4.9%	950.0	46.54	4.8	4.9%	950	46.54	0%
Miscellaneous	Well Pump	6.0%	561.0	33.39	3.4	6.0%	561	33.39	0%
Miscellaneous	Furnace Fan	73.4%	527.1	386.75	39.9	73.4%	526	386.07	0%
Miscellaneous	Miscellaneous	100.0%	17.4	17.39	1.8	100.0%	17	17.39	0%
Total				**12,792.2**	**1,321.3**			**11,272.0**	**-11.9%**

Table A-2 Multi Family Electric Market Profile, 2011

		Average Market Profile				New Units			
End Use	**Technology**	**Saturation**	**UEC (kWh)**	**Intensity (kWh/HH)**	**Usage (GWh)**	**Saturation**	**UEC (kWh)**	**Intensity (kWh/HH)**	**Compared to Average**
Cooling	Central AC	78.2%	1,042.2	815.46	16.0	82.9%	781	647.56	-25%
Cooling	Room AC	8.8%	435.9	38.37	0.8	9.0%	372	33.42	-15%
Cooling	Air-Source Heat Pump	9.8%	812.1	79.43	1.6	10.3%	581	59.66	-28%
Cooling	Geothermal Heat Pump	0.1%	674.1	0.67	0.0	0.1%	634	0.63	-6%
Heating	Electric Resistance	19.7%	2,777.2	548.12	10.8	19.7%	2,139	422.14	-23%
Heating	Furnace	31.6%	2,916.1	921.36	18.1	31.6%	2,246	709.59	-23%
Heating	Air-Source Heat Pump	9.8%	2,677.3	261.85	5.2	10.3%	1,806	185.49	-33%
Heating	Geothermal Heat Pump	0.1%	2,006.6	2.01	0.0	0.1%	1,895	1.90	-6%
Water Heating	Water Heater <=55 gal	55.0%	2,022.3	1,112.46	21.9	57.8%	1,853	1,070.38	-8%
Water Heating	Water Heater > 55 gal	6.1%	2,155.6	131.76	2.6	6.4%	1,975	126.77	-8%
Interior Lighting	Screw-in	100.0%	701.2	701.19	13.8	100.0%	764	763.73	9%
Interior Lighting	Linear Fluorescent	100.0%	103.7	103.66	2.0	100.0%	119	119.03	15%
Interior Lighting	Specialty	100.0%	294.1	294.11	5.8	100.0%	350	349.68	19%
Exterior Lighting	Screw-in	100.0%	113.2	113.24	2.2	100.0%	120	119.55	6%
Appliances	Clothes Washer	57.7%	59.9	34.59	0.7	58.9%	40	23.71	-33%
Appliances	Clothes Dryer	54.5%	478.5	260.90	5.1	56.2%	331	186.17	-31%
Appliances	Dishwasher	51.9%	291.3	151.26	3.0	53.5%	200	106.94	-31%
Appliances	Refrigerator	100.0%	755.8	755.83	14.9	100.0%	526	526.13	-30%
Appliances	Freezer	12.6%	602.1	76.1	1.5	13.0%	418	54.42	-31%
Appliances	Second Refrigerator	5.8%	616.3	35.50	0.7	5.9%	403	23.92	-35%
Appliances	Stove	87.4%	456.1	398.77	7.8	88.3%	456	402.81	0%
Appliances	Microwave	93.2%	112.1	104.45	2.1	95.0%	112	106.54	0%
Electronics	Personal Computers	57.4%	262.3	150.51	3.0	59.1%	270	159.39	3%
Electronics	Monitor	57.4%	112.1	104.45	2.1	59.1%	51	29.96	-3%
Electronics	Laptops	55.2%	113.0	62.41	1.2	56.9%	116	66.13	3%
Electronics	TVs	204.2%	213.3	435.56	8.6	210.3%	220	462.81	3%
Electronics	Printer/Fax/Copier	51.7%	40.2	20.78	0.4	53.3%	39	20.85	-3%
Electronics	Set-top Boxes/DVR	204.2%	135.5	276.69	5.4	210.3%	135	284.36	0%
Electronics	Devices and Gadgets	100.0%	30.0	30.00	0.6	103.0%	30	30.90	0%
Miscellaneous	Pool Pump	0.0%	1,500.0	-	-	0.0%	1,500	-	0%
Miscellaneous	Pool Heater	0.0%	4,981.0	-	-	0.0%	4583	-	-8%
Miscellaneous	Hot Tub / Spa	1.1%	950.0	10.47	0.2	1.1%	950.0	10.47	0%
Miscellaneous	Well Pump	0.0%	556.0	-	-	0.0%	556.0	-	0%
Miscellaneous	Furnace Fan	74.2%	273.3	202.88	4.0	74.2%	273	202.53	0%
Miscellaneous	Miscellaneous	100.0%	85.7	85.71	1.7	100.0%	86	85.71	0%
Total				**8,246.1**	**162.2**			**7,393.3**	**-10.3%**

Table A-3 Small Office Electric Market Profile, 2011

		Average Market Profiles				New Units			
End Use	Technology	Saturation	EUI (kWh)	Intensity (kWh/Sqft.)	Usage (GWh)	Saturation	EUI (kWh)	Intensity (kWh/Sqft.)	Compared to Average
Cooling	Air-Cooled Chiller	6.3%	5.8	0.37	3.1	7.1%	5	0.32	-23%
Cooling	Water-Cooled Chiller	3.0%	6.3	0.19	1.6	3.4%	5	0.17	-19%
Cooling	Roof top AC	73.0%	5.2	3.80	31.7	82.7%	4	3.37	-22%
Cooling	Air Source Heat Pump	0.2%	5.3	0.01	0.1	0.2%	4	0.01	-26%
Cooling	Geothermal Heat Pump	0.0%	3.5	0.00	0.0	0.0%	3	0.00	-17%
Cooling	Other Cooling	3.3%	3.5	0.11	0.9	3.7%	3	0.12	-8%
Heating	Air Source Heat Pump	0.2%	5.5	0.01	0.1	0.2%	5	0.01	-13%
Heating	Geothermal Heat Pump	0.0%	3.7	0.00	0.0	0.0%	3	0.00	-18%
Heating	Electric Room Heat	3.2%	5.9	0.19	1.6	3.2%	5	0.17	-12%
Heating	Electric Furnace	28.2%	6.2	1.76	14.7	28.2%	6	1.55	-12%
Ventilation	Ventilation	100.0%	1.1	1.09	9.1	100.0%	1	0.88	-19%
Water Heating	Water Heating	58.0%	0.8	0.48	4.0	58.0%	1	0.46	-4%
Interior Lighting	Screw-in	100.0%	1.6	1.56	13.1	100.0%	1	1.16	-26%
Interior Lighting	High-Bay Fixtures	100.0%	0.3	0.29	2.4	100.0%	0	0.16	-46%
Interior Lighting	Linear Fluorescent	100.0%	2.5	2.49	20.8	100.0%	2	2.24	-10%
Exterior Lighting	Screw-in	100.0%	0.2	0.15	1.3	100.0%	0	0.09	-41%
Exterior Lighting	HID	100.0%	0.8	0.79	6.6	100.0%	1	0.54	-32%
Exterior Lighting	Linear Fluorescent	100.0%	0.1	0.06	0.5	140.0%	0	0.09	-3%
Refrigeration	Walk-in Refrigerator	5.1%	-	-	-	7.1%	-	-	0%
Refrigeration	Reach-in Refrigerator	5.1%	0.2	0.01	0.1	7.1%	0	0.01	-47%
Refrigeration	Glass Door Display	5.1%	-	-	-	7.1%	-	-	0%
Refrigeration	Open Display Case	5.1%	-	-	-	7.1%	-	-	0%
Refrigeration	Icemaker	5.1%	0.2	0.01	0.1	7.1%	0	0.01	-12%
Refrigeration	Vending Machine	5.1%	0.2	0.01	0.1	7.1%	0	0.01	-29%
Food Preparation	Oven	2.1%	0.3	0.01	0.1	2.9%	0	0.01	-1%
Food Preparation	Fryer	2.1%	-	-	-	2.9%	-	-	0%
Food Preparation	Dishwasher	2.1%	0.7	0.01	0.1	2.9%	1	0.02	-24%
Food Preparation	Hot Food Container	2.1%	-	-	-	2.9%	-	-	0%
Office Equipment	Desktop Computer	100.0%	1.0	0.96	8.0	140.0%	1	1.33	-1%
Office Equipment	Laptop	100.0%	0.1	0.15	1.2	140.0%	0	0.21	-1%
Office Equipment	Server	100.0%	0.7	0.68	5.7	140.0%	1	0.90	-5%
Office Equipment	Monitor	100.0%	0.2	0.18	1.5	140.0%	0	0.24	-3%
Office Equipment	Printer/Copier/Fax	100.0%	0.2	0.23	1.9	110.0%	0	0.24	-6%
Office Equipment	POS Terminal	20.5%	0.1	0.02	0.2	24.6%	0	0.02	-16%
Miscellaneous	Non-HVAC Motors	22.0%	0.6	0.14	1.1	30.8%	1	0.18	-5%
Miscellaneous	Pool Pump	0.0%	-	-	-	0.0%	-	-	0%
Miscellaneous	Pool Heater	0.0%	-	-	-	0.0%	-	-	0%
Miscellaneous	Miscellaneous	100.0%	0.9	0.93	7.8	100.0%	1	0.93	0%
	Total			**16.7**	**139.2**			**15.4**	**-7.4%**

Table A-4 Large Office Electric Market Profile, 2011

		Average Market Profiles				New Units			
End Use	Technology	Saturation	EUI (kWh)	Intensity (kWh/Sqft.)	Usage (GWh)	Saturation	EUI (kWh)	Intensity (kWh/Sqft.)	Compared to Average
Cooling	Air-Cooled Chiller	2.0%	4.4	0.09	0.8	2.3%	3	0.07	-29%
Cooling	Water-Cooled Chiller	38.5%	4.2	1.63	15.3	43.7%	3	1.46	-21%
Cooling	Roof top AC	36.4%	5.1	1.86	17.5	41.3%	4	1.62	-23%
Cooling	Air Source Heat Pump	5.2%	5.2	0.27	2.5	5.9%	4	0.23	-24%
Cooling	Geothermal Heat Pump	1.3%	3.4	0.04	0.4	1.5%	3	0.04	-16%
Cooling	Other Cooling	3.2%	3.4	0.11	1.0	3.7%	3	0.11	-8%
Heating	Air Source Heat Pump	5.2%	4.8	0.25	2.3	5.2%	4	0.21	-17%
Heating	Geothermal Heat Pump	1.3%	3.2	0.04	0.4	1.3%	3	0.03	-19%
Heating	Electric Room Heat	0.0%	5.0	-	-	0.0%	5	-	-9%
Heating	Electric Furnace	29.1%	5.3	1.53	14.4	29.1%	5	1.40	-9%
Ventilation	Ventilation	100.0%	2.7	2.70	25.4	100.0%	2	2.21	-18%
Water Heating	Water Heating	55.3%	0.9	0.50	4.7	55.3%	1	0.48	-4%
Interior Lighting	Screw-in	100.0%	1.2	1.21	11.4	100.0%	1	0.90	-25%
Interior Lighting	High-Bay Fixtures	100.0%	0.1	0.11	1.0	100.0%	0	0.06	-46%
Interior Lighting	Linear Fluorescent	100.0%	3.3	3.28	30.9	100.0%	3	2.96	-10%
Exterior Lighting	Screw-in	100.0%	0.1	0.11	1.1	100.0%	0	0.07	-40%
Exterior Lighting	HID	100.0%	0.4	0.43	4.1	100.0%	0	0.30	-32%
Exterior Lighting	Linear Fluorescent	100.0%	0.0	0.02	0.2	140.0%	0	0.03	-3%
Refrigeration	Walk-in Refrigerator	44.9%	-	-	-	62.9%	-	-	0%
Refrigeration	Reach-in Refrigerator	44.9%	0.0	0.02	0.2	62.9%	0	0.02	-47%
Refrigeration	Glass Door Display	44.9%	0.2	0.09	0.8	62.9%	0	0.12	0%
Refrigeration	Open Display Case	44.9%	0.1	0.04	0.4	62.9%	0	0.05	0%
Refrigeration	Icemaker	44.9%	0.1	0.02	0.2	62.9%	0	0.03	-12%
Refrigeration	Vending Machine	44.9%	0.1	0.04	0.4	62.9%	0	0.04	-32%
Food Preparation	Oven	25.8%	0.1	0.03	0.3	36.1%	0	0.04	-1%
Food Preparation	Fryer	25.8%	0.2	0.04	0.4	36.1%	0	0.06	-1%
Food Preparation	Dishwasher	25.8%	0.3	0.07	0.6	36.1%	0	0.07	-24%
Food Preparation	Hot Food Container	25.8%	0.1	0.02	0.2	36.1%	0	0.03	-4%
Office Equipment	Desktop Computer	100.0%	2.3	2.33	21.9	140.0%	2	3.23	-1%
Office Equipment	Laptop	100.0%	0.4	0.36	3.4	140.0%	0	0.50	-1%
Office Equipment	Server	100.0%	0.3	0.28	2.6	140.0%	0	0.37	-5%
Office Equipment	Monitor	100.0%	0.4	0.43	4.1	140.0%	0	0.59	-3%
Office Equipment	Printer/Copier/Fax	100.0%	0.2	0.19	1.7	100.0%	0	0.17	-6%
Office Equipment	POS Terminal	12.7%	0.0	0.00	0.0	13.9%	0	0.00	-16%
Miscellaneous	Non-HVAC Motors	89.6%	0.4	0.34	3.2	125.4%	0	0.46	-5%
Miscellaneous	Pool Pump	0.0%	-	-	-	0.0%	-	-	0%
Miscellaneous	Pool Heater	0.0%	-	-	-	0.0%	-	-	0%
Miscellaneous	Miscellaneous	100.0%	0.7	0.75	7.0	100.0%	1	0.75	0%
	Total			**19.2**	**181.1**			**18.7**	**-2.7%**

Table A-5 Restaurant Electric Market Profile, 2011

		Average Market Profiles				New Units			
End Use	Technology	Saturation	EUI (kWh)	Intensity (kWh/Sqft.)	Usage (GWh)	Saturation	EUI (kWh)	Intensity (kWh/Sqft.)	Compared to Average
Cooling	Air-Cooled Chiller	1.2%	7.4	0.09	0.2	1.2%	6	0.07	-20%
Cooling	Water-Cooled Chiller	1.0%	7.5	0.08	0.1	1.1%	6	0.07	-19%
Cooling	Roof top AC	68.9%	7.7	5.29	10.0	75.8%	6	4.46	-23%
Cooling	Air Source Heat Pump	0.5%	7.7	0.04	0.1	0.6%	6	0.03	-24%
Cooling	Geothermal Heat Pump	0.1%	5.2	0.01	0.0	0.1%	4	0.01	-20%
Cooling	Other Cooling	7.9%	5.1	0.40	0.8	9.5%	5	0.45	-8%
Heating	Air Source Heat Pump	0.5%	4.5	0.02	0.0	0.5%	4	0.02	-16%
Heating	Geothermal Heat Pump	0.1%	3.0	0.00	0.0	0.1%	2	0.00	-17%
Heating	Electric Room Heat	2.1%	5.8	0.12	0.2	2.1%	5	0.10	-12%
Heating	Electric Furnace	17.8%	6.1	1.08	2.0	17.8%	5	0.95	-12%
Ventilation	Ventilation	100.0%	2.5	2.46	4.7	100.0%	2	1.57	-36%
Water Heating	Water Heating	20.9%	8.7	1.82	3.5	20.9%	8	1.75	-4%
Interior Lighting	Screw-in	100.0%	6.1	6.10	11.6	100.0%	2	2.39	-61%
Interior Lighting	High-Bay Fixtures	100.0%	0.2	0.16	0.3	100.0%	0	0.09	-46%
Interior Lighting	Linear Fluorescent	100.0%	1.4	1.36	2.6	100.0%	1	1.13	-17%
Exterior Lighting	Screw-in	100.0%	0.2	0.19	0.4	100.0%	0	0.12	-36%
Exterior Lighting	HID	100.0%	2.0	2.00	3.8	100.0%	1	1.37	-32%
Exterior Lighting	Linear Fluorescent	100.0%	0.0	0.01	0.0	140.0%	0	0.01	11%
Refrigeration	Walk-in Refrigerator	97.3%	4.1	3.99	7.6	136.2%	2	3.30	-41%
Refrigeration	Reach-in Refrigerator	97.3%	0.6	0.61	1.2	136.2%	0	0.46	-46%
Refrigeration	Glass Door Display	97.3%	2.6	2.58	4.9	136.2%	3	3.61	0%
Refrigeration	Open Display Case	97.3%	1.2	1.16	2.2	136.2%	1	1.63	0%
Refrigeration	Icemaker	97.3%	0.7	0.71	1.3	136.2%	1	0.87	-12%
Refrigeration	Vending Machine	97.3%	0.6	0.63	1.2	136.2%	0	0.56	-36%
Food Preparation	Oven	38.5%	5.2	2.01	3.8	53.8%	5	2.77	-1%
Food Preparation	Fryer	38.5%	7.8	2.99	5.7	53.8%	8	4.15	-1%
Food Preparation	Dishwasher	38.5%	6.0	2.30	4.4	53.8%	5	2.44	-24%
Food Preparation	Hot Food Container	38.5%	1.7	0.66	1.2	42.3%	2	0.69	-4%
Office Equipment	Desktop Computer	100.0%	0.2	0.21	0.4	110.0%	0	0.23	-1%
Office Equipment	Laptop	100.0%	0.0	0.03	0.1	110.0%	0	0.03	-1%
Office Equipment	Server	100.0%	0.3	0.30	0.6	110.0%	0	0.32	-5%
Office Equipment	Monitor	100.0%	0.0	0.04	0.1	110.0%	0	0.04	-3%
Office Equipment	Printer/Copier/Fax	100.0%	0.0	0.04	0.1	110.0%	0	0.04	-6%
Office Equipment	POS Terminal	100.0%	0.1	0.08	0.2	120.0%	0	0.08	-16%
Miscellaneous	Non-HVAC Motors	20.0%	0.2	0.04	0.1	28.0%	0	0.06	-5%
Miscellaneous	Pool Pump	0.0%	-	-	-	0.0%	-	-	0%
Miscellaneous	Pool Heater	0.0%	-	-	-	0.0%	-	-	0%
Miscellaneous	Miscellaneous	100.0%	1.3	1.28	2.4	100.0%	1	1.28	0%
	Total			**40.9**	**77.5**			**37.2**	**-9.1%**

Table A-6 Retail Electric Market Profile, 2011

		Average Market Profiles				New Units			
End Use	Technology	Saturation	EUI (kWh)	Intensity (kWh/Sqft.)	Usage (GWh)	Saturation	EUI (kWh)	Intensity (kWh/Sqft.)	Compared to Average
Cooling	Air-Cooled Chiller	2.7%	3.0	0.08	1.4	2.8%	2	0.07	-21%
Cooling	Water-Cooled Chiller	0.8%	2.9	0.02	0.4	0.9%	2	0.02	-18%
Cooling	Roof top AC	55.4%	4.7	2.60	46.3	58.2%	4	2.16	-21%
Cooling	Air Source Heat Pump	4.2%	4.7	0.20	3.5	4.4%	3	0.15	-27%
Cooling	Geothermal Heat Pump	1.0%	3.2	0.03	0.6	1.1%	3	0.03	-15%
Cooling	Other Cooling	6.4%	3.1	0.20	3.5	6.4%	3	0.18	-8%
Heating	Air Source Heat Pump	4.2%	5.8	0.24	4.3	4.2%	5	0.20	-18%
Heating	Geothermal Heat Pump	1.0%	3.8	0.04	0.7	1.0%	3	0.03	-16%
Heating	Electric Room Heat	2.8%	6.0	0.17	3.0	2.8%	6	0.15	-8%
Heating	Electric Furnace	19.7%	6.3	1.25	22.1	19.7%	6	1.14	-8%
Ventilation	Ventilation	100.0%	1.1	1.10	19.6	100.0%	1	0.89	-19%
Water Heating	Water Heating	52.4%	0.9	0.47	8.3	52.4%	1	0.45	-4%
Interior Lighting	Screw-in	100.0%	2.9	2.91	51.7	100.0%	1	1.49	-49%
Interior Lighting	High-Bay Fixtures	100.0%	0.4	0.41	7.2	100.0%	0	0.22	-46%
Interior Lighting	Linear Fluorescent	100.0%	2.3	2.34	41.6	100.0%	2	2.09	-11%
Exterior Lighting	Screw-in	100.0%	0.6	0.58	10.2	100.0%	1	0.70	21%
Exterior Lighting	HID	100.0%	0.3	0.32	5.7	100.0%	0	0.22	-32%
Exterior Lighting	Linear Fluorescent	100.0%	0.0	0.01	0.1	110.0%	0	0.01	1%
Refrigeration	Walk-in Refrigerator	52.4%	0.5	0.25	4.5	57.6%	0	0.17	-41%
Refrigeration	Reach-in Refrigerator	52.4%	0.1	0.04	0.7	57.6%	0	0.02	-46%
Refrigeration	Glass Door Display	52.4%	0.3	0.16	2.9	57.6%	0	0.18	0%
Refrigeration	Open Display Case	52.4%	0.1	0.07	1.3	57.6%	0	0.08	0%
Refrigeration	Icemaker	52.4%	0.2	0.09	1.6	57.6%	0	0.09	-12%
Refrigeration	Vending Machine	52.4%	0.2	0.08	1.4	73.4%	0	0.08	-29%
Food Preparation	Oven	23.5%	0.2	0.05	0.9	32.9%	0	0.07	-1%
Food Preparation	Fryer	23.5%	0.3	0.07	1.3	32.9%	0	0.10	-1%
Food Preparation	Dishwasher	23.5%	0.5	0.11	2.0	32.9%	0	0.12	-24%
Food Preparation	Hot Food Container	23.5%	0.1	0.03	0.6	29.3%	0	0.04	-4%
Office Equipment	Desktop Computer	100.0%	0.2	0.15	2.7	125.0%	0	0.19	-1%
Office Equipment	Laptop	100.0%	0.0	0.02	0.4	125.0%	0	0.03	-1%
Office Equipment	Server	100.0%	0.2	0.21	3.8	125.0%	0	0.26	-5%
Office Equipment	Monitor	100.0%	0.0	0.03	0.5	125.0%	0	0.03	-3%
Office Equipment	Printer/Copier/Fax	100.0%	0.0	0.01	0.3	110.0%	0	0.01	-6%
Office Equipment	POS Terminal	100.0%	0.1	0.06	1.0	120.0%	0	0.06	-16%
Miscellaneous	Non-HVAC Motors	40.2%	0.4	0.16	2.9	48.2%	0	0.19	-5%
Miscellaneous	Pool Pump	0.0%	-	-	-	0.0%	-	-	0%
Miscellaneous	Pool Heater	0.0%	-	-	-	0.0%	-	-	0%
Miscellaneous	Miscellaneous	100.0%	0.6	0.56	10.0	100.0%	1	0.56	0%
Total				**15.2**	**269.3**			**12.5**	**-17.7%**

Table A-7 Grocery Electric Market Profile, 2011

		Average Market Profiles				New Units			
End Use	Technology	Saturation	EUI (kWh)	Intensity (kWh/Sqft.)	Usage (GWh)	Saturation	EUI (kWh)	Intensity (kWh/Sqft.)	Compared to Average
Cooling	Air-Cooled Chiller	1.9%	5.4	0.10	0.3	1.9%	4	0.08	-23%
Cooling	Water-Cooled Chiller	1.9%	5.2	0.10	0.3	1.9%	4	0.08	-18%
Cooling	Roof top AC	61.6%	8.4	5.21	13.9	61.6%	7	4.03	-23%
Cooling	Air Source Heat Pump	4.6%	8.3	0.38	1.0	4.6%	6	0.30	-23%
Cooling	Geothermal Heat Pump	1.2%	5.5	0.06	0.2	1.2%	4	0.05	-22%
Cooling	Other Cooling	7.1%	5.6	0.40	1.1	7.1%	5	0.36	-8%
Heating	Air Source Heat Pump	4.6%	6.4	0.30	0.8	4.6%	5	0.25	-14%
Heating	Geothermal Heat Pump	1.2%	4.2	0.05	0.1	1.2%	3	0.04	-18%
Heating	Electric Room Heat	0.0%	7.1	-	-	0.0%	6	-	-12%
Heating	Electric Furnace	24.4%	7.5	1.83	4.9	24.4%	7	1.61	-12%
Ventilation	Ventilation	100.0%	2.3	2.32	6.2	100.0%	2	1.71	-26%
Water Heating	Water Heating	38.3%	2.4	0.93	2.5	38.3%	2	0.89	-4%
Interior Lighting	Screw-in	100.0%	3.1	3.09	8.3	100.0%	1	1.43	-54%
Interior Lighting	High-Bay Fixtures	100.0%	0.3	0.29	0.8	100.0%	0	0.16	-46%
Interior Lighting	Linear Fluorescent	100.0%	6.2	6.21	16.6	100.0%	6	5.78	-7%
Exterior Lighting	Screw-in	100.0%	0.3	0.28	0.7	100.0%	0	0.14	-49%
Exterior Lighting	HID	100.0%	1.0	0.95	2.6	100.0%	1	0.65	-32%
Exterior Lighting	Linear Fluorescent	100.0%	0.0	0.04	0.1	140.0%	0	0.05	0%
Refrigeration	Walk-in Refrigerator	98.9%	6.9	6.81	18.2	138.5%	4	5.64	-41%
Refrigeration	Reach-in Refrigerator	98.9%	0.3	0.30	0.8	138.5%	0	0.22	-47%
Refrigeration	Glass Door Display	98.9%	12.7	12.55	33.6	138.5%	13	17.57	0%
Refrigeration	Open Display Case	98.9%	5.7	5.67	15.2	138.5%	6	7.93	0%
Refrigeration	Icemaker	98.9%	0.2	0.17	0.5	138.5%	0	0.21	-12%
Refrigeration	Vending Machine	98.9%	0.3	0.31	0.8	138.5%	0	0.21	-52%
Food Preparation	Oven	32.8%	0.7	0.22	0.6	45.9%	1	0.30	-1%
Food Preparation	Fryer	32.8%	1.0	0.32	0.9	45.9%	1	0.45	-1%
Food Preparation	Dishwasher	32.8%	1.5	0.49	1.3	45.9%	1	0.52	-24%
Food Preparation	Hot Food Container	32.8%	0.4	0.14	0.4	41.0%	0	0.17	-4%
Office Equipment	Desktop Computer	100.0%	0.1	0.14	0.4	125.0%	0	0.18	-1%
Office Equipment	Laptop	100.0%	0.0	0.02	0.1	125.0%	0	0.03	-1%
Office Equipment	Server	100.0%	0.1	0.10	0.3	125.0%	0	0.12	-5%
Office Equipment	Monitor	100.0%	0.0	0.03	0.1	125.0%	0	0.03	-3%
Office Equipment	Printer/Copier/Fax	100.0%	0.0	0.01	0.0	110.0%	0	0.01	-6%
Office Equipment	POS Terminal	100.0%	0.1	0.07	0.2	120.0%	0	0.07	-16%
Miscellaneous	Non-HVAC Motors	34.6%	0.3	0.12	0.3	41.6%	0	0.13	-5%
Miscellaneous	Pool Pump	0.0%	-	-	-	0.0%	-	-	0%
Miscellaneous	Pool Heater	0.0%	-	-	-	0.0%	-	-	0%
Miscellaneous	Miscellaneous	100.0%	0.8	0.80	2.1	100.0%	1	0.80	0%
	Total			**50.8**	**136.0**			**52.2**	**2.8%**

Table A-8 College Electric Market Profile, 2011

		Average Market Profiles				New Units			
End Use	Technology	Saturation	EUI (kWh)	Intensity (kWh/Sqft.)	Usage (GWh)	Saturation	EUI (kWh)	Intensity (kWh/Sqft.)	Compared to Average
Cooling	Air-Cooled Chiller	4.6%	4.9	0.22	1.3	4.6%	4	0.18	-21%
Cooling	Water-Cooled Chiller	21.8%	4.7	1.02	5.9	21.8%	4	0.81	-21%
Cooling	Roof top AC	28.0%	4.1	1.15	6.6	28.0%	3	0.92	-20%
Cooling	Air Source Heat Pump	2.2%	3.6	0.08	0.5	2.2%	3	0.06	-22%
Cooling	Geothermal Heat Pump	0.6%	2.4	0.01	0.1	0.6%	2	0.01	-20%
Cooling	Other Cooling	3.8%	2.7	0.10	0.6	3.8%	2	0.09	-11%
Heating	Air Source Heat Pump	2.2%	6.7	0.15	0.8	2.2%	6	0.13	-15%
Heating	Geothermal Heat Pump	0.6%	4.5	0.02	0.1	0.6%	4	0.02	-19%
Heating	Electric Room Heat	2.0%	8.1	0.17	1.0	2.0%	7	0.15	-9%
Heating	Electric Furnace	15.7%	8.5	1.34	7.7	15.7%	8	1.21	-9%
Ventilation	Ventilation	100.0%	1.3	1.30	7.5	100.0%	1	1.06	-19%
Water Heating	Water Heating	30.9%	1.8	0.55	3.2	30.9%	2	0.53	-4%
Interior Lighting	Screw-in	100.0%	1.7	1.67	9.6	100.0%	1	1.48	-12%
Interior Lighting	High-Bay Fixtures	100.0%	0.2	0.16	0.9	100.0%	0	0.09	-46%
Interior Lighting	Linear Fluorescent	100.0%	2.8	2.77	15.9	100.0%	3	2.52	-9%
Exterior Lighting	Screw-in	100.0%	0.1	0.12	0.7	100.0%	0	0.05	-59%
Exterior Lighting	HID	100.0%	0.6	0.62	3.5	100.0%	0	0.42	-32%
Exterior Lighting	Linear Fluorescent	100.0%	0.0	0.00	0.0	110.0%	0	0.00	4%
Refrigeration	Walk-in Refrigerator	26.6%	0.2	0.05	0.3	29.3%	0	0.03	-41%
Refrigeration	Reach-in Refrigerator	26.6%	0.1	0.01	0.1	29.3%	0	0.01	-47%
Refrigeration	Glass Door Display	26.6%	0.1	0.03	0.2	29.3%	0	0.03	0%
Refrigeration	Open Display Case	26.6%	0.1	0.01	0.1	29.3%	0	0.01	0%
Refrigeration	Icemaker	26.6%	0.1	0.02	0.1	37.2%	0	0.02	-12%
Refrigeration	Vending Machine	26.6%	0.1	0.01	0.1	34.6%	0	0.01	-29%
Food Preparation	Oven	12.5%	0.2	0.03	0.2	16.3%	0	0.04	-1%
Food Preparation	Fryer	12.5%	0.4	0.04	0.3	16.3%	0	0.06	-1%
Food Preparation	Dishwasher	12.5%	0.5	0.07	0.4	16.3%	0	0.07	-24%
Food Preparation	Hot Food Container	12.5%	0.2	0.02	0.1	15.6%	0	0.02	-4%
Office Equipment	Desktop Computer	100.0%	0.4	0.39	2.3	125.0%	0	0.49	-1%
Office Equipment	Laptop	100.0%	0.1	0.06	0.4	125.0%	0	0.08	-1%
Office Equipment	Server	100.0%	0.2	0.19	1.1	125.0%	0	0.22	-5%
Office Equipment	Monitor	100.0%	0.1	0.07	0.4	125.0%	0	0.09	-3%
Office Equipment	Printer/Copier/Fax	100.0%	0.1	0.06	0.4	110.0%	0	0.07	-6%
Office Equipment	POS Terminal	20.8%	0.1	0.01	0.1	24.9%	0	0.01	-16%
Miscellaneous	Non-HVAC Motors	88.8%	0.2	0.14	0.8	106.6%	0	0.16	-5%
Miscellaneous	Pool Pump	4.9%	0.0	0.00	0.0	5.8%	0	0.00	3%
Miscellaneous	Pool Heater	1.2%	0.0	0.00	0.0	1.2%	0	0.00	9%
Miscellaneous	Miscellaneous	100.0%	0.3	0.34	2.0	100.0%	0	0.34	0%
	Total			**13.0**	**74.8**			**11.5**	**-11.9%**

Table A-9 School Electric Market Profile, 2011

		Average Market Profiles				New Units			
End Use	Technology	Saturation	EUI (kWh)	Intensity (kWh/Sqft.)	Usage (GWh)	Saturation	EUI (kWh)	Intensity (kWh/Sqft.)	Compared to Average
Cooling	Air-Cooled Chiller	9.7%	3.0	0.29	2.4	9.7%	2	0.23	-21%
Cooling	Water-Cooled Chiller	9.7%	2.9	0.28	2.3	9.7%	2	0.22	-21%
Cooling	Roof top AC	20.5%	2.5	0.52	4.3	20.5%	2	0.41	-20%
Cooling	Air Source Heat Pump	1.6%	2.2	0.04	0.3	1.6%	2	0.03	-22%
Cooling	Geothermal Heat Pump	0.4%	1.5	0.01	0.0	0.4%	1	0.00	-20%
Cooling	Other Cooling	2.8%	1.7	0.05	0.4	2.8%	1	0.04	-11%
Heating	Air Source Heat Pump	1.6%	4.6	0.08	0.6	1.6%	4	0.06	-15%
Heating	Geothermal Heat Pump	0.4%	3.1	0.01	0.1	0.4%	2	0.01	-19%
Heating	Electric Room Heat	0.9%	5.6	0.05	0.4	0.9%	5	0.05	-9%
Heating	Electric Furnace	6.2%	5.9	0.37	3.0	6.2%	5	0.33	-9%
Ventilation	Ventilation	100.0%	0.8	0.80	6.6	100.0%	1	0.65	-19%
Water Heating	Water Heating	23.6%	1.1	0.26	2.2	23.6%	1	0.25	-4%
Interior Lighting	Screw-in	100.0%	2.0	2.02	16.6	100.0%	2	1.78	-12%
Interior Lighting	High-Bay Fixtures	100.0%	0.3	0.33	2.7	100.0%	0	0.18	-46%
Interior Lighting	Linear Fluorescent	100.0%	1.5	1.49	12.2	100.0%	1	1.35	-9%
Exterior Lighting	Screw-in	100.0%	0.1	0.07	0.6	100.0%	0	0.03	-59%
Exterior Lighting	HID	100.0%	0.5	0.48	4.0	100.0%	0	0.33	-32%
Exterior Lighting	Linear Fluorescent	100.0%	0.0	0.00	0.0	140.0%	0	0.00	4%
Refrigeration	Walk-in Refrigerator	65.7%	0.2	0.13	1.1	92.0%	0	0.11	-41%
Refrigeration	Reach-in Refrigerator	65.7%	0.1	0.04	0.3	92.0%	0	0.03	-47%
Refrigeration	Glass Door Display	65.7%	0.1	0.09	0.7	92.0%	0	0.12	0%
Refrigeration	Open Display Case	65.7%	0.1	0.04	0.3	92.0%	0	0.06	0%
Refrigeration	Icemaker	65.7%	0.1	0.05	0.4	92.0%	0	0.06	-12%
Refrigeration	Vending Machine	65.7%	0.1	0.04	0.4	78.8%	0	0.04	-29%
Food Preparation	Oven	30.2%	0.2	0.05	0.4	36.3%	0	0.05	-1%
Food Preparation	Fryer	30.2%	0.2	0.07	0.6	36.3%	0	0.08	-1%
Food Preparation	Dishwasher	30.2%	0.3	0.10	0.9	36.3%	0	0.09	-24%
Food Preparation	Hot Food Container	30.2%	0.1	0.03	0.2	42.3%	0	0.04	-4%
Office Equipment	Desktop Computer	100.0%	0.2	0.20	1.6	140.0%	0	0.28	-1%
Office Equipment	Laptop	100.0%	0.0	0.02	0.2	140.0%	0	0.03	-1%
Office Equipment	Server	100.0%	0.2	0.19	1.5	140.0%	0	0.25	-5%
Office Equipment	Monitor	100.0%	0.0	0.04	0.3	140.0%	0	0.05	-3%
Office Equipment	Printer/Copier/Fax	100.0%	0.1	0.06	0.5	110.0%	0	0.07	-6%
Office Equipment	POS Terminal	4.2%	0.0	0.00	0.0	5.1%	0	0.00	-16%
Miscellaneous	Non-HVAC Motors	43.7%	0.1	0.05	0.4	43.7%	0	0.05	-5%
Miscellaneous	Pool Pump	1.2%	0.0	0.00	0.0	1.2%	0	0.00	3%
Miscellaneous	Pool Heater	0.3%	0.0	0.00	0.0	0.3%	0	0.00	9%
Miscellaneous	Miscellaneous	100.0%	0.2	0.23	1.9	100.0%	0	0.23	0%
	Total			**8.6**	**70.5**			**7.6**	**-11.2%**

Table A-10 Health Electric Market Profile, 2011

		Average Market Profiles				New Units			
End Use	Technology	Saturation	EUI (kWh)	Intensity (kWh/Sqft.)	Usage (GWh)	Saturation	EUI (kWh)	Intensity (kWh/Sqft.)	Compared to Average
Cooling	Air-Cooled Chiller	19.0%	6.4	1.22	6.3	22.7%	5	1.16	-20%
Cooling	Water-Cooled Chiller	19.0%	6.1	1.17	6.0	22.7%	5	1.10	-21%
Cooling	Roof top AC	38.5%	9.0	3.47	18.0	46.1%	8	3.50	-16%
Cooling	Air Source Heat Pump	3.5%	9.0	0.32	1.6	4.2%	7	0.29	-23%
Cooling	Geothermal Heat Pump	0.9%	6.0	0.05	0.3	1.1%	7	0.08	22%
Cooling	Other Cooling	5.1%	6.0	0.31	1.6	6.0%	5	0.32	-11%
Heating	Air Source Heat Pump	3.5%	8.9	0.31	1.6	3.5%	7	0.26	-17%
Heating	Geothermal Heat Pump	0.9%	5.9	0.05	0.3	0.9%	5	0.04	-18%
Heating	Electric Room Heat	2.4%	10.6	0.25	1.3	2.4%	9	0.22	-11%
Heating	Electric Furnace	16.9%	11.1	1.88	9.7	16.9%	10	1.67	-11%
Ventilation	Ventilation	100.0%	3.5	3.55	18.4	100.0%	3	2.71	-24%
Water Heating	Water Heating	8.9%	3.1	0.27	1.4	8.9%	3	0.26	-4%
Interior Lighting	Screw-in	100.0%	1.7	1.72	8.9	100.0%	1	1.50	-13%
Interior Lighting	High-Bay Fixtures	100.0%	0.0	0.04	0.2	100.0%	0	0.02	-46%
Interior Lighting	Linear Fluorescent	100.0%	3.9	3.88	20.1	100.0%	4	3.61	-7%
Exterior Lighting	Screw-in	100.0%	0.0	0.04	0.2	100.0%	0	0.02	-53%
Exterior Lighting	HID	100.0%	0.5	0.47	2.4	100.0%	0	0.32	-32%
Exterior Lighting	Linear Fluorescent	100.0%	0.0	0.00	0.0	130.0%	0	0.00	5%
Refrigeration	Walk-in Refrigerator	87.0%	0.3	0.23	1.2	113.1%	0	0.18	-41%
Refrigeration	Reach-in Refrigerator	87.0%	0.0	0.04	0.2	113.1%	0	0.02	-47%
Refrigeration	Glass Door Display	87.0%	0.2	0.15	0.8	113.1%	0	0.20	0%
Refrigeration	Open Display Case	87.0%	0.1	0.07	0.4	113.1%	0	0.09	0%
Refrigeration	Icemaker	87.0%	0.1	0.08	0.4	113.1%	0	0.10	-12%
Refrigeration	Vending Machine	87.0%	0.1	0.07	0.4	108.8%	0	0.08	-13%
Food Preparation	Oven	35.2%	0.6	0.21	1.1	44.0%	1	0.26	-1%
Food Preparation	Fryer	35.2%	0.9	0.31	1.6	44.0%	1	0.39	-1%
Food Preparation	Dishwasher	35.2%	1.4	0.48	2.5	44.0%	1	0.45	-24%
Food Preparation	Hot Food Container	35.2%	0.4	0.14	0.7	49.3%	0	0.18	-4%
Office Equipment	Desktop Computer	100.0%	0.5	0.49	2.5	140.0%	0	0.68	-1%
Office Equipment	Laptop	100.0%	0.1	0.08	0.4	140.0%	0	0.10	-1%
Office Equipment	Server	100.0%	0.2	0.17	0.9	140.0%	0	0.23	-5%
Office Equipment	Monitor	100.0%	0.1	0.09	0.5	135.0%	0	0.12	-3%
Office Equipment	Printer/Copier/Fax	100.0%	0.1	0.12	0.6	110.0%	0	0.12	-6%
Office Equipment	POS Terminal	5.5%	0.1	0.01	0.0	6.1%	0	0.01	-16%
Miscellaneous	Non-HVAC Motors	74.1%	1.3	0.93	4.8	74.1%	1	0.88	-5%
Miscellaneous	Pool Pump	0.9%	0.0	0.00	0.0	0.9%	0	0.00	3%
Miscellaneous	Pool Heater	0.2%	0.0	0.00	0.0	0.2%	0	0.00	9%
Miscellaneous	Miscellaneous	100.0%	3.1	3.07	15.9	100.0%	3	3.07	0%
	Total			**25.7**	**133.1**			**24.2**	**-5.8%**

Table A-11 Lodging Electric Market Profile, 2011

		Average Market Profiles				New Units			
End Use	Technology	Saturation	EUI (kWh)	Intensity (kWh/Sqft.)	Usage (GWh)	Saturation	EUI (kWh)	Intensity (kWh/Sqft.)	Compared to Average
Cooling	Air-Cooled Chiller	0.3%	1.8	0.01	0.0	0.4%	1	0.01	-16%
Cooling	Water-Cooled Chiller	5.6%	1.7	0.09	0.2	6.3%	1	0.08	-20%
Cooling	Roof top AC	35.4%	4.3	1.52	3.1	40.1%	3	1.38	-19%
Cooling	Air Source Heat Pump	3.8%	4.2	0.16	0.3	4.4%	3	0.15	-19%
Cooling	Geothermal Heat Pump	1.0%	2.8	0.03	0.1	1.1%	2	0.02	-18%
Cooling	Other Cooling	39.4%	2.8	1.12	2.3	43.3%	3	1.10	-11%
Heating	Air Source Heat Pump	3.8%	3.8	0.15	0.3	3.8%	3	0.13	-15%
Heating	Geothermal Heat Pump	1.0%	2.6	0.02	0.1	1.0%	2	0.02	-15%
Heating	Electric Room Heat	5.0%	4.0	0.20	0.4	5.0%	4	0.18	-11%
Heating	Electric Furnace	40.2%	4.2	1.70	3.5	40.2%	4	1.51	-11%
Ventilation	Ventilation	100.0%	1.2	1.22	2.5	100.0%	1	0.98	-19%
Water Heating	Water Heating	17.3%	4.1	0.71	1.5	17.3%	4	0.68	-4%
Interior Lighting	Screw-in	100.0%	4.5	4.47	9.3	100.0%	3	2.78	-38%
Interior Lighting	High-Bay Fixtures	100.0%	0.1	0.09	0.2	100.0%	0	0.05	-46%
Interior Lighting	Linear Fluorescent	100.0%	0.6	0.57	1.2	100.0%	0	0.47	-17%
Exterior Lighting	Screw-in	100.0%	0.2	0.24	0.5	100.0%	0	0.13	-47%
Exterior Lighting	HID	100.0%	0.5	0.46	1.0	100.0%	0	0.31	-32%
Exterior Lighting	Linear Fluorescent	100.0%	0.0	0.00	0.0	120.0%	0	0.00	2%
Refrigeration	Walk-in Refrigerator	58.9%	0.4	0.25	0.5	70.7%	0	0.18	-41%
Refrigeration	Reach-in Refrigerator	58.9%	0.1	0.04	0.1	70.7%	0	0.02	-47%
Refrigeration	Glass Door Display	58.9%	0.3	0.16	0.3	70.7%	0	0.20	0%
Refrigeration	Open Display Case	58.9%	0.1	0.07	0.2	70.7%	0	0.09	0%
Refrigeration	Icemaker	58.9%	0.1	0.04	0.1	70.7%	0	0.05	-12%
Refrigeration	Vending Machine	58.9%	0.1	0.08	0.2	73.6%	0	0.06	-36%
Food Preparation	Oven	18.3%	0.3	0.05	0.1	22.9%	0	0.07	-1%
Food Preparation	Fryer	18.3%	0.4	0.08	0.2	22.9%	0	0.10	-1%
Food Preparation	Dishwasher	18.3%	0.7	0.12	0.3	22.9%	1	0.12	-24%
Food Preparation	Hot Food Container	18.3%	0.2	0.04	0.1	20.2%	0	0.04	-4%
Office Equipment	Desktop Computer	100.0%	0.1	0.08	0.2	110.0%	0	0.09	-1%
Office Equipment	Laptop	100.0%	0.0	0.01	0.0	110.0%	0	0.01	-1%
Office Equipment	Server	100.0%	0.1	0.06	0.1	110.0%	0	0.06	-5%
Office Equipment	Monitor	100.0%	0.0	0.01	0.0	110.0%	0	0.02	-3%
Office Equipment	Printer/Copier/Fax	100.0%	0.0	0.01	0.0	120.0%	0	0.01	-6%
Office Equipment	POS Terminal	100.0%	0.0	0.01	0.0	120.0%	0	0.01	-16%
Miscellaneous	Non-HVAC Motors	91.3%	0.1	0.12	0.2	91.3%	0	0.11	-5%
Miscellaneous	Pool Pump	39.5%	0.0	0.01	0.0	39.5%	0	0.01	3%
Miscellaneous	Pool Heater	9.9%	0.0	0.00	0.0	9.9%	0	0.00	9%
Miscellaneous	Miscellaneous	100.0%	1.0	0.95	2.0	100.0%	1	0.95	0%
	Total			**15.0**	**31.1**			**12.2**	**-18.6%**

Table A-12 Warehouse Electric Market Profile, 2011

		Average Market Profiles				New Units			
End Use	Technology	Saturation	EUI (kWh)	Intensity (kWh/Sqft.)	Usage (GWh)	Saturation	EUI (kWh)	Intensity (kWh/Sqft.)	Compared to Average
Cooling	Air-Cooled Chiller	0.0%	2.3	-	-	0.0%	2	-	-22%
Cooling	Water-Cooled Chiller	0.2%	2.2	0.00	0.1	0.2%	2	0.00	-13%
Cooling	Roof top AC	18.4%	3.6	0.66	11.9	22.0%	3	0.63	-20%
Cooling	Air Source Heat Pump	0.2%	3.6	0.01	0.1	0.2%	3	0.01	-22%
Cooling	Geothermal Heat Pump	0.0%	2.4	0.00	0.0	0.1%	2	0.00	-18%
Cooling	Other Cooling	0.8%	2.4	0.02	0.3	0.9%	2	0.02	-11%
Heating	Air Source Heat Pump	0.2%	9.0	0.02	0.3	0.2%	8	0.01	-15%
Heating	Geothermal Heat Pump	0.0%	6.0	0.00	0.0	0.0%	5	0.00	-20%
Heating	Electric Room Heat	0.5%	9.4	0.05	0.9	0.5%	9	0.04	-8%
Heating	Electric Furnace	4.3%	9.9	0.43	7.7	4.3%	9	0.40	-8%
Ventilation	Ventilation	100.0%	0.4	0.36	6.6	100.0%	0	0.29	-20%
Water Heating	Water Heating	45.6%	0.3	0.15	2.7	45.6%	0	0.15	-4%
Interior Lighting	Screw-in	100.0%	0.8	0.76	13.8	100.0%	1	0.52	-31%
Interior Lighting	High-Bay Fixtures	100.0%	0.2	0.16	2.9	100.0%	0	0.09	-46%
Interior Lighting	Linear Fluorescent	100.0%	2.2	2.22	40.1	100.0%	2	2.08	-6%
Exterior Lighting	Screw-in	100.0%	0.0	0.00	0.0	100.0%	0	0.00	-43%
Exterior Lighting	HID	100.0%	0.6	0.60	10.8	100.0%	0	0.41	-32%
Exterior Lighting	Linear Fluorescent	100.0%	0.0	0.00	0.0	120.0%	0	0.00	0%
Refrigeration	Walk-in Refrigerator	18.0%	1.4	0.24	4.4	21.6%	1	0.17	-41%
Refrigeration	Reach-in Refrigerator	18.0%	-	-	-	21.6%	-	-	0%
Refrigeration	Glass Door Display	18.0%	-	-	-	21.6%	-	-	0%
Refrigeration	Open Display Case	18.0%	-	-	-	21.6%	-	-	0%
Refrigeration	Icemaker	18.0%	1.0	0.17	3.1	21.6%	1	0.18	-12%
Refrigeration	Vending Machine	18.0%	0.9	0.15	2.8	22.5%	1	0.14	-29%
Food Preparation	Oven	3.4%	0.3	0.01	0.2	4.2%	0	0.01	-1%
Food Preparation	Fryer	3.4%	-	-	-	4.2%	-	-	0%
Food Preparation	Dishwasher	3.4%	-	-	-	4.2%	-	-	0%
Food Preparation	Hot Food Container	3.4%	-	-	-	3.7%	-	-	0%
Office Equipment	Desktop Computer	100.0%	0.1	0.09	1.6	110.0%	0	0.10	-1%
Office Equipment	Laptop	100.0%	0.0	0.01	0.2	120.0%	0	0.01	-1%
Office Equipment	Server	100.0%	0.1	0.13	2.3	110.0%	0	0.13	-5%
Office Equipment	Monitor	100.0%	0.0	0.02	0.3	110.0%	0	0.02	-3%
Office Equipment	Printer/Copier/Fax	100.0%	0.0	0.01	0.2	125.0%	0	0.01	-6%
Office Equipment	POS Terminal	1.9%	0.0	0.00	0.0	2.3%	0	0.00	-16%
Miscellaneous	Non-HVAC Motors	49.9%	0.3	0.16	2.9	49.9%	0	0.15	-5%
Miscellaneous	Pool Pump	0.0%	-	-	-	0.0%	-	-	0%
Miscellaneous	Pool Heater	0.0%	-	-	-	0.0%	-	-	0%
Miscellaneous	Miscellaneous	100.0%	0.4	0.41	7.4	100.0%	0	0.41	0%
	Total			**6.8**	**123.8**			**6.0**	**-12.4%**

Table A-13 Miscellaneous Commercial Electric Market Profile, 2011

		Average Market Profiles				New Units			
End Use	Technology	Saturation	EUI (kWh)	Intensity (kWh/Sqft.)	Usage (GWh)	Saturation	EUI (kWh)	Intensity (kWh/Sqft.)	Compared to Average
Cooling	Air-Cooled Chiller	0.6%	1.7	0.01	0.1	0.7%	1	0.01	-20%
Cooling	Water-Cooled Chiller	10.5%	1.6	0.17	1.7	12.5%	1	0.17	-20%
Cooling	Roof top AC	34.5%	2.7	0.93	9.2	41.3%	2	0.86	-23%
Cooling	Air Source Heat Pump	1.7%	2.7	0.05	0.5	2.0%	2	0.04	-27%
Cooling	Geothermal Heat Pump	0.4%	1.8	0.01	0.1	0.5%	1	0.01	-20%
Cooling	Other Cooling	3.4%	1.8	0.06	0.6	4.1%	2	0.07	-8%
Heating	Air Source Heat Pump	1.7%	3.7	0.06	0.6	1.7%	3	0.06	-7%
Heating	Geothermal Heat Pump	0.4%	2.5	0.01	0.1	0.4%	2	0.01	-17%
Heating	Electric Room Heat	1.1%	3.9	0.04	0.4	1.1%	4	0.04	-8%
Heating	Electric Furnace	7.4%	4.1	0.30	3.0	7.4%	4	0.28	-8%
Ventilation	Ventilation	100.0%	0.6	0.55	5.4	100.0%	0	0.44	-20%
Water Heating	Water Heating	31.9%	1.0	0.33	3.3	31.9%	1	0.32	-4%
Interior Lighting	Screw-in	100.0%	0.9	0.94	9.3	100.0%	1	0.66	-30%
Interior Lighting	High-Bay Fixtures	100.0%	1.7	1.71	16.9	100.0%	1	0.93	-46%
Interior Lighting	Linear Fluorescent	100.0%	0.6	0.58	5.7	100.0%	1	0.52	-11%
Exterior Lighting	Screw-in	100.0%	0.2	0.24	2.4	100.0%	0	0.21	-12%
Exterior Lighting	HID	100.0%	0.5	0.50	5.0	100.0%	0	0.34	-32%
Exterior Lighting	Linear Fluorescent	100.0%	0.3	0.27	2.7	120.0%	0	0.36	11%
Refrigeration	Walk-in Refrigerator	21.6%	0.3	0.07	0.7	25.9%	0	0.05	-41%
Refrigeration	Reach-in Refrigerator	21.6%	0.0	0.01	0.1	25.9%	0	0.01	-46%
Refrigeration	Glass Door Display	21.6%	0.2	0.04	0.4	25.9%	0	0.05	0%
Refrigeration	Open Display Case	21.6%	0.1	0.02	0.2	25.9%	0	0.02	0%
Refrigeration	Icemaker	21.6%	0.1	0.01	0.1	25.9%	0	0.01	-12%
Refrigeration	Vending Machine	21.6%	0.1	0.02	0.2	23.8%	0	0.02	-29%
Food Preparation	Oven	9.1%	0.1	0.01	0.1	10.0%	0	0.01	-1%
Food Preparation	Fryer	9.1%	0.2	0.02	0.2	10.0%	0	0.02	-1%
Food Preparation	Dishwasher	9.1%	0.3	0.03	0.3	10.0%	0	0.02	-24%
Food Preparation	Hot Food Container	9.1%	0.1	0.01	0.1	10.0%	0	0.01	-4%
Office Equipment	Desktop Computer	100.0%	0.2	0.16	1.5	110.0%	0	0.17	-1%
Office Equipment	Laptop	100.0%	0.0	0.02	0.2	120.0%	0	0.03	-1%
Office Equipment	Server	100.0%	0.1	0.11	1.1	110.0%	0	0.12	-5%
Office Equipment	Monitor	100.0%	0.0	0.03	0.3	110.0%	0	0.03	-3%
Office Equipment	Printer/Copier/Fax	100.0%	0.0	0.03	0.3	125.0%	0	0.04	-6%
Office Equipment	POS Terminal	30.5%	0.1	0.02	0.2	36.6%	0	0.02	-16%
Miscellaneous	Non-HVAC Motors	59.9%	0.4	0.22	2.2	71.9%	0	0.25	-5%
Miscellaneous	Pool Pump	4.3%	0.0	0.00	0.0	5.1%	0	0.00	3%
Miscellaneous	Pool Heater	1.1%	0.0	0.00	0.0	1.1%	0	0.00	9%
Miscellaneous	Miscellaneous	100.0%	0.6	0.56	5.6	100.0%	1	0.56	0%
	Total			**8.2**	**80.5**			**6.7**	**-17.4%**

Table A-14 Traffic Signals Electric Market Profile, 2011

Average Market Profiles						New Units			
End Use	Technology	Saturation	EUI (kWh)	Intensity (kWh/Sqft.)[1]	Usage (GWh)	Saturation	EUI (kWh)	Intensity (kWh/Sqft.)	Compared to Average
Exterior Lighting	Traffic Lights	100.0%	323.5	323.53	0.9	100.0%	324	323.53	0%
Exterior Lighting	Crosswalk Lights	100.0%	176.5	176.46	0.5	100.0%	176	176.46	0%
Total				**500.0**	**1.3**			**500.0**	**0.0%**

[1] The overall kWh usage for traffic signals was allocated using Vectren's customer database. KWh/sqft is not a meaningful metric for traffic signals, but square footage is the unit of market size for the commercial sector, so it is translated into these terms and presented here as such solely for modeling consistency.

Table A-15 Chemicals Electric Market Profile, 2011

		Average Market Profile				New Units			
End Use	Technology	Saturation	UEC (kWh)	Intensity (kWh/empl)	Usage (GWh)	Saturation	UEC (kWh)	Intensity (kWh/empl)	Compared to Average
Cooling	Air-Cooled Chiller	2.5%	16,457.2	411.43	1.3	2.5%	12,980	324.49	-21%
Cooling	Water-Cooled Chiller	2.6%	15,784.2	415.74	1.3	2.6%	11,585	305.13	-27%
Cooling	Roof top AC	12.1%	25,313.9	3,057.03	9.9	12.1%	18,837	2,274.80	-26%
Cooling	Air-Source Heat Pump	0.1%	25,583.9	36.69	0.1	0.1%	18,988	27.23	-26%
Cooling	Geothermal Heat Pump	0.0%	17,064.4	6.12	0.0	0.0%	12,540	4.50	-27%
Cooling	Other Cooling	0.7%	16,708.8	109.19	0.4	0.7%	12,767	83.43	-24%
Heating	Air-Source Heat Pump	0.1%	63,919.0	91.66	0.3	0.1%	52,381	75.11	-18%
Heating	Geothermal Heat Pump	0.0%	42,634.0	15.28	0.0	0.0%	34,864	12.50	-18%
Heating	Electric Room Heat	0.2%	66,882.4	154.51	0.5	0.2%	62,468	144.31	-7%
Heating	Electric Furnace	1.9%	70,226.5	1,334.26	4.3	1.9%	65,592	1,246.20	-7%
Ventilation	Ventilation	100.0%	2,565.4	2,565.36	8.3	100.0%	2,264	2,263.61	-12%
Interior Lighting	Screw-in	100.0%	1,221.6	1,221.57	3.9	100.0%	842	841.91	-31%
Interior Lighting	High-Bay Fixtures	100.0%	260.0	260.01	0.8	100.0%	178	177.59	-32%
Interior Lighting	Linear Fluorescent	100.0%	3,558.5	3,558.47	11.5	100.0%	3,264	3,263.72	-8%
Exterior Lighting	Screw-in	100.0%	2.3	2.28	0.0	100.0%	1	1.31	-43%
Exterior Lighting	HID	100.0%	962.4	962.38	3.1	100.0%	683	683.05	-29%
Exterior Lighting	Linear Fluorescent	100.0%	0.3	0.28	0.0	100.0%	0	0.24	-13%
Motors	Pumps	100.0%	20,441.4	20,441.39	66.0	100.0%	20,233	20,232.79	-1%
Motors	Fans & Blowers	100.0%	5,678.2	5,678.16	18.3	100.0%	5,620	5,620.19	-1%
Motors	Compressed Air	100.0%	22,712.7	22,712.65	73.4	100.0%	22,481	22,481.45	-1%
Motors	Matl Handling	100.0%	5,678.2	5,678.16	18.3	100.0%	5,620	5,620.21	-1%
Motors	Matl Processing	100.0%	34,069.0	34,068.98	110.1	100.0%	33,721	33,721.24	-1%
Motors	Other Motors	100.0%	3,406.9	3,406.90	11.0	100.0%	3,372	3,372.12	-1%
Process	Process Heating	100.0%	10,450.8	10,450.80	33.8	100.0%	10,451	10,450.80	0%
Process	Process Cooling and Refrigeration	100.0%	11,500.0	11,499.97	37.1	100.0%	11,500	11,499.97	0%
Process	Electro-Chemical Processes	100.0%	7,281.3	7,281.32	23.5	100.0%	7,281	7,281.32	0%
Process	Other Process	100.0%	1,104.6	1,104.55	3.6	100.0%	1,105	1,104.55	0%
Miscellaneous	Miscellaneous	100.0%	3,122.0	3,122.02	10.1	100.0%	3,122	3,122.02	0%
Total				**139,647.2**	**451.1**			**136,235.8**	**-2.4%**

Table A-16 Plastics Electric Market Profile, 2011

		Average Market Profile				New Units			
End Use	Technology	Saturation	UEC (kWh)	Intensity (kWh/empl)	Usage (GWh)	Saturation	UEC (kWh)	Intensity (kWh/empl)	Compared to Average
Cooling	Air-Cooled Chiller	2.5%	19,577.3	489.43	6.3	2.5%	15,441	386.01	-21%
Cooling	Water-Cooled Chiller	2.6%	18,776.7	494.56	6.4	2.6%	13,781	362.98	-27%
Cooling	Roof top AC	12.1%	30,113.2	3,636.61	47.1	12.1%	22,408	2,706.08	-26%
Cooling	Air-Source Heat Pump	0.1%	30,434.3	43.64	0.6	0.1%	22,588	32.39	-26%
Cooling	Geothermal Heat Pump	0.0%	20,299.7	7.28	0.1	0.0%	14,917	5.35	-27%
Cooling	Other Cooling	0.7%	19,876.6	129.89	1.7	0.7%	15,188	99.25	-24%
Heating	Air-Source Heat Pump	0.1%	76,037.4	109.04	1.4	0.1%	62,311	89.35	-18%
Heating	Geothermal Heat Pump	0.0%	50,716.9	18.18	0.2	0.0%	41,474	14.87	-18%
Heating	Electric Room Heat	0.2%	79,562.6	183.81	2.4	0.2%	74,311	171.68	-7%
Heating	Electric Furnace	1.9%	83,540.8	1,587.23	20.5	1.9%	78,027	1,482.47	-7%
Ventilation	Ventilation	100.0%	3,051.7	3,051.72	39.5	100.0%	2,693	2,692.77	-12%
Interior Lighting	Screw-in	100.0%	1,773.0	1,772.96	22.9	100.0%	1,222	1,221.93	-31%
Interior Lighting	High-Bay Fixtures	100.0%	377.4	377.37	4.9	100.0%	258	257.74	-32%
Interior Lighting	Linear Fluorescent	100.0%	5,164.7	5,164.66	66.8	100.0%	4,737	4,736.87	-8%
Exterior Lighting	Screw-in	100.0%	3.3	3.31	0.0	100.0%	2	1.89	-43%
Exterior Lighting	HID	100.0%	1,396.8	1,396.77	18.1	100.0%	991	991.36	-29%
Exterior Lighting	Linear Fluorescent	100.0%	0.4	0.40	0.0	100.0%	0	0.35	-13%
Motors	Pumps	100.0%	13,210.5	13,210.52	170.9	100.0%	13,076	13,075.72	-1%
Motors	Fans & Blowers	100.0%	2,955.9	2,955.91	38.2	100.0%	2,926	2,925.73	-1%
Motors	Compressed Air	100.0%	6,836.9	6,836.89	88.5	100.0%	6,767	6,767.29	-1%
Motors	Matl Handling	100.0%	3,937.1	3,937.12	50.9	100.0%	3,897	3,896.94	-1%
Motors	Matl Processing	100.0%	23,622.7	23,622.74	305.7	100.0%	23,382	23,381.63	-1%
Motors	Other Motors	100.0%	1,944.7	1,944.74	25.2	100.0%	1,925	1,924.89	-1%
Process	Process Heating	100.0%	14,810.5	14,810.48	191.6	100.0%	14,810	14,810.48	0%
Process	Process Cooling and Refrigeration	100.0%	8,509.7	8,509.70	110.1	100.0%	8,510	8,509.70	0%
Process	Electro-Chemical Processes	100.0%	67.8	67.76	0.9	100.0%	68	67.76	0%
Process	Other Process	100.0%	1,232.9	1,232.92	16.0	100.0%	1,233	1,232.92	0%
Miscellaneous	Miscellaneous	100.0%	3,639.2	3,639.22	47.1	100.0%	3,639	3,639.22	0%
Total				**99,234.9**	**1,284.0**			**95,485.6**	**-3.8%**

Table A-17 Transportation Electric Market Profile, 2011

		Average Market Profile				New Units			
End Use	Technology	Saturation	UEC (kWh)	Intensity (kWh/empl)	Usage (GWh)	Saturation	UEC (kWh)	Intensity (kWh/empl)	Compared to Average
Cooling	Air-Cooled Chiller	2.5%	15,921.4	398.03	2.6	2.5%	12,557	313.93	-21%
Cooling	Water-Cooled Chiller	2.6%	15,270.3	402.21	2.7	2.6%	11,208	295.20	-27%
Cooling	Roof top AC	12.1%	24,489.7	2,957.50	19.6	12.1%	18,223	2,200.74	-26%
Cooling	Air-Source Heat Pump	0.1%	24,750.9	35.49	0.2	0.1%	18,370	26.34	-26%
Cooling	Geothermal Heat Pump	0.0%	16,508.8	5.92	0.0	0.0%	12,131	4.35	-27%
Cooling	Other Cooling	0.7%	16,164.7	105.64	0.7	0.7%	12,351	80.71	-24%
Heating	Air-Source Heat Pump	0.1%	61,837.9	88.68	0.6	0.1%	50,675	72.67	-18%
Heating	Geothermal Heat Pump	0.0%	41,245.9	14.79	0.1	0.0%	33,729	12.09	-18%
Heating	Electric Room Heat	0.2%	64,704.8	149.48	1.0	0.2%	60,434	139.62	-7%
Heating	Electric Furnace	1.9%	67,940.0	1,290.82	8.6	1.9%	63,456	1,205.63	-7%
Ventilation	Ventilation	100.0%	2,481.8	2,481.83	16.5	100.0%	2,190	2,189.91	-12%
Interior Lighting	Screw-in	100.0%	1,352.7	1,352.66	9.0	100.0%	932	932.26	-31%
Interior Lighting	High-Bay Fixtures	100.0%	287.9	287.91	1.9	100.0%	197	196.64	-32%
Interior Lighting	Linear Fluorescent	100.0%	3,940.3	3,940.32	26.1	100.0%	3,614	3,613.94	-8%
Exterior Lighting	Screw-in	100.0%	2.5	2.53	0.0	100.0%	1	1.45	-43%
Exterior Lighting	HID	100.0%	1,065.6	1,065.65	7.1	100.0%	756	756.35	-29%
Exterior Lighting	Linear Fluorescent	100.0%	0.3	0.30	0.0	100.0%	0	0.26	-13%
Motors	Pumps	100.0%	-	-	-	100.0%	-	-	0%
Motors	Fans & Blowers	100.0%	2,679.3	2,679.35	17.8	100.0%	2,652	2,651.99	-1%
Motors	Compressed Air	100.0%	1,004.8	1,004.75	6.7	100.0%	995	994.53	-1%
Motors	Matl Handling	100.0%	4,510.9	4,510.90	29.9	100.0%	4,465	4,464.86	-1%
Motors	Matl Processing	100.0%	8,038.0	8,038.04	53.3	100.0%	7,956	7,956.00	-1%
Motors	Other Motors	100.0%	1,004.8	1,004.75	6.7	100.0%	994	994.50	-1%
Process	Process Heating	100.0%	6,074.7	6,074.68	40.3	100.0%	6,075	6,074.68	0%
Process	Process Cooling and Refrigeration	100.0%	2,697.6	2,697.58	17.9	100.0%	2,698	2,697.58	0%
Process	Electro-Chemical Processes	100.0%	181.4	181.41	1.2	100.0%	181	181.41	0%
Process	Other Process	100.0%	993.0	993.05	6.6	100.0%	993	993.05	0%
Miscellaneous	Miscellaneous	100.0%	2,170.4	2,170.43	14.4	100.0%	2,170	2,170.43	0%
Total				**43,934.7**	**291.4**			**41,221.1**	**-6.2%**

Table A-18 Other Industrial Electric Market Profile, 2011

		Average Market Profile				New Units			
End Use	**Technology**	**Saturation**	**UEC (kWh)**	**Intensity (kWh/empl)**	**Usage (GWh)**	**Saturation**	**UEC (kWh)**	**Intensity (kWh/empl)**	**Compared to Average**
Cooling	Air-Cooled Chiller	2.5%	17,637.5	440.94	9.3	2.5%	13,911	347.77	-21%
Cooling	Water-Cooled Chiller	2.6%	16,916.3	445.56	9.4	2.6%	12,416	327.02	-27%
Cooling	Roof top AC	12.1%	27,129.5	3,276.29	69.1	12.1%	20,188	2,437.95	-26%
Cooling	Air-Source Heat Pump	0.1%	27,418.8	39.32	0.8	0.1%	20,350	29.18	-26%
Cooling	Geothermal Heat Pump	0.0%	18,288.3	6.56	0.1	0.0%	13,439	4.82	-27%
Cooling	Other Cooling	0.7%	17,907.1	117.02	2.5	0.7%	13,683	89.42	-24%
Heating	Air-Source Heat Pump	0.1%	68,503.3	98.23	2.1	0.1%	56,137	80.50	-18%
Heating	Geothermal Heat Pump	0.0%	45,691.7	16.38	0.3	0.0%	37,364	13.40	-18%
Heating	Electric Room Heat	0.2%	71,679.3	165.59	3.5	0.2%	66,948	154.67	-7%
Heating	Electric Furnace	1.9%	75,263.2	1,429.96	30.2	1.9%	70,296	1,335.58	-7%
Ventilation	Ventilation	100.0%	2,749.3	2,749.35	58.0	100.0%	2,426	2,425.96	-12%
Interior Lighting	Screw-in	100.0%	1,362.2	1,362.18	28.7	100.0%	939	938.83	-31%
Interior Lighting	High-Bay Fixtures	100.0%	289.9	289.94	6.1	100.0%	198	198.03	-32%
Interior Lighting	Linear Fluorescent	100.0%	3,968.1	3,968.07	83.7	100.0%	3,639	3,639.40	-8%
Exterior Lighting	Screw-in	100.0%	2.5	2.55	0.1	100.0%	1	1.46	-43%
Exterior Lighting	HID	100.0%	1,073.2	1,073.15	22.6	100.0%	762	761.68	-29%
Exterior Lighting	Linear Fluorescent	100.0%	0.3	0.31	0.0	100.0%	0	0.27	-13%
Motors	Pumps	100.0%	2,680.8	2,680.82	56.5	100.0%	2,653	2,653.47	-1%
Motors	Fans & Blowers	100.0%	3,219.5	3,219.51	67.9	100.0%	3,187	3,186.64	-1%
Motors	Compressed Air	100.0%	2,603.3	2,603.26	54.9	100.0%	2,577	2,576.76	-1%
Motors	Matl Handling	100.0%	1,109.2	1,109.15	23.4	100.0%	1,098	1,097.83	-1%
Motors	Matl Processing	100.0%	4,397.0	4,396.99	92.7	100.0%	4,352	4,352.11	-1%
Motors	Other Motors	100.0%	92.4	92.40	1.9	100.0%	91	91.45	-1%
Process	Process Heating	100.0%	4,330.2	4,330.17	91.3	100.0%	4,330	4,330.17	0%
Process	Process Cooling and Refrigeration	100.0%	2,268.4	2,268.37	47.8	100.0%	2,268	2,268.37	0%
Process	Electro-Chemical Processes	100.0%	108.0	108.04	2.3	100.0%	108	108.04	0%
Process	Other Process	100.0%	285.8	285.83	6.0	100.0%	286	285.83	0%
Miscellaneous	Miscellaneous	100.0%	2,207.6	2,207.59	46.6	100.0%	2,208	2,207.59	0%
Total				**38,783.5**	**818.0**			**35,944.1**	**-7.3%**

APPENDIX | B

RESIDENTIAL ENERGY EFFICIENCY EQUIPMENT AND MEASURE DATA

This appendix presents detailed information for all energy-efficiency measures (*equipment* and *non-equipment* measures per the LoadMAP taxonomy) that were evaluated as part of this study. Several sets of tables are provided.

Measure Descriptions

Table B-1 and Table B-2 provide brief descriptions for all equipment and non-equipment measures that were assessed for potential.

Equipment Measure Data

Table B-3 through Table B-6 list the detailed unit-level data for the equipment measures for each of the housing type segments — Single Family, Multi Family, and for existing and new construction, respectively. Savings are in annual kWh per household, and incremental costs are in $/household ($/HH), unless noted otherwise. The BC ratio shown in the tables are for the first year of savings potential, although the B/C ratio is calculated within LoadMAP for each year of the forecast. The B/C ratio in the tables is 1.00 if the measure represents the baseline technology, and zero if the technology is not available in the first year. The final data item in these tables is the levelized cost of conserved energy, which is defined as the cost of the measure divided by the cumulative amount of energy savings accrued over the measure's lifetime ($/kWh).

Non-Equipment Measure Data

Table B-7 through Table B-10 list the detailed unit-level data for the non-equipment energy efficiency measures for each of the housing type segments and for existing and new construction, respectively. Because these measures can produce energy-use savings for multiple end-use loads (e.g., insulation affects heating and cooling energy use) savings are expressed as a net percentage of all the relevant, combined end-use loads. Base saturation indicates the percentage of homes in which the measure is already installed. Applicability is a factor that account for whether the measure is applicable to the building. Cost is expressed in $/household. The detailed measure-level tables present the results of the benefit/cost (B/C) analysis for the first year of the analysis although the B/C ratio is calculated within LoadMAP for each year of the forecast. These tables also contain the levelized cost of conserved energy, which is defined as the cost of the measure divided by the cumulative amount of energy savings accrued over the measure's lifetime, given in terms of $/kWh.

Table B-1 Residential Energy Efficiency Equipment Measure Descriptions

End Use	Technology	Measure Description
Cooling	Central AC	Central air conditioners consist of a refrigeration system using a direct expansion cycle. Equipment includes a compressor, an air-cooled condenser (located outdoors), an expansion valve, and an evaporator coil. A supply fan near the evaporator coil distributes supply air through air ducts to the building. Cooling efficiencies vary based on materials used, equipment size, condenser type, and system configuration. CACs may be unitary (all components housed in a factory-built assembly) or split system (an outdoor condenser section and an indoor evaporator section connected by refrigerant lines and with the compressor either indoors or outdoors). Energy efficiency is rated according to the size of the unit using the Seasonal Energy Efficiency Rating (SEER). Ductless systems with Variable Refrigerant Flow further improve the operating efficiency.
Cooling	Room AC	Room air conditioners are designed to cool a single room or space. They incorporate a complete air-cooled refrigeration and air-handling system in an individual package. Room air conditioners come in several forms, including window, split-type, and packaged terminal units. Energy efficiency is rated according to the size of the unit using the Energy Efficiency Rating (EER).
Cooling / Heating	Air-Source Heat Pump	A central heat pump consists of components similar to a CAC system, but is usually designed to function both as a heat pump and an air conditioner. It consists of a refrigeration system using a direct expansion (DX) cycle. Equipment includes a compressor, an air-cooled condenser (located outdoors), an expansion valve, and an evaporator coil (located in the supply air duct near the supply fan) and a reversing valve to change the DX cycle from cooling to heating when required. The cooling and heating efficiencies vary based on the materials used, equipment size, condenser type, and system configuration. Heat pumps may be unitary (all components housed in a factory-built assembly) or a split system (an outdoor condenser section and an indoor evaporator section connected by refrigerant lines, with either outdoors or indoors. A high-efficiency option for a ductless mini-split system is also analyzed.
Cooling / Heating	Geothermal Heat Pump	Geothermal heat pumps are similar to air-source heat pumps, but use the ground or groundwater instead of outside air to provide a heat source/sink. A geothermal heat pump system generally consists of three major subsystems or parts: a geothermal heat pump to move heat between the building and the fluid in the earth connection, an earth connection for transferring heat between the fluid and the earth, and a distribution subsystem for delivering heating or cooling to the building. The system may also have a desuperheater to supplement the building's water heater, or a full-demand water heater to meet all of the building's hot water needs.
Heating	Electric Resistance	Resistive heating elements are used to convert electricity directly to heat. Conductive fins surrounding the element or another mechanism is used to deliver the heat directly to the surrounding room or area. These are typically either baseboard or wall-mounted units.
Heating	Furnace	Furnaces heat air and distribute the heated air through the building using ducts. Efficiency improvements can include: exhaust fan controls, electronic ignition (no pilot light), compact size and lighter weight to reduce cycling losses, smaller-diameter flue pipe, and sealed combustion. Very high efficiency units, or condensing units, condense the water vapor

End Use	Technology	Measure Description
		produced in the combustion process and also use the heat from this condensation.
Water Heating	Water Heater	For electric hot water heating, the most common type is a storage heater, which incorporates an electric heating element, storage tank, outer jacket, insulation, and controls in a single unit. Efficient units are characterized by a high recovery or thermal efficiency and low standby losses (the ratio of heat lost per hour to the content of the stored water). A further efficiency gain is available through a heat pump water heater (HPWH), which uses a vapor-compression thermodynamic cycle similar to that found in an air-conditioner or refrigerator to extract heat from an available source (e.g., air) and reject that heat to a higher temperature sink, in this case, the water in the water heater. Electric instantaneous water heaters are available, but are excluded from this study due to potentially high instantaneous demand concerns. For natural gas hot water heating, the most common type is a storage heater, which incorporates a burner, storage tank, outer jacket, insulation, and controls in a single unit. Efficient units are characterized by a high recovery or thermal efficiency and low standby losses (the ratio of heat lost per hour to the content of the stored water). A further efficiency gain is available in condensing units, which condense the water vapor produced in the combustion process and also use the heat from this condensation.
Interior Lighting	Screw-in	Infrared halogen lamps are designed to be a replacement for standards incandescent lamps. Also referred to as advanced incandescent lamps, these products meet the Energy Independence and Security Act (EISA) lighting standards and are phased in as the baseline technology screw-in lamp technology to reflect the timeline over which the EISA lighting standards take effect. Compact fluorescent lamps are designed to be a replacement for standard incandescent lamps and use about 25% of the energy used by standard incandescent lamps to produce the same lumen output. They can use either electronic or magnetic ballasts. Integral compact fluorescent lamps have the ballast integrated into the base of the lamp and have a standard screw-in base that permits installation into existing incandescent fixtures. Light-emitting diode (LED) lighting has seen recent penetration in specific applications such as traffic lights and exit signs. With the potential for extremely high efficiency, LEDs show promise to provide general-use lighting for interior spaces. Current models commercially available have efficacies comparable to CFLs. However, theoretical efficiencies are significantly higher. LED models under development are expected to provide improved efficacies.
Interior Lighting	Linear Fluorescent	T8 fluorescent lamps are smaller in diameter than standard T12 lamps, resulting in greater light output per watt. T8 lamps also operate at a lower current and wattage, which increases the efficiency of the ballast but requires the lamps to be compatible with the ballast. Fluorescent lamp fixtures can include a reflector that increases the light output from the fixture, and thus make it possible to use a fewer number of lamps in each fixture. T5 lamps further increase efficiency by reducing the lamp diameter to 5/8”. Light-emitting diode (LED) lighting has seen recent penetration in specific applications such as traffic lights and exit signs. With the potential for extremely high efficiency, LEDs show promise to provide general-use lighting for interior spaces. Current models commercially available have efficacies comparable to CFLs. However, theoretical efficiencies are significantly higher. LED models under development are expected to

End Use	Technology	Measure Description
		provide improved efficacies.
Interior Lighting	Specialty Lighting	Bulbs that the DOE does not consider conventional and are not covered by federal efficiency standards. These include: appliance bulbs, heavy-duty bulbs, dimmable bulbs, three-way bulbs, G shape (globe) lamps, candelabra base, and others.
Exterior Lighting	Exterior Lighting	Infrared halogen lamps are designed to be a replacement for standards incandescent lamps. Also referred to as advanced incandescent lamps, these products meet the Energy Independence and Security Act (EISA) lighting standards and are phased in as the baseline technology screw-in lamp technology to reflect the timeline over which the EISA lighting standards take effect. Compact fluorescent lamps are designed to be a replacement for standard incandescent lamps and use about 25% of the energy used by standard incandescent lamps to produce the same lumen output. They can use either electronic or magnetic ballasts. Integral compact fluorescent lamps have the ballast integrated into the base of the lamp and have a standard screw-in base that permits installation into existing incandescent fixtures. Light-emitting diode (LED) lighting has seen recent penetration in specific applications such as traffic lights and exit signs. With the potential for extremely high efficiency, LEDs show promise to provide general-use lighting for interior spaces. Current models commercially available have efficacies comparable to CFLs. However, theoretical efficiencies are significantly higher. LED models under development are expected to provide improved efficacies.
Appliances	Refrigerator	Energy-efficient refrigerators/freezers incorporate features such as improved cabinet insulation, more efficient compressors and evaporator fans, defrost controls, mullion heaters, oversized condenser coils, and improved door seals. Further efficiency increases can be obtained by reducing the volume of refrigerated space, or adding multiple compartments to reduce losses from opening doors.
Appliances	Second Refrigerator	Energy-efficient refrigerators/freezers incorporate features such as improved cabinet insulation, more efficient compressors and evaporator fans, defrost controls, mullion heaters, oversized condenser coils, and improved door seals. Further efficiency increases can be obtained by reducing the volume of refrigerated space, or adding multiple compartments to reduce losses from opening doors.
Appliances	Freezer	Energy-efficient refrigerators/freezers incorporate features such as improved cabinet insulation, more efficient compressors and evaporator fans, defrost controls, mullion heaters, oversized condenser coils, and improved door seals. Further efficiency increases can be obtained by reducing the volume of refrigerated space, or adding multiple compartments to reduce losses from opening doors.
Appliances	Clothes Washer	High efficiency clothes washers use superior designs that require less water. Sensors match the hot water needs to the size and soil level of the load, preventing energy waste. Further energy and water savings can be achieved through advanced technologies such as inverter-drive or combination washer-dryer units. MEF is the official energy efficiency metric used to compare relative efficiencies of different clothes washers. MEF considers the energy used to run the washer, heat the water, and run the dryer. The higher the MEF, the more efficient the clothes washer.
Appliances	Clothes Dryer	An energy-efficient clothes dryer has a moisture-sensing device to

End Use	Technology	Measure Description
		terminate the drying cycle rather than using a timer and an energy-efficient motor is used for spinning the dryer tub. Application of a heat pump cycle for extracting the moisture from clothes leads to additional energy savings.
Appliances	Dishwasher	High efficiency dishwashers save by using both improved technology for the primary wash cycle, and by using less hot water. Construction includes more effective washing action, energy-efficient motors, and other advanced technology such as sensors that determine the length of the wash cycle and the temperature of the water necessary to clean the dishes.
Appliances	Stove	These products have additional insulation in the oven compartment and tighter-fitting oven door gaskets and hinges to save energy. Conventional ovens must first heat up about 35 pounds of steel and a large amount of air before they heat up the food. Higher efficiency options include convection ovens, halogen burners, and induction burners.
Appliances	Microwave	Appliance that heats food with microwave radiation. No high efficiency option is modeled.
Electronics	Personal Computers	Improved power management can significantly reduce the annual energy consumption of PCs and monitors in both standby and normal operation. ENERGY STAR and Climate Savers labeled products provide increasing level of energy efficiency.
Electronics	Monitor	High efficiency electronics use efficient components and employ sleep/powersave modes.
Electronics	Laptops	High efficiency electronics use efficient components and employ sleep/powersave modes.
Electronics	Printer/Fax/Copier	High efficiency electronics use efficient components and employ sleep/powersave modes.
Electronics	TVs	In the average home, electronic products consumed significant energy, even when they are turn off, to maintain features like clocks, remote control, and channel/station memory. ENERGY STAR labeled consumer electronics can drastically reduce consumption during standby mode, in addition to saving energy through advanced power management during normal use.
Electronics	Devices and Gadgets	High efficiency electronics can use efficient components and employ sleep/powersave modes.
Electronics	Set-top Boxes/DVR	High efficiency electronics can use efficient components and employ sleep/powersave modes.
Miscellaneous	Pool Heater	Efficient pool heaters can make use of heat pump technology to achieve significantly higher coefficients of performance in the COP=5.0 range. Gas pool heaters have a burner to heat water in a loop. Efficiency improvements can include: exhaust fan controls, electronic ignition (no pilot light), compact size and lighter weight to reduce cycling losses, and sealed combustion. Very high efficiency units, or condensing units, condense the water vapor produced in the combustion process and also use the heat from this condensation.
Miscellaneous	Pool Pump	High-efficiency motors and two-speed pumps provide improved energy efficiency for this load.

End Use	Technology	Measure Description
Miscellaneous	Furnace Fan	In homes heated by a furnace, there is still substantial energy use by the fan responsible for moving the hot air throughout the ductwork. Application of an Electronically Commutating Motor (ECM) ensures that motor speed matches the heating requirements of the system and saves energy when compared to a continuously operating standard motor.
Miscellaneous	Well Pump	Existing well pumps can achieve efficiency improvements by using optimized system components and more efficient motors. Efficiencies: Baseline 40% EF, High Efficiency 60% EF
Miscellaneous	Hot Tub/Spa	High-efficiency motors and two-speed pumps provide improved energy efficiency for this load.
Miscellaneous	Miscellaneous	Improvement of miscellaneous electricity uses.

Table B-2 Residential Energy Efficiency Non-Equipment Measure Descriptions

End Use	Measure	Description
HVAC (All)	Insulation - Ceiling	Thermal insulation is material or combinations of materials that are used to inhibit the flow of heat energy by conductive, convective, and radiative transfer modes. Thus, thermal insulation above ceilings can conserve energy by reducing the heat loss or gain into attics and/or through roofs. The type of building construction defines insulating possibilities. Typical insulating materials include: loose-fill (blown) cellulose, loose-fill (blown) fiberglass, and rigid polystyrene.
Cooling	Insulation - Ducting	Air distribution ducts can be insulated to reduce heating or cooling losses. Best results can be achieved by covering the entire surface area with insulation. Several types of ducts and duct insulation are available, including flexible duct, pre-insulated duct, duct board, duct wrap, tacked, or glued rigid insulation, and waterproof hard shell materials for exterior ducts. This analysis assumes that installing duct insulation can reduce the temperature drop/gain in ducts by 50%.
HVAC (All)	Insulation - Foundation	Thermal insulation is material or combinations of materials that are used to inhibit the flow of heat energy by conductive, convective, and radiative transfer modes. Thus, thermal insulation can conserve energy by reducing heat loss or gain from a building. The type of building construction defines insulating possibilities. Typical insulating materials include: loose-fill (blown) cellulose, loose-fill (blown) fiberglass, and rigid polystyrene. Foundation insulation is modeled for new construction / major retrofits only.
HVAC (All)	Insulation - Infiltration Control	Lowering the air infiltration rate by caulking small leaks and weather-stripping around window frames, doorframes, power outlets, plumbing, and wall corners can provide significant energy savings. Weather-stripping doors and windows will create a tight seal and further reduce air infiltration.
HVAC (All)	Insulation - Radiant Barrier	Radiant barriers are materials installed to reduce the heat gain in buildings. Radiant barriers are made from materials that are highly reflective and have low emissivity like aluminum. The closer the emissivity is to 0 the better they will perform. Radiant barriers can be placed above the insulation or on the roof rafters.
HVAC (All)	Insulation - Wall Cavity	Thermal insulation is material or combinations of materials that are used to inhibit the flow of heat energy by conductive, convective, and radiative transfer modes. Thus, thermal insulation can conserve energy by reducing heat loss or gain from a building. The type of building construction defines insulating possibilities. Typical insulating materials include: loose-fill (blown) cellulose, loose-fill (blown) fiberglass, and rigid polystyrene. Wall insulation is modeled for new construction / major retrofits only.
HVAC (All)	Insulation - Wall Sheathing	Thermal insulation is material or combinations of materials that are used to inhibit the flow of heat energy by conductive, convective, and radiative transfer modes. Thus, thermal insulation can conserve energy by reducing heat loss or gain from a building. The type of building construction defines insulating possibilities. Typical insulating materials include: loose-fill (blown) cellulose, loose-fill (blown) fiberglass, and rigid polystyrene. Wall sheathing is modeled for new construction / major retrofits only.
Cooling	Ducting - Repair and Sealing	Leakage in unsealed ducts varies considerably because of the differences in fabricating machinery used, the methods for assembly, installation workmanship, and age of the ductwork. Air leaks from the system to the outdoors result in a direct loss proportional to the amount of leakage and the difference in enthalpy between the outdoor air and the conditioned air. To seal ducts, a wide variety of sealing methods and products exist. Each has a relatively short shelf life, and no documented research has identified the aging characteristics of sealant applications.
HVAC (All)	Windows - High Efficiency/ENERGY STAR	High-efficiency windows, such as those labeled under the ENERGY STAR Program, are designed to reduce energy use and increase occupant comfort. High-efficiency windows reduce the amount of heat transfer through the

End Use	Measure	Description
		glazing surface. For example, some windows have a low-E coating, a thin film of metallic oxide coating on the glass surface that allows passage of short-wave solar energy through glass and prevents long-wave energy from escaping. Another example is double-pane glass that reduces conductive and convective heat transfer. Some double-pane windows are gas-filled (usually argon) to further increase the insulating properties of the window.
HVAC (All)	Windows - Install Reflective Film	Reflective films applied to the window interior help reduce solar gain into the space and thus lower cooling energy use.
HVAC (All)	Doors - Storm and Thermal	Like other components of the shell, doors are subject to several types of heat loss: conduction, infiltration, and radiant losses. Similar to a storm window, a storm door creates an insulating air space between the storm and primary doors. A tight fitting storm door can also help reduce air leakage or infiltration. Thermal doors have exceptional thermal insulation properties and also are provided with weather-stripping on the doorframe to reduce air leakage.
HVAC (All)	Roofs - High Reflectivity	The color and material of a building structure surface will determine the amount of solar radiation absorbed by that surface and subsequently transferred into a building. This is called solar absorptance. By using a living roof or a roofing material with a light color (and a lower solar absorptance), the roof will absorb less solar radiation and consequently reduce the cooling load. Living roofs also reduce stormwater runoff.
HVAC (All)	Attic Fan - Installation	Attic fans can reduce the need for AC by reducing heat transfer from the attic through the ceiling of the house. A well-ventilated attic can be several degrees cooler than a comparable, unventilated attic. An option for an attic fan equipped with a small solar photovoltaic generator is also modeled.
HVAC (All)	Attic Fan - Photovoltaic - Installation	Attic fans can reduce the need for AC by reducing heat transfer from the attic through the ceiling of the house. A well-ventilated attic can be several degrees cooler than a comparable, unventilated attic. An option for an attic fan equipped with a small solar photovoltaic generator is also modeled.
HVAC (All)	Whole-House Fan - Installation	Whole-house fans can reduce the need for AC on moderate-weather days or on cool evenings. The fan facilitates a quick air change throughout the entire house. Several windows must be open to achieve the best results. The fan is mounted on the top floor of the house, usually in a hallway ceiling.
HVAC (All)	Ceiling Fan - Installation	Ceiling fans can reduce the need for air conditioning. However, the house occupants must also select a ceiling fan with a high-efficiency motor and either shutoff the AC system or setup the thermostat temperature of the air conditioning system to realize the potential energy savings. Some ceiling fans also come with lamps. In this analysis, it is assumed that there are no lamps, and installing a ceiling fan will allow occupants to increase the thermostat cooling setpoint up by 2°F.
HVAC (All)	Thermostat - Clock/Programmable	A programmable thermostat can be added to most heating/cooling systems. They are typically used during winter to lower temperatures at night and in summer to increase temperatures during the afternoon. The energy savings from this type of thermostat are identical to those of a "setback" strategy with standard thermostats, but the convenience of a programmable thermostat makes it a much more attractive option. In this analysis, the baseline is assumed to have no thermostat setback.
HVAC (All)	Home Energy Management System	A centralized home energy management system can be used to control and schedule cooling, space heating, lighting, and possibly appliances as well. Some designs also allow the homeowner to remotely control loads via the Internet.
Cooling	Central AC - Early Replacement	CAC systems currently on the market are significantly more efficient that older units, due to technology improvement and stricter appliance standards. This measure incents homeowners to replace an aging but still working unit with a new, higher-efficiency one.
Cooling	Central AC - Maintenance and Tune-Up	An air conditioner's filters, coils, and fins require regular cleaning and maintenance for the unit to function effectively and efficiently throughout its life. Neglecting necessary maintenance leads to a steady decline in

End Use	Measure	Description
		performance, requiring the AC unit to use more energy for the same cooling load.
Cooling / Heating	Central Heat Pump - Maintenance	A heat pump's filters, coils, and fins require regular cleaning and maintenance for the unit to function effectively and efficiently throughout its life. Neglecting necessary maintenance ensures a steady decline in performance while energy use steadily increases.
Cooling	Room AC - Removal of Second Unit	Homeowners may have a second room AC unit that is extremely inefficient. This measure incents homeowners to recycle the second unit and thus also eliminates associated electricity use.
Water Heating	Water Heater - Drainwater Heat Recovery	Drainwater Heat Recovery is a system in which drain water is used to preheat cold water entering the water heater. While these systems themselves are relatively inexpensive, upgrading an existing system could be unreasonable because of demolition costs. Thus they are modeled for new vintage only.
Water Heating	Water Heater - Faucet Aerators	Water faucet aerators are threaded screens that attach to existing faucets. They reduce the volume of water coming out of faucets while introducing air into the water stream. This measure provides energy saving by reducing hot water use, as well as water conservation for both hot and cold water.
Water Heating	Water Heater - Low-Flow Showerheads	Similar to faucet aerators, low-flow showerheads reduce the consumption of hot water, which in turn decreases water heating energy use.
Water Heating	Water Heater - Pipe Insulation	Insulating hot water pipes decreases energy losses from piping that distributes hot water throughout the building. It also results in quicker delivery of hot water and may allow the lowering of the hot water set point, which saves energy. The most common insulation materials for this purpose are polyethylene and neoprene.
Water Heating	Water Heater - Timer	These measures use either a programmable thermostat or a timer to adjust the water heater setpoint at times of low usage, typically when a home is unoccupied.
Water Heating	Water Heater - Desuperheater	A desuperheater can be added to an existing geothermal heat pump system (typically installed with the primary function of space heating and cooling) in order to draw off a portion of the geothermal heat for water heating purposes. The system can either supplement the building's water heater, or be a full-demand water heater that meets all of the building's hot water needs.
Water Heating	Water Heater - Solar System	Solar water heating systems can be used in residential buildings that have an appropriate near-south-facing roof or nearby unshaded grounds for installing a collector. Although system types vary, in general these systems use a solar absorber surface within a solar collector or an actual storage tank. Either a heat-transfer fluid or the actual potable water flows through tubes attached to the absorber and transfers heat from it. (Systems with a separate heat-transfer-fluid loop include a heat exchanger that then heats the potable water.) The heated water is stored in a separate preheat tank or a conventional water heater tank. If additional heat is needed, it is provided by a conventional water-heating system.
Interior Lighting	Interior Lighting - Occupancy Sensors	Occupancy sensors turn lights off when a space is unoccupied. They are appropriate for areas with intermittent use, such as bathrooms or storage areas.
Exterior Lighting	Exterior Lighting - Photosensor Control	Photosensor controls turn exterior lighting on or off based on ambient lighting levels. Compared with manual operation, this can reduce the operation of exterior lighting during daylight hours.
Exterior Lighting	Exterior Lighting - Photovoltaic Installation	Solar photovoltaic generation may be used to power exterior lighting and thus eliminate all or part of the electrical energy use.
Exterior Lighting	Exterior Lighting - Timeclock Installation	Lighting timers turn exterior lighting on or off based on a preset schedule. Compared with manual operation, this can reduce the operation of exterior lighting during daylight hours.
Appliances	Refrigerator - Early	Refrigerators/freezers currently on the market are significantly more efficient

End Use	Measure	Description
	Replacement	that older units, due to technology improvement and stricter appliance standards. This measure incents homeowners to replace an aging but still working unit with a new, higher-efficiency one.
Appliances	Refrigerator - Maintenance	This measure includes repairing and recharging refrigerant lines, cleaning condenser coils, and replacing the oil. This reduces energy consumption by improving the rate at which the system can compress and cool refrigerant as it moves through the system.
Appliances	Refrigerator - Remove Second Unit	Homeowners may have a second refrigerator or freezer that is not used to full capacity and that, because of its age, is extremely inefficient. This measure incents homeowners to recycle the second unit and thus also eliminates associated electricity use.
Appliances	Freezer - Remove Second Unit	Homeowners may have a second refrigerator or freezer that is not used to full capacity and that, because of its age, is extremely inefficient. This measure incents homeowners to recycle the second unit and thus also eliminates associated electricity use.
Appliances	Freezer - Early Replacement	Refrigerators/freezers currently on the market are significantly more efficient that older units, due to technology improvement and stricter appliance standards. This measure incents homeowners to replace an aging but still working unit with a new, higher-efficiency one.
Appliances	Freezer - Maintenance	This measure includes repairing and recharging refrigerant lines, cleaning condenser coils, and replacing the oil. This reduces energy consumption by improving the rate at which the system can compress and cool refrigerant as it moves through the system.
Electronics	Electronics - Smart Power Strips	Representing a growing portion of home electricity consumption, plug-in electronics such as set-top boxes, DVD players, gaming systems, digital video recorders, and even battery chargers for mobile phones and laptop computers are often designed to supply a set voltage. When the units are not in use, this voltage could be dropped significantly (~1 W) and thereby generate a significant energy savings, assumed for this analysis to be between 4-5% on average. These savings are in excess of the measures already discussed for computers and televisions.
Miscellaneous	Pool Pump - Timer	A pool pump timer allows the pump to turn off automatically, eliminating the wasted energy associated with unnecessary pumping.
Miscellaneous	Pool Heater - Solar System	This measure replaces a conventional pool heater with a solar system.
HVAC (All)	ENERGY STAR Home Design	ENERGY STAR home design uses an integrated approach to the design of new buildings to account for the interaction of building systems. Designs may specify the building orientation, building shell, proper sizing of equipment and systems, and controls strategies with the goal of optimizing building energy efficiency and comfort. Options that may be evaluated and incorporated include passive solar strategies, increased thermal mass, natural ventilation, energy recovery ventilation, daylighting strategies, and shading strategies; but with specific requirements that adhere to the ENERGY STAR standard and measurement system. This measure is modeled for new vintage only.
Cooling (All)	Dehumidifier	A dehumidifier decreases the humidity of the surrounding area by collecting water vapor from the air. Dryer air feels cooler, meaning occupants can set their thermostat to a higher cooling temperature and still feel comfortable, thus reducing the energy use of the cooling system.
Electronics	PC Power Management Software	This measure employs software and policies designed to minimize monitor and peripheral run times, and maximize the use of sleep and hibernation modes.

Table B-3 Energy Efficiency Equipment Data, Electric—Single Family, Existing Vintage

End Use	Technology	Eff. Definition	Savings (kWh/HH/yr)	Incremental Cost ($/HH)	Lifetime (Years)	BC Ratio	Levelized Cost of Energy ($/kWh)
Cooling	Central AC	SEER 13	-	$0.00	15	1.00	$0.00
Cooling	Central AC	SEER 14 (ESTAR)	235.17	$427.37	15	0.99	$0.17
Cooling	Central AC	SEER 15 (CEE Tier 2)	334.10	$1,068.41	15	0.93	$0.30
Cooling	Central AC	SEER 16 (CEE Tier 3)	416.81	$1,121.83	15	0.94	$0.25
Cooling	Central AC	Ductless Minisplit	487.36	$3,766.16	15	0.71	$0.71
Cooling	Central AC	SEER 21	935.61	$3,632.60	15	0.77	$0.36
Cooling	Room AC	EER 9.8	-	$0.00	10	1.00	$0.00
Cooling	Room AC	EER 10.8 (ESTAR)	104.30	$95.26	10	1.02	$0.11
Cooling	Room AC	EER 11.0	122.94	$121.73	10	1.02	$0.12
Cooling	Room AC	EER 11.5	166.69	$148.19	10	1.03	$0.11
Cooling	Room AC	EER 12.0	206.82	$624.51	10	0.82	$0.37
Cooling	Air Source HP	SEER 13, HSPF 7.7	-	$0.00	16	1.00	$0.00
Cooling	Air Source HP	SEER 14, HSPF 8.0	156.78	$413.78	16	0.97	$0.23
Cooling	Air Source HP	SEER 15, HSPF 8.2	225.21	$646.53	16	0.95	$0.25
Cooling	Air Source HP	SEER 16, HSPF 8.5	281.90	$1,086.18	16	0.89	$0.34
Cooling	Air Source HP	Ductless Minisplit	330.93	$3,258.53	16	0.66	$0.87
Cooling	Geo Heat Pump	EER 14.1, COP 3.3	-	$0.00	16	1.00	$0.00
Cooling	Geo Heat Pump	EER 16, COP 3.5	143.95	$416.55	16	0.99	$0.26
Cooling	Geo Heat Pump	EER 18, COP 3.8	362.75	$1,110.81	16	0.96	$0.27
Cooling	Geo Heat Pump	EER 30, COP 5.0	1,062.91	$2,499.33	16	0.95	$0.21
Heating	Elec. Resistance	Standard	-	$0.00	20	1.00	$0.00
Heating	Furnace	Standard	-	$0.00	15	1.00	$0.00
Heating	Air Source HP	SEER 13, HSPF 7.7	-	$0.00	16	1.00	$0.00
Heating	Air Source HP	SEER 14, HSPF 8.0	308.71	$249.59	16	0.99	$0.07
Heating	Air Source HP	SEER 15, HSPF 8.2	554.39	$389.98	16	0.99	$0.06
Heating	Air Source HP	SEER 16, HSPF 8.5	742.96	$655.17	16	0.96	$0.08
Heating	Air Source HP	Ductless Minisplit	887.47	$1,965.50	16	0.77	$0.20
Heating	Geo Heat Pump	EER 14.1, COP 3.3	-	$0.00	16	1.00	$0.00
Heating	Geo Heat Pump	EER 16, COP 3.5	106.13	$380.98	16	0.97	$0.32
Heating	Geo Heat Pump	EER 18, COP 3.8	383.50	$1,015.95	16	0.93	$0.23
Heating	Geo Heat Pump	EER 30, COP 5.0	1,160.13	$2,285.89	16	0.88	$0.17
Water Heating	W. Htr <= 55 gal	EF 0.9	-	$0.00	15	1.00	$0.00
Water Heating	W. Htr <= 55 gal	EF 0.95	159.10	$67.00	15	1.02	$0.04
Water Heating	W. Htr <= 55 gal	EF 2.3 (HP)	1,835.67	$1,614.00	15	0.89	$0.08
Water Heating	W. Htr > 55 gal	EF 0.9	-	$0.00	15	1.00	$0.00
Water Heating	W. Htr > 55 gal	EF 0.95	171.22	$67.00	15	1.02	$0.04
Water Heating	W. Htr > 55 gal	EF 2.3 (HP)	1,975.54	$1,614.00	15	0.92	$0.08
Int Lighting	Screw-in	Incandescent	-	$0.00	3	1.00	$0.00
Int Lighting	Screw-in	Inf. Halogen	286.86	$132.63	4	-	$0.12
Int Lighting	Screw-in	Inf. Halogen (2020)	882.34	$132.63	4	-	$0.04
Int Lighting	Screw-in	CFL	1,033.71	$56.20	6	2.40	$0.01
Int Lighting	Screw-in	LED	1,099.50	$1,587.66	15	0.49	$0.13
Int Lighting	Screw-in	LED (2020)	1,165.29	$509.17	15	-	$0.04
Int Lighting	Screw-in	LED Nightlight	31	$3	6	>1.0	$0.02
Int Lighting	Lin. Fluor.	T12	-	$0.00	10	-	$0.00
Int Lighting	Lin. Fluor.	T8	11.59	-$3.70	10	1.00	-$0.04
Int Lighting	Lin. Fluor.	Super T8	34.71	$29.56	10	0.81	$0.11
Int Lighting	Lin. Fluor.	LED (2011)	34.50	$168.59	20	0.48	$0.38
Int Lighting	Lin. Fluor.	T5	35.21	$50.71	10	0.64	$0.18
Int Lighting	Lin. Fluor.	LED (2020)	135.19	$439.48	20	-	$0.25
Int Lighting	Specialty	Incandescent	-	$0.00	3	1.00	$0.00
Int Lighting	Specialty	Inf. Halogen	131.79	$176.46	4	-	$0.36
Int Lighting	Specialty	Inf. Halogen (2020)	405.37	$176.46	4	-	$0.12
Int Lighting	Specialty	CFL	474.92	$74.77	6	1.45	$0.03
Int Lighting	Specialty	LED	505.14	$2,112.33	15	0.20	$0.39
Int Lighting	Specialty	LED (2020)	535.37	$677.43	15	-	$0.12
Ext Lighting	Screw-in	Incandescent	-	$0.00	3	1.00	$0.00
Ext Lighting	Screw-in	Inf. Halogen	34.32	$28.13	4	-	$0.22
Ext Lighting	Screw-in	Inf. Halogen (2020)	212.34	$28.13	4	-	$0.04
Ext Lighting	Screw-in	CFL	245.11	$14.51	6	2.28	$0.01

End Use	Technology	Eff. Definition	Savings (kWh/HH/yr)	Incremental Cost ($/HH)	Lifetime (Years)	BC Ratio	Levelized Cost of Energy ($/kWh)
Ext Lighting	Screw-in	LED	272.70	$307.64	15	0.59	$0.10
Ext Lighting	Screw-in	LED (2020)	299.25	$98.94	15	-	$0.03
Appliances	Clothes Washer	Standard (1.26)	-	$0.00	10	1.00	$0.00
Appliances	Clothes Washer	ESTAR (1.72)	30.63	$75.00	10	-	$0.30
Appliances	Clothes Washer	AHAM (MEF 1.72)	30.63	$75.00	10	-	$0.30
Appliances	Clothes Washer	ESTAR (MEF 2.0)	34.92	$115.00	10	0.86	$0.41
Appliances	Clothes Washer	AHAM (MEF 2.0)	34.92	$115.00	10	-	$0.41
Appliances	Clothes Washer	Compact (MEF 2.79)	42.38	$225.00	10	0.75	$0.66
Appliances	Clothes Dryer	Baseline	-	$0.00	13	1.00	$0.00
Appliances	Clothes Dryer	High Eff.	18.76	$100.00	13	0.87	$0.54
Appliances	Clothes Dryer	Baseline (2015+)	19.70	$75.00	13	-	$0.39
Appliances	Clothes Dryer	High Eff. (2015+)	44.11	$175.00	13	-	$0.40
Appliances	Clothes Dryer	HP (EF 4.52)	135.22	$458.00	13	0.62	$0.35
Appliances	Dishwasher	Standard (EF 0.63)	-	$0.00	9	-	$0.00
Appliances	Dishwasher	ESTAR (EF 0.69)	17.39	$5.00	9	-	$0.04
Appliances	Dishwasher	ESTAR (EF 0.73)	27.39	$80.00	9	-	$0.39
Appliances	Dishwasher	AHAM (EF 0.73)	27.39	$80.00	9	1.00	$0.39
Appliances	Dishwasher	Ultra Eff. (EF 1.1)	92.34	$255.00	9	0.84	$0.37
Appliances	Refrigerator	Standard	-	$0.00	13	1.00	$0.00
Appliances	Refrigerator	ESTAR	49.08	$25.00	13	1.01	$0.05
Appliances	Refrigerator	High Eff.	69.44	$425.00	13	0.72	$0.62
Appliances	Refrigerator	AHAM (2014)	104.15	$218.00	13	-	$0.21
Appliances	Refrigerator	High Eff. (2014)	134.08	$695.00	13	-	$0.53
Appliances	Freezer	Standard	-	$0.00	11	1.00	$0.00
Appliances	Freezer	ESTAR	47.02	$50.00	11	0.96	$0.12
Appliances	Freezer	High Eff.	98.31	$198.00	11	0.81	$0.23
Appliances	Freezer	AHAM (2014)	99.37	$198.00	11	-	$0.23
Appliances	Freezer	High Eff. (2014)	123.95	$352.00	11	-	$0.33
Appliances	2nd Fridge	Standard	-	$0.00	13	1.00	$0.00
Appliances	2nd Fridge	ESTAR	48.36	$25.00	13	1.00	$0.05
Appliances	2nd Fridge	High Eff.	68.41	$425.00	13	0.72	$0.63
Appliances	2nd Fridge	AHAM (2014)	102.62	$218.00	13	-	$0.22
Appliances	2nd Fridge	High Eff. (2014)	132.11	$695.00	13	-	$0.54
Appliances	Stove	Baseline	-	$0.00	13	1.00	$0.00
Appliances	Stove	Convection	1.36	$121.00	13	0.91	$9.10
Appliances	Stove	Halogen Burner	4.48	$580.00	13	0.68	$13.22
Appliances	Stove	Induction	25.14	$898.00	13	0.58	$3.64
Appliances	Microwave	Standard	-	$0.00	9	1.00	$0.00
Electronics	PCs	Standard	-	$0.00	5	1.00	$0.00
Electronics	PCs	ESTAR	99.63	$0.01	5	1.03	$0.00
Electronics	Monitor	Standard	-	$0.00	5	1.00	$0.00
Electronics	Monitor	ESTAR	12.32	$0.01	5	1.02	$0.00
Electronics	Laptops	Standard	-	$0.00	4	1.00	$0.00
Electronics	Laptops	ESTAR	45.89	$0.01	4	1.02	$0.00
Electronics	TVs	Standard	-	$0.00	11	1.00	$0.00
Electronics	TVs	ESTAR (4.1)	127.82	$0.02	11	-	$0.00
Electronics	TVs	ESTAR (5.1)	143.93	$0.03	11	1.12	$0.00
Electronics	Print/Fax/Copy	Standard	-	$0.00	5	1.00	$0.00
Electronics	Print/Fax/Copy	ESTAR	12.56	$0.01	5	1.02	$0.00
Electronics	Set-top Box/DVR	Standard	-	$0.00	5	1.00	$0.00
Electronics	Set-top Box/DVR	ESTAR (2009)	50.90	$0.01	5	-	$0.00
Electronics	Set-top Box/DVR	ESTAR (2011)	67.87	$0.02	5	1.05	$0.00
Electronics	Devices/Gadget	Standard	-	$0.00	5	1.00	$0.00
Miscellaneous	Pool Pump	Standard	-	$0.00	15	1.00	$0.00
Miscellaneous	Pool Pump	High Eff.	150.00	$85.00	15	1.01	$0.05
Miscellaneous	Pool Pump	Two-Speed	600.00	$579.00	15	0.90	$0.09
Miscellaneous	Pool Heater	Electric Resistance	-	$0.00	15	1.00	$0.00
Miscellaneous	Pool Heater	Heat Pump (COP 5.0)	3,984.80	$2,550.00	15	1.04	$0.06
Miscellaneous	Hot Tub / Spa	Standard	-	$0.00	15	1.00	$0.00
Miscellaneous	Hot Tub / Spa	Efficient Pumps	146.15	$300.00	15	0.94	$0.19
Miscellaneous	Hot Tub / Spa	Imp. Controls/Pumps	194.87	$350.00	15	0.94	$0.17
Miscellaneous	Well Pump	Baseline (40% EF)	-	$0.00	10	1.00	$0.00

End Use	Technology	Eff. Definition	Savings (kWh/HH/yr)	Incremental Cost ($/HH)	Lifetime (Years)	BC Ratio	Levelized Cost of Energy ($/kWh)
Miscellaneous	Well Pump	High Eff. (60% EF)	200.36	$110.00	10	0.97	$0.07
Miscellaneous	Furnace Fan	Standard	-	$0.00	18	1.00	$0.00
Miscellaneous	Furnace Fan	ECM	380	$200	18	>1.0	$0.04
Miscellaneous	Miscellaneous	Standard	-	$0.00	5	1.00	$0.00

Table B-4 Energy Efficiency Equipment Data, Electric—Single Family, New Vintage

End Use	Technology	Eff. Definition	Savings (kWh/HH/yr)	Incremental Cost ($/HH)	Lifetime (Years)	BC Ratio	Levelized Cost of Energy ($/kWh)
Cooling	Central AC	SEER 13	-	$0.00	15	1.00	$0.00
Cooling	Central AC	SEER 14 (ESTAR)	193.45	$487.05	15	0.97	$0.23
Cooling	Central AC	SEER 15 (CEE Tier 2)	272.45	$1,217.63	15	0.90	$0.41
Cooling	Central AC	SEER 16 (CEE Tier 3)	338.38	$1,278.51	15	0.90	$0.35
Cooling	Central AC	Ductless Minisplit	394.98	$4,292.15	15	0.65	$1.00
Cooling	Central AC	SEER 21	764.53	$4,139.95	15	0.70	$0.50
Cooling	Room AC	EER 9.8	-	$0.00	10	1.00	$0.00
Cooling	Room AC	EER 10.8 (ESTAR)	99.72	$95.26	10	1.02	$0.12
Cooling	Room AC	EER 11.0	117.56	$121.73	10	1.01	$0.13
Cooling	Room AC	EER 11.5	159.26	$148.19	10	1.03	$0.12
Cooling	Room AC	EER 12.0	197.34	$624.51	10	0.81	$0.39
Cooling	Air Source HP	SEER 13, HSPF 7.7	-	$0.00	16	1.00	$0.00
Cooling	Air Source HP	SEER 14, HSPF 8.0	144.39	$422.91	16	0.96	$0.26
Cooling	Air Source HP	SEER 15, HSPF 8.2	203.35	$660.80	16	0.93	$0.29
Cooling	Air Source HP	SEER 16, HSPF 8.5	252.56	$1,110.15	16	0.88	$0.39
Cooling	Air Source HP	Ductless Minisplit	294.81	$3,330.44	16	0.64	$1.00
Cooling	Geo Heat Pump	EER 14.1, COP 3.3	-	$0.00	16	1.00	$0.00
Cooling	Geo Heat Pump	EER 16, COP 3.5	130.24	$425.75	16	0.98	$0.29
Cooling	Geo Heat Pump	EER 18, COP 3.8	341.39	$1,135.32	16	0.96	$0.29
Cooling	Geo Heat Pump	EER 30, COP 5.0	1,017.07	$2,554.48	16	0.94	$0.22
Heating	Elec. Resistance	Standard	-	$0.00	20	1.00	$0.00
Heating	Furnace	Standard	-	$0.00	15	1.00	$0.00
Heating	Air Source HP	SEER 13, HSPF 7.7	-	$0.00	16	1.00	$0.00
Heating	Air Source HP	SEER 14, HSPF 8.0	229.93	$255.09	16	0.97	$0.10
Heating	Air Source HP	SEER 15, HSPF 8.2	406.19	$398.58	16	0.97	$0.09
Heating	Air Source HP	SEER 16, HSPF 8.5	543.07	$669.61	16	0.93	$0.11
Heating	Air Source HP	Ductless Minisplit	647.94	$2,008.84	16	0.72	$0.27
Heating	Geo Heat Pump	EER 14.1, COP 3.3	-	$0.00	16	1.00	$0.00
Heating	Geo Heat Pump	EER 16, COP 3.5	68.14	$389.38	16	0.97	$0.51
Heating	Geo Heat Pump	EER 18, COP 3.8	328.14	$1,038.36	16	0.93	$0.28
Heating	Geo Heat Pump	EER 30, COP 5.0	1,056.13	$2,336.31	16	0.87	$0.20
Water Heating	W. Htr <= 55 gal	EF 0.9	-	$0.00	15	1.00	$0.00
Water Heating	W. Htr <= 55 gal	EF 0.95	152.98	$67.00	15	1.01	$0.04
Water Heating	W. Htr <= 55 gal	EF 2.3 (HP)	1,765.07	$1,614.00	15	0.87	$0.08
Water Heating	W. Htr > 55 gal	EF 0.9	-	$0.00	15	1.00	$0.00
Water Heating	W. Htr > 55 gal	EF 0.95	163.07	$67.00	15	1.02	$0.04
Water Heating	W. Htr > 55 gal	EF 2.3 (HP)	1,881.46	$1,614.00	15	0.90	$0.08
Int Lighting	Screw-in	Incandescent	-	$0.00	3	1.00	$0.00
Int Lighting	Screw-in	Inf. Halogen	251.88	$150.68	4	-	$0.16
Int Lighting	Screw-in	Inf. Halogen (2020)	774.72	$150.68	4	-	$0.05
Int Lighting	Screw-in	CFL	907.64	$63.85	6	2.16	$0.01
Int Lighting	Screw-in	LED	965.40	$1,803.76	15	0.39	$0.17
Int Lighting	Screw-in	LED (2020)	1,023.17	$578.47	15	-	$0.05
Int Lighting	Lin. Fluor.	T12	-	$0.00	10	-	$0.00
Int Lighting	Lin. Fluor.	T8	13.16	-$4.20	10	1.00	-$0.04
Int Lighting	Lin. Fluor.	Super T8	39.44	$33.59	10	0.81	$0.11
Int Lighting	Lin. Fluor.	LED (2011)	39.19	$191.54	20	0.48	$0.38
Int Lighting	Lin. Fluor.	T5	40.00	$57.61	10	0.64	$0.18
Int Lighting	Lin. Fluor.	LED (2020)	153.59	$499.29	20	-	$0.25
Int Lighting	Specialty	Incandescent	-	$0.00	3	1.00	$0.00
Int Lighting	Specialty	Inf. Halogen	138.49	$200.48	4	-	$0.39

End Use	Technology	Eff. Definition	Savings (kWh/HH/yr)	Incremental Cost ($/HH)	Lifetime (Years)	BC Ratio	Levelized Cost of Energy ($/kWh)
Int Lighting	Specialty	Inf. Halogen (2020)	425.97	$200.48	4	-	$0.13
Int Lighting	Specialty	CFL	499.05	$84.95	6	1.39	$0.03
Int Lighting	Specialty	LED	530.81	$2,399.84	15	0.19	$0.42
Int Lighting	Specialty	LED (2020)	562.57	$769.64	15	-	$0.13
Ext Lighting	Screw-in	Incandescent	-	$0.00	3	1.00	$0.00
Ext Lighting	Screw-in	Inf. Halogen	39.00	$31.96	4	-	$0.22
Ext Lighting	Screw-in	Inf. Halogen (2020)	241.28	$31.96	4	-	$0.04
Ext Lighting	Screw-in	CFL	278.52	$16.49	6	2.28	$0.01
Ext Lighting	Screw-in	LED	309.86	$349.51	15	0.59	$0.10
Ext Lighting	Screw-in	LED (2020)	340.04	$112.41	15	-	$0.03
Appliances	Clothes Washer	Standard (1.26)	-	$0.00	10	1.00	$0.00
Appliances	Clothes Washer	ESTAR (1.72)	30.63	$75.00	10	-	$0.30
Appliances	Clothes Washer	AHAM (MEF 1.72)	30.63	$75.00	10	-	$0.30
Appliances	Clothes Washer	ESTAR (MEF 2.0)	34.92	$115.00	10	0.86	$0.41
Appliances	Clothes Washer	AHAM (MEF 2.0)	34.92	$115.00	10	-	$0.41
Appliances	Clothes Washer	Compact (MEF 2.79)	42.38	$225.00	10	0.75	$0.66
Appliances	Clothes Dryer	Baseline	-	$0.00	13	1.00	$0.00
Appliances	Clothes Dryer	High Eff.	18.76	$100.00	13	0.87	$0.54
Appliances	Clothes Dryer	Baseline (2015+)	19.70	$75.00	13	-	$0.39
Appliances	Clothes Dryer	High Eff. (2015+)	44.11	$175.00	13	-	$0.40
Appliances	Clothes Dryer	HP (EF 4.52)	135.22	$458.00	13	0.62	$0.35
Appliances	Dishwasher	Standard (EF 0.63)	-	$0.00	9	-	$0.00
Appliances	Dishwasher	ESTAR (EF 0.69)	17.39	$5.00	9	-	$0.04
Appliances	Dishwasher	ESTAR (EF 0.73)	27.39	$80.00	9	-	$0.39
Appliances	Dishwasher	AHAM (EF 0.73)	27.39	$80.00	9	1.00	$0.39
Appliances	Dishwasher	Ultra Eff. (EF 1.1)	92.34	$255.00	9	0.84	$0.37
Appliances	Refrigerator	Standard	-	$0.00	13	1.00	$0.00
Appliances	Refrigerator	ESTAR	49.08	$25.00	13	1.01	$0.05
Appliances	Refrigerator	High Eff.	69.44	$425.00	13	0.72	$0.62
Appliances	Refrigerator	AHAM (2014)	104.15	$218.00	13	-	$0.21
Appliances	Refrigerator	High Eff. (2014)	134.08	$695.00	13	-	$0.53
Appliances	Freezer	Standard	-	$0.00	11	1.00	$0.00
Appliances	Freezer	ESTAR	47.02	$50.00	11	0.96	$0.12
Appliances	Freezer	High Eff.	98.31	$198.00	11	0.81	$0.23
Appliances	Freezer	AHAM (2014)	99.37	$198.00	11	-	$0.23
Appliances	Freezer	High Eff. (2014)	123.95	$352.00	11	-	$0.33
Appliances	2nd Fridge	Standard	-	$0.00	13	1.00	$0.00
Appliances	2nd Fridge	ESTAR	48.36	$25.00	13	1.00	$0.05
Appliances	2nd Fridge	High Eff.	68.41	$425.00	13	0.72	$0.63
Appliances	2nd Fridge	AHAM (2014)	102.62	$218.00	13	-	$0.22
Appliances	2nd Fridge	High Eff. (2014)	132.11	$695.00	13	-	$0.54
Appliances	Stove	Baseline	-	$0.00	13	1.00	$0.00
Appliances	Stove	Convection	1.36	$121.00	13	0.91	$9.10
Appliances	Stove	Halogen Burner	4.48	$580.00	13	0.68	$13.22
Appliances	Stove	Induction	25.14	$898.00	13	0.58	$3.64
Appliances	Microwave	Standard	-	$0.00	9	1.00	$0.00
Electronics	PCs	Standard	-	$0.00	5	1.00	$0.00
Electronics	PCs	ESTAR	99.63	$0.01	5	1.03	$0.00
Electronics	Monitor	Standard	-	$0.00	5	1.00	$0.00
Electronics	Monitor	ESTAR	13.16	$0.01	5	1.02	$0.00
Electronics	Laptops	Standard	-	$0.00	4	1.00	$0.00
Electronics	Laptops	ESTAR	45.89	$0.01	4	1.02	$0.00
Electronics	TVs	Standard	-	$0.00	11	1.00	$0.00
Electronics	TVs	ESTAR (4.1)	127.82	$0.02	11	-	$0.00
Electronics	TVs	ESTAR (5.1)	143.93	$0.03	11	1.12	$0.00
Electronics	Print/Fax/Copy	Standard	-	$0.00	5	1.00	$0.00
Electronics	Print/Fax/Copy	ESTAR	12.56	$0.01	5	1.02	$0.00
Electronics	Set-top Box/DVR	Standard	-	$0.00	5	1.00	$0.00
Electronics	Set-top Box/DVR	ESTAR (2009)	50.90	$0.01	5	-	$0.00
Electronics	Set-top Box/DVR	ESTAR (2011)	67.87	$0.02	5	1.05	$0.00
Electronics	Devices/Gadget	Standard	-	$0.00	5	1.00	$0.00
Miscellaneous	Pool Pump	Standard	-	$0.00	15	1.00	$0.00

End Use	Technology	Eff. Definition	Savings (kWh/HH/yr)	Incremental Cost ($/HH)	Lifetime (Years)	BC Ratio	Levelized Cost of Energy ($/kWh)
Miscellaneous	Pool Pump	High Eff.	154.64	$85.00	15	1.02	$0.05
Miscellaneous	Pool Pump	Two-Speed	618.56	$579.00	15	0.91	$0.09
Miscellaneous	Pool Heater	Electric Resistance	-	$0.00	15	1.00	$0.00
Miscellaneous	Pool Heater	Heat Pump (COP 5.0)	3,984.80	$2,550.00	15	1.04	$0.06
Miscellaneous	Hot Tub / Spa	Standard	-	$0.00	15	1.00	$0.00
Miscellaneous	Hot Tub / Spa	Efficient Pumps	146.15	$300.00	15	0.94	$0.19
Miscellaneous	Hot Tub / Spa	Imp. Controls/Pumps	194.87	$350.00	15	0.94	$0.17
Miscellaneous	Well Pump	Baseline (40% EF)	-	$0.00	10	1.00	$0.00
Miscellaneous	Well Pump	High Eff. (60% EF)	204.00	$110.00	10	0.98	$0.07
Miscellaneous	Furnace Fan	Standard	-	$0.00	18	1.00	$0.00
Miscellaneous	Furnace Fan	ECM	92.27	$769.00	18	0.45	$0.68
Miscellaneous	Miscellaneous	Standard	-	$0.00	5	1.00	$0.00

Table B-5 Energy Efficiency Equipment Data, Electric—Multi Family, Existing Vintage

End Use	Technology	Eff. Definition	Savings (kWh/HH/yr)	Incremental Cost ($/HH)	Lifetime (Years)	BC Ratio	Levelized Cost of Energy ($/kWh)
Cooling	Central AC	SEER 13	-	$0.00	15	1.00	$0.00
Cooling	Central AC	SEER 14 (ESTAR)	79.53	$144.51	15	0.99	$0.17
Cooling	Central AC	SEER 15 (CEE Tier 2)	155.33	$361.28	15	0.95	$0.21
Cooling	Central AC	SEER 16 (CEE Tier 3)	219.01	$379.34	15	0.98	$0.16
Cooling	Central AC	Ductless Minisplit	273.31	$1,273.51	15	0.74	$0.43
Cooling	Central AC	SEER 21	404.20	$1,228.35	15	0.79	$0.28
Cooling	Room AC	EER 9.8	-	$0.00	10	1.00	$0.00
Cooling	Room AC	EER 10.8 (ESTAR)	40.16	$143.72	10	0.90	$0.44
Cooling	Room AC	EER 11.0	47.33	$183.64	10	0.88	$0.48
Cooling	Room AC	EER 11.5	64.14	$223.56	10	0.86	$0.43
Cooling	Room AC	EER 12.0	79.55	$942.14	10	0.53	$1.47
Cooling	Air Source HP	SEER 13, HSPF 7.7	-	$0.00	16	1.00	$0.00
Cooling	Air Source HP	SEER 14, HSPF 8.0	54.96	$138.21	16	0.97	$0.22
Cooling	Air Source HP	SEER 15, HSPF 8.2	78.95	$215.95	16	0.95	$0.24
Cooling	Air Source HP	SEER 16, HSPF 8.5	98.82	$362.80	16	0.89	$0.32
Cooling	Air Source HP	Ductless Minisplit	116.01	$1,088.39	16	0.66	$0.83
Cooling	Geo Heat Pump	EER 14.1, COP 3.3	-	$0.00	16	1.00	$0.00
Cooling	Geo Heat Pump	EER 16, COP 3.5	42.70	$131.45	16	0.98	$0.27
Cooling	Geo Heat Pump	EER 18, COP 3.8	107.61	$350.54	16	0.96	$0.29
Cooling	Geo Heat Pump	EER 30, COP 5.0	315.33	$788.71	16	0.93	$0.22
Heating	Elec. Resistance	Standard	-	$0.00	20	1.00	$0.00
Heating	Furnace	Standard	-	$0.00	15	1.00	$0.00
Heating	Air Source HP	SEER 13, HSPF 7.7	-	$0.00	16	1.00	$0.00
Heating	Air Source HP	SEER 14, HSPF 8.0	132.74	$107.32	16	0.99	$0.07
Heating	Air Source HP	SEER 15, HSPF 8.2	238.38	$167.69	16	0.99	$0.06
Heating	Air Source HP	SEER 16, HSPF 8.5	319.46	$281.71	16	0.96	$0.08
Heating	Air Source HP	Ductless Minisplit	381.60	$845.14	16	0.77	$0.20
Heating	Geo Heat Pump	EER 14.1, COP 3.3	-	$0.00	16	1.00	$0.00
Heating	Geo Heat Pump	EER 16, COP 3.5	57.44	$214.12	16	0.97	$0.33
Heating	Geo Heat Pump	EER 18, COP 3.8	207.56	$570.98	16	0.93	$0.24
Heating	Geo Heat Pump	EER 30, COP 5.0	627.91	$1,284.72	16	0.87	$0.18
Water Heating	W. Htr <= 55 gal	EF 0.9	-	$0.00	15	1.00	$0.00
Water Heating	W. Htr <= 55 gal	EF 0.95	97.56	$67.00	15	1.00	$0.06
Water Heating	W. Htr <= 55 gal	EF 2.3 (HP)	1,128.00	$1,614.00	15	0.68	$0.13
Water Heating	W. Htr > 55 gal	EF 0.9	-	$0.00	15	1.00	$0.00
Water Heating	W. Htr > 55 gal	EF 0.95	104.66	$67.00	15	1.00	$0.06
Water Heating	W. Htr > 55 gal	EF 2.3 (HP)	1,210.09	$1,614.00	15	0.71	$0.12
Int Lighting	Screw-in	Incandescent	-	$0.00	3	1.00	$0.00
Int Lighting	Screw-in	Inf. Halogen	188.45	$88.43	4	-	$0.13
Int Lighting	Screw-in	Inf. Halogen (2020)	579.62	$88.43	4	-	$0.04
Int Lighting	Screw-in	CFL	679.06	$37.47	6	2.39	$0.01
Int Lighting	Screw-in	LED	722.28	$1,058.63	15	0.48	$0.14
Int Lighting	Screw-in	LED (2020)	765.50	$339.51	15	-	$0.04

End Use	Technology	Eff. Definition	Savings (kWh/HH/yr)	Incremental Cost ($/HH)	Lifetime (Years)	BC Ratio	Levelized Cost of Energy ($/kWh)
Int Lighting	Lin. Fluor.	T12	-	$0.00	10	-	$0.00
Int Lighting	Lin. Fluor.	T8	9.72	-$3.22	10	1.00	-$0.04
Int Lighting	Lin. Fluor.	Super T8	29.11	$25.71	10	0.80	$0.11
Int Lighting	Lin. Fluor.	LED (2011)	28.93	$146.63	20	0.47	$0.39
Int Lighting	Lin. Fluor.	T5	29.53	$44.10	10	0.63	$0.19
Int Lighting	Lin. Fluor.	LED (2020)	113.38	$382.24	20	-	$0.26
Int Lighting	Specialty	Incandescent	-	$0.00	3	1.00	$0.00
Int Lighting	Specialty	Inf. Halogen	76.37	$111.28	4	-	$0.39
Int Lighting	Specialty	Inf. Halogen (2020)	234.91	$111.28	4	-	$0.13
Int Lighting	Specialty	CFL	275.21	$47.15	6	1.38	$0.03
Int Lighting	Specialty	LED	292.73	$1,332.10	15	0.19	$0.42
Int Lighting	Specialty	LED (2020)	310.24	$427.21	15	-	$0.13
Ext Lighting	Screw-in	Incandescent	-	$0.00	3	1.00	$0.00
Ext Lighting	Screw-in	Inf. Halogen	13.41	$13.51	4	-	$0.27
Ext Lighting	Screw-in	Inf. Halogen (2020)	82.99	$13.51	4	-	$0.04
Ext Lighting	Screw-in	CFL	95.80	$6.97	6	2.10	$0.01
Ext Lighting	Screw-in	LED	106.59	$147.69	15	0.50	$0.13
Ext Lighting	Screw-in	LED (2020)	116.97	$47.50	15	-	$0.04
Appliances	Clothes Washer	Standard (1.26)	-	$0.00	10	1.00	$0.00
Appliances	Clothes Washer	ESTAR (1.72)	26.22	$75.00	10	-	$0.35
Appliances	Clothes Washer	AHAM (MEF 1.72)	26.22	$75.00	10	-	$0.35
Appliances	Clothes Washer	ESTAR (MEF 2.0)	29.89	$115.00	10	0.86	$0.48
Appliances	Clothes Washer	AHAM (MEF 2.0)	29.89	$115.00	10	-	$0.48
Appliances	Clothes Washer	Compact (MEF 2.79)	36.28	$225.00	10	0.75	$0.77
Appliances	Clothes Dryer	Baseline	-	$0.00	13	1.00	$0.00
Appliances	Clothes Dryer	High Eff.	16.67	$100.00	13	0.87	$0.61
Appliances	Clothes Dryer	Baseline (2015+)	17.51	$75.00	13	-	$0.44
Appliances	Clothes Dryer	High Eff. (2015+)	39.20	$175.00	13	-	$0.46
Appliances	Clothes Dryer	HP (EF 4.52)	120.18	$458.00	13	0.60	$0.39
Appliances	Dishwasher	Standard (EF 0.63)	-	$0.00	9	-	$0.00
Appliances	Dishwasher	ESTAR (EF 0.69)	17.39	$5.00	9	-	$0.04
Appliances	Dishwasher	ESTAR (EF 0.73)	27.39	$80.00	9	-	$0.39
Appliances	Dishwasher	AHAM (EF 0.73)	27.39	$80.00	9	1.00	$0.39
Appliances	Dishwasher	Ultra Eff. (EF 1.1)	92.33	$255.00	9	0.84	$0.37
Appliances	Refrigerator	Standard	-	$0.00	13	1.00	$0.00
Appliances	Refrigerator	ESTAR	49.07	$25.00	13	1.00	$0.05
Appliances	Refrigerator	High Eff.	69.41	$425.00	13	0.72	$0.62
Appliances	Refrigerator	AHAM (2014)	104.12	$218.00	13	-	$0.21
Appliances	Refrigerator	High Eff. (2014)	134.03	$695.00	13	-	$0.53
Appliances	Freezer	Standard	-	$0.00	11	1.00	$0.00
Appliances	Freezer	ESTAR	46.99	$50.00	11	0.96	$0.12
Appliances	Freezer	High Eff.	98.26	$198.00	11	0.81	$0.23
Appliances	Freezer	AHAM (2014)	99.33	$198.00	11	-	$0.23
Appliances	Freezer	High Eff. (2014)	123.89	$352.00	11	-	$0.33
Appliances	2nd Fridge	Standard	-	$0.00	13	1.00	$0.00
Appliances	2nd Fridge	ESTAR	35.00	$25.00	13	1.00	$0.07
Appliances	2nd Fridge	High Eff.	49.51	$425.00	13	0.69	$0.88
Appliances	2nd Fridge	AHAM (2014)	74.26	$218.00	13	-	$0.30
Appliances	2nd Fridge	High Eff. (2014)	95.60	$695.00	13	-	$0.74
Appliances	Stove	Baseline	-	$0.00	13	1.00	$0.00
Appliances	Stove	Convection	1.31	$121.00	13	0.91	$9.44
Appliances	Stove	Halogen Burner	4.31	$580.00	13	0.68	$13.71
Appliances	Stove	Induction	24.23	$898.00	13	0.58	$3.78
Appliances	Microwave	Standard	-	$0.00	9	1.00	$0.00
Electronics	PCs	Standard	-	$0.00	5	1.00	$0.00
Electronics	PCs	ESTAR	99.63	$0.01	5	1.03	$0.00
Electronics	Monitor	Standard	-	$0.00	5	1.00	$0.00
Electronics	Monitor	ESTAR	13.16	$0.01	5	1.02	$0.00
Electronics	Laptops	Standard	-	$0.00	4	1.00	$0.00
Electronics	Laptops	ESTAR	45.89	$0.01	4	1.02	$0.00
Electronics	TVs	Standard	-	$0.00	11	1.00	$0.00
Electronics	TVs	ESTAR (4.1)	130.30	$0.02	11	-	$0.00

End Use	Technology	Eff. Definition	Savings (kWh/HH/yr)	Incremental Cost ($/HH)	Lifetime (Years)	BC Ratio	Levelized Cost of Energy ($/kWh)
Electronics	TVs	ESTAR (5.1)	146.73	$0.03	11	1.12	$0.00
Electronics	Print/Fax/Copy	Standard	-	$0.00	5	1.00	$0.00
Electronics	Print/Fax/Copy	ESTAR	12.56	$0.01	5	1.02	$0.00
Electronics	Set-top Box/DVR	Standard	-	$0.00	5	1.00	$0.00
Electronics	Set-top Box/DVR	ESTAR (2009)	50.90	$0.01	5	-	$0.00
Electronics	Set-top Box/DVR	ESTAR (2011)	67.87	$0.02	5	1.05	$0.00
Electronics	Devices/Gadget	Standard	-	$0.00	5	1.00	$0.00
Miscellaneous	Pool Pump	Standard	-	$0.00	15	1.00	$0.00
Miscellaneous	Pool Pump	High Eff.	154.64	$85.00	15	1.02	$0.05
Miscellaneous	Pool Pump	Two-Speed	618.56	$579.00	15	0.91	$0.09
Miscellaneous	Pool Heater	Electric Resistance	-	$0.00	15	1.00	$0.00
Miscellaneous	Pool Heater	Heat Pump (COP 5.0)	3,984.80	$2,550.00	15	1.04	$0.06
Miscellaneous	Hot Tub / Spa	Standard	-	$0.00	15	1.00	$0.00
Miscellaneous	Hot Tub / Spa	Efficient Pumps	144.67	$300.00	15	0.94	$0.19
Miscellaneous	Hot Tub / Spa	Imp. Controls/Pumps	192.89	$350.00	15	0.94	$0.17
Miscellaneous	Well Pump	Baseline (40% EF)	-	$0.00	10	1.00	$0.00
Miscellaneous	Well Pump	High Eff. (60% EF)	198.57	$110.00	10	0.97	$0.07
Miscellaneous	Furnace Fan	Standard	-	$0.00	18	1.00	$0.00
Miscellaneous	Furnace Fan	ECM	47.85	$769.00	18	0.33	$1.32
Miscellaneous	Miscellaneous	Standard	-	$0.00	5	1.00	$0.00

Table B-6 Energy Efficiency Equipment Data, Electric—Multi Family, New Vintage

End Use	Technology	Eff. Definition	Savings (kWh/HH/yr)	Incremental Cost ($/HH)	Lifetime (Years)	BC Ratio	Levelized Cost of Energy ($/kWh)
Cooling	Central AC	SEER 13	-	$0.00	15	1.00	$0.00
Cooling	Central AC	SEER 14 (ESTAR)	65.25	$164.70	15	0.97	$0.23
Cooling	Central AC	SEER 15 (CEE Tier 2)	127.26	$411.74	15	0.91	$0.30
Cooling	Central AC	SEER 16 (CEE Tier 3)	179.37	$432.33	15	0.93	$0.22
Cooling	Central AC	Ductless Minisplit	223.76	$1,451.38	15	0.67	$0.60
Cooling	Central AC	SEER 21	317.58	$1,399.91	15	0.71	$0.41
Cooling	Room AC	EER 9.8	-	$0.00	10	1.00	$0.00
Cooling	Room AC	EER 10.8 (ESTAR)	37.14	$135.89	10	0.90	$0.45
Cooling	Room AC	EER 11.0	43.78	$173.64	10	0.88	$0.49
Cooling	Room AC	EER 11.5	59.32	$211.39	10	0.86	$0.44
Cooling	Room AC	EER 12.0	73.56	$890.84	10	0.52	$1.50
Cooling	Air Source HP	SEER 13, HSPF 7.7	-	$0.00	16	1.00	$0.00
Cooling	Air Source HP	SEER 14, HSPF 8.0	48.23	$141.26	16	0.96	$0.26
Cooling	Air Source HP	SEER 15, HSPF 8.2	67.92	$220.72	16	0.93	$0.29
Cooling	Air Source HP	SEER 16, HSPF 8.5	84.36	$370.80	16	0.87	$0.39
Cooling	Air Source HP	Ductless Minisplit	98.47	$1,112.41	16	0.63	$1.00
Cooling	Geo Heat Pump	EER 14.1, COP 3.3	-	$0.00	16	1.00	$0.00
Cooling	Geo Heat Pump	EER 16, COP 3.5	40.67	$133.11	16	0.98	$0.29
Cooling	Geo Heat Pump	EER 18, COP 3.8	106.61	$354.97	16	0.95	$0.29
Cooling	Geo Heat Pump	EER 30, COP 5.0	317.61	$798.68	16	0.93	$0.22
Heating	Elec. Resistance	Standard	-	$0.00	20	1.00	$0.00
Heating	Furnace	Standard	-	$0.00	15	1.00	$0.00
Heating	Air Source HP	SEER 13, HSPF 7.7	-	$0.00	16	1.00	$0.00
Heating	Air Source HP	SEER 14, HSPF 8.0	98.87	$109.69	16	0.97	$0.10
Heating	Air Source HP	SEER 15, HSPF 8.2	174.66	$171.38	16	0.97	$0.09
Heating	Air Source HP	SEER 16, HSPF 8.5	233.51	$287.92	16	0.93	$0.11
Heating	Air Source HP	Ductless Minisplit	278.60	$863.77	16	0.72	$0.27
Heating	Geo Heat Pump	EER 14.1, COP 3.3	-	$0.00	16	1.00	$0.00
Heating	Geo Heat Pump	EER 16, COP 3.5	38.59	$219.69	16	0.97	$0.50
Heating	Geo Heat Pump	EER 18, COP 3.8	185.81	$585.83	16	0.93	$0.28
Heating	Geo Heat Pump	EER 30, COP 5.0	598.03	$1,318.12	16	0.87	$0.20
Water Heating	W. Htr <= 55 gal	EF 0.9	-	$0.00	15	1.00	$0.00
Water Heating	W. Htr <= 55 gal	EF 0.95	98.18	$67.00	15	1.00	$0.06
Water Heating	W. Htr <= 55 gal	EF 2.3 (HP)	1,135.23	$1,614.00	15	0.69	$0.13
Water Heating	W. Htr > 55 gal	EF 0.9	-	$0.00	15	1.00	$0.00

End Use	Technology	Eff. Definition	Savings (kWh/HH/yr)	Incremental Cost ($/HH)	Lifetime (Years)	BC Ratio	Levelized Cost of Energy ($/kWh)
Water Heating	W. Htr > 55 gal	EF 0.95	104.66	$67.00	15	1.00	$0.06
Water Heating	W. Htr > 55 gal	EF 2.3 (HP)	1,210.09	$1,614.00	15	0.71	$0.12
Int Lighting	Screw-in	Incandescent	-	$0.00	3	1.00	$0.00
Int Lighting	Screw-in	Inf. Halogen	216.63	$101.70	4	-	$0.13
Int Lighting	Screw-in	Inf. Halogen (2020)	666.31	$101.70	4	-	$0.04
Int Lighting	Screw-in	CFL	780.62	$43.10	6	2.39	$0.01
Int Lighting	Screw-in	LED	830.30	$1,217.42	15	0.48	$0.14
Int Lighting	Screw-in	LED (2020)	879.99	$390.43	15	-	$0.04
Int Lighting	Lin. Fluor.	T12	-	$0.00	10	-	$0.00
Int Lighting	Lin. Fluor.	T8	11.18	-$3.70	10	1.00	-$0.04
Int Lighting	Lin. Fluor.	Super T8	33.48	$29.57	10	0.80	$0.11
Int Lighting	Lin. Fluor.	LED (2011)	33.27	$168.63	20	0.47	$0.39
Int Lighting	Lin. Fluor.	T5	33.96	$50.72	10	0.63	$0.19
Int Lighting	Lin. Fluor.	LED (2020)	130.39	$439.58	20	-	$0.26
Int Lighting	Specialty	Incandescent	-	$0.00	3	1.00	$0.00
Int Lighting	Specialty	Inf. Halogen	87.83	$127.97	4	-	$0.39
Int Lighting	Specialty	Inf. Halogen (2020)	270.15	$127.97	4	-	$0.13
Int Lighting	Specialty	CFL	316.50	$54.23	6	1.38	$0.03
Int Lighting	Specialty	LED	336.64	$1,531.91	15	0.19	$0.42
Int Lighting	Specialty	LED (2020)	356.78	$491.29	15	-	$0.13
Ext Lighting	Screw-in	Incandescent	-	$0.00	3	1.00	$0.00
Ext Lighting	Screw-in	Inf. Halogen	14.88	$14.50	4	-	$0.26
Ext Lighting	Screw-in	Inf. Halogen (2020)	92.07	$14.50	4	-	$0.04
Ext Lighting	Screw-in	CFL	106.28	$7.48	6	2.13	$0.01
Ext Lighting	Screw-in	LED	118.24	$158.52	15	0.51	$0.12
Ext Lighting	Screw-in	LED (2020)	129.76	$50.98	15	-	$0.04
Appliances	Clothes Washer	Standard (1.26)	-	$0.00	10	1.00	$0.00
Appliances	Clothes Washer	ESTAR (1.72)	-	$75.00	10	-	$0.00
Appliances	Clothes Washer	AHAM (MEF 1.72)	-	$75.00	10	-	$0.00
Appliances	Clothes Washer	ESTAR (MEF 2.0)	-	$115.00	10	0.84	$0.00
Appliances	Clothes Washer	AHAM (MEF 2.0)	-	$115.00	10	-	$0.00
Appliances	Clothes Washer	Compact (MEF 2.79)	-	$225.00	10	0.73	$0.00
Appliances	Clothes Dryer	Baseline	-	$0.00	13	1.00	$0.00
Appliances	Clothes Dryer	High Eff.	16.67	$100.00	13	0.87	$0.61
Appliances	Clothes Dryer	Baseline (2015+)	17.51	$75.00	13	-	$0.44
Appliances	Clothes Dryer	High Eff. (2015+)	39.20	$175.00	13	-	$0.46
Appliances	Clothes Dryer	HP (EF 4.52)	120.18	$458.00	13	0.60	$0.39
Appliances	Dishwasher	Standard (EF 0.63)	-	$0.00	9	-	$0.00
Appliances	Dishwasher	ESTAR (EF 0.69)	17.39	$5.00	9	-	$0.04
Appliances	Dishwasher	ESTAR (EF 0.73)	27.39	$80.00	9	-	$0.39
Appliances	Dishwasher	AHAM (EF 0.73)	27.39	$80.00	9	1.00	$0.39
Appliances	Dishwasher	Ultra Eff. (EF 1.1)	92.33	$255.00	9	0.84	$0.37
Appliances	Refrigerator	Standard	-	$0.00	13	1.00	$0.00
Appliances	Refrigerator	ESTAR	49.07	$25.00	13	1.00	$0.05
Appliances	Refrigerator	High Eff.	69.41	$425.00	13	0.72	$0.62
Appliances	Refrigerator	AHAM (2014)	104.12	$218.00	13	-	$0.21
Appliances	Refrigerator	High Eff. (2014)	134.03	$695.00	13	-	$0.53
Appliances	Freezer	Standard	-	$0.00	11	1.00	$0.00
Appliances	Freezer	ESTAR	46.99	$50.00	11	0.96	$0.12
Appliances	Freezer	High Eff.	98.26	$198.00	11	0.81	$0.23
Appliances	Freezer	AHAM (2014)	99.33	$198.00	11	-	$0.23
Appliances	Freezer	High Eff. (2014)	123.89	$352.00	11	-	$0.33
Appliances	2nd Fridge	Standard	-	$0.00	13	1.00	$0.00
Appliances	2nd Fridge	ESTAR	34.99	$25.00	13	1.00	$0.07
Appliances	2nd Fridge	High Eff.	49.50	$425.00	13	0.69	$0.88
Appliances	2nd Fridge	AHAM (2014)	74.24	$218.00	13	-	$0.30
Appliances	2nd Fridge	High Eff. (2014)	95.58	$695.00	13	-	$0.74
Appliances	Stove	Baseline	-	$0.00	13	1.00	$0.00
Appliances	Stove	Convection	1.31	$121.00	13	0.91	$9.44
Appliances	Stove	Halogen Burner	4.31	$580.00	13	0.68	$13.71
Appliances	Stove	Induction	24.23	$898.00	13	0.58	$3.78
Appliances	Microwave	Standard	-	$0.00	9	1.00	$0.00

End Use	Technology	Eff. Definition	Savings (kWh/HH/yr)	Incremental Cost ($/HH)	Lifetime (Years)	BC Ratio	Levelized Cost of Energy ($/kWh)
Electronics	PCs	Standard	-	$0.00	5	1.00	$0.00
Electronics	PCs	ESTAR	99.63	$0.01	5	1.03	$0.00
Electronics	Monitor	Standard	-	$0.00	5	1.00	$0.00
Electronics	Monitor	ESTAR	13.16	$0.01	5	1.02	$0.00
Electronics	Laptops	Standard	-	$0.00	4	1.00	$0.00
Electronics	Laptops	ESTAR	51.20	$0.01	4	1.02	$0.00
Electronics	TVs	Standard	-	$0.00	11	1.00	$0.00
Electronics	TVs	ESTAR (4.1)	127.82	$0.02	11	-	$0.00
Electronics	TVs	ESTAR (5.1)	143.93	$0.03	11	1.12	$0.00
Electronics	Print/Fax/Copy	Standard	-	$0.00	5	1.00	$0.00
Electronics	Print/Fax/Copy	ESTAR	12.56	$0.01	5	1.02	$0.00
Electronics	Set-top Box/DVR	Standard	-	$0.00	5	1.00	$0.00
Electronics	Set-top Box/DVR	ESTAR (2009)	50.90	$0.01	5	-	$0.00
Electronics	Set-top Box/DVR	ESTAR (2011)	67.87	$0.02	5	1.05	$0.00
Electronics	Devices/Gadget	Standard	-	$0.00	5	1.00	$0.00
Miscellaneous	Pool Pump	Standard	-	$0.00	15	1.00	$0.00
Miscellaneous	Pool Pump	High Eff.	154.64	$85.00	15	1.02	$0.05
Miscellaneous	Pool Pump	Two-Speed	618.56	$579.00	15	0.91	$0.09
Miscellaneous	Pool Heater	Electric Resistance	-	$0.00	15	1.00	$0.00
Miscellaneous	Pool Heater	Heat Pump (COP 5.0)	4,213.81	$2,550.00	15	1.08	$0.06
Miscellaneous	Hot Tub / Spa	Standard	-	$0.00	15	1.00	$0.00
Miscellaneous	Hot Tub / Spa	Efficient Pumps	146.15	$300.00	15	0.94	$0.19
Miscellaneous	Hot Tub / Spa	Imp. Controls/Pumps	194.87	$350.00	15	0.94	$0.17
Miscellaneous	Well Pump	Baseline (40% EF)	-	$0.00	10	1.00	$0.00
Miscellaneous	Well Pump	High Eff. (60% EF)	198.57	$110.00	10	0.97	$0.07
Miscellaneous	Furnace Fan	Standard	-	$0.00	18	1.00	$0.00
Miscellaneous	Furnace Fan	ECM	47.85	$769.00	18	0.33	$1.32
Miscellaneous	Miscellaneous	Standard	-	$0.00	5	1.00	$0.00

Table B-7 Energy Efficiency Non-Equipment Data, Electric—Single Family, Existing Vintage

Measure	Base Saturation	Applicability	Lifetime (Years)	Cost ($/HH)	Savings (kWh)	BC Ratio	Levelized Cost ($/kWh)
Insulation - Ceiling	16.0%	37.5%	20	$363.46	360.71	1.44	$0.08
Insulation - Ducting	15.0%	75.0%	20	$95.00	79.09	2.12	$0.09
Insulation - Foundation	20.0%	45.0%	20	$583.04	3,241.09	7.58	$0.01
Insulation - Infiltration Control	46.0%	90.0%	15	$327.96	793.77	2.28	$0.04
Insulation - Radiant Barrier	5.0%	90.0%	20	$82.85	335.50	5.85	$0.02
Insulation - Wall Cavity	13.0%	45.0%	20	$6,048.35	662.41	0.14	$0.70
Insulation - Wall Sheathing	20.0%	45.0%	20	$4,435.45	-	-	$-
Ducting - Repair and Sealing	11.8%	50.0%	18	$497.62	1,176.17	3.24	$0.03
Windows - High Efficiency/ENERGY STAR	24.0%	90.0%	20	$7,132.86	1,117.45	0.43	$0.49
Windows - Install Reflective Film	5.0%	45.0%	10	$1,028.72	1,098.09	1.46	$0.12
Doors - Storm and Thermal	38.0%	75.0%	25	$133.00	187.58	2.63	$0.05
Roofs - High Reflectivity	5.0%	10.0%	20	$85.52	185.80	6.16	$0.04
Attic Fan - Installation	12.0%	22.5%	20	$120.48	10.00	0.24	$0.93
Attic Fan - Photovoltaic - Installation	13.0%	45.0%	20	$461.52	10.00	0.06	$3.56
Whole-House Fan - Installation	4.0%	18.8%	20	$546.60	338.03	1.75	$0.12
Ceiling Fan - Installation	56.0%	75.0%	10	$135.00	327.27	3.32	$0.05
Thermostat - Clock/Programmable	46.0%	56.3%	5	$30.00	856.44	8.69	$0.01
Home Energy Management System	2.0%	37.5%	15	$1,747.00	1,058.48	0.63	$0.15
Air Filter Alarm			1	$3	41	>1.0	$0.07
Central AC - Early Replacement	37.0%	100.0%	15	$3,373.96	396.27	0.25	$0.79
Central AC - Maintenance and Tune-Up	15.0%	100.0%	2	$175.00	334.17	0.52	$0.27
Central Heat Pump - Maintenance	15.0%	90.0%	2	$175.00	612.09	0.29	$0.15
Room AC - Removal of Second Unit	0.0%	37.5%	4	$120.00	1,291.50	6.58	$0.02
Water Heater - Drainwater Heat Recovery	1.0%	45.0%	40	$529.00	503.20	2.89	$0.06
Water Heater - Faucet Aerators	12.0%	90.0%	9	$16.00	107.82	3.23	$0.02
Water Heater - Low-Flow Showerheads	27.0%	75.0%	10	$24.00	490.93	11.00	$0.01

Water Heater - Pipe Insulation	42.0%	38.1%	15	$512.22	159.81	0.27	$0.30
Water Heater - Timer	17.0%	40.0%	5	$115.00	86.40	0.19	$0.29
Water Heater - Desuperheater	0.0%	75.0%	0	$-	-	2.00	$-
Water Heater - Solar System	0.0%	75.0%	20	$5,400.00	2,515.99	0.56	$0.17
Interior Lighting - Occupancy Sensors	3.6%	5.0%	10	$547.62	612.33	0.48	$0.11
Exterior Lighting - Photosensor Control	10.0%	45.0%	8	$130.00	136.66	0.30	$0.14
Exterior Lighting - Photovoltaic Installation	26.0%	45.0%	12	$2,973.50	27.33	0.00	$11.75
Exterior Lighting - Timeclock Installation	10.0%	45.0%	5	$115.00	27.33	0.04	$0.93
Refrigerator - Early Replacement	37.0%	100.0%	9	$876.00	249.51	0.12	$0.47
Refrigerator - Maintenance	37.0%	100.0%	4	$50.00	90.02	-	$0.12
Refrigerator - Remove Second Unit	0.0%	100.0%	5	$120.00	968.78	1.76	$0.03
Freezer - Remove Second Unit	0.0%	37.5%	5	$120.00	933	>1.0	$0.03
Freezer - Early Replacement	37.0%	100.0%	6	$403.00	198.77	0.13	$0.38
Freezer - Maintenance	0.0%	100.0%	4	$50.00	33.13	-	$0.41
Electronics - Smart Power Strips	5.0%	90.0%	4	$26.00	103.00	0.85	$0.07
Pool Pump - Timer	25.0%	90.0%	5	$115.00	129.03	0.30	$0.20
Pool Heater - Solar System	0.0%	75.0%	10	$3,500.00	3,735.75	-	$0.12
ENERGY STAR Home Design	0.0%	0.0%	25	$-	3,704.66	3.00	$-

Table B-8 Energy Efficiency Non-Equipment Data, Electric—Single Family, New Vintage

Measure	Base Saturation	Applicability	Lifetime (Years)	Cost ($/HH)	Savings (kWh)	BC Ratio	Levelized Cost ($/kWh)
Insulation - Ceiling	4.0%	8.0%	12	$300.00	256.07	3.87	$0.13
Insulation - Ducting	5.0%	90.0%	5	$12.00	309.14	4.59	$0.01
Insulation - Foundation	16.0%	47.5%	20	$575.75	2,563.88	0.68	$0.02
Insulation - Infiltration Control	50.0%	75.0%	20	$95.00	535.76	4.86	$0.01
Insulation - Radiant Barrier	20.0%	90.0%	20	$760.32	88.52	4.97	$0.66
Insulation - Wall Cavity	46.0%	90.0%	15	$427.68	398.40	1.26	$0.10
Insulation - Wall Sheathing	25.0%	90.0%	20	$94.61	1,165.01	1.42	$0.01
Ducting - Repair and Sealing	13.0%	90.0%	20	$4,367.34	605.07	0.12	$0.56
Windows - High Efficiency/ENERGY STAR	20.0%	90.0%	20	$757.78	959.09	2.16	$0.06
Windows - Install Reflective Film	11.8%	50.0%	18	$497.62	951.30	1.74	$0.04
Doors - Storm and Thermal	24.0%	90.0%	20	$6,852.83	44.66	0.42	$11.83
Roofs - High Reflectivity	2.0%	45.0%	10	$656.80	124.10	2.16	$0.66
Attic Fan - Installation	13.0%	75.0%	25	$133.00	10.65	0.64	$0.85
Attic Fan - Photovoltaic - Installation	5.0%	90.0%	20	$97.66	10.65	3.99	$0.71
Whole-House Fan - Installation	4.0%	22.5%	20	$120.48	326.98	0.28	$0.03
Ceiling Fan - Installation	4.0%	11.3%	20	$461.52	300.83	0.07	$0.12
Thermostat - Clock/Programmable	4.0%	18.8%	20	$712.80	505.02	1.44	$0.11
Home Energy Management System	57.0%	75.0%	10	$135.00	813.68	3.33	$0.02
Central AC - Early Replacement	57.0%	75.0%	5	$30.00	300.22	5.47	$0.02
Central AC - Maintenance and Tune-Up	0.0%	67.5%	15	$1,747.00	254.64	0.50	$0.63
Central Heat Pump - Maintenance	24.0%	100.0%	15	$966.35	154.48	0.71	$0.58
Room AC - Removal of Second Unit	15.0%	100.0%	2	$175.00	1,109.24	0.41	$0.08
Water Heater - Drainwater Heat Recovery	15.0%	90.0%	2	$175.00	460.54	0.09	$0.19
Water Heater - Faucet Aerators	0.0%	37.5%	4	$120.00	98.61	5.83	$0.33
Water Heater - Low-Flow Showerheads	1.0%	90.0%	40	$529.00	449.41	2.60	$0.07
Water Heater - Pipe Insulation	3.0%	90.0%	9	$16.00	146.30	2.86	$0.01
Water Heater - Timer	12.0%	75.0%	10	$24.00	86.40	9.74	$0.03
Water Heater - Desuperheater	42.0%	41.3%	15	$584.93	-	0.21	$-
Water Heater - Solar System	5.0%	40.0%	5	$115.00	2,302.83	0.19	$0.01
Interior Lighting - Occupancy Sensors	0.0%	75.0%	0	$-	726.95	2.00	$-
Exterior Lighting - Photosensor Control	0.0%	75.0%	20	$5,400.00	143.87	0.50	$2.89
Exterior Lighting - Photovoltaic Installation	2.8%	9.0%	10	$547.62	28.77	0.53	$2.36
Exterior Lighting - Timeclock Installation	10.0%	45.0%	8	$130.00	28.77	0.38	$0.67
Refrigerator - Early Replacement	19.0%	45.0%	12	$2,973.50	173.69	0.00	$1.85
Refrigerator - Maintenance	16.0%	45.0%	4	$115.00	60.64	0.05	$0.42
Refrigerator - Remove Second Unit	24.0%	100.0%	9	$876.00	633.81	0.10	$0.19
Freezer - Remove Second Unit	24.0%	100.0%	5	$120	933	>1.0	$0.03
Freezer - Early Replacement	0.0%	100.0%	5	$120.00	137.93	1.37	$0.19
Freezer - Maintenance	0.0%	37.5%	4	$120.00	22.99	0.76	$1.40

Electronics - Smart Power Strips	24.0%	100.0%	6	$403.00	103.00	0.10	$0.74
Pool Pump - Timer	0.0%	100.0%	0	$50.00	108.25	-	$-
Pool Heater - Solar System	5.0%	90.0%	4	$26.00	3,437.04	0.80	$0.00
ENERGY STAR Home Design	25.0%	90.0%	5	$115.00	2,937.94	0.25	$0.01

Table B-9 Energy Efficiency Non-Equipment Data, Electric—Multi Family, Existing Vintage

Measure	Base Saturation	Applicability	Lifetime (Years)	Cost ($/HH)	Savings (kWh)	BC Ratio	Levelized Cost ($/kWh)
Insulation - Ceiling	0.0%	75.0%	0	$3,500.00	291.25	-	$-
Insulation - Ducting	14.0%	75.0%	25	$8,544.00	24.00	0.68	$24.32
Insulation - Foundation	3.0%	3.0%	12	$300.00	-	3.21	$-
Insulation - Infiltration Control	5.0%	90.0%	5	$12.00	562.07	4.56	$0.00
Insulation - Radiant Barrier	11.0%	18.8%	20	$574.60	273.38	0.75	$0.16
Insulation - Wall Cavity	13.0%	75.0%	20	$95.00	347.09	0.53	$0.02
Insulation - Wall Sheathing	0.0%	0.0%	20	$-	-	2.00	$-
Ducting - Repair and Sealing	19.0%	90.0%	15	$152.10	271.12	3.40	$0.05
Windows - High Efficiency/ENERGY STAR	5.0%	90.0%	20	$130.98	238.51	3.10	$0.04
Windows - Install Reflective Film	17.0%	45.0%	20	$703.35	220.17	0.65	$0.25
Doors - Storm and Thermal	4.0%	45.0%	20	$515.79	50.71	-	$0.78
Roofs - High Reflectivity	11.8%	50.0%	18	$497.62	73.14	0.75	$0.56
Attic Fan - Installation	13.0%	90.0%	20	$1,578.78	-	0.39	$-
Attic Fan - Photovoltaic - Installation	5.0%	45.0%	10	$227.70	-	1.26	$-
Whole-House Fan - Installation	17.0%	75.0%	25	$133.00	-	0.73	$-
Ceiling Fan - Installation	3.0%	10.0%	20	$135.20	239.02	1.46	$0.04
Thermostat - Clock/Programmable	1.0%	22.5%	20	$120.48	115.65	-	$0.08
Home Energy Management System	2.0%	11.3%	20	$461.52	990.22	-	$0.04
Central AC - Early Replacement	4.0%	18.8%	20	$253.50	114.19	-	$0.17
Central AC - Maintenance and Tune-Up	56.0%	75.0%	10	$135.00	45.49	2.30	$0.37
Central Heat Pump - Maintenance	27.0%	67.5%	5	$30.00	43.41	1.21	$0.15
Room AC - Removal of Second Unit	2.0%	12.5%	15	$1,747.00	397.97	0.61	$0.41
Water Heater - Drainwater Heat Recovery	27.0%	100.0%	15	$3,430.28	322.88	0.07	$0.98
Water Heater - Faucet Aerators	15.0%	100.0%	2	$175.00	96.75	0.07	$0.93
Water Heater - Low-Flow Showerheads	15.0%	90.0%	2	$175.00	441.42	0.02	$0.20
Water Heater - Pipe Insulation	0.0%	37.5%	4	$120.00	102.49	1.69	$0.31
Water Heater - Timer	1.0%	45.0%	40	$529.00	86.40	1.87	$0.34
Water Heater - Desuperheater	8.0%	90.0%	9	$16.00	-	2.89	$-
Water Heater - Solar System	17.0%	75.0%	10	$24.00	1,614.38	9.86	$0.00
Interior Lighting - Occupancy Sensors	42.0%	38.1%	15	$348.83	390.68	0.25	$0.08
Exterior Lighting - Photosensor Control	5.0%	40.0%	5	$115.00	56.62	0.19	$0.45
Exterior Lighting - Photovoltaic Installation	0.0%	75.0%	0	$-	11.32	2.00	$-
Exterior Lighting - Timeclock Installation	0.0%	75.0%	20	$5,400.00	11.32	0.36	$36.76
Refrigerator - Early Replacement	1.0%	5.0%	10	$273.81	226.75	0.59	$0.15
Refrigerator - Maintenance	10.0%	45.0%	4	$130.00	81.81	0.17	$0.24
Refrigerator - Remove Second Unit	11.0%	45.0%	12	$2,973.50	880.39	0.00	$0.36
Freezer - Remove Second Unit	6.0%	45.0%	5	$120	933	>1.0	$0.03
Freezer - Early Replacement	27.0%	100.0%	9	$876.00	180.62	0.11	$0.65
Freezer - Maintenance	27.0%	100.0%	0	$50.00	30.10	-	$-
Electronics - Smart Power Strips	0.0%	100.0%	5	$120.00	103.00	1.47	$0.26
Pool Pump - Timer	0.0%	37.5%	4	$120.00	129.03	0.88	$0.25
Pool Heater - Solar System	27.0%	100.0%	6	$403.00	3,735.73	0.12	$0.02
ENERGY STAR Home Design	0.0%	100.0%	0	$50.00	1,134.01	-	$-

Table B-10 Energy Efficiency Non-Equipment Data, Electric—Multi Family, New Vintage

Measure	Base Saturation	Applicability	Lifetime (Years)	Cost ($/HH)	Savings (kWh)	BC Ratio	Levelized Cost ($/kWh)
Insulation - Ceiling	5.0%	90.0%	4	$26.00	175.09	0.84	$0.04
Insulation - Ducting	25.0%	90.0%	5	$115.00	75.59	0.30	$0.34
Insulation - Foundation	0.0%	75.0%	0	$3,500.00	-	-	$-
Insulation - Infiltration Control	0.0%	0.0%	25	$-	306.65	3.00	$-
Insulation - Radiant Barrier	2.0%	3.0%	12	$300.00	61.69	1.05	$0.53
Insulation - Wall Cavity	5.0%	90.0%	5	$12.00	197.51	4.59	$0.01
Insulation - Wall Sheathing	13.0%	47.5%	20	$741.42	572.56	0.36	$0.10
Ducting - Repair and Sealing	50.0%	75.0%	20	$95.00	146.56	1.16	$0.05
Windows - High Efficiency/ENERGY STAR	0.0%	0.0%	20	$-	230.23	2.00	$-
Windows - Install Reflective Film	19.0%	90.0%	15	$141.48	218.72	2.03	$0.06
Doors - Storm and Thermal	5.0%	90.0%	20	$121.83	12.30	0.76	$0.76
Roofs - High Reflectivity	17.0%	90.0%	20	$392.77	32.60	0.66	$0.93
Attic Fan - Installation	4.0%	90.0%	20	$68.15	-	11.45	$-
Attic Fan - Photovoltaic - Installation	11.8%	50.0%	18	$497.62	-	0.41	$-
Whole-House Fan - Installation	13.0%	90.0%	20	$1,708.83	-	0.39	$-
Ceiling Fan - Installation	2.0%	45.0%	10	$163.78	164.85	1.89	$0.12
Thermostat - Clock/Programmable	19.0%	75.0%	25	$133.00	289.28	0.18	$0.03
Home Energy Management System	0.0%	90.0%	20	$125.76	762.27	0.77	$0.01
Central AC - Early Replacement	15.0%	22.5%	20	$120.48	85.55	-	$0.11
Central AC - Maintenance and Tune-Up	5.0%	11.3%	20	$461.52	72.46	-	$0.49
Central Heat Pump - Maintenance	4.0%	18.8%	20	$235.80	11.43	-	$1.59
Room AC - Removal of Second Unit	33.0%	75.0%	10	$135.00	339.85	1.73	$0.05
Water Heater - Drainwater Heat Recovery	19.0%	25.0%	5	$30.00	295.87	2.51	$0.02
Water Heater - Faucet Aerators	0.0%	67.5%	15	$1,747.00	88.64	0.48	$1.82
Water Heater - Low-Flow Showerheads	9.0%	100.0%	15	$999.22	404.48	0.19	$0.23
Water Heater - Pipe Insulation	15.0%	100.0%	2	$175.00	93.92	0.11	$0.95
Water Heater - Timer	15.0%	90.0%	2	$175.00	86.40	0.01	$1.04
Water Heater - Desuperheater	0.0%	37.5%	4	$120.00	-	1.49	$-
Water Heater - Solar System	1.0%	90.0%	40	$529.00	1,479.35	1.71	$0.02
Interior Lighting - Occupancy Sensors	4.0%	90.0%	9	$16.00	459.66	2.61	$0.00
Exterior Lighting - Photosensor Control	19.0%	75.0%	10	$24.00	59.85	8.91	$0.05
Exterior Lighting - Photovoltaic Installation	42.0%	41.3%	15	$336.43	11.97	0.24	$2.60
Exterior Lighting - Timeclock Installation	5.0%	40.0%	5	$115.00	11.97	0.19	$2.12
Refrigerator - Early Replacement	0.0%	75.0%	0	$-	157.84	2.00	$-
Refrigerator - Maintenance	0.0%	75.0%	4	$5,400.00	-	0.33	$-
Refrigerator - Remove Second Unit	1.4%	9.0%	10	$273.81	-	0.76	$-
Freezer - Remove Second Unit	10.0%	45.0%	5	$120.00	933	>1.0	$0.03
Freezer - Early Replacement	0.0%	45.0%	12	$2,973.50	-	0.00	$-
Freezer - Maintenance	11.0%	45.0%	5	$115.00	-	0.03	$-
Electronics - Smart Power Strips	9.0%	100.0%	9	$876.00	-	0.09	$-
Pool Pump - Timer	9.0%	100.0%	0	$50.00	-	-	$-
Pool Heater - Solar System	0.0%	100.0%	5	$120.00	-	1.20	$-
ENERGY STAR Home Design	0.0%	37.5%	4	$120.00	-	0.69	$-

COMMERCIAL ENERGY EFFICIENCY EQUIPMENT AND MEASURE DATA

This appendix presents detailed information for all commercial energy-efficiency measures (*equipment* and *non-equipment* measures per the LoadMAP taxonomy) that were evaluated in this study.

Table C-1 and Table C-2 provide brief narrative descriptions for all equipment and non-equipment measures that were assessed for potential.

Table C-3 through Table C-24 list the detailed unit-level data (including economic screen results) for commercial equipment measures in existing and new buildings. The column headings and units are the same as described for the corresponding residential sector tables above.

Table C-27 through Table C-48 list the detailed unit-level data (including economic screen results) for commercial non-equipment measures in existing and new construction. The column headings and units are the same as described for the corresponding residential sector tables above.

Table C-1 Commercial Energy Efficiency Equipment Measure Descriptions

End Use	Technology	Measure Description
Cooling	Air-Cooled Chiller	A central chiller plant creates chilled water for distribution throughout the facility. Because of the wide variety of system types and sizes, savings and cost values for efficiency improvements represent an average over screw, reciprocating, and centrifugal technologies. Under this simplified approach, each central system is characterized by an aggregate efficiency value (inclusive of chiller, pumps, and motors), in kW/ton with a further efficiency upgrade through the application of variable refrigerant flow technology.
Cooling	Water-Cooled Chiller	A central chiller plant creates chilled water for distribution throughout the facility. Water source chillers include heat rejection via a condenser loop and cooling tower. Because of the wide variety of system types and sizes, savings and cost values for efficiency improvements represent an average over screw, reciprocating, and centrifugal technologies. Under this simplified approach, each central system is characterized by an aggregate efficiency value (inclusive of chiller, pumps, motors, and condenser loop equipment), in kW/ton with a further efficiency upgrade through the application of variable refrigerant flow technology.
Cooling	Roof Top AC	Packaged cooling systems, such as rooftop units (RTUs), are simple to install and maintain, and are commonly used in small and medium-sized commercial buildings. Applications range from a single supply system with air intake filters, supply fan, and cooling coil, or can become more complex with the addition of a return air duct, return air fan, and various controls to optimize performance. For packaged RTUs, varying Energy Efficiency Ratios (EER) are modeled, as well as a ductless mini-split system.
Cooling	Other Cooling	This measure includes efficiency upgrades to other small cooling systems in commercial buildings including room AC units, packaged terminal air conditioning (PTAC) units, and packaged terminal heat pumps (PTHP).
Cooling / Heating	Air-Source Heat Pump	For heat pumps, units with increasing EER and COP levels are evaluated, as well as a ductless mini-split system.
Cooling / Heating	Geothermal Heat Pump	For heat pumps, units with increasing EER and COP levels are evaluated.
Heating	Electric Furnace	Resistive heating elements are used to convert electricity directly to heat. The heat is then delivered by a supply fan and duct system to the regions that require heating.
Heating	Electric Room Heat	Resistive heating elements are used to convert electricity directly to heat. Conductive fins surrounding the element or another mechanism is used to deliver the heat directly to the surrounding room or area. These are typically either baseboard or wall-mounted units.
Ventilation	Ventilation	A variable air volume ventilation system modulates the air flow rate as needed based on the interior conditions of the building to reduce fan load, improve dehumidification, and reduce energy usage.
Water Heating	Water Heater	Efficient electric water heaters are characterized by a high recovery or thermal efficiency (percentage of delivered electric energy which is transferred to the water) and low standby losses (the ratio of heat lost per hour to the content of the stored water). Included in the savings associated with high-efficiency electric water heaters are timers that allow temperature setpoints to change with hot water demand patterns. For example, the heating element could be shut off throughout the night, increasing the overall energy factor of the unit. In addition, tank and pipe insulation reduces standby losses and therefore reduces the demands on the water heater. This analysis considers conventional electric water heaters and heat pump water heaters. For natural gas hot water heating, the most common type is a storage heater, which incorporates a burner, storage tank, outer jacket, insulation, and controls in a single unit. Efficient units are characterized by a high recovery or thermal efficiency and low standby losses (the ratio of heat lost per hour to the content of the stored water). A further efficiency gain is available in condensing

End Use	Technology	Measure Description
		units, which condense the water vapor produced in the combustion process and also use the heat from this condensation.
Interior Lighting	Screw-in	This measure evaluates higher-efficiency alternatives for screw-in interior lamps including halogen, CFL, and LED.
Interior Lighting	High-Bay Fixtures	With the exception of screw-in lighting, commercial lighting efficiency changes typically require more than the simple purchase and installation of an alternative lamp Restrictions regarding ballasts, fixtures, and circuitry limit the potential for direct substitution of one lamp type for another. Also, during the buildout for a leased office space, management could decide to replace all lamps, ballasts, and fixtures with different configurations. This type of decision-making is modeled on a stock turnover basis because of the time between opportunities for upgrades. For High-Bay fixtures, alternatives include mercury vapor, metal halides, T5 fluorescent high output, and high-pressure sodium.
Interior Lighting	Linear Fluorescent	With the exception of screw-in lighting, commercial lighting efficiency changes typically require more than the simple purchase and installation of an alternative lamp Restrictions regarding ballasts, fixtures, and circuitry limit the potential for direct substitution of one lamp type for another. Also, during the buildout for a leased office space, management could decide to replace all lamps, ballasts, and fixtures with different configurations. This type of decision-making is modeled on a stock turnover basis because of the time between opportunities for upgrades. For linear fluorescent fixtures, alternatives include T12, T8, Super T8, T5, and LED.
Exterior Lighting	Screw-in	This measure evaluates higher-efficiency alternatives for screw-in interior lamps including halogen, CFL, and LED.
Exterior Lighting	HID	Alternatives modeled include metal halides, T8 and T5 high output, high pressure sodium, and LEDs
Exterior Lighting	Linear Fluorescent	For linear fluorescent fixtures, alternatives include T12, T8, Super T8, T5, and LED.
Refrigeration	Walk-in Refrigerator	These refrigerators can be designed to perform at higher efficiency through a combination of compressor equipment upgrades, default temperature settings, and defrost patterns. Standard refrigeration compressors typically operate at approximately 65% efficiency. High-efficiency models are available that can improve compressor efficiency by 15%. Analysis assumes unit with: 140 square feet, Cooling capacity of 26,230 BTU/hr.
Refrigeration	Reach-in Refrigerator	A significant amount of energy in the commercial sector can be attributed to "reach-in" units. These stand-alone appliances can range from a residential-style refrigerator/freezer unit in an office kitchen or the breakroom of a retail store, to the larger reach-in units in foodservice applications. As in the case of residential units, these refrigerators can be designed to perform at higher efficiency through a combination of compressor equipment upgrades, default temperature settings, and defrost patterns. Analysis assumes unit with: 48 cubic feet, Cooling capacity of 3000 BTU/hr.
Refrigeration	Glass Door Display, Open Display Case	These refrigerators can be designed to perform at higher efficiency through a combination of compressor equipment upgrades, default temperature settings, and defrost patterns. Standard refrigeration compressors typically operate at approximately 65% efficiency. High-efficiency models are available that can improve compressor efficiency by 15%. Analysis assumes unit with: Cooling capacity of 20,000 BTU/hr
Refrigeration	Icemaker	By optimizing the timing of ice production and the type of output to the specific application, icemakers are assumed to deliver electricity savings.
Refrigeration	Vending Machine	High-efficiency vending machines incorporate more efficient compressors and lighting.
Food Preparation	Ovens,Fryers, Hot Food Containers, Dishwashers	This set of measures includes high-efficiency fryers, ovens, dishwashers, and hot food containers. Less common equipment, such as broilers and steamers, and assumed to be modeled with the other more common equipment types.

End Use	Technology	Measure Description
Office Equipment	Desktop Computer, Laptop, Monitors	ENERGY STAR labeled computers automatically power down to 15 watts or less when not in use and may actually last longer than conventional products because they spend a large portion of time in a low-power sleep mode. ENERGY STAR labeled computers also generate less heat than conventional models.
Office Equipment	Server	In addition to the "sleep" mode a reductions, servers have additional energy-saving opportunities through "virtualization" and other architecture solutions that involve optimal matching of computation tasks to hardware requirements
Office Equipment	Printer/Copier/Fax	ENERGY STAR labeled office equipment saves energy by powering down and "going to sleep" when not in use. ENERGY STAR labeled copiers are equipped with a feature that allows them to automatically turn off after a period of inactivity.
Office Equipment	POS Terminal	Point-of-sale terminals in retail and supermarket facilities are always on. Efficient models incorporate a high-efficiency power supply to reduce energy use.
Miscellaneous	Non-HVAC Motors	Includes motors for a variety of non-HVAC uses including vertical transportation. Premium efficiency motors can provide savings of 0.5% to 3% over standard motors. The savings results from the fact that energy efficient motors run cooler than their standard counterparts, resulting in an increase in the life of the motor insulation and bearing. In general, an efficient motor is a more reliable motor because there are fewer winding failures, longer periods between needed maintenance, and fewer forced outages. For example, using copper instead of aluminum in the windings, and increasing conductor cross-sectional area, lowers a motor's I2R losses.
Miscellaneous	Pool Pump	High-efficiency motors and two-speed pumps provide improved energy efficiency for this load.
Miscellaneous	Pool Heater	Efficient pool heaters can make use of heat pump technology to achieve significantly higher coefficients of performance in the COP=5.0 range. Gas pool heaters have a burner to heat water in a loop. Efficiency improvements can include: exhaust fan controls, electronic ignition (no pilot light), compact size and lighter weight to reduce cycling losses, and sealed combustion. Very high efficiency units, or condensing units, condense the water vapor produced in the combustion process and also use the heat from this condensation.
Miscellaneous	Miscellaneous	Improvement of miscellaneous electricity uses
Exterior Lighting	LED Traffic Signals	This measure installs an LED traffic signal that is not only more efficient, but lasts multiples longer than conventional technology lifetimes, thereby avoiding significant operational and maintenance costs.
Exterior Lighting	LED Crosswalk Lights	This measure installs an LED pedestrian signals that is not only more efficient, but lasts multiples longer than conventional technology lifetimes, thereby avoiding significant operational and maintenance costs.

Table C-2 Commercial Energy Efficiency Non-Equipment Measure Descriptions

End Use	Measure	Description
HVAC (All)	Insulation - Ceiling	Thermal insulation is material or combinations of materials that are used to inhibit the flow of heat energy by conductive, convective, and radiative transfer modes. Thus, thermal insulation can conserve energy by reducing the heat loss or gain of a building. The type of building construction defines insulating possibilities. Typical insulating materials include: loose-fill (blown) cellulose; loose-fill (blown) fiberglass; and rigid polystyrene.
HVAC (All)	Insulation - Ducting	Air distribution ducts can be insulated to reduce heating or cooling losses. Best results can be achieved by covering the entire surface area with insulation. Insulation material inhibits the transfer of heat through the air-supply duct. Several types of ducts and duct insulation are available, including flexible duct, pre-insulated duct, duct board, duct wrap, tacked, or glued rigid insulation, and waterproof hard shell materials for exterior ducts.
HVAC (All)	Insulation - Radiant Barrier	Radiant barriers are materials installed to reduce the heat gain in buildings. Radiant barriers are made from materials that are highly reflective and have low emissivity like aluminum. The closer the emissivity is to 0 the better they will perform. Radiant barriers can be placed above the insulation or on the roof rafters.
HVAC (All)	Insulation - Wall Cavity	Thermal insulation is material or combinations of materials that are used to inhibit the flow of heat energy by conductive, convective, and radiative transfer modes. Thus, thermal insulation can conserve energy by reducing the heat loss or gain of a building. The type of building construction defines insulating possibilities. Typical insulating materials include: loose-fill (blown) cellulose; loose-fill (blown) fiberglass; and rigid polystyrene.
HVAC (All)	HVAC - Duct Repair and Sealing	Leakage in unsealed ducts varies considerably because of the differences in fabricating machinery used, the methods for assembly, installation workmanship, and age of the ductwork. Air leaks from the system to the outdoors result in a direct loss proportional to the amount of leakage and the difference in enthalpy between the outdoor air and the conditioned air. To seal ducts, a wide variety of sealing methods and products exist. Each has a relatively short shelf life, and no documented research has identified the aging characteristics of sealant applications.
HVAC (All)	Doors - High Efficiency	Like other components of the shell, doors are subject to several types of heat loss: conduction, infiltration, and radiant losses. High efficiency doors have exceptional thermal insulation properties and tight-fitting, weather-stripping on the doorframe to reduce air leakage.
HVAC (All)	Windows - High Efficiency	High-efficiency windows, such as those labeled under the ENERGY STAR Program, are designed to reduce a building's energy bill while increasing comfort for the occupants at the same time. High-efficiency windows have reducing properties that reduce the amount of heat transfer through the glazing surface. For example, some windows have a low-E coating, which is a thin film of metallic oxide coating on the glass surface that allows passage of short-wave solar energy through glass and prevents long-wave energy from escaping. Another example is double-pane glass that reduces conductive and convective heat transfer. There are also double-pane glasses that are gas-filled (usually argon) to further increase the insulating properties of the window.
HVAC (All)	Roof - High Reflectivity	The color and material of a building structure surface will determine the amount of solar radiation absorbed by that surface and subsequently transferred into a building. This is called solar absorptance. By using a living roof or a roofing material with a light color (and a lower solar absorptance), the roof will absorb less solar radiation and consequently reduce the cooling load. Living roofs also reduce stormwater runoff.
Cooling	Air-Cooled Chiller - Condenser Water Temperature Reset	Resetting the condenser water temperature to the lowest possible setting allows the cooling tower to generate cooler water whenever possible and decreases the temperature lift between the condenser and the evaporator. This will generally increase chiller part-load efficiency, though it may require

End Use	Measure	Description
		increased tower fan energy use.
Cooling	Air-Cooled Chiller - Economizer	Economizers allow outside air (when it is cool and dry enough) to be brought into the building space to meet cooling loads instead of using mechanically cooled interior air. A dual enthalpy economizer consists of indoor and outdoor temperature and humidity sensors, dampers, motors, and motor controls. Economizers are most applicable to temperate climates and savings will be smaller in extremely hot or humid areas.
Cooling	Air-Cooled Chiller - Thermal Energy Storage	This measure uses energy at off-peak times to create a chilled media, typically cool water or ice, then stores it in an insulated chamber until peak hours. During peak hours, it uses the cooling energy stored in the media by running the chiller loop through a heat exchanger in the thermal storage chamber, thereby reducing energy and peak demand from the grid.
Cooling	Air-Cooled Chiller - VSD on Fans	Variable speed drives, which reduce chiller energy use under part load, are modeled for both air-cooled and water-cooled chillers.
Cooling	Air-Cooled Chiller - Chilled Water Reset	Chilled water reset controls save energy by improving chiller performance through increasing the supply chilled water temperature, which allows increased suction pressure during low load periods. Raising the chilled water temperature also reduces chilled water piping losses. However, the primary savings from the chilled water reset measure results from chiller efficiency improvement. This is due partly to the smaller temperature difference between chilled water and ambient air, and partly due to the sensitivity of chiller performance to suction temperature.
Cooling	Air-Cooled Chiller - Chilled Water Variable-Flow System	The part-load efficiency of chilled water loops can be improved substantially by varying the flow speed of the delivered water with the building demand for cooling.
Cooling	Air-Cooled Chiller - High Efficiency Cooling Tower Fans	High-efficiency cooling fans utilize efficient components and variable frequency drives that improve fan performance by adjusting fan speed and rotation as conditions change.
Cooling	Air-Cooled Chiller - Maintenance	Filters, coils, and fins require regular cleaning and maintenance for the heat pump or roof top unit to function effectively and efficiently throughout its years of service. Neglecting necessary maintenance leads to a steady decline in performance while energy use increases.
Water-Cooled Chiller	Water Cooled Chiller Condenser Water Temperature Reset	Resetting the condenser water temperature to the lowest possible setting allows the cooling tower to generate cooler water whenever possible and decreases the temperature lift between the condenser and the evaporator. This will generally increase chiller part-load efficiency, though it may require increased tower fan energy use.
Water-Cooled Chiller	Water Cooled Chiller Economizer	Economizers allow outside air (when it is cool and dry enough) to be brought into the building space to meet cooling loads instead of using mechanically cooled interior air. A dual enthalpy economizer consists of indoor and outdoor temperature and humidity sensors, dampers, motors, and motor controls. Economizers are most applicable to temperate climates and savings will be smaller in extremely hot or humid areas.
Water-Cooled Chiller	Water Cooled Chiller-Thermal Energy Storage	This measure uses energy at off-peak times to create a chilled media, typically cool water or ice, then stores it in an insulated chamber until peak hours. During peak hours, it uses the cooling energy stored in the media by running the chiller loop through a heat exchanger in the thermal storage chamber, thereby reducing energy and peak demand from the grid.
Water-Cooled Chiller	Water-Cooled Chiller VSD on Fans	Variable speed drives, which reduce chiller energy use under part load, are modeled for both air-cooled and water-cooled chillers.
Water-Cooled Chiller	Water-Cooled Chiller-Chiller Water reset	Chilled water reset controls save energy by improving chiller performance through increasing the supply chilled water temperature, which allows increased suction pressure during low load periods. Raising the chilled water temperature also reduces chilled water piping losses. However, the primary savings from the chilled water reset measure results from chiller efficiency

End Use	Measure	Description
		improvement. This is due partly to the smaller temperature difference between chilled water and ambient air, and partly due to the sensitivity of chiller performance to suction temperature.
Water-Cooled Chiller	Water- Cooled Chiller Variable Flow System	The part-load efficiency of chilled water loops can be improved substantially by varying the flow speed of the delivered water with the building demand for cooling.
Water-Cooled Chiller Water Cooled Chiller	Water-Cooled Chiller High Efficiency Cooling Tower Fans	High-efficiency cooling fans utilize efficient components and variable frequency drives that improve fan performance by adjusting fan speed and rotation as conditions change.
Water-Cooled Chiller	Water-Cooled Chiller Maintenance	Filters, coils, and fins require regular cleaning and maintenance for the heat pump or roof top unit to function effectively and efficiently throughout its years of service. Neglecting necessary maintenance leads to a steady decline in performance while energy use increases.
Water-Cooled Chiller	Water-Cooled Chiller Heat Recovery	Capturing the waste heat from the cooling tower of a chiller by means of a heat exchanger in order to meet water heating loads.
Water Heating	Air-Cooled Chiller - Chiller Heat Recovery	Capturing the waste heat from the cooling tower of a chiller by means of a heat exchanger in order to meet water heating loads.
Water Heating	Pre-rinse Sprayer	Low-flow pre-rinse sprayer are attachments in a kitchen or wash area that aerate and optimize the efficiency of water flow and the associated water heating energy. They are effective at rinsing and cleaning while using less hot water.
Cooling	RTU - Evaporative Precooler	Evaporative precooling can improve the performance of air conditioning systems, most commonly RTUs. These systems typically use indirect evaporative cooling as a first stage to pre-cool outside air. If the evaporative system cannot meet the full cooling load, the air steam is further cooled with conventional refrigerative air conditioning technology.
Cooling	RTU - Maintenance	Regular cleaning and maintenance enables a roof top unit to function effectively and efficiently throughout its years of service. Neglecting necessary maintenance leads to a steady decline in performance while energy use increases. Maintenance can increase the efficiency of poorly performing equipment by as much as 10%.
Heating	Space Heating - Heat Recovery Ventilator	Heat recovery ventilation uses a counter-flow, air-to-air heat exchanger between inbound and outbound air flow to selectively transfer heat and reduce space heating loads.
Cooling / Heating	Heat Pump - Maintenance	Regular cleaning and maintenance enables a heat pump to function effectively and efficiently throughout its years of service. Neglecting necessary maintenance leads to a steady decline in performance while energy use increases. Maintenance can increase the efficiency of poorly performing equipment by as much as 10%.
Ventilation	Ventilation - ECM on VAV Boxes	ECM motors are well suited to the variable flow rates of VAV boxes. ECMs are a higher efficiency option for the air blowers and maintain efficiency better over a wide range of loads.
Ventilation	Ventilation - Variable Speed Control	Variable speed controls adjust ventilation fans for part-load conditions to reduce energy use.
Water Heating	Water Heater - Drainwater Heat Recovery	Drainwater Heat Recovery is a system in which drain water is used to preheat cold water entering the water heater. While these systems themselves are relatively inexpensive, upgrading an existing system could be unreasonable because of demolition costs. Thus they are modeled for new vintage only.
Water Heating	Water Heater - Faucet Aerators/Low Flow Nozzles	A faucet aerator or low flow nozzle spreads the stream from a faucet helping to reduce water usage. The amount of water passing through the aerator is measured in gallons per minute (GPM) and the lower the GPM the more water the aerator conserves.
Water	Water Heater - High	A high efficiency circulation pump uses an electronically commutated motor

End Use	Measure	Description
Heating	Efficiency Circulation Pump	(ECM) to improve motor efficiency over a larger range of partial loads. In addition, an ECM allows for improved low RPM performance with greater torque and smaller pump dimensions.
Water Heating	Water Heater - Desuperheater	A desuperheater can be added to an existing geothermal heat pump system (typically installed with the primary function of space heating and cooling) in order to draw off a portion of the geothermal heat for water heating purposes. The system can either supplement the building's water heater, or be a full-demand water heater that meets all of the building's hot water needs.
Water Heating	Water Heater - Solar System	Solar water heating systems can be used in residential buildings that have an appropriate near-south-facing roof or nearby unshaded grounds for installing a collector. Although system types vary, in general these systems use a solar absorber surface within a solar collector or an actual storage tank. Either a heat-transfer fluid or the actual potable water flows through tubes attached to the absorber and transfers heat from it. (Systems with a separate heat-transfer-fluid loop include a heat exchanger that then heats the potable water.) The heated water is stored in a separate preheat tank or a conventional water heater tank. If additional heat is needed, it is provided by a conventional water-heating system.
Water Heating	Water Heater - Install Timer	These measures use either a programmable thermostat or a timer to adjust the water heater setpoint at times of low usage, typically when a home is unoccupied.
Water Heating	Water Heater - Pipe Insulation	Insulating hot water pipes decreases the amount of energy lost during distribution of hot water throughout the building. Insulating pipes will result in quicker delivery of hot water and allows lowering the water heating set point. There are several different types of insulation, the most common being polyethylene and neoprene.
Water Heating	Water Heater - Tank Blanket/Insulation	Insulation levels on hot water heaters can be increased by installing a fiberglass blanket on the outside of the tank. This increase in insulation reduces standby losses and thus saves energy. Water heater insulation is available either by the blanket or by square foot of fiberglass insulation with R-values ranging from 5 to 14.
Interior Lighting	Interior Lighting - Daylighting Controls	Daylighting controls use a photosensor to detect ambient light and adjust or turn off electric lights accordingly.
Interior Lighting	Interior Lighting - LED Exit Lighting	The lamps inside exit signs represent a significant energy end-use, since they usually operate 24 hours per day. Many old exit signs use incandescent lamps, which consume approximately 40 watts per sign. The incandescent lamps can be replaced with LED lamps that are specially designed for this specific purpose. In comparison, the LED lamps consume approximately 2-5 watts.
Interior Lighting	Interior Lighting - Occupancy Sensors	The installation of occupancy sensors allows lights to be turned off during periods when a space is unoccupied, virtually eliminating the wasted energy due to lights being left on. There are several types of occupancy sensors in the market.
Interior Lighting	Interior Lighting - Timeclocks and Timers	In many cases lighting remains on at night and during weekends. A simple timer can set a schedule for turning lights off to reduce operating hours.
Interior Lighting	Interior Lighting - Task Lighting	Individual work areas can use task lighting instead of brightly lighting the entire area. Significant energy savings can be realized by focusing light directly where it is needed and lowering the general lighting level. An example of task lighting is the common desk lamp. A 25W desk lamp can be installed in place of a typical lamp in a fixture.
Interior Lighting	Interior Fluorescent - Bi-Level Fixture	Bi-level fixtures have the ability to reduce light output to a lower level, given a control strategy that is based on a timer, occupancy sensor, motion sensor, or manual switch.
Interior Lighting	Interior Fluorescent - Delamp and Install Reflectors	While sometimes included in lighting retrofit projects, delamping is often performed as a separate energy efficiency measure in which a lighting engineer analyzes the lighting provided by current systems compared to the

End Use	Measure	Description
		requirements of building occupants. This often leads to the removal of unnecessary lamps corresponding to an overall reduction in energy usage. In addition, installing a reflector in each fixture can improve light distribution from the remaining lamps.
Exterior Lighting	Exterior Lighting - Bi-Level Fixture	Bi-level fixtures have the ability to reduce light output to a lower level, given a control strategy that is based on a timer, occupancy sensor, motion sensor, or manual switch.
Exterior Lighting	Exterior Lighting - Daylighting Controls	Daylighting controls use a photosensor to detect ambient light and adjust or turn off electric lights accordingly.
Exterior Lighting	Exterior Lighting - Photovoltaic Installation	Solar photovoltaic generation may be used to power exterior lighting and thus eliminate all or part of the electrical energy use.
Refrigeration	Refrigerator - Anti-Sweat Heater	Anti-sweat heaters are used in virtually all low-temperature display cases and many medium-temperature cases to control humidity and prevent the condensation of water vapor on the sides and doors and on the products contained in the cases. Typically, these heaters stay on all the time, even though they only need to be on about half the time. Anti-sweat heater controls can come in the form of humidity sensors or time clocks.
Refrigeration	Refrigerator - Decommissioning	Early retirement, removal, and recycling or older, little used refrigerators and freezers removes the energy use of these inefficient, aging units.
Refrigeration	Refrigerator - Demand Defrost	Units can be designed to perform at higher efficiency with a sensing and control system that runs defrost cycles based on demand/only when necessary.
Refrigeration	Refrigerator - Door Gasket Replacement	This measure involves replacing aging door gaskets that no longer adequately seal reach-in refrigerators or glass door display cases.
Refrigeration	Refrigerator - Evaporator Fan Controls	Evaporator fan motor controls allow for part load use or demand scheduling based on variable refrigeration load requirements, reducing energy consumption.
Refrigeration	Refrigerator - Floating Head Pressure	Floating head pressure control allows the pressure in the condenser to "float" with ambient temperatures. This method reduces refrigeration compression ratios, improves system efficiency and extends the compressor life. The greatest savings with a floating head pressure approach occurs when the ambient temperatures are low, such as in the winter season. Floating head pressure control is most practical for new installations. However, retrofits installation can be completed with some existing refrigeration systems. Installing floating head pressure control increases the capacity of the compressor when temperatures are low, which may lead to short cycling.
Refrigeration	Refrigerator - Strip Curtain	Strip curtains at the entrances to large walk-in coolers or freezers, such as those used in supermarkets, reduce air transfer between the refrigerated space and the surrounding space.
Refrigeration	Refrigerator - High Efficiency Compressor	Standard compressors typically operate at approximately 65% efficiency. High-efficiency models are available that can improve compressor efficiency by 15%.
Refrigeration	Refrigerator - Variable Speed Compressor	The part-load efficiency of drive systems can be improved by varying the speed of the motor drive. An additional benefit of variable-speed controls is the ability to start and stop the motor and process gradually, thus extending the life of the motor and associated machinery.
Refrigeration	Refrigerator - eCube	The eCube consists of a solid, waxy food simulant that is fitted around a thermostat sensor that would otherwise measure air temperature. The refrigeration controls therefore attempt to regulate the temperature of food, which changes more slowly and gradually than air, thereby reducing the frequency of refrigeration cycles.
Refrigeration	Vending Machine - Controller	Cold beverage vending machines usually operate 24 hours a day regardless of whether the surrounding area is occupied or not. The result is that the vending machine consumes energy unnecessarily, because it will operate all night to keep the beverage cold even when there would be no customers until the next

End Use	Measure	Description
		morning. A vending machine controller can reduce energy consumption without compromising the temperature of the vended product. The controller uses an infrared sensor to monitor the surrounding area's occupancy and will power down the vending machine when the area is unoccupied. It will also monitor the room's temperature and will re-power the machine at one to three hour intervals independent of occupancy to ensure that the product stays cold.
Office Equipment	Office Equipment - ENERGY STAR Power Supplies	Power supplies with an efficient ac-dc or ac-ac conversion process can obtain the ENERGY STAR label. These devices can be used to power computers, phones, and other office equipment.
Office Equipment	Office Equipment - Plug Load Occupancy Sensors	Occupancy sensors can control power strips and thus turn off energy used by plug loads, such as task lights, when an office is unoccupied.
Miscellaneous	Pool Heater - Solar	This measure replaces a conventional pool heater with a solar system.
Miscellaneous	Pool Pump - Timer	A pool pump timer allows the pump to turn off automatically, eliminating the wasted energy associated with unnecessary pumping.
Ventilation	Ventilation - CO2 Controlled	Also known as Demand Controlled Ventilation, this measure uses carbon dioxide (CO2) levels to indicate the level of occupancy in a space. Sensors monitor CO2 levels so that air handling controls can adjust the amount of outside air the system needs to intake. Ventilation rates are thereby controlled based on occupancy, rather than a fixed rate, thus saving HVAC energy use.
Miscellaneous	Non-HVAC Motors - Variable Speed Control	The part-load efficiency of motors can be improved by varying the speed of the motor drive. There are two major types of variable speed controls: mechanical and electronic. An additional benefit of variable-speed controls is the ability to start and stop the motor gradually, thus extending the life of the motor and associated machinery. This analysis assumes that electronic variable speed controls are installed.
HVAC (All)	Energy Management System	An energy management system (EMS) allows managers/owners to monitor and control the major energy-consuming systems within a commercial building. At the minimum, the EMS can be used to monitor and record energy consumption of the different end-uses in a building, and can control operation schedules of the HVAC and lighting systems. The monitoring function helps building managers/owners to identify systems that are operating inefficiently so that actions can be taken to correct the problem. The EMS can also provide preventive maintenance scheduling that will reduce the cost of operations and maintenance in the long run. The control functionality of the EMS allows the building manager/owner to operate building systems from one central location. The operation schedules set via the EMS help to prevent building systems from operating during unwanted or unoccupied periods. This analysis assumes that this measure is limited to buildings with a central HVAC system.
HVAC (All)	Thermostat - Clock/Programmable	A programmable thermostat can be added to most heating/cooling systems. They are typically used during winter to lower temperatures at night and in summer to increase temperatures during the afternoon. There are two-setting models, and well as models that allow separate programming for each day of the week. The energy savings from this type of thermostat are identical to those of a "setback" strategy with standard thermostats, but the convenience of a programmable thermostat makes it a much more attractive option. In this analysis, the baseline is assumed to have no thermostat setback.
HVAC, Lighting	HVAC - Occupancy Sensors	Occupancy sensors turn off or adjust HVAC settings when a space is unoccupied.
HVAC, Lighting	Commissioning - HVAC, Lighting	For new construction and major renovations, commissioning ensures that building systems are properly designed, specified, and installed to meet the design intent and provide high-efficiency performance. Commissioning begins during the design process.
HVAC, Lighting	Retrocommissioning - HVAC, Lighting	In existing buildings, the retrocommissioning process identifies low-cost or no cost measures, including controls adjustments, to improve building performance and reduce operating costs. Retrocommissioning addresses

End Use	Measure	Description
		HVAC, lighting, DHW, and other major building systems.
HVAC (All)	Advanced New Construction Designs	Advanced new construction designs use an integrated approach to the design of new buildings to account for the interaction of building systems. Designs may specify the building orientation, building shell, proper sizing of equipment and systems, and controls strategies with the goal of optimizing building energy efficiency and comfort. Options that may be evaluated and incorporated include passive solar strategies, increased thermal mass, natural ventilation, energy recovery ventilation, daylighting strategies, and shading strategies. This measure is modeled for new vintage only.
HVAC, Lighting	Custom Measures	Custom measures may be included in the analysis to serve as a "catch all" for measures for which costs and savings are not easily quantified and that could be part of a custom program. Typical costs and energy savings are assumed such that the measures pass the economic screen.
Office Equipment	PC Power Management Software	This measure employs software and policies designed to minimize monitor and peripheral run times, and maximize the use of sleep and hibernation modes.

Table C-3 Energy Efficiency Equipment Data, Electric—Small Office, Existing Vintage

End Use	Technology	Efficiency Definition	Savings (kWh/SQ FT/yr)	Incremental Cost ($/SQ FT)	Lifetime (Years)	BC Ratio	Levelized Cost of Energy ($/kWh)
Cooling	Air-Cooled Chiller	1.5 kw/ton, COP 2.3	-	$0.00	20	1.00	$0.000
Cooling	Air-Cooled Chiller	1.3 kw/ton, COP 2.7	1.10	$0.32	20	1.16	$0.022
Cooling	Air-Cooled Chiller	1.26 kw/ton, COP 2.8	1.24	$0.41	20	1.18	$0.026
Cooling	Air-Cooled Chiller	1.0 kw/ton, COP 3.5	1.46	$0.51	20	1.22	$0.027
Cooling	Air-Cooled Chiller	0.97 kw/ton, COP 3.6	1.75	$0.60	20	1.27	$0.026
Cooling	Water-Cooled Chiller	0.75 kw/ton, COP 4.7	-	$0.00	20	1.00	$0.000
Cooling	Water-Cooled Chiller	0.60 kw/ton, COP 5.9	1.68	$0.18	20	1.19	$0.008
Cooling	Water-Cooled Chiller	0.58 kw/ton, COP 6.1	1.90	$0.36	20	1.21	$0.015
Cooling	Water-Cooled Chiller	0.55 kw/Ton, COP 6.4	2.23	$0.43	20	1.26	$0.015
Cooling	Water-Cooled Chiller	0.51 kw/ton, COP 6.9	2.68	$0.68	20	1.30	$0.019
Cooling	Water-Cooled Chiller	0.50 kw/Ton, COP 7.0	2.79	$0.75	20	1.32	$0.021
Cooling	Water-Cooled Chiller	0.48 kw/ton, COP 7.3	3.02	$0.82	20	1.35	$0.021
Cooling	Roof top AC	EER 9.2	-	$0.00	16	-	$0.000
Cooling	Roof top AC	EER 10.1	0.55	$0.33	16	-	$0.053
Cooling	Roof top AC	EER 11.2	1.10	$0.63	16	1.00	$0.051
Cooling	Roof top AC	EER 12.0	1.44	$1.21	16	0.98	$0.075
Cooling	Roof top AC	Ductless Minisplit	1.80	$3.98	16	0.79	$0.195
Cooling	Air Source Heat Pump	EER 9.3, COP 3.1	-	$0.00	16	-	$0.000
Cooling	Air Source Heat Pump	EER 10.3, COP 3.2	0.60	$0.41	16	-	$0.060
Cooling	Air Source Heat Pump	EER 11.0, COP 3.3	0.96	$0.59	16	1.00	$0.055
Cooling	Air Source Heat Pump	EER 11.7, COP 3.4	1.27	$1.51	16	0.95	$0.105
Cooling	Air Source Heat Pump	EER 12.0, COP 3.4	1.39	$1.97	16	0.92	$0.125
Cooling	Air Source Heat Pump	Ductless Minisplit	1.76	$3.78	16	0.82	$0.190
Cooling	Geo Heat Pump	EER 14.1, COP 3.3	-	$0.00	16	1.00	$0.000
Cooling	Geo Heat Pump	EER 16, COP 3.5	0.37	$0.99	16	0.96	$0.234
Cooling	Geo Heat Pump	EER 18, COP 3.8	0.68	$1.97	16	0.91	$0.257
Cooling	Geo Heat Pump	EER 30, COP 5.0	1.66	$2.60	16	0.97	$0.138
Cooling	Other Cooling	EER 9.8	-	$0.00	14	1.00	$0.000
Cooling	Other Cooling	EER 10.2	0.07	$0.02	14	1.02	$0.027
Cooling	Other Cooling	EER 10.8	0.14	$0.23	14	0.99	$0.156
Cooling	Other Cooling	EER 11	0.21	$0.25	14	1.00	$0.112
Cooling	Other Cooling	EER 11.5	0.28	$0.28	14	1.01	$0.097
Heating	Air Source Heat Pump	EER 9.3, COP 3.1	-	$0.00	16	-	$0.000
Heating	Air Source Heat Pump	EER 10.3, COP 3.2	0.04	$0.15	16	-	$0.361
Heating	Air Source Heat Pump	EER 11.0, COP 3.3	0.07	$0.21	16	1.00	$0.274
Heating	Air Source Heat Pump	EER 11.7, COP 3.4	0.10	$0.54	16	0.94	$0.500
Heating	Air Source Heat Pump	EER 12.0, COP 3.4	0.10	$0.71	16	0.91	$0.652
Heating	Air Source Heat Pump	Ductless Minisplit	0.12	$1.35	16	0.81	$0.992
Heating	Geo Heat Pump	EER 14.1, COP 3.3	-	$0.00	16	1.00	$0.000
Heating	Geo Heat Pump	EER 16, COP 3.5	0.39	$0.33	16	0.99	$0.075
Heating	Geo Heat Pump	EER 18, COP 3.8	0.70	$0.65	16	0.96	$0.082
Heating	Geo Heat Pump	EER 30, COP 5.0	0.11	$0.86	16	0.85	$0.685
Heating	Electric Room Heat	Standard	-	$0.00	25	1.00	$0.000
Heating	Electric Furnace	Standard	-	$0.00	25	1.00	$0.000
Ventilation	Ventilation	Constant Volume	-	$0.00	10	1.00	$0.000
Ventilation	Ventilation	Variable Air Volume	1.76	-$0.10	10	1.29	-$0.007
Water Heating	Water Heating	EF .97	-	$0.00	15	1.00	$0.000
Water Heating	Water Heating	EF .98	0.01	$0.00	15	1.01	$0.000
Water Heating	Water Heating	EF 2.0	0.41	$0.00	15	2.06	$0.000
Water Heating	Water Heating	EF 2.3	0.46	$0.00	15	2.37	$0.000
Water Heating	Water Heating	EF 2.4	0.47	$0.00	15	2.47	$0.000
Int. Lighting	Screw-in	Incandescent	-	$0.00	2	1.00	$0.000
Int. Lighting	Screw-in	90W Halogen PAR-38	1.04	$0.05	3	-	$0.017
Int. Lighting	Screw-in	70W HIR PAR-38	1.59	$0.07	3	-	$0.015
Int. Lighting	Screw-in	CFL	2.98	$0.04	6	3.46	$0.003
Int. Lighting	Screw-in	LED (2010)	3.23	$1.07	20	1.95	$0.026
Int. Lighting	Screw-in	LED (2020)	3.71	$0.30	20	-	$0.006
Int. Lighting	High-Bay Fixtures	Metal Halides	-	$0.00	3	1.00	$0.000
Int. Lighting	High-Bay Fixtures	LED (2010)	0.13	$0.24	15	0.68	$0.166

End Use	Technology	Efficiency Definition	Savings (kWh/SQ FT/yr)	Incremental Cost ($/SQ FT)	Lifetime (Years)	BC Ratio	Levelized Cost of Energy ($/kWh)
Int. Lighting	High-Bay Fixtures	T8	0.14	-$0.01	10	1.81	-$0.006
Int. Lighting	High-Bay Fixtures	HP Sodium	0.15	$0.00	6	1.76	$0.001
Int. Lighting	High-Bay Fixtures	Light Emitting Plasma	0.17	$0.00	15	1.95	$0.002
Int. Lighting	High-Bay Fixtures	T5	0.17	$0.00	10	2.21	-$0.003
Int. Lighting	High-Bay Fixtures	LED (2020)	0.26	$0.06	15	-	$0.022
Int. Lighting	Linear Fluorescent	T12	-	$0.00	10	1.00	$0.000
Int. Lighting	Linear Fluorescent	LED (2010)	0.82	$3.73	15	0.48	$0.421
Int. Lighting	Linear Fluorescent	T8	0.85	$0.00	10	1.34	$0.000
Int. Lighting	Linear Fluorescent	Super T8	1.18	$0.02	10	1.51	$0.003
Int. Lighting	Linear Fluorescent	T5	1.37	$0.04	10	1.63	$0.004
Int. Lighting	Linear Fluorescent	LED (2020)	2.50	$1.03	15	-	$0.038
Ext. Lighting	Screw-in	Incandescent	-	$0.00	2	1.00	$0.000
Ext. Lighting	Screw-in	90W Halogen PAR-38	0.08	$0.00	3	-	$0.017
Ext. Lighting	Screw-in	70W HIR PAR-38	0.12	$0.01	3	-	$0.015
Ext. Lighting	Screw-in	CFL	0.23	$0.00	6	3.21	$0.003
Ext. Lighting	Screw-in	LED (2010)	0.25	$0.08	20	1.50	$0.026
Ext. Lighting	Screw-in	LED (2020)	0.29	$0.02	20	-	$0.006
Ext. Lighting	HID	Metal Halides	-	$0.00	3	1.00	$0.000
Ext. Lighting	HID	LED (2010)	0.45	$0.66	15	0.61	$0.137
Ext. Lighting	HID	T8	0.45	-$0.02	10	1.76	-$0.005
Ext. Lighting	HID	HP Sodium	0.48	$0.00	6	1.73	$0.001
Ext. Lighting	HID	Light Emitting Plasma	0.56	$0.01	15	1.84	$0.002
Ext. Lighting	HID	T5	0.58	-$0.01	10	2.15	-$0.002
Ext. Lighting	HID	LED (2020)	0.85	$0.17	15	-	$0.018
Ext. Lighting	Linear Fluorescent	T12	-	$0.00	10	1.00	$0.000
Ext. Lighting	Linear Fluorescent	LED (2010)	0.02	$0.09	15	0.39	$0.421
Ext. Lighting	Linear Fluorescent	T8	0.02	$0.00	10	1.34	$0.000
Ext. Lighting	Linear Fluorescent	Super T8	0.03	$0.00	10	1.50	$0.003
Ext. Lighting	Linear Fluorescent	T5	0.03	$0.00	10	1.61	$0.004
Ext. Lighting	Linear Fluorescent	LED (2020)	0.06	$0.03	15	-	$0.038
Refrigeration	Walk-in Refrigerator	14600 kWh/yr	-	$0.00	12	1.00	$0.000
Refrigeration	Walk-in Refrigerator	10800 kWh/yr	-	$0.00	12	1.00	$0.000
Refrigeration	Walk-in Refrigerator	10000 kWh/yr	-	$0.00	12	1.00	$0.000
Refrigeration	Walk-in Refrigerator	9000 kWh/yr	-	$0.00	12	1.00	$0.000
Refrigeration	Reach-in Refrigerator	3800 kWh/yr	-	$0.00	12	1.00	$0.000
Refrigeration	Reach-in Refrigerator	3100 kWh/yr	0.04	$0.00	12	1.20	$0.003
Refrigeration	Reach-in Refrigerator	2500 kWh/yr	0.07	$0.00	12	1.45	$0.003
Refrigeration	Reach-in Refrigerator	2400 kWh/yr	0.07	$0.00	12	1.50	$0.003
Refrigeration	Reach-in Refrigerator	1500 kWh/yr	0.12	$0.00	12	2.28	$0.002
Refrigeration	Glass Door Display	14480 kWh/yr	-	$0.00	12	-	$0.000
Refrigeration	Glass Door Display	11700 kWh/yr	-	$0.00	12	-	$0.000
Refrigeration	Glass Door Display	8400 kWh/yr	-	$0.00	12	1.00	$0.000
Refrigeration	Glass Door Display	6800 kWh/yr	-	$0.00	12	1.00	$0.000
Refrigeration	Open Display Case	6500 kWh/yr	-	$0.00	18	-	$0.000
Refrigeration	Open Display Case	5350 kWh/yr	-	$0.00	18	1.00	$0.000
Refrigeration	Open Display Case	5300 kWh/yr	-	$0.00	18	-	$0.000
Refrigeration	Open Display Case	4330 kWh/yr	-	$0.00	18	1.00	$0.000
Refrigeration	Icemaker	7.0 kWh/100 lbs	-	$0.00	10	1.00	$0.000
Refrigeration	Icemaker	6.3 kWh/100 lbs	0.02	$0.01	10	1.01	$0.054
Refrigeration	Icemaker	6.0 kWh/100 lbs	0.03	$0.01	10	1.00	$0.057
Refrigeration	Icemaker	5.5 kWh/100 lbs	0.05	$0.05	10	0.88	$0.142
Refrigeration	Vending Machine	3400 kWh/year	-	$0.00	10	1.00	$0.000
Refrigeration	Vending Machine	3000 kWh/year	0.02	$0.00	10	1.05	$0.012
Refrigeration	Vending Machine	2400 kWh/year	0.05	$0.01	10	1.14	$0.012
Refrigeration	Vending Machine	1700 kWh/year	0.09	$0.02	10	1.20	$0.022
Food Prep.	Oven	Standard	-	$0.00	12	1.00	$0.000
Food Prep.	Oven	Energy Star	0.05	$0.00	12	1.14	$0.000
Food Prep.	Fryer	Standard	-	$0.00	12	1.00	$0.000
Food Prep.	Fryer	Energy Star	-	$0.00	12	1.00	$0.000
Food Prep.	Dishwasher	Standard	-	$0.00	12	1.00	$0.000
Food Prep.	Dishwasher	Energy Star	0.24	$0.01	12	1.36	$0.005
Food Prep.	Hot Food Container	Standard	-	$0.00	12	1.00	$0.000

End Use	Technology	Efficiency Definition	Savings (kWh/SQ FT/yr)	Incremental Cost ($/SQ FT)	Lifetime (Years)	BC Ratio	Levelized Cost of Energy ($/kWh)
Food Prep.	Hot Food Container	Energy Star	-	$0.00	12	1.00	$0.000
Office Equip.	Desktop Computer	Standard	-	$0.00	5	1.00	$0.000
Office Equip.	Desktop Computer	Energy Star	0.39	$0.00	5	1.05	$0.000
Office Equip.	Laptop	Standard	-	$0.00	4	1.00	$0.000
Office Equip.	Laptop	Energy Star	0.06	$0.00	4	1.02	$0.000
Office Equip.	Server	Standard	-	$0.00	3	1.00	$0.000
Office Equip.	Server	Energy Star	0.18	$0.00	3	1.04	$0.000
Office Equip.	Monitor	Standard	-	$0.00	4	1.00	$0.000
Office Equip.	Monitor	Energy Star	0.04	$0.00	4	1.02	$0.000
Office Equip.	Printer/Copier/Fax	Standard	-	$0.00	6	1.00	$0.000
Office Equip.	Printer/Copier/Fax	Energy Star	0.13	$0.00	6	1.10	$0.000
Office Equip.	POS Terminal	Standard	-	$0.00	4	1.00	$0.000
Office Equip.	POS Terminal	Energy Star	0.05	$0.03	4	0.95	$0.152
Miscellaneous	Non-HVAC Motors	Standard (EPAct)	-	$0.00	15	1.00	$0.000
Miscellaneous	Non-HVAC Motors	Standard (EPAct 2015)	0.00	$0.00	15	-	$0.000
Miscellaneous	Non-HVAC Motors	High Eff.	0.01	$0.00	15	1.01	$0.010
Miscellaneous	Non-HVAC Motors	High Eff. (2015)	0.01	$0.00	15	-	$0.007
Miscellaneous	Non-HVAC Motors	Premium (NEMA)	0.02	$0.00	15	1.02	$0.010
Miscellaneous	Non-HVAC Motors	Premium (NEMA 2015)	0.02	$0.00	15	-	$0.008
Miscellaneous	Pool Pump	Standard	-	$0.00	15	1.00	$0.000
Miscellaneous	Pool Pump	High Eff.	-	$0.00	15	1.00	$0.000
Miscellaneous	Pool Pump	High Eff. Multi-Speed	-	$0.00	15	1.00	$0.000
Miscellaneous	Pool Heater	Standard	-	$0.00	15	1.00	$0.000
Miscellaneous	Pool Heater	Heat Pump	-	$0.00	15	1.00	$0.000
Miscellaneous	Miscellaneous	Standard	-	$0.00	5	1.00	$0.000

Table C-4 Energy Efficiency Equipment Data, Electric—Small Office, New Vintage

End Use	Technology	Efficiency Definition	Savings (kWh/SQ FT/yr)	Incremental Cost ($/SQ FT)	Lifetime (Years)	BC Ratio	Levelized Cost of Energy ($/kWh)
Cooling	Air-Cooled Chiller	1.5 kw/ton, COP 2.3	-	$0.00	20	1.00	$0.000
Cooling	Air-Cooled Chiller	1.3 kw/ton, COP 2.7	0.90	$0.33	20	1.14	$0.028
Cooling	Air-Cooled Chiller	1.26 kw/ton, COP 2.8	1.02	$0.43	20	1.16	$0.032
Cooling	Air-Cooled Chiller	1.0 kw/ton, COP 3.5	1.20	$0.53	20	1.19	$0.034
Cooling	Air-Cooled Chiller	0.97 kw/ton, COP 3.6	1.44	$0.63	20	1.23	$0.033
Cooling	Water-Cooled Chiller	0.75 kw/ton, COP 4.7	-	$0.00	20	1.00	$0.000
Cooling	Water-Cooled Chiller	0.60 kw/ton, COP 5.9	1.56	$0.21	20	1.18	$0.011
Cooling	Water-Cooled Chiller	0.58 kw/ton, COP 6.1	1.77	$0.43	20	1.19	$0.019
Cooling	Water-Cooled Chiller	0.55 kw/Ton, COP 6.4	2.08	$0.51	20	1.23	$0.019
Cooling	Water-Cooled Chiller	0.51 kw/ton, COP 6.9	2.50	$0.80	20	1.27	$0.025
Cooling	Water-Cooled Chiller	0.50 kw/Ton, COP 7.0	2.60	$0.88	20	1.28	$0.026
Cooling	Water-Cooled Chiller	0.48 kw/ton, COP 7.3	2.81	$0.97	20	1.31	$0.027
Cooling	Roof top AC	EER 9.2	-	$0.00	16	-	$0.000
Cooling	Roof top AC	EER 10.1	0.51	$0.32	16	-	$0.056
Cooling	Roof top AC	EER 11.2	1.03	$0.62	16	1.00	$0.053
Cooling	Roof top AC	EER 12.0	1.34	$1.18	16	0.98	$0.078
Cooling	Roof top AC	Ductless Minisplit	1.68	$3.89	16	0.78	$0.204
Cooling	Air Source Heat Pump	EER 9.3, COP 3.1	-	$0.00	16	-	$0.000
Cooling	Air Source Heat Pump	EER 10.3, COP 3.2	0.52	$0.37	16	-	$0.063
Cooling	Air Source Heat Pump	EER 11.0, COP 3.3	0.83	$0.53	16	1.00	$0.057
Cooling	Air Source Heat Pump	EER 11.7, COP 3.4	1.10	$1.37	16	0.95	$0.111
Cooling	Air Source Heat Pump	EER 12.0, COP 3.4	1.20	$1.79	16	0.92	$0.131
Cooling	Air Source Heat Pump	Ductless Minisplit	1.52	$3.43	16	0.81	$0.199
Cooling	Geo Heat Pump	EER 14.1, COP 3.3	-	$0.00	16	1.00	$0.000
Cooling	Geo Heat Pump	EER 16, COP 3.5	0.35	$0.96	16	0.96	$0.245
Cooling	Geo Heat Pump	EER 18, COP 3.8	0.63	$1.93	16	0.91	$0.269
Cooling	Geo Heat Pump	EER 30, COP 5.0	1.55	$2.54	16	0.96	$0.145
Cooling	Other Cooling	EER 9.8	-	$0.00	14	1.00	$0.000

End Use	Technology	Efficiency Definition	Savings (kWh/SQ FT/yr)	Incremental Cost ($/SQ FT)	Lifetime (Years)	BC Ratio	Levelized Cost of Energy ($/kWh)
Cooling	Other Cooling	EER 10.2	0.07	$0.02	14	1.02	$0.027
Cooling	Other Cooling	EER 10.8	0.14	$0.23	14	0.99	$0.155
Cooling	Other Cooling	EER 11	0.21	$0.24	14	1.00	$0.111
Cooling	Other Cooling	EER 11.5	0.27	$0.27	14	1.01	$0.097
Heating	Air Source Heat Pump	EER 9.3, COP 3.1	-	$0.00	16	-	$0.000
Heating	Air Source Heat Pump	EER 10.3, COP 3.2	0.09	$0.19	16	-	$0.195
Heating	Air Source Heat Pump	EER 11.0, COP 3.3	0.17	$0.27	16	1.00	$0.139
Heating	Air Source Heat Pump	EER 11.7, COP 3.4	0.26	$0.70	16	0.93	$0.238
Heating	Air Source Heat Pump	EER 12.0, COP 3.4	0.26	$0.91	16	0.89	$0.311
Heating	Air Source Heat Pump	Ductless Minisplit	0.35	$1.75	16	0.78	$0.445
Heating	Geo Heat Pump	EER 14.1, COP 3.3	-	$0.00	16	1.00	$0.000
Heating	Geo Heat Pump	EER 16, COP 3.5	0.36	$0.39	16	0.97	$0.098
Heating	Geo Heat Pump	EER 18, COP 3.8	0.65	$0.78	16	0.93	$0.107
Heating	Geo Heat Pump	EER 30, COP 5.0	0.89	$1.04	16	0.92	$0.102
Heating	Electric Room Heat	Standard	-	$0.00	25	1.00	$0.000
Heating	Electric Furnace	Standard	-	$0.00	25	1.00	$0.000
Ventilation	Ventilation	Constant Volume	-	$0.00	10	1.00	$0.000
Ventilation	Ventilation	Variable Air Volume	1.99	-$0.12	10	1.26	-$0.008
Water Heating	Water Heating	EF .97	-	$0.00	15	1.00	$0.000
Water Heating	Water Heating	EF .98	0.01	$0.00	15	1.01	$0.000
Water Heating	Water Heating	EF 2.0	0.41	$0.00	15	2.06	$0.000
Water Heating	Water Heating	EF 2.3	0.46	$0.00	15	2.37	$0.000
Water Heating	Water Heating	EF 2.4	0.47	$0.00	15	2.47	$0.000
Int. Lighting	Screw-in	Incandescent	-	$0.00	2	1.00	$0.000
Int. Lighting	Screw-in	90W Halogen PAR-38	1.04	$0.05	3	-	$0.017
Int. Lighting	Screw-in	70W HIR PAR-38	1.59	$0.07	3	-	$0.015
Int. Lighting	Screw-in	CFL	2.98	$0.04	6	3.46	$0.003
Int. Lighting	Screw-in	LED (2010)	3.23	$1.07	20	1.95	$0.026
Int. Lighting	Screw-in	LED (2020)	3.71	$0.30	20	-	$0.006
Int. Lighting	High-Bay Fixtures	Metal Halides	-	$0.00	3	1.00	$0.000
Int. Lighting	High-Bay Fixtures	LED (2010)	0.13	$0.24	15	0.68	$0.166
Int. Lighting	High-Bay Fixtures	T8	0.14	-$0.01	10	1.81	-$0.006
Int. Lighting	High-Bay Fixtures	HP Sodium	0.15	$0.00	6	1.76	$0.001
Int. Lighting	High-Bay Fixtures	Light Emitting Plasma	0.17	$0.00	15	1.95	$0.002
Int. Lighting	High-Bay Fixtures	T5	0.17	$0.00	10	2.21	-$0.003
Int. Lighting	High-Bay Fixtures	LED (2020)	0.26	$0.06	15	-	$0.022
Int. Lighting	Linear Fluorescent	T12	-	$0.00	10	1.00	$0.000
Int. Lighting	Linear Fluorescent	LED (2010)	0.82	$3.73	15	0.48	$0.421
Int. Lighting	Linear Fluorescent	T8	0.85	$0.00	10	1.34	$0.000
Int. Lighting	Linear Fluorescent	Super T8	1.18	$0.02	10	1.51	$0.003
Int. Lighting	Linear Fluorescent	T5	1.37	$0.04	10	1.63	$0.004
Int. Lighting	Linear Fluorescent	LED (2020)	2.50	$1.03	15	-	$0.038
Ext. Lighting	Screw-in	Incandescent	-	$0.00	2	1.00	$0.000
Ext. Lighting	Screw-in	90W Halogen PAR-38	0.08	$0.00	3	-	$0.017
Ext. Lighting	Screw-in	70W HIR PAR-38	0.12	$0.01	3	-	$0.015
Ext. Lighting	Screw-in	CFL	0.23	$0.00	6	3.21	$0.003
Ext. Lighting	Screw-in	LED (2010)	0.25	$0.08	20	1.50	$0.026
Ext. Lighting	Screw-in	LED (2020)	0.29	$0.02	20	-	$0.006
Ext. Lighting	HID	Metal Halides	-	$0.00	3	1.00	$0.000
Ext. Lighting	HID	LED (2010)	0.45	$0.66	15	0.61	$0.137
Ext. Lighting	HID	T8	0.45	-$0.02	10	1.76	-$0.005
Ext. Lighting	HID	HP Sodium	0.48	$0.00	6	1.73	$0.001
Ext. Lighting	HID	Light Emitting Plasma	0.56	$0.01	15	1.84	$0.002
Ext. Lighting	HID	T5	0.58	-$0.01	10	2.15	-$0.002
Ext. Lighting	HID	LED (2020)	0.85	$0.17	15	-	$0.018
Ext. Lighting	Linear Fluorescent	T12	-	$0.00	10	1.00	$0.000
Ext. Lighting	Linear Fluorescent	LED (2010)	0.02	$0.09	15	0.39	$0.421
Ext. Lighting	Linear Fluorescent	T8	0.02	$0.00	10	1.34	$0.000
Ext. Lighting	Linear Fluorescent	Super T8	0.03	$0.00	10	1.50	$0.003
Ext. Lighting	Linear Fluorescent	T5	0.03	$0.00	10	1.61	$0.004
Ext. Lighting	Linear Fluorescent	LED (2020)	0.06	$0.03	15	-	$0.038
Refrigeration	Walk-in Refrigerator	14600 kWh/yr	-	$0.00	12	1.00	$0.000

End Use	Technology	Efficiency Definition	Savings (kWh/SQ FT/yr)	Incremental Cost ($/SQ FT)	Lifetime (Years)	BC Ratio	Levelized Cost of Energy ($/kWh)
Refrigeration	Walk-in Refrigerator	10800 kWh/yr	-	$0.00	12	1.00	$0.000
Refrigeration	Walk-in Refrigerator	10000 kWh/yr	-	$0.00	12	1.00	$0.000
Refrigeration	Walk-in Refrigerator	9000 kWh/yr	-	$0.00	12	1.00	$0.000
Refrigeration	Reach-in Refrigerator	3800 kWh/yr	-	$0.00	12	1.00	$0.000
Refrigeration	Reach-in Refrigerator	3100 kWh/yr	0.04	$0.00	12	1.19	$0.005
Refrigeration	Reach-in Refrigerator	2500 kWh/yr	0.07	$0.00	12	1.43	$0.005
Refrigeration	Reach-in Refrigerator	2400 kWh/yr	0.07	$0.00	12	1.47	$0.005
Refrigeration	Reach-in Refrigerator	1500 kWh/yr	0.12	$0.00	12	2.19	$0.003
Refrigeration	Glass Door Display	14480 kWh/yr	-	$0.00	12	-	$0.000
Refrigeration	Glass Door Display	11700 kWh/yr	-	$0.00	12	-	$0.000
Refrigeration	Glass Door Display	8400 kWh/yr	-	$0.00	12	1.00	$0.000
Refrigeration	Glass Door Display	6800 kWh/yr	-	$0.00	12	1.00	$0.000
Refrigeration	Open Display Case	6500 kWh/yr	-	$0.00	18	-	$0.000
Refrigeration	Open Display Case	5350 kWh/yr	-	$0.00	18	1.00	$0.000
Refrigeration	Open Display Case	5300 kWh/yr	-	$0.00	18	-	$0.000
Refrigeration	Open Display Case	4330 kWh/yr	-	$0.00	18	1.00	$0.000
Refrigeration	Icemaker	7.0 kWh/100 lbs	-	$0.00	10	1.00	$0.000
Refrigeration	Icemaker	6.3 kWh/100 lbs	0.02	$0.01	10	1.01	$0.054
Refrigeration	Icemaker	6.0 kWh/100 lbs	0.03	$0.01	10	1.00	$0.057
Refrigeration	Icemaker	5.5 kWh/100 lbs	0.05	$0.05	10	0.88	$0.142
Refrigeration	Vending Machine	3400 kWh/year	-	$0.00	10	1.00	$0.000
Refrigeration	Vending Machine	3000 kWh/year	0.02	$0.00	10	1.05	$0.012
Refrigeration	Vending Machine	2400 kWh/year	0.05	$0.01	10	1.14	$0.012
Refrigeration	Vending Machine	1700 kWh/year	0.09	$0.02	10	1.20	$0.022
Food Prep.	Oven	Standard	-	$0.00	12	1.00	$0.000
Food Prep.	Oven	Energy Star	0.05	$0.00	12	1.14	$0.000
Food Prep.	Fryer	Standard	-	$0.00	12	1.00	$0.000
Food Prep.	Fryer	Energy Star	-	$0.00	12	1.00	$0.000
Food Prep.	Dishwasher	Standard	-	$0.00	12	1.00	$0.000
Food Prep.	Dishwasher	Energy Star	0.24	$0.01	12	1.36	$0.005
Food Prep.	Hot Food Container	Standard	-	$0.00	12	1.00	$0.000
Food Prep.	Hot Food Container	Energy Star	-	$0.00	12	1.00	$0.000
Office Equip.	Desktop Computer	Standard	-	$0.00	5	1.00	$0.000
Office Equip.	Desktop Computer	Energy Star	0.39	$0.00	5	1.05	$0.000
Office Equip.	Laptop	Standard	-	$0.00	4	1.00	$0.000
Office Equip.	Laptop	Energy Star	0.06	$0.00	4	1.02	$0.000
Office Equip.	Server	Standard	-	$0.00	3	1.00	$0.000
Office Equip.	Server	Energy Star	0.18	$0.00	3	1.04	$0.000
Office Equip.	Monitor	Standard	-	$0.00	4	1.00	$0.000
Office Equip.	Monitor	Energy Star	0.04	$0.00	4	1.02	$0.000
Office Equip.	Printer/Copier/Fax	Standard	-	$0.00	6	1.00	$0.000
Office Equip.	Printer/Copier/Fax	Energy Star	0.13	$0.00	6	1.10	$0.000
Office Equip.	POS Terminal	Standard	-	$0.00	4	1.00	$0.000
Office Equip.	POS Terminal	Energy Star	0.05	$0.03	4	0.95	$0.152
Miscellaneous	Non-HVAC Motors	Standard (EPAct)	-	$0.00	15	1.00	$0.000
Miscellaneous	Non-HVAC Motors	Standard (EPAct 2015)	0.00	$0.00	15	-	$0.000
Miscellaneous	Non-HVAC Motors	High Eff.	0.01	$0.00	15	1.01	$0.010
Miscellaneous	Non-HVAC Motors	High Eff. (2015)	0.01	$0.00	15	-	$0.007
Miscellaneous	Non-HVAC Motors	Premium (NEMA)	0.02	$0.00	15	1.02	$0.010
Miscellaneous	Non-HVAC Motors	Premium (NEMA 2015)	0.02	$0.00	15	-	$0.008
Miscellaneous	Pool Pump	Standard	-	$0.00	15	1.00	$0.000
Miscellaneous	Pool Pump	High Eff.	-	$0.00	15	1.00	$0.000
Miscellaneous	Pool Pump	High Eff. Multi-Speed	-	$0.00	15	1.00	$0.000
Miscellaneous	Pool Heater	Standard	-	$0.00	15	1.00	$0.000
Miscellaneous	Pool Heater	Heat Pump	-	$0.00	15	1.00	$0.000
Miscellaneous	Miscellaneous	Standard	-	$0.00	5	1.00	$0.000

Table C-5 Energy Efficiency Equipment Data, Large Office, Existing Vintage

End Use	Technology	Efficiency Definition	Savings (kWh/SQ FT/yr)	Incremental Cost ($/SQ FT)	Lifetime (Years)	BC Ratio	Levelized Cost of Energy ($/kWh)
Cooling	Air-Cooled Chiller	1.5 kw/ton, COP 2.3	-	$0.00	20	1.00	$0.000
Cooling	Air-Cooled Chiller	1.3 kw/ton, COP 2.7	0.88	$0.23	20	1.14	$0.020
Cooling	Air-Cooled Chiller	1.26 kw/ton, COP 2.8	1.00	$0.30	20	1.15	$0.023
Cooling	Air-Cooled Chiller	1.0 kw/ton, COP 3.5	1.18	$0.37	20	1.18	$0.024
Cooling	Air-Cooled Chiller	0.97 kw/ton, COP 3.6	1.41	$0.44	20	1.23	$0.024
Cooling	Water-Cooled Chiller	0.75 kw/ton, COP 4.7	-	$0.00	20	1.00	$0.000
Cooling	Water-Cooled Chiller	0.60 kw/ton, COP 5.9	1.11	$0.11	20	1.18	$0.008
Cooling	Water-Cooled Chiller	0.58 kw/ton, COP 6.1	1.26	$0.22	20	1.19	$0.013
Cooling	Water-Cooled Chiller	0.55 kw/Ton, COP 6.4	1.48	$0.26	20	1.23	$0.014
Cooling	Water-Cooled Chiller	0.51 kw/ton, COP 6.9	1.78	$0.41	20	1.27	$0.018
Cooling	Water-Cooled Chiller	0.50 kw/Ton, COP 7.0	1.85	$0.46	20	1.28	$0.019
Cooling	Water-Cooled Chiller	0.48 kw/ton, COP 7.3	2.00	$0.50	20	1.30	$0.019
Cooling	Roof top AC	EER 9.2	-	$0.00	16	-	$0.000
Cooling	Roof top AC	EER 10.1	0.54	$0.31	16	-	$0.051
Cooling	Roof top AC	EER 11.2	1.08	$0.60	16	1.00	$0.049
Cooling	Roof top AC	EER 12.0	1.41	$1.15	16	0.96	$0.072
Cooling	Roof top AC	Ductless Minisplit	1.77	$3.76	16	0.73	$0.188
Cooling	Air Source Heat Pump	EER 9.3, COP 3.1	-	$0.00	16	-	$0.000
Cooling	Air Source Heat Pump	EER 10.3, COP 3.2	0.59	$0.39	16	-	$0.058
Cooling	Air Source Heat Pump	EER 11.0, COP 3.3	0.94	$0.56	16	1.00	$0.053
Cooling	Air Source Heat Pump	EER 11.7, COP 3.4	1.24	$1.43	16	0.93	$0.101
Cooling	Air Source Heat Pump	EER 12.0, COP 3.4	1.36	$1.86	16	0.89	$0.121
Cooling	Air Source Heat Pump	Ductless Minisplit	1.73	$3.57	16	0.77	$0.183
Cooling	Geo Heat Pump	EER 14.1, COP 3.3	-	$0.00	16	1.00	$0.000
Cooling	Geo Heat Pump	EER 16, COP 3.5	0.37	$0.93	16	0.94	$0.225
Cooling	Geo Heat Pump	EER 18, COP 3.8	0.67	$1.86	16	0.88	$0.247
Cooling	Geo Heat Pump	EER 30, COP 5.0	1.63	$2.45	16	0.91	$0.133
Cooling	Other Cooling	EER 9.8	-	$0.00	14	1.00	$0.000
Cooling	Other Cooling	EER 10.2	0.07	$0.02	14	1.01	$0.027
Cooling	Other Cooling	EER 10.8	0.14	$0.23	14	0.96	$0.156
Cooling	Other Cooling	EER 11	0.21	$0.24	14	0.98	$0.112
Cooling	Other Cooling	EER 11.5	0.27	$0.27	14	0.98	$0.097
Heating	Air Source Heat Pump	EER 9.3, COP 3.1	-	$0.00	16	-	$0.000
Heating	Air Source Heat Pump	EER 10.3, COP 3.2	0.02	$0.17	16	-	$0.725
Heating	Air Source Heat Pump	EER 11.0, COP 3.3	0.04	$0.25	16	1.00	$0.566
Heating	Air Source Heat Pump	EER 11.7, COP 3.4	0.05	$0.65	16	0.92	$1.050
Heating	Air Source Heat Pump	EER 12.0, COP 3.4	0.05	$0.84	16	0.89	$1.370
Heating	Air Source Heat Pump	Ductless Minisplit	0.07	$1.61	16	0.77	$2.143
Heating	Geo Heat Pump	EER 14.1, COP 3.3	-	$0.00	16	1.00	$0.000
Heating	Geo Heat Pump	EER 16, COP 3.5	0.34	$0.38	16	0.97	$0.100
Heating	Geo Heat Pump	EER 18, COP 3.8	0.62	$0.77	16	0.93	$0.109
Heating	Geo Heat Pump	EER 30, COP 5.0	0.03	$1.01	16	0.82	$2.894
Heating	Electric Room Heat	Standard	-	$0.00	25	1.00	$0.000
Heating	Electric Furnace	Standard	-	$0.00	25	1.00	$0.000
Ventilation	Ventilation	Constant Volume	-	$0.00	10	1.00	$0.000
Ventilation	Ventilation	Variable Air Volume	1.77	-$0.11	10	1.22	-$0.007
Water Heating	Water Heating	EF .97	-	$0.00	15	1.00	$0.000
Water Heating	Water Heating	EF .98	0.01	$0.00	15	1.01	$0.024
Water Heating	Water Heating	EF 2.0	0.46	$0.00	15	2.01	$0.001
Water Heating	Water Heating	EF 2.3	0.52	$0.01	15	2.28	$0.001
Water Heating	Water Heating	EF 2.4	0.53	$0.01	15	2.37	$0.001
Int. Lighting	Screw-in	Incandescent	-	$0.00	2	1.00	$0.000
Int. Lighting	Screw-in	90W Halogen PAR-38	0.80	$0.03	3	-	$0.014
Int. Lighting	Screw-in	70W HIR PAR-38	1.23	$0.04	3	-	$0.012
Int. Lighting	Screw-in	CFL	2.30	$0.02	6	3.47	$0.002
Int. Lighting	Screw-in	LED (2010)	2.49	$0.66	20	2.05	$0.020
Int. Lighting	Screw-in	LED (2020)	2.86	$0.19	20	-	$0.005
Int. Lighting	High-Bay Fixtures	Metal Halides	-	$0.00	3	1.00	$0.000
Int. Lighting	High-Bay Fixtures	LED (2010)	0.05	$0.07	15	0.72	$0.132

End Use	Technology	Efficiency Definition	Savings (kWh/SQ FT/yr)	Incremental Cost ($/SQ FT)	Lifetime (Years)	BC Ratio	Levelized Cost of Energy ($/kWh)
Int. Lighting	High-Bay Fixtures	T8	0.05	$0.00	10	1.76	-$0.005
Int. Lighting	High-Bay Fixtures	HP Sodium	0.05	$0.00	6	1.76	$0.001
Int. Lighting	High-Bay Fixtures	Light Emitting Plasma	0.06	$0.00	15	1.91	$0.002
Int. Lighting	High-Bay Fixtures	T5	0.07	$0.00	10	2.17	-$0.002
Int. Lighting	High-Bay Fixtures	LED (2020)	0.10	$0.02	15	-	$0.018
Int. Lighting	Linear Fluorescent	T12	-	$0.00	10	1.00	$0.000
Int. Lighting	Linear Fluorescent	LED (2010)	1.08	$3.92	15	0.52	$0.335
Int. Lighting	Linear Fluorescent	T8	1.12	$0.00	10	1.34	$0.000
Int. Lighting	Linear Fluorescent	Super T8	1.56	$0.03	10	1.52	$0.002
Int. Lighting	Linear Fluorescent	T5	1.81	$0.04	10	1.64	$0.003
Int. Lighting	Linear Fluorescent	LED (2020)	3.30	$1.09	15	-	$0.030
Ext. Lighting	Screw-in	Incandescent	-	$0.00	2	1.00	$0.000
Ext. Lighting	Screw-in	90W Halogen PAR-38	0.06	$0.00	3	-	$0.014
Ext. Lighting	Screw-in	70W HIR PAR-38	0.09	$0.00	3	-	$0.012
Ext. Lighting	Screw-in	CFL	0.17	$0.00	6	3.31	$0.002
Ext. Lighting	Screw-in	LED (2010)	0.19	$0.05	20	1.72	$0.020
Ext. Lighting	Screw-in	LED (2020)	0.22	$0.01	20	-	$0.005
Ext. Lighting	HID	Metal Halides	-	$0.00	3	1.00	$0.000
Ext. Lighting	HID	LED (2010)	0.25	$0.29	15	0.68	$0.109
Ext. Lighting	HID	T8	0.25	-$0.01	10	1.72	-$0.004
Ext. Lighting	HID	HP Sodium	0.27	$0.00	6	1.73	$0.001
Ext. Lighting	HID	Light Emitting Plasma	0.31	$0.00	15	1.82	$0.001
Ext. Lighting	HID	T5	0.32	$0.00	10	2.11	-$0.002
Ext. Lighting	HID	LED (2020)	0.47	$0.07	15	-	$0.015
Ext. Lighting	Linear Fluorescent	T12	-	$0.00	10	1.00	$0.000
Ext. Lighting	Linear Fluorescent	LED (2010)	0.01	$0.03	15	0.45	$0.335
Ext. Lighting	Linear Fluorescent	T8	0.01	$0.00	10	1.34	$0.000
Ext. Lighting	Linear Fluorescent	Super T8	0.01	$0.00	10	1.51	$0.002
Ext. Lighting	Linear Fluorescent	T5	0.01	$0.00	10	1.63	$0.003
Ext. Lighting	Linear Fluorescent	LED (2020)	0.02	$0.01	15	-	$0.030
Refrigeration	Walk-in Refrigerator	14600 kWh/yr	-	$0.00	12	1.00	$0.000
Refrigeration	Walk-in Refrigerator	10800 kWh/yr	-	$0.00	12	1.00	$0.000
Refrigeration	Walk-in Refrigerator	10000 kWh/yr	-	$0.00	12	1.00	$0.000
Refrigeration	Walk-in Refrigerator	9000 kWh/yr	-	$0.00	12	1.00	$0.000
Refrigeration	Reach-in Refrigerator	3800 kWh/yr	-	$0.00	12	1.00	$0.000
Refrigeration	Reach-in Refrigerator	3100 kWh/yr	0.01	$0.00	12	1.08	$0.029
Refrigeration	Reach-in Refrigerator	2500 kWh/yr	0.02	$0.00	12	1.15	$0.030
Refrigeration	Reach-in Refrigerator	2400 kWh/yr	0.02	$0.01	12	1.17	$0.030
Refrigeration	Reach-in Refrigerator	1500 kWh/yr	0.03	$0.01	12	1.44	$0.019
Refrigeration	Glass Door Display	14480 kWh/yr	-	$0.00	12	-	$0.000
Refrigeration	Glass Door Display	11700 kWh/yr	0.04	$0.02	12	-	$0.072
Refrigeration	Glass Door Display	8400 kWh/yr	0.08	$0.00	12	1.00	$0.000
Refrigeration	Glass Door Display	6800 kWh/yr	0.10	$0.02	12	0.91	$0.026
Refrigeration	Open Display Case	6500 kWh/yr	-	$0.00	18	-	$0.000
Refrigeration	Open Display Case	5350 kWh/yr	0.02	$0.00	18	1.00	$0.000
Refrigeration	Open Display Case	5300 kWh/yr	0.02	$0.01	18	-	$0.056
Refrigeration	Open Display Case	4330 kWh/yr	0.03	$0.01	18	1.00	$0.032
Refrigeration	Icemaker	7.0 kWh/100 lbs	-	$0.00	10	1.00	$0.000
Refrigeration	Icemaker	6.3 kWh/100 lbs	0.01	$0.00	10	1.01	$0.054
Refrigeration	Icemaker	6.0 kWh/100 lbs	0.01	$0.00	10	1.00	$0.057
Refrigeration	Icemaker	5.5 kWh/100 lbs	0.01	$0.01	10	0.88	$0.142
Refrigeration	Vending Machine	3400 kWh/year	-	$0.00	10	1.00	$0.000
Refrigeration	Vending Machine	3000 kWh/year	0.01	$0.00	10	1.05	$0.012
Refrigeration	Vending Machine	2400 kWh/year	0.03	$0.00	10	1.14	$0.012
Refrigeration	Vending Machine	1700 kWh/year	0.04	$0.01	10	1.20	$0.022
Food Prep.	Oven	Standard	-	$0.00	12	1.00	$0.000
Food Prep.	Oven	Energy Star	0.02	$0.00	12	1.13	$0.000
Food Prep.	Fryer	Standard	-	$0.00	12	1.00	$0.000
Food Prep.	Fryer	Energy Star	0.01	$0.00	12	1.04	$0.024
Food Prep.	Dishwasher	Standard	-	$0.00	12	1.00	$0.000
Food Prep.	Dishwasher	Energy Star	0.09	$0.00	12	1.36	$0.005
Food Prep.	Hot Food Container	Standard	-	$0.00	12	1.00	$0.000

End Use	Technology	Efficiency Definition	Savings (kWh/SQ FT/yr)	Incremental Cost ($/SQ FT)	Lifetime (Years)	BC Ratio	Levelized Cost of Energy ($/kWh)
Food Prep.	Hot Food Container	Energy Star	0.06	$0.01	12	1.35	$0.024
Office Equip.	Desktop Computer	Standard	-	$0.00	5	1.00	$0.000
Office Equip.	Desktop Computer	Energy Star	0.95	$0.00	5	1.05	$0.000
Office Equip.	Laptop	Standard	-	$0.00	4	1.00	$0.000
Office Equip.	Laptop	Energy Star	0.15	$0.00	4	1.02	$0.000
Office Equip.	Server	Standard	-	$0.00	3	1.00	$0.000
Office Equip.	Server	Energy Star	0.07	$0.00	3	1.03	$0.000
Office Equip.	Monitor	Standard	-	$0.00	4	1.00	$0.000
Office Equip.	Monitor	Energy Star	0.11	$0.00	4	1.02	$0.000
Office Equip.	Printer/Copier/Fax	Standard	-	$0.00	6	1.00	$0.000
Office Equip.	Printer/Copier/Fax	Energy Star	0.11	$0.00	6	1.09	$0.000
Office Equip.	POS Terminal	Standard	-	$0.00	4	1.00	$0.000
Office Equip.	POS Terminal	Energy Star	0.01	$0.00	4	0.95	$0.152
Miscellaneous	Non-HVAC Motors	Standard (EPAct)	-	$0.00	15	1.00	$0.000
Miscellaneous	Non-HVAC Motors	Standard (EPAct 2015)	0.00	$0.00	15	-	$0.000
Miscellaneous	Non-HVAC Motors	High Eff.	0.00	$0.00	15	1.01	$0.010
Miscellaneous	Non-HVAC Motors	High Eff. (2015)	0.01	$0.00	15	-	$0.007
Miscellaneous	Non-HVAC Motors	Premium (NEMA)	0.01	$0.00	15	1.02	$0.010
Miscellaneous	Non-HVAC Motors	Premium (NEMA 2015)	0.01	$0.00	15	-	$0.008
Miscellaneous	Pool Pump	Standard	-	$0.00	15	1.00	$0.000
Miscellaneous	Pool Pump	High Eff.	-	$0.00	15	1.00	$0.000
Miscellaneous	Pool Pump	High Eff. Multi-Speed	-	$0.00	15	1.00	$0.000
Miscellaneous	Pool Heater	Standard	-	$0.00	15	1.00	$0.000
Miscellaneous	Pool Heater	Heat Pump	-	$0.00	15	1.00	$0.000
Miscellaneous	Miscellaneous	Standard	-	$0.00	5	1.00	$0.000

Table C-6 Energy Efficiency Equipment Data, Electric—Large Office, New Vintage

End Use	Technology	Efficiency Definition	Savings (kWh/SQ FT/yr)	Incremental Cost ($/SQ FT)	Lifetime (Years)	BC Ratio	Levelized Cost of Energy ($/kWh)
Cooling	Air-Cooled Chiller	1.5 kw/ton, COP 2.3	-	$0.00	20	1.00	$0.000
Cooling	Air-Cooled Chiller	1.3 kw/ton, COP 2.7	0.70	$0.24	20	1.12	$0.027
Cooling	Air-Cooled Chiller	1.26 kw/ton, COP 2.8	0.79	$0.32	20	1.13	$0.031
Cooling	Air-Cooled Chiller	1.0 kw/ton, COP 3.5	0.93	$0.39	20	1.15	$0.032
Cooling	Air-Cooled Chiller	0.97 kw/ton, COP 3.6	1.12	$0.46	20	1.18	$0.032
Cooling	Water-Cooled Chiller	0.75 kw/ton, COP 4.7	-	$0.00	20	1.00	$0.000
Cooling	Water-Cooled Chiller	0.60 kw/ton, COP 5.9	1.02	$0.13	20	1.16	$0.010
Cooling	Water-Cooled Chiller	0.58 kw/ton, COP 6.1	1.16	$0.27	20	1.17	$0.018
Cooling	Water-Cooled Chiller	0.55 kw/Ton, COP 6.4	1.36	$0.32	20	1.20	$0.018
Cooling	Water-Cooled Chiller	0.51 kw/ton, COP 6.9	1.63	$0.50	20	1.23	$0.023
Cooling	Water-Cooled Chiller	0.50 kw/Ton, COP 7.0	1.70	$0.55	20	1.23	$0.025
Cooling	Water-Cooled Chiller	0.48 kw/ton, COP 7.3	1.84	$0.60	20	1.25	$0.025
Cooling	Roof top AC	EER 9.2	-	$0.00	16	-	$0.000
Cooling	Roof top AC	EER 10.1	0.49	$0.32	16	-	$0.058
Cooling	Roof top AC	EER 11.2	0.99	$0.62	16	1.00	$0.055
Cooling	Roof top AC	EER 12.0	1.29	$1.19	16	0.96	$0.081
Cooling	Roof top AC	Ductless Minisplit	1.62	$3.89	16	0.71	$0.213
Cooling	Air Source Heat Pump	EER 9.3, COP 3.1	-	$0.00	16	-	$0.000
Cooling	Air Source Heat Pump	EER 10.3, COP 3.2	0.52	$0.39	16	-	$0.066
Cooling	Air Source Heat Pump	EER 11.0, COP 3.3	0.82	$0.55	16	1.00	$0.060
Cooling	Air Source Heat Pump	EER 11.7, COP 3.4	1.09	$1.42	16	0.92	$0.115
Cooling	Air Source Heat Pump	EER 12.0, COP 3.4	1.20	$1.86	16	0.88	$0.137
Cooling	Air Source Heat Pump	Ductless Minisplit	1.52	$3.56	16	0.75	$0.207
Cooling	Geo Heat Pump	EER 14.1, COP 3.3	-	$0.00	16	1.00	$0.000
Cooling	Geo Heat Pump	EER 16, COP 3.5	0.34	$0.99	16	0.93	$0.255
Cooling	Geo Heat Pump	EER 18, COP 3.8	0.62	$1.97	16	0.87	$0.280
Cooling	Geo Heat Pump	EER 30, COP 5.0	1.53	$2.60	16	0.89	$0.151
Cooling	Other Cooling	EER 9.8	-	$0.00	14	1.00	$0.000
Cooling	Other Cooling	EER 10.2	0.07	$0.02	14	1.01	$0.027

End Use	Technology	Efficiency Definition	Savings (kWh/SQ FT/yr)	Incremental Cost ($/SQ FT)	Lifetime (Years)	BC Ratio	Levelized Cost of Energy ($/kWh)
Cooling	Other Cooling	EER 10.8	0.14	$0.22	14	0.96	$0.155
Cooling	Other Cooling	EER 11	0.20	$0.24	14	0.98	$0.111
Cooling	Other Cooling	EER 11.5	0.27	$0.27	14	0.98	$0.097
Heating	Air Source Heat Pump	EER 9.3, COP 3.1	-	$0.00	16	-	$0.000
Heating	Air Source Heat Pump	EER 10.3, COP 3.2	0.07	$0.19	16	-	$0.259
Heating	Air Source Heat Pump	EER 11.0, COP 3.3	0.13	$0.28	16	1.00	$0.184
Heating	Air Source Heat Pump	EER 11.7, COP 3.4	0.20	$0.71	16	0.92	$0.314
Heating	Air Source Heat Pump	EER 12.0, COP 3.4	0.20	$0.92	16	0.88	$0.410
Heating	Air Source Heat Pump	Ductless Minisplit	0.27	$1.77	16	0.75	$0.585
Heating	Geo Heat Pump	EER 14.1, COP 3.3	-	$0.00	16	1.00	$0.000
Heating	Geo Heat Pump	EER 16, COP 3.5	0.31	$0.40	16	0.96	$0.116
Heating	Geo Heat Pump	EER 18, COP 3.8	0.56	$0.81	16	0.91	$0.127
Heating	Geo Heat Pump	EER 30, COP 5.0	0.78	$1.06	16	0.89	$0.121
Heating	Electric Room Heat	Standard	-	$0.00	25	1.00	$0.000
Heating	Electric Furnace	Standard	-	$0.00	25	1.00	$0.000
Ventilation	Ventilation	Constant Volume	-	$0.00	10	1.00	$0.000
Ventilation	Ventilation	Variable Air Volume	1.79	-$0.14	10	1.19	-$0.010
Water Heating	Water Heating	EF .97	-	$0.00	15	1.00	$0.000
Water Heating	Water Heating	EF .98	0.01	$0.00	15	1.01	$0.022
Water Heating	Water Heating	EF 2.0	0.45	$0.00	15	2.01	$0.001
Water Heating	Water Heating	EF 2.3	0.50	$0.01	15	2.29	$0.001
Water Heating	Water Heating	EF 2.4	0.52	$0.01	15	2.38	$0.001
Int. Lighting	Screw-in	Incandescent	-	$0.00	2	1.00	$0.000
Int. Lighting	Screw-in	90W Halogen PAR-38	0.80	$0.03	3	-	$0.014
Int. Lighting	Screw-in	70W HIR PAR-38	1.23	$0.04	3	-	$0.012
Int. Lighting	Screw-in	CFL	2.30	$0.02	6	3.47	$0.002
Int. Lighting	Screw-in	LED (2010)	2.49	$0.66	20	2.05	$0.020
Int. Lighting	Screw-in	LED (2020)	2.86	$0.19	20	-	$0.005
Int. Lighting	High-Bay Fixtures	Metal Halides	-	$0.00	3	1.00	$0.000
Int. Lighting	High-Bay Fixtures	LED (2010)	0.05	$0.07	15	0.72	$0.132
Int. Lighting	High-Bay Fixtures	T8	0.05	$0.00	10	1.76	-$0.005
Int. Lighting	High-Bay Fixtures	HP Sodium	0.05	$0.00	6	1.76	$0.001
Int. Lighting	High-Bay Fixtures	Light Emitting Plasma	0.06	$0.00	15	1.91	$0.002
Int. Lighting	High-Bay Fixtures	T5	0.07	$0.00	10	2.17	-$0.002
Int. Lighting	High-Bay Fixtures	LED (2020)	0.10	$0.02	15	-	$0.018
Int. Lighting	Linear Fluorescent	T12	-	$0.00	10	1.00	$0.000
Int. Lighting	Linear Fluorescent	LED (2010)	1.08	$3.92	15	0.52	$0.335
Int. Lighting	Linear Fluorescent	T8	1.12	$0.00	10	1.34	$0.000
Int. Lighting	Linear Fluorescent	Super T8	1.56	$0.03	10	1.52	$0.002
Int. Lighting	Linear Fluorescent	T5	1.81	$0.04	10	1.64	$0.003
Int. Lighting	Linear Fluorescent	LED (2020)	3.30	$1.09	15	-	$0.030
Ext. Lighting	Screw-in	Incandescent	-	$0.00	2	1.00	$0.000
Ext. Lighting	Screw-in	90W Halogen PAR-38	0.06	$0.00	3	-	$0.014
Ext. Lighting	Screw-in	70W HIR PAR-38	0.09	$0.00	3	-	$0.012
Ext. Lighting	Screw-in	CFL	0.17	$0.00	6	3.31	$0.002
Ext. Lighting	Screw-in	LED (2010)	0.19	$0.05	20	1.72	$0.020
Ext. Lighting	Screw-in	LED (2020)	0.22	$0.01	20	-	$0.005
Ext. Lighting	HID	Metal Halides	-	$0.00	3	1.00	$0.000
Ext. Lighting	HID	LED (2010)	0.25	$0.29	15	0.68	$0.109
Ext. Lighting	HID	T8	0.25	-$0.01	10	1.72	-$0.004
Ext. Lighting	HID	HP Sodium	0.27	$0.00	6	1.73	$0.001
Ext. Lighting	HID	Light Emitting Plasma	0.31	$0.00	15	1.82	$0.001
Ext. Lighting	HID	T5	0.32	$0.00	10	2.11	-$0.002
Ext. Lighting	HID	LED (2020)	0.47	$0.07	15	-	$0.015
Ext. Lighting	Linear Fluorescent	T12	-	$0.00	10	1.00	$0.000
Ext. Lighting	Linear Fluorescent	LED (2010)	0.01	$0.03	15	0.45	$0.335
Ext. Lighting	Linear Fluorescent	T8	0.01	$0.00	10	1.34	$0.000
Ext. Lighting	Linear Fluorescent	Super T8	0.01	$0.00	10	1.51	$0.002
Ext. Lighting	Linear Fluorescent	T5	0.01	$0.00	10	1.63	$0.003
Ext. Lighting	Linear Fluorescent	LED (2020)	0.02	$0.01	15	-	$0.030
Refrigeration	Walk-in Refrigerator	14600 kWh/yr	-	$0.00	12	1.00	$0.000
Refrigeration	Walk-in Refrigerator	10800 kWh/yr	-	$0.00	12	1.00	$0.000

End Use	Technology	Efficiency Definition	Savings (kWh/SQ FT/yr)	Incremental Cost ($/SQ FT)	Lifetime (Years)	BC Ratio	Levelized Cost of Energy ($/kWh)
Refrigeration	Walk-in Refrigerator	10000 kWh/yr	-	$0.00	12	1.00	$0.000
Refrigeration	Walk-in Refrigerator	9000 kWh/yr	-	$0.00	12	1.00	$0.000
Refrigeration	Reach-in Refrigerator	3800 kWh/yr	-	$0.00	12	1.00	$0.000
Refrigeration	Reach-in Refrigerator	3100 kWh/yr	0.01	$0.00	12	1.05	$0.040
Refrigeration	Reach-in Refrigerator	2500 kWh/yr	0.02	$0.01	12	1.08	$0.043
Refrigeration	Reach-in Refrigerator	2400 kWh/yr	0.02	$0.01	12	1.09	$0.042
Refrigeration	Reach-in Refrigerator	1500 kWh/yr	0.03	$0.01	12	1.30	$0.027
Refrigeration	Glass Door Display	14480 kWh/yr	-	$0.00	12	-	$0.000
Refrigeration	Glass Door Display	11700 kWh/yr	0.04	$0.02	12	-	$0.072
Refrigeration	Glass Door Display	8400 kWh/yr	0.08	$0.00	12	1.00	$0.000
Refrigeration	Glass Door Display	6800 kWh/yr	0.10	$0.02	12	0.91	$0.026
Refrigeration	Open Display Case	6500 kWh/yr	-	$0.00	18	-	$0.000
Refrigeration	Open Display Case	5350 kWh/yr	0.02	$0.00	18	1.00	$0.000
Refrigeration	Open Display Case	5300 kWh/yr	0.02	$0.01	18	-	$0.056
Refrigeration	Open Display Case	4330 kWh/yr	0.03	$0.01	18	1.00	$0.032
Refrigeration	Icemaker	7.0 kWh/100 lbs	-	$0.00	10	1.00	$0.000
Refrigeration	Icemaker	6.3 kWh/100 lbs	0.01	$0.00	10	1.01	$0.054
Refrigeration	Icemaker	6.0 kWh/100 lbs	0.01	$0.00	10	1.00	$0.057
Refrigeration	Icemaker	5.5 kWh/100 lbs	0.01	$0.01	10	0.88	$0.142
Refrigeration	Vending Machine	3400 kWh/year	-	$0.00	10	1.00	$0.000
Refrigeration	Vending Machine	3000 kWh/year	0.01	$0.00	10	1.05	$0.012
Refrigeration	Vending Machine	2400 kWh/year	0.03	$0.00	10	1.14	$0.012
Refrigeration	Vending Machine	1700 kWh/year	0.04	$0.01	10	1.20	$0.022
Food Prep.	Oven	Standard	-	$0.00	12	1.00	$0.000
Food Prep.	Oven	Energy Star	0.02	$0.00	12	1.13	$0.000
Food Prep.	Fryer	Standard	-	$0.00	12	1.00	$0.000
Food Prep.	Fryer	Energy Star	0.01	$0.00	12	1.04	$0.024
Food Prep.	Dishwasher	Standard	-	$0.00	12	1.00	$0.000
Food Prep.	Dishwasher	Energy Star	0.09	$0.00	12	1.36	$0.005
Food Prep.	Hot Food Container	Standard	-	$0.00	12	1.00	$0.000
Food Prep.	Hot Food Container	Energy Star	0.06	$0.01	12	1.35	$0.024
Office Equip.	Desktop Computer	Standard	-	$0.00	5	1.00	$0.000
Office Equip.	Desktop Computer	Energy Star	0.95	$0.00	5	1.05	$0.000
Office Equip.	Laptop	Standard	-	$0.00	4	1.00	$0.000
Office Equip.	Laptop	Energy Star	0.15	$0.00	4	1.02	$0.000
Office Equip.	Server	Standard	-	$0.00	3	1.00	$0.000
Office Equip.	Server	Energy Star	0.07	$0.00	3	1.03	$0.000
Office Equip.	Monitor	Standard	-	$0.00	4	1.00	$0.000
Office Equip.	Monitor	Energy Star	0.11	$0.00	4	1.02	$0.000
Office Equip.	Printer/Copier/Fax	Standard	-	$0.00	6	1.00	$0.000
Office Equip.	Printer/Copier/Fax	Energy Star	0.11	$0.00	6	1.09	$0.000
Office Equip.	POS Terminal	Standard	-	$0.00	4	1.00	$0.000
Office Equip.	POS Terminal	Energy Star	0.01	$0.00	4	0.95	$0.152
Miscellaneous	Non-HVAC Motors	Standard (EPAct)	-	$0.00	15	1.00	$0.000
Miscellaneous	Non-HVAC Motors	Standard (EPAct 2015)	0.00	$0.00	15	-	$0.000
Miscellaneous	Non-HVAC Motors	High Eff.	0.00	$0.00	15	1.01	$0.010
Miscellaneous	Non-HVAC Motors	High Eff. (2015)	0.01	$0.00	15	-	$0.007
Miscellaneous	Non-HVAC Motors	Premium (NEMA)	0.01	$0.00	15	1.02	$0.010
Miscellaneous	Non-HVAC Motors	Premium (NEMA 2015)	0.01	$0.00	15	-	$0.008
Miscellaneous	Pool Pump	Standard	-	$0.00	15	1.00	$0.000
Miscellaneous	Pool Pump	High Eff.	-	$0.00	15	1.00	$0.000
Miscellaneous	Pool Pump	High Eff. Multi-Speed	-	$0.00	15	1.00	$0.000
Miscellaneous	Pool Heater	Standard	-	$0.00	15	1.00	$0.000
Miscellaneous	Pool Heater	Heat Pump	-	$0.00	15	1.00	$0.000
Miscellaneous	Miscellaneous	Standard	-	$0.00	5	1.00	$0.000

Table C-7 Energy Efficiency Equipment Data, Electric—Restaurant, Existing Vintage

End Use	Technology	Efficiency Definition	Savings (kWh/SQ FT/yr)	Incremental Cost ($/SQ FT)	Lifetime (Years)	BC Ratio	Levelized Cost of Energy ($/kWh)
Cooling	Air-Cooled Chiller	1.5 kw/ton, COP 2.3	-	$0.00	20	1.00	$0.000
Cooling	Air-Cooled Chiller	1.3 kw/ton, COP 2.7	1.39	$0.27	20	1.18	$0.015
Cooling	Air-Cooled Chiller	1.26 kw/ton, COP 2.8	1.58	$0.35	20	1.20	$0.017
Cooling	Air-Cooled Chiller	1.0 kw/ton, COP 3.5	1.86	$0.43	20	1.24	$0.018
Cooling	Air-Cooled Chiller	0.97 kw/ton, COP 3.6	2.23	$0.51	20	1.31	$0.018
Cooling	Water-Cooled Chiller	0.75 kw/ton, COP 4.7	-	$0.00	20	1.00	$0.000
Cooling	Water-Cooled Chiller	0.60 kw/ton, COP 5.9	2.00	$0.14	20	1.20	$0.006
Cooling	Water-Cooled Chiller	0.58 kw/ton, COP 6.1	2.26	$0.29	20	1.22	$0.010
Cooling	Water-Cooled Chiller	0.55 kw/Ton, COP 6.4	2.66	$0.35	20	1.27	$0.010
Cooling	Water-Cooled Chiller	0.51 kw/ton, COP 6.9	3.20	$0.54	20	1.33	$0.013
Cooling	Water-Cooled Chiller	0.50 kw/Ton, COP 7.0	3.33	$0.60	20	1.35	$0.014
Cooling	Water-Cooled Chiller	0.48 kw/ton, COP 7.3	3.60	$0.65	20	1.39	$0.014
Cooling	Roof top AC	EER 9.2	-	$0.00	16	-	$0.000
Cooling	Roof top AC	EER 10.1	0.79	$0.27	16	-	$0.030
Cooling	Roof top AC	EER 11.2	1.58	$0.51	16	1.00	$0.029
Cooling	Roof top AC	EER 12.0	2.07	$0.98	16	1.01	$0.042
Cooling	Roof top AC	Ductless Minisplit	2.59	$3.22	16	0.86	$0.110
Cooling	Air Source Heat Pump	EER 9.3, COP 3.1	-	$0.00	16	-	$0.000
Cooling	Air Source Heat Pump	EER 10.3, COP 3.2	0.86	$0.33	16	-	$0.034
Cooling	Air Source Heat Pump	EER 11.0, COP 3.3	1.37	$0.47	16	1.00	$0.031
Cooling	Air Source Heat Pump	EER 11.7, COP 3.4	1.82	$1.22	16	0.98	$0.059
Cooling	Air Source Heat Pump	EER 12.0, COP 3.4	1.99	$1.59	16	0.96	$0.071
Cooling	Air Source Heat Pump	Ductless Minisplit	2.52	$3.04	16	0.89	$0.107
Cooling	Geo Heat Pump	EER 14.1, COP 3.3	-	$0.00	16	1.00	$0.000
Cooling	Geo Heat Pump	EER 16, COP 3.5	0.80	$1.19	16	0.98	$0.132
Cooling	Geo Heat Pump	EER 18, COP 3.8	1.46	$2.38	16	0.96	$0.144
Cooling	Geo Heat Pump	EER 30, COP 5.0	3.57	$3.13	16	1.07	$0.078
Cooling	Other Cooling	EER 9.8	-	$0.00	14	1.00	$0.000
Cooling	Other Cooling	EER 10.2	0.11	$0.03	14	1.01	$0.027
Cooling	Other Cooling	EER 10.8	0.21	$0.34	14	0.98	$0.156
Cooling	Other Cooling	EER 11	0.31	$0.36	14	0.99	$0.112
Cooling	Other Cooling	EER 11.5	0.41	$0.41	14	1.00	$0.097
Heating	Air Source Heat Pump	EER 9.3, COP 3.1	-	$0.00	16	-	$0.000
Heating	Air Source Heat Pump	EER 10.3, COP 3.2	0.06	$0.29	16	-	$0.411
Heating	Air Source Heat Pump	EER 11.0, COP 3.3	0.12	$0.42	16	1.00	$0.307
Heating	Air Source Heat Pump	EER 11.7, COP 3.4	0.18	$1.08	16	0.89	$0.545
Heating	Air Source Heat Pump	EER 12.0, COP 3.4	0.18	$1.41	16	0.85	$0.711
Heating	Air Source Heat Pump	Ductless Minisplit	0.22	$2.70	16	0.70	$1.062
Heating	Geo Heat Pump	EER 14.1, COP 3.3	-	$0.00	16	1.00	$0.000
Heating	Geo Heat Pump	EER 16, COP 3.5	0.33	$0.76	16	0.93	$0.202
Heating	Geo Heat Pump	EER 18, COP 3.8	0.61	$1.53	16	0.87	$0.222
Heating	Geo Heat Pump	EER 30, COP 5.0	0.39	$2.02	16	0.80	$0.456
Heating	Electric Room Heat	Standard	-	$0.00	25	1.00	$0.000
Heating	Electric Furnace	Standard	-	$0.00	25	1.00	$0.000
Ventilation	Ventilation	Constant Volume	-	$0.00	10	1.00	$0.000
Ventilation	Ventilation	Variable Air Volume	2.04	-$0.69	10	1.08	-$0.042
Water Heating	Water Heating	EF .97	-	$0.00	15	1.00	$0.000
Water Heating	Water Heating	EF .98	0.09	$0.01	15	1.01	$0.013
Water Heating	Water Heating	EF 2.0	4.45	$0.03	15	2.03	$0.001
Water Heating	Water Heating	EF 2.3	5.00	$0.04	15	2.32	$0.001
Water Heating	Water Heating	EF 2.4	5.15	$0.04	15	2.41	$0.001
Int. Lighting	Screw-in	Incandescent	-	$0.00	2	1.00	$0.000
Int. Lighting	Screw-in	90W Halogen PAR-38	2.17	$0.07	3	-	$0.011
Int. Lighting	Screw-in	70W HIR PAR-38	3.33	$0.09	3	-	$0.010
Int. Lighting	Screw-in	CFL	6.23	$0.05	6	3.52	$0.002
Int. Lighting	Screw-in	LED (2010)	6.75	$1.46	20	2.22	$0.017
Int. Lighting	Screw-in	LED (2020)	7.75	$0.41	20	-	$0.004
Int. Lighting	High-Bay Fixtures	Metal Halides	-	$0.00	3	1.00	$0.000
Int. Lighting	High-Bay Fixtures	LED (2010)	0.08	$0.09	15	0.77	$0.108

End Use	Technology	Efficiency Definition	Savings (kWh/SQ FT/yr)	Incremental Cost ($/SQ FT)	Lifetime (Years)	BC Ratio	Levelized Cost of Energy ($/kWh)
Int. Lighting	High-Bay Fixtures	T8	0.08	$0.00	10	1.73	-$0.004
Int. Lighting	High-Bay Fixtures	HP Sodium	0.08	$0.00	6	1.76	$0.001
Int. Lighting	High-Bay Fixtures	Light Emitting Plasma	0.10	$0.00	15	1.88	$0.001
Int. Lighting	High-Bay Fixtures	T5	0.10	$0.00	10	2.13	-$0.002
Int. Lighting	High-Bay Fixtures	LED (2020)	0.14	$0.02	15	-	$0.015
Int. Lighting	Linear Fluorescent	T12	-	$0.00	10	1.00	$0.000
Int. Lighting	Linear Fluorescent	LED (2010)	0.40	$1.19	15	0.57	$0.273
Int. Lighting	Linear Fluorescent	T8	0.42	$0.00	10	1.34	$0.000
Int. Lighting	Linear Fluorescent	Super T8	0.58	$0.01	10	1.52	$0.002
Int. Lighting	Linear Fluorescent	T5	0.67	$0.01	10	1.65	$0.002
Int. Lighting	Linear Fluorescent	LED (2020)	1.22	$0.33	15	-	$0.025
Ext. Lighting	Screw-in	Incandescent	-	$0.00	2	1.00	$0.000
Ext. Lighting	Screw-in	90W Halogen PAR-38	0.11	$0.00	3	-	$0.011
Ext. Lighting	Screw-in	70W HIR PAR-38	0.17	$0.00	3	-	$0.010
Ext. Lighting	Screw-in	CFL	0.33	$0.00	6	3.39	$0.002
Ext. Lighting	Screw-in	LED (2010)	0.35	$0.08	20	1.93	$0.017
Ext. Lighting	Screw-in	LED (2020)	0.41	$0.02	20	-	$0.004
Ext. Lighting	HID	Metal Halides	-	$0.00	3	1.00	$0.000
Ext. Lighting	HID	LED (2010)	1.14	$1.09	15	0.74	$0.089
Ext. Lighting	HID	T8	1.16	-$0.03	10	1.68	-$0.003
Ext. Lighting	HID	HP Sodium	1.23	$0.01	6	1.73	$0.001
Ext. Lighting	HID	Light Emitting Plasma	1.44	$0.02	15	1.81	$0.001
Ext. Lighting	HID	T5	1.48	-$0.02	10	2.08	-$0.001
Ext. Lighting	HID	LED (2020)	2.17	$0.28	15	-	$0.012
Ext. Lighting	Linear Fluorescent	T12	-	$0.00	10	1.00	$0.000
Ext. Lighting	Linear Fluorescent	LED (2010)	0.00	$0.01	15	0.51	$0.273
Ext. Lighting	Linear Fluorescent	T8	0.00	$0.00	10	1.34	$0.000
Ext. Lighting	Linear Fluorescent	Super T8	0.00	$0.00	10	1.52	$0.002
Ext. Lighting	Linear Fluorescent	T5	0.00	$0.00	10	1.64	$0.002
Ext. Lighting	Linear Fluorescent	LED (2020)	0.01	$0.00	15	-	$0.025
Refrigeration	Walk-in Refrigerator	14600 kWh/yr	-	$0.00	12	1.00	$0.000
Refrigeration	Walk-in Refrigerator	10800 kWh/yr	0.63	$0.24	12	1.03	$0.041
Refrigeration	Walk-in Refrigerator	10000 kWh/yr	0.76	$0.31	12	1.03	$0.043
Refrigeration	Walk-in Refrigerator	9000 kWh/yr	0.93	$0.55	12	1.00	$0.064
Refrigeration	Reach-in Refrigerator	3800 kWh/yr	-	$0.00	12	1.00	$0.000
Refrigeration	Reach-in Refrigerator	3100 kWh/yr	0.13	$0.07	12	1.00	$0.062
Refrigeration	Reach-in Refrigerator	2500 kWh/yr	0.24	$0.14	12	0.99	$0.066
Refrigeration	Reach-in Refrigerator	2400 kWh/yr	0.26	$0.15	12	0.99	$0.065
Refrigeration	Reach-in Refrigerator	1500 kWh/yr	0.42	$0.16	12	1.13	$0.042
Refrigeration	Glass Door Display	14480 kWh/yr	-	$0.00	12	-	$0.000
Refrigeration	Glass Door Display	11700 kWh/yr	0.51	$0.34	12	-	$0.072
Refrigeration	Glass Door Display	8400 kWh/yr	1.11	$0.00	12	1.00	$0.000
Refrigeration	Glass Door Display	6800 kWh/yr	1.40	$0.34	12	0.91	$0.026
Refrigeration	Open Display Case	6500 kWh/yr	-	$0.00	18	-	$0.000
Refrigeration	Open Display Case	5350 kWh/yr	0.22	$0.00	18	1.00	$0.000
Refrigeration	Open Display Case	5300 kWh/yr	0.23	$0.15	18	-	$0.056
Refrigeration	Open Display Case	4330 kWh/yr	0.40	$0.15	18	1.00	$0.032
Refrigeration	Icemaker	7.0 kWh/100 lbs	-	$0.00	10	1.00	$0.000
Refrigeration	Icemaker	6.3 kWh/100 lbs	0.08	$0.03	10	1.01	$0.054
Refrigeration	Icemaker	6.0 kWh/100 lbs	0.11	$0.05	10	1.00	$0.057
Refrigeration	Icemaker	5.5 kWh/100 lbs	0.16	$0.18	10	0.88	$0.142
Refrigeration	Vending Machine	3400 kWh/year	-	$0.00	10	1.00	$0.000
Refrigeration	Vending Machine	3000 kWh/year	0.07	$0.01	10	1.05	$0.012
Refrigeration	Vending Machine	2400 kWh/year	0.18	$0.02	10	1.14	$0.012
Refrigeration	Vending Machine	1700 kWh/year	0.31	$0.05	10	1.20	$0.022
Food Prep.	Oven	Standard	-	$0.00	12	1.00	$0.000
Food Prep.	Oven	Energy Star	0.80	$0.00	12	1.13	$0.000
Food Prep.	Fryer	Standard	-	$0.00	12	1.00	$0.000
Food Prep.	Fryer	Energy Star	0.50	$0.11	12	1.03	$0.024
Food Prep.	Dishwasher	Standard	-	$0.00	12	1.00	$0.000
Food Prep.	Dishwasher	Energy Star	2.00	$0.09	12	1.35	$0.005
Food Prep.	Hot Food Container	Standard	-	$0.00	12	1.00	$0.000

End Use	Technology	Efficiency Definition	Savings (kWh/SQ FT/yr)	Incremental Cost ($/SQ FT)	Lifetime (Years)	BC Ratio	Levelized Cost of Energy ($/kWh)
Food Prep.	Hot Food Container	Energy Star	1.35	$0.30	12	1.30	$0.024
Office Equip.	Desktop Computer	Standard	-	$0.00	5	1.00	$0.000
Office Equip.	Desktop Computer	Energy Star	0.09	$0.00	5	1.05	$0.000
Office Equip.	Laptop	Standard	-	$0.00	4	1.00	$0.000
Office Equip.	Laptop	Energy Star	0.01	$0.00	4	1.01	$0.000
Office Equip.	Server	Standard	-	$0.00	3	1.00	$0.000
Office Equip.	Server	Energy Star	0.08	$0.00	3	1.03	$0.000
Office Equip.	Monitor	Standard	-	$0.00	4	1.00	$0.000
Office Equip.	Monitor	Energy Star	0.01	$0.00	4	1.02	$0.000
Office Equip.	Printer/Copier/Fax	Standard	-	$0.00	6	1.00	$0.000
Office Equip.	Printer/Copier/Fax	Energy Star	0.02	$0.00	6	1.09	$0.000
Office Equip.	POS Terminal	Standard	-	$0.00	4	1.00	$0.000
Office Equip.	POS Terminal	Energy Star	0.05	$0.03	4	0.95	$0.152
Miscellaneous	Non-HVAC Motors	Standard (EPAct)	-	$0.00	15	1.00	$0.000
Miscellaneous	Non-HVAC Motors	Standard (EPAct 2015)	0.00	$0.00	15	-	$0.000
Miscellaneous	Non-HVAC Motors	High Eff.	0.00	$0.00	15	1.01	$0.010
Miscellaneous	Non-HVAC Motors	High Eff. (2015)	0.00	$0.00	15	-	$0.007
Miscellaneous	Non-HVAC Motors	Premium (NEMA)	0.01	$0.00	15	1.02	$0.010
Miscellaneous	Non-HVAC Motors	Premium (NEMA 2015)	0.01	$0.00	15	-	$0.008
Miscellaneous	Pool Pump	Standard	-	$0.00	15	1.00	$0.000
Miscellaneous	Pool Pump	High Eff.	-	$0.00	15	1.00	$0.000
Miscellaneous	Pool Pump	High Eff. Multi-Speed	-	$0.00	15	1.00	$0.000
Miscellaneous	Pool Heater	Standard	-	$0.00	15	1.00	$0.000
Miscellaneous	Pool Heater	Heat Pump	-	$0.00	15	1.00	$0.000
Miscellaneous	Miscellaneous	Standard	-	$0.00	5	1.00	$0.000

Table C-8 Energy Efficiency Equipment Data, Electric— Restaurant, New Vintage

End Use	Technology	Efficiency Definition	Savings (kWh/SQ FT/yr)	Incremental Cost ($/SQ FT)	Lifetime (Years)	BC Ratio	Levelized Cost of Energy ($/kWh)
Cooling	Air-Cooled Chiller	1.5 kw/ton, COP 2.3	-	$0.00	20	1.00	$0.000
Cooling	Air-Cooled Chiller	1.3 kw/ton, COP 2.7	1.18	$0.36	20	1.15	$0.024
Cooling	Air-Cooled Chiller	1.26 kw/ton, COP 2.8	1.33	$0.47	20	1.16	$0.027
Cooling	Air-Cooled Chiller	1.0 kw/ton, COP 3.5	1.57	$0.57	20	1.19	$0.028
Cooling	Air-Cooled Chiller	0.97 kw/ton, COP 3.6	1.88	$0.68	20	1.24	$0.028
Cooling	Water-Cooled Chiller	0.75 kw/ton, COP 4.7	-	$0.00	20	1.00	$0.000
Cooling	Water-Cooled Chiller	0.60 kw/ton, COP 5.9	1.84	$0.21	20	1.18	$0.009
Cooling	Water-Cooled Chiller	0.58 kw/ton, COP 6.1	2.09	$0.42	20	1.19	$0.016
Cooling	Water-Cooled Chiller	0.55 kw/Ton, COP 6.4	2.46	$0.51	20	1.24	$0.016
Cooling	Water-Cooled Chiller	0.51 kw/ton, COP 6.9	2.95	$0.79	20	1.28	$0.021
Cooling	Water-Cooled Chiller	0.50 kw/Ton, COP 7.0	3.08	$0.87	20	1.29	$0.022
Cooling	Water-Cooled Chiller	0.48 kw/ton, COP 7.3	3.33	$0.96	20	1.31	$0.022
Cooling	Roof top AC	EER 9.2	-	$0.00	16	-	$0.000
Cooling	Roof top AC	EER 10.1	0.74	$0.38	16	-	$0.045
Cooling	Roof top AC	EER 11.2	1.48	$0.73	16	1.00	$0.043
Cooling	Roof top AC	EER 12.0	1.94	$1.39	16	0.98	$0.064
Cooling	Roof top AC	Ductless Minisplit	2.43	$4.57	16	0.79	$0.167
Cooling	Air Source Heat Pump	EER 9.3, COP 3.1	-	$0.00	16	-	$0.000
Cooling	Air Source Heat Pump	EER 10.3, COP 3.2	0.78	$0.46	16	-	$0.052
Cooling	Air Source Heat Pump	EER 11.0, COP 3.3	1.25	$0.66	16	1.00	$0.047
Cooling	Air Source Heat Pump	EER 11.7, COP 3.4	1.66	$1.68	16	0.95	$0.090
Cooling	Air Source Heat Pump	EER 12.0, COP 3.4	1.82	$2.20	16	0.92	$0.107
Cooling	Air Source Heat Pump	Ductless Minisplit	2.30	$4.21	16	0.82	$0.162
Cooling	Geo Heat Pump	EER 14.1, COP 3.3	-	$0.00	16	1.00	$0.000
Cooling	Geo Heat Pump	EER 16, COP 3.5	0.76	$1.71	16	0.96	$0.200
Cooling	Geo Heat Pump	EER 18, COP 3.8	1.38	$3.41	16	0.91	$0.219
Cooling	Geo Heat Pump	EER 30, COP 5.0	3.37	$4.50	16	0.97	$0.118
Cooling	Other Cooling	EER 9.8	-	$0.00	14	1.00	$0.000
Cooling	Other Cooling	EER 10.2	0.11	$0.03	14	1.01	$0.027

End Use	Technology	Efficiency Definition	Savings (kWh/SQ FT/yr)	Incremental Cost ($/SQ FT)	Lifetime (Years)	BC Ratio	Levelized Cost of Energy ($/kWh)
Cooling	Other Cooling	EER 10.8	0.21	$0.33	14	0.98	$0.155
Cooling	Other Cooling	EER 11	0.31	$0.35	14	0.99	$0.111
Cooling	Other Cooling	EER 11.5	0.40	$0.40	14	1.00	$0.097
Heating	Air Source Heat Pump	EER 9.3, COP 3.1	-	$0.00	16	-	$0.000
Heating	Air Source Heat Pump	EER 10.3, COP 3.2	0.06	$0.33	16	-	$0.483
Heating	Air Source Heat Pump	EER 11.0, COP 3.3	0.12	$0.48	16	1.00	$0.361
Heating	Air Source Heat Pump	EER 11.7, COP 3.4	0.17	$1.23	16	0.88	$0.641
Heating	Air Source Heat Pump	EER 12.0, COP 3.4	0.17	$1.60	16	0.83	$0.837
Heating	Air Source Heat Pump	Ductless Minisplit	0.22	$3.06	16	0.68	$1.249
Heating	Geo Heat Pump	EER 14.1, COP 3.3	-	$0.00	16	1.00	$0.000
Heating	Geo Heat Pump	EER 16, COP 3.5	0.32	$0.89	16	0.92	$0.244
Heating	Geo Heat Pump	EER 18, COP 3.8	0.59	$1.78	16	0.85	$0.267
Heating	Geo Heat Pump	EER 30, COP 5.0	0.41	$2.35	16	0.80	$0.505
Heating	Electric Room Heat	Standard	-	$0.00	25	1.00	$0.000
Heating	Electric Furnace	Standard	-	$0.00	25	1.00	$0.000
Ventilation	Ventilation	Constant Volume	-	$0.00	10	1.00	$0.000
Ventilation	Ventilation	Variable Air Volume	1.44	-$0.75	10	1.06	-$0.064
Water Heating	Water Heating	EF .97	-	$0.00	15	1.00	$0.000
Water Heating	Water Heating	EF .98	0.09	$0.01	15	1.01	$0.014
Water Heating	Water Heating	EF 2.0	4.32	$0.03	15	2.03	$0.001
Water Heating	Water Heating	EF 2.3	4.85	$0.04	15	2.32	$0.001
Water Heating	Water Heating	EF 2.4	4.99	$0.04	15	2.41	$0.001
Int. Lighting	Screw-in	Incandescent	-	$0.00	2	1.00	$0.000
Int. Lighting	Screw-in	90W Halogen PAR-38	2.17	$0.07	3	-	$0.011
Int. Lighting	Screw-in	70W HIR PAR-38	3.33	$0.09	3	-	$0.010
Int. Lighting	Screw-in	CFL	6.23	$0.05	6	3.52	$0.002
Int. Lighting	Screw-in	LED (2010)	6.75	$1.46	20	2.22	$0.017
Int. Lighting	Screw-in	LED (2020)	7.75	$0.41	20	-	$0.004
Int. Lighting	High-Bay Fixtures	Metal Halides	-	$0.00	3	1.00	$0.000
Int. Lighting	High-Bay Fixtures	LED (2010)	0.08	$0.09	15	0.77	$0.108
Int. Lighting	High-Bay Fixtures	T8	0.08	$0.00	10	1.73	-$0.004
Int. Lighting	High-Bay Fixtures	HP Sodium	0.08	$0.00	6	1.76	$0.001
Int. Lighting	High-Bay Fixtures	Light Emitting Plasma	0.10	$0.00	15	1.88	$0.001
Int. Lighting	High-Bay Fixtures	T5	0.10	$0.00	10	2.13	-$0.002
Int. Lighting	High-Bay Fixtures	LED (2020)	0.14	$0.02	15	-	$0.015
Int. Lighting	Linear Fluorescent	T12	-	$0.00	10	1.00	$0.000
Int. Lighting	Linear Fluorescent	LED (2010)	0.40	$1.19	15	0.57	$0.273
Int. Lighting	Linear Fluorescent	T8	0.42	$0.00	10	1.34	$0.000
Int. Lighting	Linear Fluorescent	Super T8	0.58	$0.01	10	1.52	$0.002
Int. Lighting	Linear Fluorescent	T5	0.67	$0.01	10	1.65	$0.002
Int. Lighting	Linear Fluorescent	LED (2020)	1.22	$0.33	15	-	$0.025
Ext. Lighting	Screw-in	Incandescent	-	$0.00	2	1.00	$0.000
Ext. Lighting	Screw-in	90W Halogen PAR-38	0.11	$0.00	3	-	$0.011
Ext. Lighting	Screw-in	70W HIR PAR-38	0.17	$0.00	3	-	$0.010
Ext. Lighting	Screw-in	CFL	0.33	$0.00	6	3.39	$0.002
Ext. Lighting	Screw-in	LED (2010)	0.35	$0.08	20	1.93	$0.017
Ext. Lighting	Screw-in	LED (2020)	0.41	$0.02	20	-	$0.004
Ext. Lighting	HID	Metal Halides	-	$0.00	3	1.00	$0.000
Ext. Lighting	HID	LED (2010)	1.14	$1.09	15	0.74	$0.089
Ext. Lighting	HID	T8	1.16	-$0.03	10	1.68	-$0.003
Ext. Lighting	HID	HP Sodium	1.23	$0.01	6	1.73	$0.001
Ext. Lighting	HID	Light Emitting Plasma	1.44	$0.02	15	1.81	$0.001
Ext. Lighting	HID	T5	1.48	-$0.02	10	2.08	-$0.001
Ext. Lighting	HID	LED (2020)	2.17	$0.28	15	-	$0.012
Ext. Lighting	Linear Fluorescent	T12	-	$0.00	10	1.00	$0.000
Ext. Lighting	Linear Fluorescent	LED (2010)	0.00	$0.01	15	0.51	$0.273
Ext. Lighting	Linear Fluorescent	T8	0.00	$0.00	10	1.34	$0.000
Ext. Lighting	Linear Fluorescent	Super T8	0.00	$0.00	10	1.52	$0.002
Ext. Lighting	Linear Fluorescent	T5	0.00	$0.00	10	1.64	$0.002
Ext. Lighting	Linear Fluorescent	LED (2020)	0.01	$0.00	15	-	$0.025
Refrigeration	Walk-in Refrigerator	14600 kWh/yr	-	$0.00	12	1.00	$0.000
Refrigeration	Walk-in Refrigerator	10800 kWh/yr	0.63	$0.34	12	1.01	$0.058

End Use	Technology	Efficiency Definition	Savings (kWh/SQ FT/yr)	Incremental Cost ($/SQ FT)	Lifetime (Years)	BC Ratio	Levelized Cost of Energy ($/kWh)
Refrigeration	Walk-in Refrigerator	10000 kWh/yr	0.76	$0.43	12	1.00	$0.061
Refrigeration	Walk-in Refrigerator	9000 kWh/yr	0.93	$0.77	12	0.96	$0.089
Refrigeration	Reach-in Refrigerator	3800 kWh/yr	-	$0.00	12	1.00	$0.000
Refrigeration	Reach-in Refrigerator	3100 kWh/yr	0.13	$0.10	12	0.97	$0.087
Refrigeration	Reach-in Refrigerator	2500 kWh/yr	0.24	$0.20	12	0.93	$0.092
Refrigeration	Reach-in Refrigerator	2400 kWh/yr	0.26	$0.22	12	0.93	$0.091
Refrigeration	Reach-in Refrigerator	1500 kWh/yr	0.42	$0.23	12	1.02	$0.059
Refrigeration	Glass Door Display	14480 kWh/yr	-	$0.00	12	-	$0.000
Refrigeration	Glass Door Display	11700 kWh/yr	0.51	$0.34	12	-	$0.072
Refrigeration	Glass Door Display	8400 kWh/yr	1.11	$0.00	12	1.00	$0.000
Refrigeration	Glass Door Display	6800 kWh/yr	1.40	$0.34	12	0.91	$0.026
Refrigeration	Open Display Case	6500 kWh/yr	-	$0.00	18	-	$0.000
Refrigeration	Open Display Case	5350 kWh/yr	0.22	$0.00	18	1.00	$0.000
Refrigeration	Open Display Case	5300 kWh/yr	0.23	$0.15	18	-	$0.056
Refrigeration	Open Display Case	4330 kWh/yr	0.40	$0.15	18	1.00	$0.032
Refrigeration	Icemaker	7.0 kWh/100 lbs	-	$0.00	10	1.00	$0.000
Refrigeration	Icemaker	6.3 kWh/100 lbs	0.08	$0.03	10	1.01	$0.054
Refrigeration	Icemaker	6.0 kWh/100 lbs	0.11	$0.05	10	1.00	$0.057
Refrigeration	Icemaker	5.5 kWh/100 lbs	0.16	$0.18	10	0.88	$0.142
Refrigeration	Vending Machine	3400 kWh/year	-	$0.00	10	1.00	$0.000
Refrigeration	Vending Machine	3000 kWh/year	0.07	$0.01	10	1.05	$0.012
Refrigeration	Vending Machine	2400 kWh/year	0.18	$0.02	10	1.14	$0.012
Refrigeration	Vending Machine	1700 kWh/year	0.31	$0.05	10	1.20	$0.022
Food Prep.	Oven	Standard	-	$0.00	12	1.00	$0.000
Food Prep.	Oven	Energy Star	0.80	$0.00	12	1.13	$0.000
Food Prep.	Fryer	Standard	-	$0.00	12	1.00	$0.000
Food Prep.	Fryer	Energy Star	0.50	$0.11	12	1.03	$0.024
Food Prep.	Dishwasher	Standard	-	$0.00	12	1.00	$0.000
Food Prep.	Dishwasher	Energy Star	2.00	$0.09	12	1.35	$0.005
Food Prep.	Hot Food Container	Standard	-	$0.00	12	1.00	$0.000
Food Prep.	Hot Food Container	Energy Star	1.35	$0.30	12	1.30	$0.024
Office Equip.	Desktop Computer	Standard	-	$0.00	5	1.00	$0.000
Office Equip.	Desktop Computer	Energy Star	0.09	$0.00	5	1.05	$0.000
Office Equip.	Laptop	Standard	-	$0.00	4	1.00	$0.000
Office Equip.	Laptop	Energy Star	0.01	$0.00	4	1.01	$0.000
Office Equip.	Server	Standard	-	$0.00	3	1.00	$0.000
Office Equip.	Server	Energy Star	0.08	$0.00	3	1.03	$0.000
Office Equip.	Monitor	Standard	-	$0.00	4	1.00	$0.000
Office Equip.	Monitor	Energy Star	0.01	$0.00	4	1.02	$0.000
Office Equip.	Printer/Copier/Fax	Standard	-	$0.00	6	1.00	$0.000
Office Equip.	Printer/Copier/Fax	Energy Star	0.02	$0.00	6	1.09	$0.000
Office Equip.	POS Terminal	Standard	-	$0.00	4	1.00	$0.000
Office Equip.	POS Terminal	Energy Star	0.05	$0.03	4	0.95	$0.152
Miscellaneous	Non-HVAC Motors	Standard (EPAct)	-	$0.00	15	1.00	$0.000
Miscellaneous	Non-HVAC Motors	Standard (EPAct 2015)	0.00	$0.00	15	-	$0.000
Miscellaneous	Non-HVAC Motors	High Eff.	0.00	$0.00	15	1.01	$0.010
Miscellaneous	Non-HVAC Motors	High Eff. (2015)	0.00	$0.00	15	-	$0.007
Miscellaneous	Non-HVAC Motors	Premium (NEMA)	0.01	$0.00	15	1.02	$0.010
Miscellaneous	Non-HVAC Motors	Premium (NEMA 2015)	0.01	$0.00	15	-	$0.008
Miscellaneous	Pool Pump	Standard	-	$0.00	15	1.00	$0.000
Miscellaneous	Pool Pump	High Eff.	-	$0.00	15	1.00	$0.000
Miscellaneous	Pool Pump	High Eff. Multi-Speed	-	$0.00	15	1.00	$0.000
Miscellaneous	Pool Heater	Standard	-	$0.00	15	1.00	$0.000
Miscellaneous	Pool Heater	Heat Pump	-	$0.00	15	1.00	$0.000
Miscellaneous	Miscellaneous	Standard	-	$0.00	5	1.00	$0.000

Table C-9 Energy Efficiency Equipment Data, Electric—Retail, Existing Vintage

End Use	Technology	Efficiency Definition	Savings (kWh/SQ FT/yr)	Incremental Cost ($/SQ FT)	Lifetime (Years)	BC Ratio	Levelized Cost of Energy ($/kWh)
Cooling	Air-Cooled Chiller	1.5 kw/ton, COP 2.3	-	$0.00	20	1.00	$0.000
Cooling	Air-Cooled Chiller	1.3 kw/ton, COP 2.7	0.56	$0.11	20	1.18	$0.015
Cooling	Air-Cooled Chiller	1.26 kw/ton, COP 2.8	0.63	$0.14	20	1.21	$0.017
Cooling	Air-Cooled Chiller	1.0 kw/ton, COP 3.5	0.75	$0.18	20	1.25	$0.018
Cooling	Air-Cooled Chiller	0.97 kw/ton, COP 3.6	0.90	$0.21	20	1.32	$0.018
Cooling	Water-Cooled Chiller	0.75 kw/ton, COP 4.7	-	$0.00	20	1.00	$0.000
Cooling	Water-Cooled Chiller	0.60 kw/ton, COP 5.9	0.76	$0.06	20	1.21	$0.006
Cooling	Water-Cooled Chiller	0.58 kw/ton, COP 6.1	0.86	$0.11	20	1.23	$0.010
Cooling	Water-Cooled Chiller	0.55 kw/Ton, COP 6.4	1.02	$0.14	20	1.28	$0.010
Cooling	Water-Cooled Chiller	0.51 kw/ton, COP 6.9	1.22	$0.21	20	1.35	$0.013
Cooling	Water-Cooled Chiller	0.50 kw/Ton, COP 7.0	1.27	$0.23	20	1.36	$0.014
Cooling	Water-Cooled Chiller	0.48 kw/ton, COP 7.3	1.37	$0.26	20	1.40	$0.014
Cooling	Roof top AC	EER 9.2	-	$0.00	16	-	$0.000
Cooling	Roof top AC	EER 10.1	0.50	$0.23	16	-	$0.041
Cooling	Roof top AC	EER 11.2	0.99	$0.44	16	1.00	$0.039
Cooling	Roof top AC	EER 12.0	1.30	$0.85	16	1.00	$0.058
Cooling	Roof top AC	Ductless Minisplit	1.63	$2.79	16	0.83	$0.152
Cooling	Air Source Heat Pump	EER 9.3, COP 3.1	-	$0.00	16	-	$0.000
Cooling	Air Source Heat Pump	EER 10.3, COP 3.2	0.54	$0.29	16	-	$0.047
Cooling	Air Source Heat Pump	EER 11.0, COP 3.3	0.86	$0.41	16	1.00	$0.042
Cooling	Air Source Heat Pump	EER 11.7, COP 3.4	1.14	$1.05	16	0.97	$0.082
Cooling	Air Source Heat Pump	EER 12.0, COP 3.4	1.25	$1.38	16	0.95	$0.097
Cooling	Air Source Heat Pump	Ductless Minisplit	1.58	$2.64	16	0.86	$0.148
Cooling	Geo Heat Pump	EER 14.1, COP 3.3	-	$0.00	16	1.00	$0.000
Cooling	Geo Heat Pump	EER 16, COP 3.5	0.33	$0.69	16	0.97	$0.182
Cooling	Geo Heat Pump	EER 18, COP 3.8	0.61	$1.37	16	0.94	$0.199
Cooling	Geo Heat Pump	EER 30, COP 5.0	1.49	$1.81	16	1.02	$0.107
Cooling	Other Cooling	EER 9.8	-	$0.00	14	1.00	$0.000
Cooling	Other Cooling	EER 10.2	0.07	$0.02	14	1.02	$0.027
Cooling	Other Cooling	EER 10.8	0.13	$0.21	14	0.99	$0.156
Cooling	Other Cooling	EER 11	0.19	$0.22	14	1.00	$0.112
Cooling	Other Cooling	EER 11.5	0.25	$0.25	14	1.01	$0.097
Heating	Air Source Heat Pump	EER 9.3, COP 3.1	-	$0.00	16	-	$0.000
Heating	Air Source Heat Pump	EER 10.3, COP 3.2	0.04	$0.25	16	-	$0.558
Heating	Air Source Heat Pump	EER 11.0, COP 3.3	0.07	$0.36	16	1.00	$0.429
Heating	Air Source Heat Pump	EER 11.7, COP 3.4	0.10	$0.92	16	0.91	$0.789
Heating	Air Source Heat Pump	EER 12.0, COP 3.4	0.10	$1.20	16	0.87	$1.029
Heating	Air Source Heat Pump	Ductless Minisplit	0.13	$2.30	16	0.75	$1.586
Heating	Geo Heat Pump	EER 14.1, COP 3.3	-	$0.00	16	1.00	$0.000
Heating	Geo Heat Pump	EER 16, COP 3.5	0.39	$0.64	16	0.95	$0.143
Heating	Geo Heat Pump	EER 18, COP 3.8	0.72	$1.27	16	0.89	$0.156
Heating	Geo Heat Pump	EER 30, COP 5.0	0.09	$1.68	16	0.80	$1.710
Heating	Electric Room Heat	Standard	-	$0.00	25	1.00	$0.000
Heating	Electric Furnace	Standard	-	$0.00	25	1.00	$0.000
Ventilation	Ventilation	Constant Volume	-	$0.00	10	1.00	$0.000
Ventilation	Ventilation	Variable Air Volume	0.76	-$0.07	10	1.17	-$0.012
Water Heating	Water Heating	EF .97	-	$0.00	15	1.00	$0.000
Water Heating	Water Heating	EF .98	0.01	$0.00	15	1.01	$0.016
Water Heating	Water Heating	EF 2.0	0.46	$0.00	15	2.03	$0.001
Water Heating	Water Heating	EF 2.3	0.51	$0.00	15	2.31	$0.001
Water Heating	Water Heating	EF 2.4	0.53	$0.00	15	2.40	$0.001
Int. Lighting	Screw-in	Incandescent	-	$0.00	2	1.00	$0.000
Int. Lighting	Screw-in	90W Halogen PAR-38	1.33	$0.06	3	-	$0.015
Int. Lighting	Screw-in	70W HIR PAR-38	2.04	$0.08	3	-	$0.013
Int. Lighting	Screw-in	CFL	3.82	$0.05	6	3.42	$0.002
Int. Lighting	Screw-in	LED (2010)	4.14	$1.21	20	1.89	$0.023
Int. Lighting	Screw-in	LED (2020)	4.76	$0.34	20	-	$0.006
Int. Lighting	High-Bay Fixtures	Metal Halides	-	$0.00	3	1.00	$0.000
Int. Lighting	High-Bay Fixtures	LED (2010)	0.19	$0.30	15	0.67	$0.146

End Use	Technology	Efficiency Definition	Savings (kWh/SQ FT/yr)	Incremental Cost ($/SQ FT)	Lifetime (Years)	BC Ratio	Levelized Cost of Energy ($/kWh)
Int. Lighting	High-Bay Fixtures	T8	0.19	-$0.01	10	1.78	-$0.005
Int. Lighting	High-Bay Fixtures	HP Sodium	0.21	$0.00	6	1.75	$0.001
Int. Lighting	High-Bay Fixtures	Light Emitting Plasma	0.24	$0.00	15	1.91	$0.002
Int. Lighting	High-Bay Fixtures	T5	0.25	$0.00	10	2.18	-$0.002
Int. Lighting	High-Bay Fixtures	LED (2020)	0.36	$0.08	15	-	$0.020
Int. Lighting	Linear Fluorescent	T12	-	$0.00	10	1.00	$0.000
Int. Lighting	Linear Fluorescent	LED (2010)	0.76	$3.05	15	0.48	$0.370
Int. Lighting	Linear Fluorescent	T8	0.79	$0.00	10	1.34	$0.000
Int. Lighting	Linear Fluorescent	Super T8	1.10	$0.02	10	1.51	$0.002
Int. Lighting	Linear Fluorescent	T5	1.27	$0.03	10	1.63	$0.003
Int. Lighting	Linear Fluorescent	LED (2020)	2.32	$0.85	15	-	$0.034
Ext. Lighting	Screw-in	Incandescent	-	$0.00	2	1.00	$0.000
Ext. Lighting	Screw-in	90W Halogen PAR-38	0.62	$0.03	3	-	$0.015
Ext. Lighting	Screw-in	70W HIR PAR-38	0.95	$0.04	3	-	$0.013
Ext. Lighting	Screw-in	CFL	1.79	$0.02	6	3.27	$0.002
Ext. Lighting	Screw-in	LED (2010)	1.93	$0.57	20	1.62	$0.023
Ext. Lighting	Screw-in	LED (2020)	2.22	$0.16	20	-	$0.006
Ext. Lighting	HID	Metal Halides	-	$0.00	3	1.00	$0.000
Ext. Lighting	HID	LED (2010)	0.18	$0.24	15	0.65	$0.120
Ext. Lighting	HID	T8	0.19	-$0.01	10	1.74	-$0.004
Ext. Lighting	HID	HP Sodium	0.20	$0.00	6	1.73	$0.001
Ext. Lighting	HID	Light Emitting Plasma	0.23	$0.00	15	1.83	$0.001
Ext. Lighting	HID	T5	0.24	$0.00	10	2.12	-$0.002
Ext. Lighting	HID	LED (2020)	0.35	$0.06	15	-	$0.016
Ext. Lighting	Linear Fluorescent	T12	-	$0.00	10	1.00	$0.000
Ext. Lighting	Linear Fluorescent	LED (2010)	0.00	$0.01	15	0.42	$0.370
Ext. Lighting	Linear Fluorescent	T8	0.00	$0.00	10	1.34	$0.000
Ext. Lighting	Linear Fluorescent	Super T8	0.00	$0.00	10	1.50	$0.002
Ext. Lighting	Linear Fluorescent	T5	0.00	$0.00	10	1.62	$0.003
Ext. Lighting	Linear Fluorescent	LED (2020)	0.01	$0.00	15	-	$0.034
Refrigeration	Walk-in Refrigerator	14600 kWh/yr	-	$0.00	12	1.00	$0.000
Refrigeration	Walk-in Refrigerator	10800 kWh/yr	0.07	$0.02	12	1.09	$0.022
Refrigeration	Walk-in Refrigerator	10000 kWh/yr	0.09	$0.02	12	1.11	$0.023
Refrigeration	Walk-in Refrigerator	9000 kWh/yr	0.11	$0.03	12	1.09	$0.034
Refrigeration	Reach-in Refrigerator	3800 kWh/yr	-	$0.00	12	1.00	$0.000
Refrigeration	Reach-in Refrigerator	3100 kWh/yr	0.02	$0.00	12	1.06	$0.034
Refrigeration	Reach-in Refrigerator	2500 kWh/yr	0.03	$0.01	12	1.12	$0.035
Refrigeration	Reach-in Refrigerator	2400 kWh/yr	0.03	$0.01	12	1.13	$0.035
Refrigeration	Reach-in Refrigerator	1500 kWh/yr	0.05	$0.01	12	1.37	$0.023
Refrigeration	Glass Door Display	14480 kWh/yr	-	$0.00	12	-	$0.000
Refrigeration	Glass Door Display	11700 kWh/yr	0.06	$0.04	12	-	$0.072
Refrigeration	Glass Door Display	8400 kWh/yr	0.13	$0.00	12	1.00	$0.000
Refrigeration	Glass Door Display	6800 kWh/yr	0.17	$0.04	12	0.91	$0.026
Refrigeration	Open Display Case	6500 kWh/yr	-	$0.00	18	-	$0.000
Refrigeration	Open Display Case	5350 kWh/yr	0.03	$0.00	18	1.00	$0.000
Refrigeration	Open Display Case	5300 kWh/yr	0.03	$0.02	18	-	$0.056
Refrigeration	Open Display Case	4330 kWh/yr	0.05	$0.02	18	1.00	$0.032
Refrigeration	Icemaker	7.0 kWh/100 lbs	-	$0.00	10	1.00	$0.000
Refrigeration	Icemaker	6.3 kWh/100 lbs	0.02	$0.01	10	1.01	$0.054
Refrigeration	Icemaker	6.0 kWh/100 lbs	0.03	$0.01	10	1.00	$0.057
Refrigeration	Icemaker	5.5 kWh/100 lbs	0.04	$0.04	10	0.88	$0.142
Refrigeration	Vending Machine	3400 kWh/year	-	$0.00	10	1.00	$0.000
Refrigeration	Vending Machine	3000 kWh/year	0.02	$0.00	10	1.05	$0.012
Refrigeration	Vending Machine	2400 kWh/year	0.04	$0.00	10	1.14	$0.012
Refrigeration	Vending Machine	1700 kWh/year	0.07	$0.01	10	1.20	$0.022
Food Prep.	Oven	Standard	-	$0.00	12	1.00	$0.000
Food Prep.	Oven	Energy Star	0.03	$0.00	12	1.13	$0.000
Food Prep.	Fryer	Standard	-	$0.00	12	1.00	$0.000
Food Prep.	Fryer	Energy Star	0.02	$0.00	12	1.03	$0.024
Food Prep.	Dishwasher	Standard	-	$0.00	12	1.00	$0.000
Food Prep.	Dishwasher	Energy Star	0.16	$0.01	12	1.35	$0.005
Food Prep.	Hot Food Container	Standard	-	$0.00	12	1.00	$0.000

End Use	Technology	Efficiency Definition	Savings (kWh/SQ FT/yr)	Incremental Cost ($/SQ FT)	Lifetime (Years)	BC Ratio	Levelized Cost of Energy ($/kWh)
Food Prep.	Hot Food Container	Energy Star	0.11	$0.02	12	1.31	$0.024
Office Equip.	Desktop Computer	Standard	-	$0.00	5	1.00	$0.000
Office Equip.	Desktop Computer	Energy Star	0.06	$0.00	5	1.05	$0.000
Office Equip.	Laptop	Standard	-	$0.00	4	1.00	$0.000
Office Equip.	Laptop	Energy Star	0.01	$0.00	4	1.01	$0.000
Office Equip.	Server	Standard	-	$0.00	3	1.00	$0.000
Office Equip.	Server	Energy Star	0.06	$0.00	3	1.03	$0.000
Office Equip.	Monitor	Standard	-	$0.00	4	1.00	$0.000
Office Equip.	Monitor	Energy Star	0.01	$0.00	4	1.02	$0.000
Office Equip.	Printer/Copier/Fax	Standard	-	$0.00	6	1.00	$0.000
Office Equip.	Printer/Copier/Fax	Energy Star	0.01	$0.00	6	1.09	$0.000
Office Equip.	POS Terminal	Standard	-	$0.00	4	1.00	$0.000
Office Equip.	POS Terminal	Energy Star	0.03	$0.02	4	0.95	$0.152
Miscellaneous	Non-HVAC Motors	Standard (EPAct)	-	$0.00	15	1.00	$0.000
Miscellaneous	Non-HVAC Motors	Standard (EPAct 2015)	0.00	$0.00	15	-	$0.000
Miscellaneous	Non-HVAC Motors	High Eff.	0.00	$0.00	15	1.01	$0.010
Miscellaneous	Non-HVAC Motors	High Eff. (2015)	0.01	$0.00	15	-	$0.007
Miscellaneous	Non-HVAC Motors	Premium (NEMA)	0.01	$0.00	15	1.02	$0.010
Miscellaneous	Non-HVAC Motors	Premium (NEMA 2015)	0.01	$0.00	15	-	$0.008
Miscellaneous	Pool Pump	Standard	-	$0.00	15	1.00	$0.000
Miscellaneous	Pool Pump	High Eff.	-	$0.00	15	1.00	$0.000
Miscellaneous	Pool Pump	High Eff. Multi-Speed	-	$0.00	15	1.00	$0.000
Miscellaneous	Pool Heater	Standard	-	$0.00	15	1.00	$0.000
Miscellaneous	Pool Heater	Heat Pump	-	$0.00	15	1.00	$0.000
Miscellaneous	Miscellaneous	Standard	-	$0.00	5	1.00	$0.000

Table C-10 Energy Efficiency Equipment Data, Electric— Retail, New Vintage

End Use	Technology	Efficiency Definition	Savings (kWh/SQ FT/yr)	Incremental Cost ($/SQ FT)	Lifetime (Years)	BC Ratio	Levelized Cost of Energy ($/kWh)
Cooling	Air-Cooled Chiller	1.5 kw/ton, COP 2.3	-	$0.00	20	1.00	$0.000
Cooling	Air-Cooled Chiller	1.3 kw/ton, COP 2.7	0.47	$0.14	20	1.16	$0.023
Cooling	Air-Cooled Chiller	1.26 kw/ton, COP 2.8	0.53	$0.18	20	1.18	$0.026
Cooling	Air-Cooled Chiller	1.0 kw/ton, COP 3.5	0.62	$0.22	20	1.21	$0.028
Cooling	Air-Cooled Chiller	0.97 kw/ton, COP 3.6	0.75	$0.26	20	1.26	$0.027
Cooling	Water-Cooled Chiller	0.75 kw/ton, COP 4.7	-	$0.00	20	1.00	$0.000
Cooling	Water-Cooled Chiller	0.60 kw/ton, COP 5.9	0.72	$0.08	20	1.19	$0.009
Cooling	Water-Cooled Chiller	0.58 kw/ton, COP 6.1	0.81	$0.16	20	1.21	$0.015
Cooling	Water-Cooled Chiller	0.55 kw/Ton, COP 6.4	0.95	$0.19	20	1.25	$0.016
Cooling	Water-Cooled Chiller	0.51 kw/ton, COP 6.9	1.15	$0.30	20	1.30	$0.020
Cooling	Water-Cooled Chiller	0.50 kw/Ton, COP 7.0	1.19	$0.33	20	1.31	$0.021
Cooling	Water-Cooled Chiller	0.48 kw/ton, COP 7.3	1.29	$0.36	20	1.34	$0.022
Cooling	Roof top AC	EER 9.2	-	$0.00	16	-	$0.000
Cooling	Roof top AC	EER 10.1	0.47	$0.18	16	-	$0.034
Cooling	Roof top AC	EER 11.2	0.93	$0.34	16	1.00	$0.033
Cooling	Roof top AC	EER 12.0	1.22	$0.66	16	1.01	$0.048
Cooling	Roof top AC	Ductless Minisplit	1.53	$2.17	16	0.86	$0.126
Cooling	Air Source Heat Pump	EER 9.3, COP 3.1	-	$0.00	16	-	$0.000
Cooling	Air Source Heat Pump	EER 10.3, COP 3.2	0.46	$0.20	16	-	$0.039
Cooling	Air Source Heat Pump	EER 11.0, COP 3.3	0.73	$0.29	16	1.00	$0.035
Cooling	Air Source Heat Pump	EER 11.7, COP 3.4	0.97	$0.74	16	0.98	$0.068
Cooling	Air Source Heat Pump	EER 12.0, COP 3.4	1.07	$0.97	16	0.97	$0.081
Cooling	Air Source Heat Pump	Ductless Minisplit	1.35	$1.86	16	0.90	$0.122
Cooling	Geo Heat Pump	EER 14.1, COP 3.3	-	$0.00	16	1.00	$0.000
Cooling	Geo Heat Pump	EER 16, COP 3.5	0.32	$0.54	16	0.98	$0.151
Cooling	Geo Heat Pump	EER 18, COP 3.8	0.58	$1.08	16	0.96	$0.165
Cooling	Geo Heat Pump	EER 30, COP 5.0	1.42	$1.43	16	1.07	$0.089
Cooling	Other Cooling	EER 9.8	-	$0.00	14	1.00	$0.000
Cooling	Other Cooling	EER 10.2	0.06	$0.02	14	1.02	$0.027

End Use	Technology	Efficiency Definition	Savings (kWh/SQ FT/yr)	Incremental Cost ($/SQ FT)	Lifetime (Years)	BC Ratio	Levelized Cost of Energy ($/kWh)
Cooling	Other Cooling	EER 10.8	0.13	$0.20	14	0.99	$0.155
Cooling	Other Cooling	EER 11	0.19	$0.22	14	1.00	$0.111
Cooling	Other Cooling	EER 11.5	0.25	$0.25	14	1.01	$0.097
Heating	Air Source Heat Pump	EER 9.3, COP 3.1	-	$0.00	16	-	$0.000
Heating	Air Source Heat Pump	EER 10.3, COP 3.2	0.05	$0.10	16	-	$0.166
Heating	Air Source Heat Pump	EER 11.0, COP 3.3	0.11	$0.15	16	1.00	$0.118
Heating	Air Source Heat Pump	EER 11.7, COP 3.4	0.16	$0.37	16	0.95	$0.202
Heating	Air Source Heat Pump	EER 12.0, COP 3.4	0.16	$0.49	16	0.93	$0.263
Heating	Air Source Heat Pump	Ductless Minisplit	0.22	$0.94	16	0.85	$0.376
Heating	Geo Heat Pump	EER 14.1, COP 3.3	-	$0.00	16	1.00	$0.000
Heating	Geo Heat Pump	EER 16, COP 3.5	0.41	$0.23	16	1.01	$0.049
Heating	Geo Heat Pump	EER 18, COP 3.8	0.75	$0.46	16	1.01	$0.054
Heating	Geo Heat Pump	EER 30, COP 5.0	0.91	$0.60	16	1.00	$0.059
Heating	Electric Room Heat	Standard	-	$0.00	25	1.00	$0.000
Heating	Electric Furnace	Standard	-	$0.00	25	1.00	$0.000
Ventilation	Ventilation	Constant Volume	-	$0.00	10	1.00	$0.000
Ventilation	Ventilation	Variable Air Volume	0.69	-$0.08	10	1.14	-$0.015
Water Heating	Water Heating	EF .97	-	$0.00	15	1.00	$0.000
Water Heating	Water Heating	EF .98	0.01	$0.00	15	1.01	$0.023
Water Heating	Water Heating	EF 2.0	0.45	$0.00	15	2.01	$0.001
Water Heating	Water Heating	EF 2.3	0.51	$0.01	15	2.28	$0.001
Water Heating	Water Heating	EF 2.4	0.52	$0.01	15	2.37	$0.001
Int. Lighting	Screw-in	Incandescent	-	$0.00	2	1.00	$0.000
Int. Lighting	Screw-in	90W Halogen PAR-38	1.33	$0.06	3	-	$0.015
Int. Lighting	Screw-in	70W HIR PAR-38	2.04	$0.08	3	-	$0.013
Int. Lighting	Screw-in	CFL	3.82	$0.05	6	3.42	$0.002
Int. Lighting	Screw-in	LED (2010)	4.14	$1.21	20	1.89	$0.023
Int. Lighting	Screw-in	LED (2020)	4.76	$0.34	20	-	$0.006
Int. Lighting	High-Bay Fixtures	Metal Halides	-	$0.00	3	1.00	$0.000
Int. Lighting	High-Bay Fixtures	LED (2010)	0.19	$0.30	15	0.67	$0.146
Int. Lighting	High-Bay Fixtures	T8	0.19	-$0.01	10	1.78	-$0.005
Int. Lighting	High-Bay Fixtures	HP Sodium	0.21	$0.00	6	1.75	$0.001
Int. Lighting	High-Bay Fixtures	Light Emitting Plasma	0.24	$0.00	15	1.91	$0.002
Int. Lighting	High-Bay Fixtures	T5	0.25	$0.00	10	2.18	-$0.002
Int. Lighting	High-Bay Fixtures	LED (2020)	0.36	$0.08	15	-	$0.020
Int. Lighting	Linear Fluorescent	T12	-	$0.00	10	1.00	$0.000
Int. Lighting	Linear Fluorescent	LED (2010)	0.76	$3.05	15	0.48	$0.370
Int. Lighting	Linear Fluorescent	T8	0.79	$0.00	10	1.34	$0.000
Int. Lighting	Linear Fluorescent	Super T8	1.10	$0.02	10	1.51	$0.002
Int. Lighting	Linear Fluorescent	T5	1.27	$0.03	10	1.63	$0.003
Int. Lighting	Linear Fluorescent	LED (2020)	2.32	$0.85	15	-	$0.034
Ext. Lighting	Screw-in	Incandescent	-	$0.00	2	1.00	$0.000
Ext. Lighting	Screw-in	90W Halogen PAR-38	0.62	$0.03	3	-	$0.015
Ext. Lighting	Screw-in	70W HIR PAR-38	0.95	$0.04	3	-	$0.013
Ext. Lighting	Screw-in	CFL	1.79	$0.02	6	3.27	$0.002
Ext. Lighting	Screw-in	LED (2010)	1.93	$0.57	20	1.62	$0.023
Ext. Lighting	Screw-in	LED (2020)	2.22	$0.16	20	-	$0.006
Ext. Lighting	HID	Metal Halides	-	$0.00	3	1.00	$0.000
Ext. Lighting	HID	LED (2010)	0.18	$0.24	15	0.65	$0.120
Ext. Lighting	HID	T8	0.19	-$0.01	10	1.74	-$0.004
Ext. Lighting	HID	HP Sodium	0.20	$0.00	6	1.73	$0.001
Ext. Lighting	HID	Light Emitting Plasma	0.23	$0.00	15	1.83	$0.001
Ext. Lighting	HID	T5	0.24	$0.00	10	2.12	-$0.002
Ext. Lighting	HID	LED (2020)	0.35	$0.06	15	-	$0.016
Ext. Lighting	Linear Fluorescent	T12	-	$0.00	10	1.00	$0.000
Ext. Lighting	Linear Fluorescent	LED (2010)	0.00	$0.01	15	0.42	$0.370
Ext. Lighting	Linear Fluorescent	T8	0.00	$0.00	10	1.34	$0.000
Ext. Lighting	Linear Fluorescent	Super T8	0.00	$0.00	10	1.50	$0.002
Ext. Lighting	Linear Fluorescent	T5	0.00	$0.00	10	1.62	$0.003
Ext. Lighting	Linear Fluorescent	LED (2020)	0.01	$0.00	15	-	$0.034
Refrigeration	Walk-in Refrigerator	14600 kWh/yr	-	$0.00	12	1.00	$0.000
Refrigeration	Walk-in Refrigerator	10800 kWh/yr	0.07	$0.02	12	1.08	$0.025

End Use	Technology	Efficiency Definition	Savings (kWh/SQ FT/yr)	Incremental Cost ($/SQ FT)	Lifetime (Years)	BC Ratio	Levelized Cost of Energy ($/kWh)
Refrigeration	Walk-in Refrigerator	10000 kWh/yr	0.09	$0.02	12	1.09	$0.026
Refrigeration	Walk-in Refrigerator	9000 kWh/yr	0.11	$0.04	12	1.08	$0.038
Refrigeration	Reach-in Refrigerator	3800 kWh/yr	-	$0.00	12	1.00	$0.000
Refrigeration	Reach-in Refrigerator	3100 kWh/yr	0.02	$0.01	12	1.05	$0.037
Refrigeration	Reach-in Refrigerator	2500 kWh/yr	0.03	$0.01	12	1.10	$0.039
Refrigeration	Reach-in Refrigerator	2400 kWh/yr	0.03	$0.01	12	1.11	$0.038
Refrigeration	Reach-in Refrigerator	1500 kWh/yr	0.05	$0.01	12	1.33	$0.025
Refrigeration	Glass Door Display	14480 kWh/yr	-	$0.00	12	-	$0.000
Refrigeration	Glass Door Display	11700 kWh/yr	0.06	$0.04	12	-	$0.072
Refrigeration	Glass Door Display	8400 kWh/yr	0.13	$0.00	12	1.00	$0.000
Refrigeration	Glass Door Display	6800 kWh/yr	0.17	$0.04	12	0.91	$0.026
Refrigeration	Open Display Case	6500 kWh/yr	-	$0.00	18	-	$0.000
Refrigeration	Open Display Case	5350 kWh/yr	0.03	$0.00	18	1.00	$0.000
Refrigeration	Open Display Case	5300 kWh/yr	0.03	$0.02	18	-	$0.056
Refrigeration	Open Display Case	4330 kWh/yr	0.05	$0.02	18	1.00	$0.032
Refrigeration	Icemaker	7.0 kWh/100 lbs	-	$0.00	10	1.00	$0.000
Refrigeration	Icemaker	6.3 kWh/100 lbs	0.02	$0.01	10	1.01	$0.054
Refrigeration	Icemaker	6.0 kWh/100 lbs	0.03	$0.01	10	1.00	$0.057
Refrigeration	Icemaker	5.5 kWh/100 lbs	0.04	$0.04	10	0.88	$0.142
Refrigeration	Vending Machine	3400 kWh/year	-	$0.00	10	1.00	$0.000
Refrigeration	Vending Machine	3000 kWh/year	0.02	$0.00	10	1.05	$0.012
Refrigeration	Vending Machine	2400 kWh/year	0.04	$0.00	10	1.14	$0.012
Refrigeration	Vending Machine	1700 kWh/year	0.07	$0.01	10	1.20	$0.022
Food Prep.	Oven	Standard	-	$0.00	12	1.00	$0.000
Food Prep.	Oven	Energy Star	0.03	$0.00	12	1.13	$0.000
Food Prep.	Fryer	Standard	-	$0.00	12	1.00	$0.000
Food Prep.	Fryer	Energy Star	0.02	$0.00	12	1.03	$0.024
Food Prep.	Dishwasher	Standard	-	$0.00	12	1.00	$0.000
Food Prep.	Dishwasher	Energy Star	0.16	$0.01	12	1.35	$0.005
Food Prep.	Hot Food Container	Standard	-	$0.00	12	1.00	$0.000
Food Prep.	Hot Food Container	Energy Star	0.11	$0.02	12	1.31	$0.024
Office Equip.	Desktop Computer	Standard	-	$0.00	5	1.00	$0.000
Office Equip.	Desktop Computer	Energy Star	0.06	$0.00	5	1.05	$0.000
Office Equip.	Laptop	Standard	-	$0.00	4	1.00	$0.000
Office Equip.	Laptop	Energy Star	0.01	$0.00	4	1.01	$0.000
Office Equip.	Server	Standard	-	$0.00	3	1.00	$0.000
Office Equip.	Server	Energy Star	0.06	$0.00	3	1.03	$0.000
Office Equip.	Monitor	Standard	-	$0.00	4	1.00	$0.000
Office Equip.	Monitor	Energy Star	0.01	$0.00	4	1.02	$0.000
Office Equip.	Printer/Copier/Fax	Standard	-	$0.00	6	1.00	$0.000
Office Equip.	Printer/Copier/Fax	Energy Star	0.01	$0.00	6	1.09	$0.000
Office Equip.	POS Terminal	Standard	-	$0.00	4	1.00	$0.000
Office Equip.	POS Terminal	Energy Star	0.03	$0.02	4	0.95	$0.152
Miscellaneous	Non-HVAC Motors	Standard (EPAct)	-	$0.00	15	1.00	$0.000
Miscellaneous	Non-HVAC Motors	Standard (EPAct 2015)	0.00	$0.00	15	-	$0.000
Miscellaneous	Non-HVAC Motors	High Eff.	0.00	$0.00	15	1.01	$0.010
Miscellaneous	Non-HVAC Motors	High Eff. (2015)	0.01	$0.00	15	-	$0.007
Miscellaneous	Non-HVAC Motors	Premium (NEMA)	0.01	$0.00	15	1.02	$0.010
Miscellaneous	Non-HVAC Motors	Premium (NEMA 2015)	0.01	$0.00	15	-	$0.008
Miscellaneous	Pool Pump	Standard	-	$0.00	15	1.00	$0.000
Miscellaneous	Pool Pump	High Eff.	-	$0.00	15	1.00	$0.000
Miscellaneous	Pool Pump	High Eff. Multi-Speed	-	$0.00	15	1.00	$0.000
Miscellaneous	Pool Heater	Standard	-	$0.00	15	1.00	$0.000
Miscellaneous	Pool Heater	Heat Pump	-	$0.00	15	1.00	$0.000
Miscellaneous	Miscellaneous	Standard	-	$0.00	5	1.00	$0.000

Table C-11 Energy Efficiency Equipment Data, Electric—Grocery, Existing Vintage

End Use	Technology	Efficiency Definition	Savings (kWh/SQ FT/yr)	Incremental Cost ($/SQ FT)	Lifetime (Years)	BC Ratio	Levelized Cost of Energy ($/kWh)
Cooling	Air-Cooled Chiller	1.5 kw/ton, COP 2.3	-	$0.00	20	1.00	$0.000
Cooling	Air-Cooled Chiller	1.3 kw/ton, COP 2.7	1.06	$0.21	20	1.21	$0.015
Cooling	Air-Cooled Chiller	1.26 kw/ton, COP 2.8	1.20	$0.27	20	1.24	$0.017
Cooling	Air-Cooled Chiller	1.0 kw/ton, COP 3.5	1.41	$0.34	20	1.30	$0.018
Cooling	Air-Cooled Chiller	0.97 kw/ton, COP 3.6	1.70	$0.40	20	1.38	$0.018
Cooling	Water-Cooled Chiller	0.75 kw/ton, COP 4.7	-	$0.00	20	1.00	$0.000
Cooling	Water-Cooled Chiller	0.60 kw/ton, COP 5.9	1.37	$0.10	20	1.22	$0.006
Cooling	Water-Cooled Chiller	0.58 kw/ton, COP 6.1	1.55	$0.20	20	1.26	$0.010
Cooling	Water-Cooled Chiller	0.55 kw/Ton, COP 6.4	1.83	$0.24	20	1.32	$0.010
Cooling	Water-Cooled Chiller	0.51 kw/ton, COP 6.9	2.20	$0.38	20	1.40	$0.013
Cooling	Water-Cooled Chiller	0.50 kw/Ton, COP 7.0	2.29	$0.42	20	1.42	$0.014
Cooling	Water-Cooled Chiller	0.48 kw/ton, COP 7.3	2.47	$0.46	20	1.47	$0.014
Cooling	Roof top AC	EER 9.2	-	$0.00	16	-	$0.000
Cooling	Roof top AC	EER 10.1	0.87	$1.38	16	-	$0.141
Cooling	Roof top AC	EER 11.2	1.74	$2.66	16	1.00	$0.135
Cooling	Roof top AC	EER 12.0	2.28	$5.11	16	0.97	$0.199
Cooling	Roof top AC	Ductless Minisplit	2.85	$16.77	16	0.74	$0.520
Cooling	Air Source Heat Pump	EER 9.3, COP 3.1	-	$0.00	16	-	$0.000
Cooling	Air Source Heat Pump	EER 10.3, COP 3.2	0.92	$1.67	16	-	$0.160
Cooling	Air Source Heat Pump	EER 11.0, COP 3.3	1.47	$2.41	16	1.00	$0.145
Cooling	Air Source Heat Pump	EER 11.7, COP 3.4	1.95	$6.17	16	0.93	$0.280
Cooling	Air Source Heat Pump	EER 12.0, COP 3.4	2.14	$8.05	16	0.89	$0.333
Cooling	Air Source Heat Pump	Ductless Minisplit	2.71	$15.43	16	0.77	$0.504
Cooling	Geo Heat Pump	EER 14.1, COP 3.3	-	$0.00	16	1.00	$0.000
Cooling	Geo Heat Pump	EER 16, COP 3.5	0.55	$3.86	16	0.94	$0.625
Cooling	Geo Heat Pump	EER 18, COP 3.8	1.00	$7.72	16	0.88	$0.685
Cooling	Geo Heat Pump	EER 30, COP 5.0	2.44	$10.18	16	0.91	$0.369
Cooling	Other Cooling	EER 9.8	-	$0.00	14	1.00	$0.000
Cooling	Other Cooling	EER 10.2	0.12	$0.03	14	1.02	$0.027
Cooling	Other Cooling	EER 10.8	0.23	$0.38	14	1.01	$0.156
Cooling	Other Cooling	EER 11	0.34	$0.40	14	1.03	$0.112
Cooling	Other Cooling	EER 11.5	0.45	$0.45	14	1.05	$0.097
Heating	Air Source Heat Pump	EER 9.3, COP 3.1	-	$0.00	16	-	$0.000
Heating	Air Source Heat Pump	EER 10.3, COP 3.2	0.06	$0.34	16	-	$0.508
Heating	Air Source Heat Pump	EER 11.0, COP 3.3	0.11	$0.49	16	1.00	$0.381
Heating	Air Source Heat Pump	EER 11.7, COP 3.4	0.15	$1.26	16	0.90	$0.762
Heating	Air Source Heat Pump	EER 12.0, COP 3.4	0.15	$1.64	16	0.86	$0.995
Heating	Air Source Heat Pump	Ductless Minisplit	0.17	$3.14	16	0.72	$1.602
Heating	Geo Heat Pump	EER 14.1, COP 3.3	-	$0.00	16	1.00	$0.000
Heating	Geo Heat Pump	EER 16, COP 3.5	0.46	$0.77	16	0.95	$0.148
Heating	Geo Heat Pump	EER 18, COP 3.8	0.84	$1.54	16	0.89	$0.162
Heating	Geo Heat Pump	EER 30, COP 5.0	0.27	$2.03	16	0.81	$0.658
Heating	Electric Room Heat	Standard	-	$0.00	25	1.00	$0.000
Heating	Electric Furnace	Standard	-	$0.00	25	1.00	$0.000
Ventilation	Ventilation	Constant Volume	-	$0.00	10	1.00	$0.000
Ventilation	Ventilation	Variable Air Volume	1.03	-$0.48	10	1.06	-$0.057
Water Heating	Water Heating	EF .97	-	$0.00	15	1.00	$0.000
Water Heating	Water Heating	EF .98	0.02	$0.00	15	1.01	$0.018
Water Heating	Water Heating	EF 2.0	1.22	$0.01	15	2.02	$0.001
Water Heating	Water Heating	EF 2.3	1.37	$0.01	15	2.30	$0.001
Water Heating	Water Heating	EF 2.4	1.41	$0.02	15	2.39	$0.001
Int. Lighting	Screw-in	Incandescent	-	$0.00	2	1.00	$0.000
Int. Lighting	Screw-in	90W Halogen PAR-38	1.38	$0.04	3	-	$0.010
Int. Lighting	Screw-in	70W HIR PAR-38	2.12	$0.05	3	-	$0.009
Int. Lighting	Screw-in	CFL	3.97	$0.03	6	3.60	$0.001
Int. Lighting	Screw-in	LED (2010)	4.30	$0.84	20	2.48	$0.015
Int. Lighting	Screw-in	LED (2020)	4.94	$0.24	20	-	$0.004
Int. Lighting	High-Bay Fixtures	Metal Halides	-	$0.00	3	1.00	$0.000
Int. Lighting	High-Bay Fixtures	LED (2010)	0.14	$0.14	15	0.84	$0.097

End Use	Technology	Efficiency Definition	Savings (kWh/SQ FT/yr)	Incremental Cost ($/SQ FT)	Lifetime (Years)	BC Ratio	Levelized Cost of Energy ($/kWh)
Int. Lighting	High-Bay Fixtures	T8	0.14	$0.00	10	1.72	-$0.003
Int. Lighting	High-Bay Fixtures	HP Sodium	0.15	$0.00	6	1.77	$0.001
Int. Lighting	High-Bay Fixtures	Light Emitting Plasma	0.18	$0.00	15	1.91	$0.001
Int. Lighting	High-Bay Fixtures	T5	0.18	$0.00	10	2.14	-$0.002
Int. Lighting	High-Bay Fixtures	LED (2020)	0.26	$0.04	15	-	$0.013
Int. Lighting	Linear Fluorescent	T12	-	$0.00	10	1.00	$0.000
Int. Lighting	Linear Fluorescent	LED (2010)	2.05	$5.47	15	0.63	$0.246
Int. Lighting	Linear Fluorescent	T8	2.13	$0.00	10	1.34	$0.000
Int. Lighting	Linear Fluorescent	Super T8	2.96	$0.04	10	1.53	$0.002
Int. Lighting	Linear Fluorescent	T5	3.43	$0.06	10	1.66	$0.002
Int. Lighting	Linear Fluorescent	LED (2020)	6.26	$1.52	15	-	$0.022
Ext. Lighting	Screw-in	Incandescent	-	$0.00	2	1.00	$0.000
Ext. Lighting	Screw-in	90W Halogen PAR-38	0.14	$0.00	3	-	$0.010
Ext. Lighting	Screw-in	70W HIR PAR-38	0.21	$0.01	3	-	$0.009
Ext. Lighting	Screw-in	CFL	0.39	$0.00	6	3.42	$0.001
Ext. Lighting	Screw-in	LED (2010)	0.43	$0.08	20	2.03	$0.015
Ext. Lighting	Screw-in	LED (2020)	0.49	$0.02	20	-	$0.004
Ext. Lighting	HID	Metal Halides	-	$0.00	3	1.00	$0.000
Ext. Lighting	HID	LED (2010)	0.54	$0.47	15	0.78	$0.080
Ext. Lighting	HID	T8	0.55	-$0.01	10	1.67	-$0.003
Ext. Lighting	HID	HP Sodium	0.59	$0.00	6	1.73	$0.001
Ext. Lighting	HID	Light Emitting Plasma	0.69	$0.01	15	1.80	$0.001
Ext. Lighting	HID	T5	0.70	-$0.01	10	2.06	-$0.001
Ext. Lighting	HID	LED (2020)	1.03	$0.12	15	-	$0.011
Ext. Lighting	Linear Fluorescent	T12	-	$0.00	10	1.00	$0.000
Ext. Lighting	Linear Fluorescent	LED (2010)	0.01	$0.03	15	0.54	$0.246
Ext. Lighting	Linear Fluorescent	T8	0.01	$0.00	10	1.34	$0.000
Ext. Lighting	Linear Fluorescent	Super T8	0.02	$0.00	10	1.52	$0.002
Ext. Lighting	Linear Fluorescent	T5	0.02	$0.00	10	1.65	$0.002
Ext. Lighting	Linear Fluorescent	LED (2020)	0.04	$0.01	15	-	$0.022
Refrigeration	Walk-in Refrigerator	14600 kWh/yr	-	$0.00	12	1.00	$0.000
Refrigeration	Walk-in Refrigerator	10800 kWh/yr	1.06	$0.41	12	1.03	$0.042
Refrigeration	Walk-in Refrigerator	10000 kWh/yr	1.28	$0.52	12	1.03	$0.044
Refrigeration	Walk-in Refrigerator	9000 kWh/yr	1.56	$0.94	12	1.00	$0.065
Refrigeration	Reach-in Refrigerator	3800 kWh/yr	-	$0.00	12	1.00	$0.000
Refrigeration	Reach-in Refrigerator	3100 kWh/yr	0.06	$0.04	12	1.00	$0.063
Refrigeration	Reach-in Refrigerator	2500 kWh/yr	0.11	$0.07	12	0.99	$0.067
Refrigeration	Reach-in Refrigerator	2400 kWh/yr	0.12	$0.07	12	0.99	$0.066
Refrigeration	Reach-in Refrigerator	1500 kWh/yr	0.20	$0.08	12	1.13	$0.042
Refrigeration	Glass Door Display	14480 kWh/yr	-	$0.00	12	-	$0.000
Refrigeration	Glass Door Display	11700 kWh/yr	2.44	$1.62	12	-	$0.072
Refrigeration	Glass Door Display	8400 kWh/yr	5.33	$0.00	12	1.00	$0.000
Refrigeration	Glass Door Display	6800 kWh/yr	6.73	$1.62	12	0.91	$0.026
Refrigeration	Open Display Case	6500 kWh/yr	-	$0.00	18	-	$0.000
Refrigeration	Open Display Case	5350 kWh/yr	1.04	$0.00	18	1.00	$0.000
Refrigeration	Open Display Case	5300 kWh/yr	1.08	$0.74	18	-	$0.056
Refrigeration	Open Display Case	4330 kWh/yr	1.92	$0.74	18	1.00	$0.032
Refrigeration	Icemaker	7.0 kWh/100 lbs	-	$0.00	10	1.00	$0.000
Refrigeration	Icemaker	6.3 kWh/100 lbs	0.02	$0.01	10	1.01	$0.054
Refrigeration	Icemaker	6.0 kWh/100 lbs	0.03	$0.01	10	1.01	$0.057
Refrigeration	Icemaker	5.5 kWh/100 lbs	0.04	$0.04	10	0.88	$0.142
Refrigeration	Vending Machine	3400 kWh/year	-	$0.00	10	1.00	$0.000
Refrigeration	Vending Machine	3000 kWh/year	0.04	$0.00	10	1.05	$0.012
Refrigeration	Vending Machine	2400 kWh/year	0.09	$0.01	10	1.14	$0.012
Refrigeration	Vending Machine	1700 kWh/year	0.15	$0.03	10	1.20	$0.022
Food Prep.	Oven	Standard	-	$0.00	12	1.00	$0.000
Food Prep.	Oven	Energy Star	0.10	$0.00	12	1.14	$0.000
Food Prep.	Fryer	Standard	-	$0.00	12	1.00	$0.000
Food Prep.	Fryer	Energy Star	0.06	$0.01	12	1.04	$0.024
Food Prep.	Dishwasher	Standard	-	$0.00	12	1.00	$0.000
Food Prep.	Dishwasher	Energy Star	0.50	$0.02	12	1.36	$0.005
Food Prep.	Hot Food Container	Standard	-	$0.00	12	1.00	$0.000

End Use	Technology	Efficiency Definition	Savings (kWh/SQ FT/yr)	Incremental Cost ($/SQ FT)	Lifetime (Years)	BC Ratio	Levelized Cost of Energy ($/kWh)
Food Prep.	Hot Food Container	Energy Star	0.34	$0.08	12	1.37	$0.024
Office Equip.	Desktop Computer	Standard	-	$0.00	5	1.00	$0.000
Office Equip.	Desktop Computer	Energy Star	0.06	$0.00	5	1.05	$0.000
Office Equip.	Laptop	Standard	-	$0.00	4	1.00	$0.000
Office Equip.	Laptop	Energy Star	0.01	$0.00	4	1.02	$0.000
Office Equip.	Server	Standard	-	$0.00	3	1.00	$0.000
Office Equip.	Server	Energy Star	0.03	$0.00	3	1.04	$0.000
Office Equip.	Monitor	Standard	-	$0.00	4	1.00	$0.000
Office Equip.	Monitor	Energy Star	0.01	$0.00	4	1.02	$0.000
Office Equip.	Printer/Copier/Fax	Standard	-	$0.00	6	1.00	$0.000
Office Equip.	Printer/Copier/Fax	Energy Star	0.01	$0.00	6	1.10	$0.000
Office Equip.	POS Terminal	Standard	-	$0.00	4	1.00	$0.000
Office Equip.	POS Terminal	Energy Star	0.04	$0.02	4	0.95	$0.152
Miscellaneous	Non-HVAC Motors	Standard (EPAct)	-	$0.00	15	1.00	$0.000
Miscellaneous	Non-HVAC Motors	Standard (EPAct 2015)	0.00	$0.00	15	-	$0.000
Miscellaneous	Non-HVAC Motors	High Eff.	0.00	$0.00	15	1.01	$0.010
Miscellaneous	Non-HVAC Motors	High Eff. (2015)	0.01	$0.00	15	-	$0.007
Miscellaneous	Non-HVAC Motors	Premium (NEMA)	0.01	$0.00	15	1.02	$0.010
Miscellaneous	Non-HVAC Motors	Premium (NEMA 2015)	0.01	$0.00	15	-	$0.008
Miscellaneous	Pool Pump	Standard	-	$0.00	15	1.00	$0.000
Miscellaneous	Pool Pump	High Eff.	-	$0.00	15	1.00	$0.000
Miscellaneous	Pool Pump	High Eff. Multi-Speed	-	$0.00	15	1.00	$0.000
Miscellaneous	Pool Heater	Standard	-	$0.00	15	1.00	$0.000
Miscellaneous	Pool Heater	Heat Pump	-	$0.00	15	1.00	$0.000
Miscellaneous	Miscellaneous	Standard	-	$0.00	5	1.00	$0.000

Table C-12 Energy Efficiency Equipment Data, Electric— Grocery, New Vintage

End Use	Technology	Efficiency Definition	Savings (kWh/SQ FT/yr)	Incremental Cost ($/SQ FT)	Lifetime (Years)	BC Ratio	Levelized Cost of Energy ($/kWh)
Cooling	Air-Cooled Chiller	1.5 kw/ton, COP 2.3	-	$0.00	20	1.00	$0.000
Cooling	Air-Cooled Chiller	1.3 kw/ton, COP 2.7	0.87	$0.26	20	1.20	$0.023
Cooling	Air-Cooled Chiller	1.26 kw/ton, COP 2.8	0.99	$0.34	20	1.22	$0.026
Cooling	Air-Cooled Chiller	1.0 kw/ton, COP 3.5	1.17	$0.42	20	1.27	$0.028
Cooling	Air-Cooled Chiller	0.97 kw/ton, COP 3.6	1.40	$0.50	20	1.34	$0.027
Cooling	Water-Cooled Chiller	0.75 kw/ton, COP 4.7	-	$0.00	20	1.00	$0.000
Cooling	Water-Cooled Chiller	0.60 kw/ton, COP 5.9	1.29	$0.14	20	1.21	$0.009
Cooling	Water-Cooled Chiller	0.58 kw/ton, COP 6.1	1.46	$0.29	20	1.24	$0.015
Cooling	Water-Cooled Chiller	0.55 kw/Ton, COP 6.4	1.72	$0.35	20	1.30	$0.016
Cooling	Water-Cooled Chiller	0.51 kw/ton, COP 6.9	2.06	$0.54	20	1.37	$0.020
Cooling	Water-Cooled Chiller	0.50 kw/Ton, COP 7.0	2.15	$0.60	20	1.38	$0.021
Cooling	Water-Cooled Chiller	0.48 kw/ton, COP 7.3	2.32	$0.65	20	1.43	$0.022
Cooling	Roof top AC	EER 9.2	-	$0.00	16	-	$0.000
Cooling	Roof top AC	EER 10.1	0.82	$1.81	16	-	$0.195
Cooling	Roof top AC	EER 11.2	1.65	$3.49	16	1.00	$0.188
Cooling	Roof top AC	EER 12.0	2.15	$6.70	16	0.95	$0.276
Cooling	Roof top AC	Ductless Minisplit	2.70	$21.99	16	0.69	$0.722
Cooling	Air Source Heat Pump	EER 9.3, COP 3.1	-	$0.00	16	-	$0.000
Cooling	Air Source Heat Pump	EER 10.3, COP 3.2	0.85	$2.14	16	-	$0.222
Cooling	Air Source Heat Pump	EER 11.0, COP 3.3	1.36	$3.07	16	1.00	$0.201
Cooling	Air Source Heat Pump	EER 11.7, COP 3.4	1.80	$7.88	16	0.91	$0.388
Cooling	Air Source Heat Pump	EER 12.0, COP 3.4	1.97	$10.28	16	0.86	$0.461
Cooling	Air Source Heat Pump	Ductless Minisplit	2.50	$19.70	16	0.72	$0.698
Cooling	Geo Heat Pump	EER 14.1, COP 3.3	-	$0.00	16	1.00	$0.000
Cooling	Geo Heat Pump	EER 16, COP 3.5	0.51	$4.99	16	0.93	$0.869
Cooling	Geo Heat Pump	EER 18, COP 3.8	0.93	$9.98	16	0.86	$0.953
Cooling	Geo Heat Pump	EER 30, COP 5.0	2.27	$13.17	16	0.87	$0.514
Cooling	Other Cooling	EER 9.8	-	$0.00	14	1.00	$0.000
Cooling	Other Cooling	EER 10.2	0.12	$0.03	14	1.02	$0.027

End Use	Technology	Efficiency Definition	Savings (kWh/SQ FT/yr)	Incremental Cost ($/SQ FT)	Lifetime (Years)	BC Ratio	Levelized Cost of Energy ($/kWh)
Cooling	Other Cooling	EER 10.8	0.23	$0.37	14	1.01	$0.155
Cooling	Other Cooling	EER 11	0.34	$0.39	14	1.03	$0.111
Cooling	Other Cooling	EER 11.5	0.44	$0.44	14	1.05	$0.097
Heating	Air Source Heat Pump	EER 9.3, COP 3.1	-	$0.00	16	-	$0.000
Heating	Air Source Heat Pump	EER 10.3, COP 3.2	0.02	$0.80	16	-	$3.329
Heating	Air Source Heat Pump	EER 11.0, COP 3.3	0.04	$1.15	16	1.00	$2.585
Heating	Air Source Heat Pump	EER 11.7, COP 3.4	0.10	$2.94	16	0.86	$2.519
Heating	Air Source Heat Pump	EER 12.0, COP 3.4	0.10	$3.84	16	0.80	$3.288
Heating	Air Source Heat Pump	Ductless Minisplit	0.17	$7.36	16	0.63	$3.871
Heating	Geo Heat Pump	EER 14.1, COP 3.3	-	$0.00	16	1.00	$0.000
Heating	Geo Heat Pump	EER 16, COP 3.5	0.41	$1.76	16	0.91	$0.377
Heating	Geo Heat Pump	EER 18, COP 3.8	0.75	$3.51	16	0.83	$0.413
Heating	Geo Heat Pump	EER 30, COP 5.0	0.00	$4.63	16	0.76	$84.135
Heating	Electric Room Heat	Standard	-	$0.00	25	1.00	$0.000
Heating	Electric Furnace	Standard	-	$0.00	25	1.00	$0.000
Ventilation	Ventilation	Constant Volume	-	$0.00	10	1.00	$0.000
Ventilation	Ventilation	Variable Air Volume	0.07	-$0.66	10	1.03	-$1.189
Water Heating	Water Heating	EF .97	-	$0.00	15	1.00	$0.000
Water Heating	Water Heating	EF .98	0.02	$0.00	15	1.01	$0.018
Water Heating	Water Heating	EF 2.0	1.20	$0.01	15	2.02	$0.001
Water Heating	Water Heating	EF 2.3	1.35	$0.01	15	2.30	$0.001
Water Heating	Water Heating	EF 2.4	1.39	$0.01	15	2.39	$0.001
Int. Lighting	Screw-in	Incandescent	-	$0.00	2	1.00	$0.000
Int. Lighting	Screw-in	90W Halogen PAR-38	1.38	$0.04	3	-	$0.010
Int. Lighting	Screw-in	70W HIR PAR-38	2.12	$0.05	3	-	$0.009
Int. Lighting	Screw-in	CFL	3.97	$0.03	6	3.60	$0.001
Int. Lighting	Screw-in	LED (2010)	4.30	$0.84	20	2.48	$0.015
Int. Lighting	Screw-in	LED (2020)	4.94	$0.24	20	-	$0.004
Int. Lighting	High-Bay Fixtures	Metal Halides	-	$0.00	3	1.00	$0.000
Int. Lighting	High-Bay Fixtures	LED (2010)	0.14	$0.14	15	0.84	$0.097
Int. Lighting	High-Bay Fixtures	T8	0.14	$0.00	10	1.72	-$0.003
Int. Lighting	High-Bay Fixtures	HP Sodium	0.15	$0.00	6	1.77	$0.001
Int. Lighting	High-Bay Fixtures	Light Emitting Plasma	0.18	$0.00	15	1.91	$0.001
Int. Lighting	High-Bay Fixtures	T5	0.18	$0.00	10	2.14	-$0.002
Int. Lighting	High-Bay Fixtures	LED (2020)	0.26	$0.04	15	-	$0.013
Int. Lighting	Linear Fluorescent	T12	-	$0.00	10	1.00	$0.000
Int. Lighting	Linear Fluorescent	LED (2010)	2.05	$5.47	15	0.63	$0.246
Int. Lighting	Linear Fluorescent	T8	2.13	$0.00	10	1.34	$0.000
Int. Lighting	Linear Fluorescent	Super T8	2.96	$0.04	10	1.53	$0.002
Int. Lighting	Linear Fluorescent	T5	3.43	$0.06	10	1.66	$0.002
Int. Lighting	Linear Fluorescent	LED (2020)	6.26	$1.52	15	-	$0.022
Ext. Lighting	Screw-in	Incandescent	-	$0.00	2	1.00	$0.000
Ext. Lighting	Screw-in	90W Halogen PAR-38	0.14	$0.00	3	-	$0.010
Ext. Lighting	Screw-in	70W HIR PAR-38	0.21	$0.01	3	-	$0.009
Ext. Lighting	Screw-in	CFL	0.39	$0.00	6	3.42	$0.001
Ext. Lighting	Screw-in	LED (2010)	0.43	$0.08	20	2.03	$0.015
Ext. Lighting	Screw-in	LED (2020)	0.49	$0.02	20	-	$0.004
Ext. Lighting	HID	Metal Halides	-	$0.00	3	1.00	$0.000
Ext. Lighting	HID	LED (2010)	0.54	$0.47	15	0.78	$0.080
Ext. Lighting	HID	T8	0.55	-$0.01	10	1.67	-$0.003
Ext. Lighting	HID	HP Sodium	0.59	$0.00	6	1.73	$0.001
Ext. Lighting	HID	Light Emitting Plasma	0.69	$0.01	15	1.80	$0.001
Ext. Lighting	HID	T5	0.70	-$0.01	10	2.06	-$0.001
Ext. Lighting	HID	LED (2020)	1.03	$0.12	15	-	$0.011
Ext. Lighting	Linear Fluorescent	T12	-	$0.00	10	1.00	$0.000
Ext. Lighting	Linear Fluorescent	LED (2010)	0.01	$0.03	15	0.54	$0.246
Ext. Lighting	Linear Fluorescent	T8	0.01	$0.00	10	1.34	$0.000
Ext. Lighting	Linear Fluorescent	Super T8	0.02	$0.00	10	1.52	$0.002
Ext. Lighting	Linear Fluorescent	T5	0.02	$0.00	10	1.65	$0.002
Ext. Lighting	Linear Fluorescent	LED (2020)	0.04	$0.01	15	-	$0.022
Refrigeration	Walk-in Refrigerator	14600 kWh/yr	-	$0.00	12	1.00	$0.000
Refrigeration	Walk-in Refrigerator	10800 kWh/yr	1.06	$0.58	12	1.01	$0.059

End Use	Technology	Efficiency Definition	Savings (kWh/SQ FT/yr)	Incremental Cost ($/SQ FT)	Lifetime (Years)	BC Ratio	Levelized Cost of Energy ($/kWh)
Refrigeration	Walk-in Refrigerator	10000 kWh/yr	1.28	$0.73	12	1.00	$0.062
Refrigeration	Walk-in Refrigerator	9000 kWh/yr	1.56	$1.31	12	0.96	$0.091
Refrigeration	Reach-in Refrigerator	3800 kWh/yr	-	$0.00	12	1.00	$0.000
Refrigeration	Reach-in Refrigerator	3100 kWh/yr	0.06	$0.05	12	0.97	$0.089
Refrigeration	Reach-in Refrigerator	2500 kWh/yr	0.11	$0.10	12	0.93	$0.094
Refrigeration	Reach-in Refrigerator	2400 kWh/yr	0.12	$0.10	12	0.93	$0.092
Refrigeration	Reach-in Refrigerator	1500 kWh/yr	0.20	$0.11	12	1.02	$0.059
Refrigeration	Glass Door Display	14480 kWh/yr	-	$0.00	12	-	$0.000
Refrigeration	Glass Door Display	11700 kWh/yr	2.44	$1.62	12	-	$0.072
Refrigeration	Glass Door Display	8400 kWh/yr	5.33	$0.00	12	1.00	$0.000
Refrigeration	Glass Door Display	6800 kWh/yr	6.73	$1.62	12	0.91	$0.026
Refrigeration	Open Display Case	6500 kWh/yr	-	$0.00	18	-	$0.000
Refrigeration	Open Display Case	5350 kWh/yr	1.04	$0.00	18	1.00	$0.000
Refrigeration	Open Display Case	5300 kWh/yr	1.08	$0.74	18	-	$0.056
Refrigeration	Open Display Case	4330 kWh/yr	1.92	$0.74	18	1.00	$0.032
Refrigeration	Icemaker	7.0 kWh/100 lbs	-	$0.00	10	1.00	$0.000
Refrigeration	Icemaker	6.3 kWh/100 lbs	0.02	$0.01	10	1.01	$0.054
Refrigeration	Icemaker	6.0 kWh/100 lbs	0.03	$0.01	10	1.01	$0.057
Refrigeration	Icemaker	5.5 kWh/100 lbs	0.04	$0.04	10	0.88	$0.142
Refrigeration	Vending Machine	3400 kWh/year	-	$0.00	10	1.00	$0.000
Refrigeration	Vending Machine	3000 kWh/year	0.04	$0.00	10	1.05	$0.012
Refrigeration	Vending Machine	2400 kWh/year	0.09	$0.01	10	1.14	$0.012
Refrigeration	Vending Machine	1700 kWh/year	0.15	$0.03	10	1.20	$0.022
Food Prep.	Oven	Standard	-	$0.00	12	1.00	$0.000
Food Prep.	Oven	Energy Star	0.10	$0.00	12	1.14	$0.000
Food Prep.	Fryer	Standard	-	$0.00	12	1.00	$0.000
Food Prep.	Fryer	Energy Star	0.06	$0.01	12	1.04	$0.024
Food Prep.	Dishwasher	Standard	-	$0.00	12	1.00	$0.000
Food Prep.	Dishwasher	Energy Star	0.50	$0.02	12	1.36	$0.005
Food Prep.	Hot Food Container	Standard	-	$0.00	12	1.00	$0.000
Food Prep.	Hot Food Container	Energy Star	0.34	$0.08	12	1.37	$0.024
Office Equip.	Desktop Computer	Standard	-	$0.00	5	1.00	$0.000
Office Equip.	Desktop Computer	Energy Star	0.06	$0.00	5	1.05	$0.000
Office Equip.	Laptop	Standard	-	$0.00	4	1.00	$0.000
Office Equip.	Laptop	Energy Star	0.01	$0.00	4	1.02	$0.000
Office Equip.	Server	Standard	-	$0.00	3	1.00	$0.000
Office Equip.	Server	Energy Star	0.03	$0.00	3	1.04	$0.000
Office Equip.	Monitor	Standard	-	$0.00	4	1.00	$0.000
Office Equip.	Monitor	Energy Star	0.01	$0.00	4	1.02	$0.000
Office Equip.	Printer/Copier/Fax	Standard	-	$0.00	6	1.00	$0.000
Office Equip.	Printer/Copier/Fax	Energy Star	0.01	$0.00	6	1.10	$0.000
Office Equip.	POS Terminal	Standard	-	$0.00	4	1.00	$0.000
Office Equip.	POS Terminal	Energy Star	0.04	$0.02	4	0.95	$0.152
Miscellaneous	Non-HVAC Motors	Standard (EPAct)	-	$0.00	15	1.00	$0.000
Miscellaneous	Non-HVAC Motors	Standard (EPAct 2015)	0.00	$0.00	15	-	$0.000
Miscellaneous	Non-HVAC Motors	High Eff.	0.00	$0.00	15	1.01	$0.010
Miscellaneous	Non-HVAC Motors	High Eff. (2015)	0.01	$0.00	15	-	$0.007
Miscellaneous	Non-HVAC Motors	Premium (NEMA)	0.01	$0.00	15	1.02	$0.010
Miscellaneous	Non-HVAC Motors	Premium (NEMA 2015)	0.01	$0.00	15	-	$0.008
Miscellaneous	Pool Pump	Standard	-	$0.00	15	1.00	$0.000
Miscellaneous	Pool Pump	High Eff.	-	$0.00	15	1.00	$0.000
Miscellaneous	Pool Pump	High Eff. Multi-Speed	-	$0.00	15	1.00	$0.000
Miscellaneous	Pool Heater	Standard	-	$0.00	15	1.00	$0.000
Miscellaneous	Pool Heater	Heat Pump	-	$0.00	15	1.00	$0.000
Miscellaneous	Miscellaneous	Standard	-	$0.00	5	1.00	$0.000

Table C-13 Energy Efficiency Equipment Data, Electric—College, Existing Vintage

End Use	Technology	Efficiency Definition	Savings (kWh/SQ FT/yr)	Incremental Cost ($/SQ FT)	Lifetime (Years)	BC Ratio	Levelized Cost of Energy ($/kWh)
Cooling	Air-Cooled Chiller	1.5 kw/ton, COP 2.3	-	$0.00	20	1.00	$0.000
Cooling	Air-Cooled Chiller	1.3 kw/ton, COP 2.7	0.96	$0.45	20	1.12	$0.036
Cooling	Air-Cooled Chiller	1.26 kw/ton, COP 2.8	1.08	$0.59	20	1.13	$0.042
Cooling	Air-Cooled Chiller	1.0 kw/ton, COP 3.5	1.28	$0.72	20	1.16	$0.044
Cooling	Air-Cooled Chiller	0.97 kw/ton, COP 3.6	1.53	$0.86	20	1.19	$0.043
Cooling	Water-Cooled Chiller	0.75 kw/ton, COP 4.7	-	$0.00	20	1.00	$0.000
Cooling	Water-Cooled Chiller	0.60 kw/ton, COP 5.9	1.24	$0.22	20	1.17	$0.014
Cooling	Water-Cooled Chiller	0.58 kw/ton, COP 6.1	1.40	$0.44	20	1.17	$0.024
Cooling	Water-Cooled Chiller	0.55 kw/Ton, COP 6.4	1.65	$0.53	20	1.21	$0.025
Cooling	Water-Cooled Chiller	0.51 kw/ton, COP 6.9	1.98	$0.82	20	1.24	$0.032
Cooling	Water-Cooled Chiller	0.50 kw/Ton, COP 7.0	2.07	$0.90	20	1.24	$0.034
Cooling	Water-Cooled Chiller	0.48 kw/ton, COP 7.3	2.23	$0.99	20	1.26	$0.034
Cooling	Roof top AC	EER 9.2	-	$0.00	16	-	$0.000
Cooling	Roof top AC	EER 10.1	0.43	$0.44	16	-	$0.089
Cooling	Roof top AC	EER 11.2	0.87	$0.84	16	1.00	$0.085
Cooling	Roof top AC	EER 12.0	1.14	$1.61	16	0.96	$0.125
Cooling	Roof top AC	Ductless Minisplit	1.42	$5.27	16	0.71	$0.328
Cooling	Air Source Heat Pump	EER 9.3, COP 3.1	-	$0.00	16	-	$0.000
Cooling	Air Source Heat Pump	EER 10.3, COP 3.2	0.41	$0.47	16	-	$0.101
Cooling	Air Source Heat Pump	EER 11.0, COP 3.3	0.66	$0.68	16	1.00	$0.092
Cooling	Air Source Heat Pump	EER 11.7, COP 3.4	0.87	$1.74	16	0.92	$0.177
Cooling	Air Source Heat Pump	EER 12.0, COP 3.4	0.96	$2.28	16	0.88	$0.210
Cooling	Air Source Heat Pump	Ductless Minisplit	1.21	$4.36	16	0.74	$0.319
Cooling	Geo Heat Pump	EER 14.1, COP 3.3	-	$0.00	16	1.00	$0.000
Cooling	Geo Heat Pump	EER 16, COP 3.5	0.52	$2.31	16	0.93	$0.393
Cooling	Geo Heat Pump	EER 18, COP 3.8	0.95	$4.61	16	0.87	$0.431
Cooling	Geo Heat Pump	EER 30, COP 5.0	2.32	$6.09	16	0.88	$0.232
Cooling	Other Cooling	EER 9.8	-	$0.00	14	1.00	$0.000
Cooling	Other Cooling	EER 10.2	0.06	$0.05	14	1.01	$0.076
Cooling	Other Cooling	EER 10.8	0.11	$0.52	14	0.92	$0.443
Cooling	Other Cooling	EER 11	0.17	$0.55	14	0.92	$0.318
Cooling	Other Cooling	EER 11.5	0.22	$0.63	14	0.92	$0.277
Heating	Air Source Heat Pump	EER 9.3, COP 3.1	-	$0.00	16	-	$0.000
Heating	Air Source Heat Pump	EER 10.3, COP 3.2	0.14	$0.17	16	-	$0.109
Heating	Air Source Heat Pump	EER 11.0, COP 3.3	0.27	$0.25	16	1.00	$0.081
Heating	Air Source Heat Pump	EER 11.7, COP 3.4	0.39	$0.63	16	0.95	$0.142
Heating	Air Source Heat Pump	EER 12.0, COP 3.4	0.39	$0.82	16	0.92	$0.186
Heating	Air Source Heat Pump	Ductless Minisplit	0.51	$1.58	16	0.82	$0.276
Heating	Geo Heat Pump	EER 14.1, COP 3.3	-	$0.00	16	1.00	$0.000
Heating	Geo Heat Pump	EER 16, COP 3.5	0.60	$0.53	16	0.98	$0.079
Heating	Geo Heat Pump	EER 18, COP 3.8	1.09	$1.07	16	0.96	$0.087
Heating	Geo Heat Pump	EER 30, COP 5.0	1.40	$1.41	16	0.94	$0.089
Heating	Electric Room Heat	Standard	-	$0.00	25	1.00	$0.000
Heating	Electric Furnace	Standard	-	$0.00	25	1.00	$0.000
Ventilation	Ventilation	Constant Volume	-	$0.00	10	1.00	$0.000
Ventilation	Ventilation	Variable Air Volume	1.01	-$0.29	10	1.08	-$0.036
Water Heating	Water Heating	EF .97	-	$0.00	15	1.00	$0.000
Water Heating	Water Heating	EF .98	0.02	$0.00	15	1.01	$0.024
Water Heating	Water Heating	EF 2.0	0.89	$0.01	15	2.01	$0.001
Water Heating	Water Heating	EF 2.3	1.00	$0.01	15	2.28	$0.001
Water Heating	Water Heating	EF 2.4	1.03	$0.01	15	2.37	$0.001
Int. Lighting	Screw-in	Incandescent	-	$0.00	2	1.00	$0.000
Int. Lighting	Screw-in	90W Halogen PAR-38	1.32	$0.03	3	-	$0.009
Int. Lighting	Screw-in	70W HIR PAR-38	2.03	$0.05	3	-	$0.008
Int. Lighting	Screw-in	CFL	3.81	$0.03	6	3.59	$0.001
Int. Lighting	Screw-in	LED (2010)	4.12	$0.74	20	2.48	$0.014
Int. Lighting	Screw-in	LED (2020)	4.74	$0.21	20	-	$0.003
Int. Lighting	High-Bay Fixtures	Metal Halides	-	$0.00	3	1.00	$0.000
Int. Lighting	High-Bay Fixtures	LED (2010)	0.08	$0.07	15	0.85	$0.089

End Use	Technology	Efficiency Definition	Savings (kWh/SQ FT/yr)	Incremental Cost ($/SQ FT)	Lifetime (Years)	BC Ratio	Levelized Cost of Energy ($/kWh)
Int. Lighting	High-Bay Fixtures	T8	0.08	$0.00	10	1.71	-$0.003
Int. Lighting	High-Bay Fixtures	HP Sodium	0.08	$0.00	6	1.76	$0.001
Int. Lighting	High-Bay Fixtures	Light Emitting Plasma	0.10	$0.00	15	1.88	$0.001
Int. Lighting	High-Bay Fixtures	T5	0.10	$0.00	10	2.12	-$0.001
Int. Lighting	High-Bay Fixtures	LED (2020)	0.15	$0.02	15	-	$0.012
Int. Lighting	Linear Fluorescent	T12	-	$0.00	10	1.00	$0.000
Int. Lighting	Linear Fluorescent	LED (2010)	0.92	$2.25	15	0.64	$0.227
Int. Lighting	Linear Fluorescent	T8	0.95	$0.00	10	1.34	$0.000
Int. Lighting	Linear Fluorescent	Super T8	1.32	$0.02	10	1.53	$0.001
Int. Lighting	Linear Fluorescent	T5	1.53	$0.02	10	1.66	$0.002
Int. Lighting	Linear Fluorescent	LED (2020)	2.80	$0.62	15	-	$0.021
Ext. Lighting	Screw-in	Incandescent	-	$0.00	2	1.00	$0.000
Ext. Lighting	Screw-in	90W Halogen PAR-38	0.05	$0.00	3	-	$0.009
Ext. Lighting	Screw-in	70W HIR PAR-38	0.07	$0.00	3	-	$0.008
Ext. Lighting	Screw-in	CFL	0.13	$0.00	6	3.44	$0.001
Ext. Lighting	Screw-in	LED (2010)	0.14	$0.03	20	2.12	$0.014
Ext. Lighting	Screw-in	LED (2020)	0.16	$0.01	20	-	$0.003
Ext. Lighting	HID	Metal Halides	-	$0.00	3	1.00	$0.000
Ext. Lighting	HID	LED (2010)	0.35	$0.28	15	0.80	$0.074
Ext. Lighting	HID	T8	0.36	-$0.01	10	1.66	-$0.003
Ext. Lighting	HID	HP Sodium	0.38	$0.00	6	1.73	$0.001
Ext. Lighting	HID	Light Emitting Plasma	0.44	$0.00	15	1.80	$0.001
Ext. Lighting	HID	T5	0.45	$0.00	10	2.05	-$0.001
Ext. Lighting	HID	LED (2020)	0.67	$0.07	15	-	$0.010
Ext. Lighting	Linear Fluorescent	T12	-	$0.00	10	1.00	$0.000
Ext. Lighting	Linear Fluorescent	LED (2010)	0.00	$0.00	15	0.56	$0.227
Ext. Lighting	Linear Fluorescent	T8	0.00	$0.00	10	1.34	$0.000
Ext. Lighting	Linear Fluorescent	Super T8	0.00	$0.00	10	1.52	$0.001
Ext. Lighting	Linear Fluorescent	T5	0.00	$0.00	10	1.65	$0.002
Ext. Lighting	Linear Fluorescent	LED (2020)	0.00	$0.00	15	-	$0.021
Refrigeration	Walk-in Refrigerator	14600 kWh/yr	-	$0.00	12	1.00	$0.000
Refrigeration	Walk-in Refrigerator	10800 kWh/yr	0.03	$0.00	12	1.16	$0.011
Refrigeration	Walk-in Refrigerator	10000 kWh/yr	0.03	$0.00	12	1.20	$0.012
Refrigeration	Walk-in Refrigerator	9000 kWh/yr	0.04	$0.01	12	1.22	$0.017
Refrigeration	Reach-in Refrigerator	3800 kWh/yr	-	$0.00	12	1.00	$0.000
Refrigeration	Reach-in Refrigerator	3100 kWh/yr	0.01	$0.00	12	1.12	$0.017
Refrigeration	Reach-in Refrigerator	2500 kWh/yr	0.02	$0.00	12	1.25	$0.018
Refrigeration	Reach-in Refrigerator	2400 kWh/yr	0.02	$0.00	12	1.28	$0.018
Refrigeration	Reach-in Refrigerator	1500 kWh/yr	0.04	$0.00	12	1.69	$0.011
Refrigeration	Glass Door Display	14480 kWh/yr	-	$0.00	12	-	$0.000
Refrigeration	Glass Door Display	11700 kWh/yr	0.02	$0.01	12	-	$0.072
Refrigeration	Glass Door Display	8400 kWh/yr	0.05	$0.00	12	1.00	$0.000
Refrigeration	Glass Door Display	6800 kWh/yr	0.06	$0.01	12	0.91	$0.026
Refrigeration	Open Display Case	6500 kWh/yr	-	$0.00	18	-	$0.000
Refrigeration	Open Display Case	5350 kWh/yr	0.01	$0.00	18	1.00	$0.000
Refrigeration	Open Display Case	5300 kWh/yr	0.01	$0.01	18	-	$0.056
Refrigeration	Open Display Case	4330 kWh/yr	0.02	$0.01	18	1.00	$0.032
Refrigeration	Icemaker	7.0 kWh/100 lbs	-	$0.00	10	1.00	$0.000
Refrigeration	Icemaker	6.3 kWh/100 lbs	0.01	$0.00	10	1.01	$0.054
Refrigeration	Icemaker	6.0 kWh/100 lbs	0.01	$0.00	10	1.01	$0.057
Refrigeration	Icemaker	5.5 kWh/100 lbs	0.01	$0.02	10	0.88	$0.142
Refrigeration	Vending Machine	3400 kWh/year	-	$0.00	10	1.00	$0.000
Refrigeration	Vending Machine	3000 kWh/year	0.01	$0.00	10	1.05	$0.012
Refrigeration	Vending Machine	2400 kWh/year	0.02	$0.00	10	1.14	$0.012
Refrigeration	Vending Machine	1700 kWh/year	0.03	$0.00	10	1.20	$0.022
Food Prep.	Oven	Standard	-	$0.00	12	1.00	$0.000
Food Prep.	Oven	Energy Star	0.04	$0.00	12	1.13	$0.000
Food Prep.	Fryer	Standard	-	$0.00	12	1.00	$0.000
Food Prep.	Fryer	Energy Star	0.02	$0.01	12	1.04	$0.024
Food Prep.	Dishwasher	Standard	-	$0.00	12	1.00	$0.000
Food Prep.	Dishwasher	Energy Star	0.18	$0.01	12	1.35	$0.005
Food Prep.	Hot Food Container	Standard	-	$0.00	12	1.00	$0.000

End Use	Technology	Efficiency Definition	Savings (kWh/SQ FT/yr)	Incremental Cost ($/SQ FT)	Lifetime (Years)	BC Ratio	Levelized Cost of Energy ($/kWh)
Food Prep.	Hot Food Container	Energy Star	0.12	$0.03	12	1.33	$0.024
Office Equip.	Desktop Computer	Standard	-	$0.00	5	1.00	$0.000
Office Equip.	Desktop Computer	Energy Star	0.16	$0.00	5	1.05	$0.000
Office Equip.	Laptop	Standard	-	$0.00	4	1.00	$0.000
Office Equip.	Laptop	Energy Star	0.02	$0.00	4	1.02	$0.000
Office Equip.	Server	Standard	-	$0.00	3	1.00	$0.000
Office Equip.	Server	Energy Star	0.05	$0.00	3	1.03	$0.000
Office Equip.	Monitor	Standard	-	$0.00	4	1.00	$0.000
Office Equip.	Monitor	Energy Star	0.02	$0.00	4	1.02	$0.000
Office Equip.	Printer/Copier/Fax	Standard	-	$0.00	6	1.00	$0.000
Office Equip.	Printer/Copier/Fax	Energy Star	0.04	$0.00	6	1.09	$0.000
Office Equip.	POS Terminal	Standard	-	$0.00	4	1.00	$0.000
Office Equip.	POS Terminal	Energy Star	0.04	$0.02	4	0.95	$0.152
Miscellaneous	Non-HVAC Motors	Standard (EPAct)	-	$0.00	15	1.00	$0.000
Miscellaneous	Non-HVAC Motors	Standard (EPAct 2015)	0.00	$0.00	15	-	$0.000
Miscellaneous	Non-HVAC Motors	High Eff.	0.00	$0.00	15	1.01	$0.010
Miscellaneous	Non-HVAC Motors	High Eff. (2015)	0.00	$0.00	15	-	$0.007
Miscellaneous	Non-HVAC Motors	Premium (NEMA)	0.00	$0.00	15	1.02	$0.010
Miscellaneous	Non-HVAC Motors	Premium (NEMA 2015)	0.00	$0.00	15	-	$0.008
Miscellaneous	Pool Pump	Standard	-	$0.00	15	1.00	$0.000
Miscellaneous	Pool Pump	High Eff.	0.00	$0.00	15	1.05	$0.030
Miscellaneous	Pool Pump	High Eff. Multi-Speed	0.00	$0.00	15	1.10	$0.051
Miscellaneous	Pool Heater	Standard	-	$0.00	15	1.00	$0.000
Miscellaneous	Pool Heater	Heat Pump	0.01	$0.01	15	1.09	$0.059
Miscellaneous	Miscellaneous	Standard	-	$0.00	5	1.00	$0.000

Table C-14 Energy Efficiency Equipment Data, Electric— College, New Vintage

End Use	Technology	Efficiency Definition	Savings (kWh/SQ FT/yr)	Incremental Cost ($/SQ FT)	Lifetime (Years)	BC Ratio	Levelized Cost of Energy ($/kWh)
Cooling	Air-Cooled Chiller	1.5 kw/ton, COP 2.3	-	$0.00	20	1.00	$0.000
Cooling	Air-Cooled Chiller	1.3 kw/ton, COP 2.7	0.86	$0.47	20	1.11	$0.042
Cooling	Air-Cooled Chiller	1.26 kw/ton, COP 2.8	0.98	$0.61	20	1.12	$0.048
Cooling	Air-Cooled Chiller	1.0 kw/ton, COP 3.5	1.15	$0.75	20	1.14	$0.050
Cooling	Air-Cooled Chiller	0.97 kw/ton, COP 3.6	1.38	$0.88	20	1.17	$0.049
Cooling	Water-Cooled Chiller	0.75 kw/ton, COP 4.7	-	$0.00	20	1.00	$0.000
Cooling	Water-Cooled Chiller	0.60 kw/ton, COP 5.9	1.13	$0.23	20	1.16	$0.016
Cooling	Water-Cooled Chiller	0.58 kw/ton, COP 6.1	1.28	$0.46	20	1.16	$0.028
Cooling	Water-Cooled Chiller	0.55 kw/Ton, COP 6.4	1.50	$0.55	20	1.19	$0.028
Cooling	Water-Cooled Chiller	0.51 kw/ton, COP 6.9	1.81	$0.85	20	1.21	$0.036
Cooling	Water-Cooled Chiller	0.50 kw/Ton, COP 7.0	1.88	$0.94	20	1.22	$0.039
Cooling	Water-Cooled Chiller	0.48 kw/ton, COP 7.3	2.03	$1.04	20	1.24	$0.039
Cooling	Roof top AC	EER 9.2	-	$0.00	16	-	$0.000
Cooling	Roof top AC	EER 10.1	0.41	$0.45	16	-	$0.098
Cooling	Roof top AC	EER 11.2	0.83	$0.87	16	1.00	$0.094
Cooling	Roof top AC	EER 12.0	1.08	$1.68	16	0.95	$0.138
Cooling	Roof top AC	Ductless Minisplit	1.35	$5.51	16	0.69	$0.360
Cooling	Air Source Heat Pump	EER 9.3, COP 3.1	-	$0.00	16	-	$0.000
Cooling	Air Source Heat Pump	EER 10.3, COP 3.2	0.38	$0.47	16	-	$0.111
Cooling	Air Source Heat Pump	EER 11.0, COP 3.3	0.60	$0.68	16	1.00	$0.101
Cooling	Air Source Heat Pump	EER 11.7, COP 3.4	0.80	$1.75	16	0.91	$0.194
Cooling	Air Source Heat Pump	EER 12.0, COP 3.4	0.87	$2.28	16	0.87	$0.231
Cooling	Air Source Heat Pump	Ductless Minisplit	1.10	$4.37	16	0.73	$0.350
Cooling	Geo Heat Pump	EER 14.1, COP 3.3	-	$0.00	16	1.00	$0.000
Cooling	Geo Heat Pump	EER 16, COP 3.5	0.49	$2.39	16	0.93	$0.432
Cooling	Geo Heat Pump	EER 18, COP 3.8	0.89	$4.77	16	0.86	$0.473
Cooling	Geo Heat Pump	EER 30, COP 5.0	2.18	$6.29	16	0.87	$0.255
Cooling	Other Cooling	EER 9.8	-	$0.00	14	1.00	$0.000
Cooling	Other Cooling	EER 10.2	0.06	$0.05	14	1.00	$0.085

End Use	Technology	Efficiency Definition	Savings (kWh/SQ FT/yr)	Incremental Cost ($/SQ FT)	Lifetime (Years)	BC Ratio	Levelized Cost of Energy ($/kWh)
Cooling	Other Cooling	EER 10.8	0.11	$0.55	14	0.91	$0.494
Cooling	Other Cooling	EER 11	0.16	$0.59	14	0.91	$0.355
Cooling	Other Cooling	EER 11.5	0.21	$0.67	14	0.91	$0.309
Heating	Air Source Heat Pump	EER 9.3, COP 3.1	-	$0.00	16	-	$0.000
Heating	Air Source Heat Pump	EER 10.3, COP 3.2	0.13	$0.23	16	-	$0.154
Heating	Air Source Heat Pump	EER 11.0, COP 3.3	0.25	$0.33	16	1.00	$0.114
Heating	Air Source Heat Pump	EER 11.7, COP 3.4	0.37	$0.84	16	0.93	$0.202
Heating	Air Source Heat Pump	EER 12.0, COP 3.4	0.37	$1.09	16	0.89	$0.264
Heating	Air Source Heat Pump	Ductless Minisplit	0.47	$2.09	16	0.78	$0.392
Heating	Geo Heat Pump	EER 14.1, COP 3.3	-	$0.00	16	1.00	$0.000
Heating	Geo Heat Pump	EER 16, COP 3.5	0.58	$0.73	16	0.96	$0.111
Heating	Geo Heat Pump	EER 18, COP 3.8	1.06	$1.45	16	0.92	$0.122
Heating	Geo Heat Pump	EER 30, COP 5.0	1.29	$1.92	16	0.89	$0.132
Heating	Electric Room Heat	Standard	-	$0.00	25	1.00	$0.000
Heating	Electric Furnace	Standard	-	$0.00	25	1.00	$0.000
Ventilation	Ventilation	Constant Volume	-	$0.00	10	1.00	$0.000
Ventilation	Ventilation	Variable Air Volume	1.02	-$0.29	10	1.08	-$0.035
Water Heating	Water Heating	EF .97	-	$0.00	15	1.00	$0.000
Water Heating	Water Heating	EF .98	0.02	$0.00	15	1.01	$0.023
Water Heating	Water Heating	EF 2.0	0.88	$0.01	15	2.01	$0.001
Water Heating	Water Heating	EF 2.3	0.99	$0.01	15	2.29	$0.001
Water Heating	Water Heating	EF 2.4	1.02	$0.01	15	2.38	$0.001
Int. Lighting	Screw-in	Incandescent	-	$0.00	2	1.00	$0.000
Int. Lighting	Screw-in	90W Halogen PAR-38	1.32	$0.03	3	-	$0.009
Int. Lighting	Screw-in	70W HIR PAR-38	2.03	$0.05	3	-	$0.008
Int. Lighting	Screw-in	CFL	3.81	$0.03	6	3.59	$0.001
Int. Lighting	Screw-in	LED (2010)	4.12	$0.74	20	2.48	$0.014
Int. Lighting	Screw-in	LED (2020)	4.74	$0.21	20	-	$0.003
Int. Lighting	High-Bay Fixtures	Metal Halides	-	$0.00	3	1.00	$0.000
Int. Lighting	High-Bay Fixtures	LED (2010)	0.08	$0.07	15	0.85	$0.089
Int. Lighting	High-Bay Fixtures	T8	0.08	$0.00	10	1.71	-$0.003
Int. Lighting	High-Bay Fixtures	HP Sodium	0.08	$0.00	6	1.76	$0.001
Int. Lighting	High-Bay Fixtures	Light Emitting Plasma	0.10	$0.00	15	1.88	$0.001
Int. Lighting	High-Bay Fixtures	T5	0.10	$0.00	10	2.12	-$0.001
Int. Lighting	High-Bay Fixtures	LED (2020)	0.15	$0.02	15	-	$0.012
Int. Lighting	Linear Fluorescent	T12	-	$0.00	10	1.00	$0.000
Int. Lighting	Linear Fluorescent	LED (2010)	0.92	$2.25	15	0.64	$0.227
Int. Lighting	Linear Fluorescent	T8	0.95	$0.00	10	1.34	$0.000
Int. Lighting	Linear Fluorescent	Super T8	1.32	$0.02	10	1.53	$0.001
Int. Lighting	Linear Fluorescent	T5	1.53	$0.02	10	1.66	$0.002
Int. Lighting	Linear Fluorescent	LED (2020)	2.80	$0.62	15	-	$0.021
Ext. Lighting	Screw-in	Incandescent	-	$0.00	2	1.00	$0.000
Ext. Lighting	Screw-in	90W Halogen PAR-38	0.05	$0.00	3	-	$0.009
Ext. Lighting	Screw-in	70W HIR PAR-38	0.07	$0.00	3	-	$0.008
Ext. Lighting	Screw-in	CFL	0.13	$0.00	6	3.44	$0.001
Ext. Lighting	Screw-in	LED (2010)	0.14	$0.03	20	2.12	$0.014
Ext. Lighting	Screw-in	LED (2020)	0.16	$0.01	20	-	$0.003
Ext. Lighting	HID	Metal Halides	-	$0.00	3	1.00	$0.000
Ext. Lighting	HID	LED (2010)	0.35	$0.28	15	0.80	$0.074
Ext. Lighting	HID	T8	0.36	-$0.01	10	1.66	-$0.003
Ext. Lighting	HID	HP Sodium	0.38	$0.00	6	1.73	$0.001
Ext. Lighting	HID	Light Emitting Plasma	0.44	$0.00	15	1.80	$0.001
Ext. Lighting	HID	T5	0.45	$0.00	10	2.05	-$0.001
Ext. Lighting	HID	LED (2020)	0.67	$0.07	15	-	$0.010
Ext. Lighting	Linear Fluorescent	T12	-	$0.00	10	1.00	$0.000
Ext. Lighting	Linear Fluorescent	LED (2010)	0.00	$0.00	15	0.56	$0.227
Ext. Lighting	Linear Fluorescent	T8	0.00	$0.00	10	1.34	$0.000
Ext. Lighting	Linear Fluorescent	Super T8	0.00	$0.00	10	1.52	$0.001
Ext. Lighting	Linear Fluorescent	T5	0.00	$0.00	10	1.65	$0.002
Ext. Lighting	Linear Fluorescent	LED (2020)	0.00	$0.00	15	-	$0.021
Refrigeration	Walk-in Refrigerator	14600 kWh/yr	-	$0.00	12	1.00	$0.000
Refrigeration	Walk-in Refrigerator	10800 kWh/yr	0.03	$0.00	12	1.15	$0.012

End Use	Technology	Efficiency Definition	Savings (kWh/SQ FT/yr)	Incremental Cost ($/SQ FT)	Lifetime (Years)	BC Ratio	Levelized Cost of Energy ($/kWh)
Refrigeration	Walk-in Refrigerator	10000 kWh/yr	0.03	$0.00	12	1.19	$0.013
Refrigeration	Walk-in Refrigerator	9000 kWh/yr	0.04	$0.01	12	1.20	$0.019
Refrigeration	Reach-in Refrigerator	3800 kWh/yr	-	$0.00	12	1.00	$0.000
Refrigeration	Reach-in Refrigerator	3100 kWh/yr	0.01	$0.00	12	1.12	$0.019
Refrigeration	Reach-in Refrigerator	2500 kWh/yr	0.02	$0.00	12	1.23	$0.020
Refrigeration	Reach-in Refrigerator	2400 kWh/yr	0.02	$0.00	12	1.26	$0.020
Refrigeration	Reach-in Refrigerator	1500 kWh/yr	0.04	$0.00	12	1.64	$0.013
Refrigeration	Glass Door Display	14480 kWh/yr	-	$0.00	12	-	$0.000
Refrigeration	Glass Door Display	11700 kWh/yr	0.02	$0.01	12	-	$0.072
Refrigeration	Glass Door Display	8400 kWh/yr	0.05	$0.00	12	1.00	$0.000
Refrigeration	Glass Door Display	6800 kWh/yr	0.06	$0.01	12	0.91	$0.026
Refrigeration	Open Display Case	6500 kWh/yr	-	$0.00	18	-	$0.000
Refrigeration	Open Display Case	5350 kWh/yr	0.01	$0.00	18	1.00	$0.000
Refrigeration	Open Display Case	5300 kWh/yr	0.01	$0.01	18	-	$0.056
Refrigeration	Open Display Case	4330 kWh/yr	0.02	$0.01	18	1.00	$0.032
Refrigeration	Icemaker	7.0 kWh/100 lbs	-	$0.00	10	1.00	$0.000
Refrigeration	Icemaker	6.3 kWh/100 lbs	0.01	$0.00	10	1.01	$0.054
Refrigeration	Icemaker	6.0 kWh/100 lbs	0.01	$0.00	10	1.01	$0.057
Refrigeration	Icemaker	5.5 kWh/100 lbs	0.01	$0.02	10	0.88	$0.142
Refrigeration	Vending Machine	3400 kWh/year	-	$0.00	10	1.00	$0.000
Refrigeration	Vending Machine	3000 kWh/year	0.01	$0.00	10	1.05	$0.012
Refrigeration	Vending Machine	2400 kWh/year	0.02	$0.00	10	1.14	$0.012
Refrigeration	Vending Machine	1700 kWh/year	0.03	$0.00	10	1.20	$0.022
Food Prep.	Oven	Standard	-	$0.00	12	1.00	$0.000
Food Prep.	Oven	Energy Star	0.04	$0.00	12	1.13	$0.000
Food Prep.	Fryer	Standard	-	$0.00	12	1.00	$0.000
Food Prep.	Fryer	Energy Star	0.02	$0.01	12	1.04	$0.024
Food Prep.	Dishwasher	Standard	-	$0.00	12	1.00	$0.000
Food Prep.	Dishwasher	Energy Star	0.18	$0.01	12	1.35	$0.005
Food Prep.	Hot Food Container	Standard	-	$0.00	12	1.00	$0.000
Food Prep.	Hot Food Container	Energy Star	0.12	$0.03	12	1.33	$0.024
Office Equip.	Desktop Computer	Standard	-	$0.00	5	1.00	$0.000
Office Equip.	Desktop Computer	Energy Star	0.16	$0.00	5	1.05	$0.000
Office Equip.	Laptop	Standard	-	$0.00	4	1.00	$0.000
Office Equip.	Laptop	Energy Star	0.02	$0.00	4	1.02	$0.000
Office Equip.	Server	Standard	-	$0.00	3	1.00	$0.000
Office Equip.	Server	Energy Star	0.05	$0.00	3	1.03	$0.000
Office Equip.	Monitor	Standard	-	$0.00	4	1.00	$0.000
Office Equip.	Monitor	Energy Star	0.02	$0.00	4	1.02	$0.000
Office Equip.	Printer/Copier/Fax	Standard	-	$0.00	6	1.00	$0.000
Office Equip.	Printer/Copier/Fax	Energy Star	0.04	$0.00	6	1.09	$0.000
Office Equip.	POS Terminal	Standard	-	$0.00	4	1.00	$0.000
Office Equip.	POS Terminal	Energy Star	0.04	$0.02	4	0.95	$0.152
Miscellaneous	Non-HVAC Motors	Standard (EPAct)	-	$0.00	15	1.00	$0.000
Miscellaneous	Non-HVAC Motors	Standard (EPAct 2015)	0.00	$0.00	15	-	$0.000
Miscellaneous	Non-HVAC Motors	High Eff.	0.00	$0.00	15	1.01	$0.010
Miscellaneous	Non-HVAC Motors	High Eff. (2015)	0.00	$0.00	15	-	$0.007
Miscellaneous	Non-HVAC Motors	Premium (NEMA)	0.00	$0.00	15	1.02	$0.010
Miscellaneous	Non-HVAC Motors	Premium (NEMA 2015)	0.00	$0.00	15	-	$0.008
Miscellaneous	Pool Pump	Standard	-	$0.00	15	1.00	$0.000
Miscellaneous	Pool Pump	High Eff.	0.00	$0.00	15	1.05	$0.030
Miscellaneous	Pool Pump	High Eff. Multi-Speed	0.00	$0.00	15	1.10	$0.051
Miscellaneous	Pool Heater	Standard	-	$0.00	15	1.00	$0.000
Miscellaneous	Pool Heater	Heat Pump	0.01	$0.01	15	1.09	$0.059
Miscellaneous	Miscellaneous	Standard	-	$0.00	5	1.00	$0.000

Table C-15 Energy Efficiency Equipment Data, Electric—School, Existing Vintage

End Use	Technology	Efficiency Definition	Savings (kWh/SQ FT/yr)	Incremental Cost ($/SQ FT)	Lifetime (Years)	BC Ratio	Levelized Cost of Energy ($/kWh)
Cooling	Air-Cooled Chiller	1.5 kw/ton, COP 2.3	-	$0.00	20	1.00	$0.000
Cooling	Air-Cooled Chiller	1.3 kw/ton, COP 2.7	0.59	$0.28	20	1.16	$0.036
Cooling	Air-Cooled Chiller	1.26 kw/ton, COP 2.8	0.66	$0.36	20	1.18	$0.042
Cooling	Air-Cooled Chiller	1.0 kw/ton, COP 3.5	0.78	$0.44	20	1.21	$0.044
Cooling	Air-Cooled Chiller	0.97 kw/ton, COP 3.6	0.94	$0.52	20	1.27	$0.043
Cooling	Water-Cooled Chiller	0.75 kw/ton, COP 4.7	-	$0.00	20	1.00	$0.000
Cooling	Water-Cooled Chiller	0.60 kw/ton, COP 5.9	0.76	$0.13	20	1.19	$0.014
Cooling	Water-Cooled Chiller	0.58 kw/ton, COP 6.1	0.86	$0.27	20	1.21	$0.024
Cooling	Water-Cooled Chiller	0.55 kw/Ton, COP 6.4	1.01	$0.32	20	1.25	$0.025
Cooling	Water-Cooled Chiller	0.51 kw/ton, COP 6.9	1.22	$0.50	20	1.30	$0.032
Cooling	Water-Cooled Chiller	0.50 kw/Ton, COP 7.0	1.27	$0.55	20	1.31	$0.034
Cooling	Water-Cooled Chiller	0.48 kw/ton, COP 7.3	1.37	$0.61	20	1.34	$0.034
Cooling	Roof top AC	EER 9.2	-	$0.00	16	-	$0.000
Cooling	Roof top AC	EER 10.1	0.27	$0.27	16	-	$0.089
Cooling	Roof top AC	EER 11.2	0.53	$0.51	16	1.00	$0.085
Cooling	Roof top AC	EER 12.0	0.70	$0.98	16	0.98	$0.125
Cooling	Roof top AC	Ductless Minisplit	0.87	$3.23	16	0.78	$0.328
Cooling	Air Source Heat Pump	EER 9.3, COP 3.1	-	$0.00	16	-	$0.000
Cooling	Air Source Heat Pump	EER 10.3, COP 3.2	0.25	$0.29	16	-	$0.101
Cooling	Air Source Heat Pump	EER 11.0, COP 3.3	0.40	$0.42	16	1.00	$0.092
Cooling	Air Source Heat Pump	EER 11.7, COP 3.4	0.53	$1.07	16	0.95	$0.177
Cooling	Air Source Heat Pump	EER 12.0, COP 3.4	0.59	$1.39	16	0.92	$0.210
Cooling	Air Source Heat Pump	Ductless Minisplit	0.74	$2.67	16	0.81	$0.319
Cooling	Geo Heat Pump	EER 14.1, COP 3.3	-	$0.00	16	1.00	$0.000
Cooling	Geo Heat Pump	EER 16, COP 3.5	0.32	$1.41	16	0.96	$0.393
Cooling	Geo Heat Pump	EER 18, COP 3.8	0.58	$2.83	16	0.91	$0.431
Cooling	Geo Heat Pump	EER 30, COP 5.0	1.42	$3.73	16	0.96	$0.232
Cooling	Other Cooling	EER 9.8	-	$0.00	14	1.00	$0.000
Cooling	Other Cooling	EER 10.2	0.04	$0.03	14	1.01	$0.076
Cooling	Other Cooling	EER 10.8	0.07	$0.32	14	0.95	$0.443
Cooling	Other Cooling	EER 11	0.10	$0.34	14	0.96	$0.318
Cooling	Other Cooling	EER 11.5	0.13	$0.38	14	0.97	$0.277
Heating	Air Source Heat Pump	EER 9.3, COP 3.1	-	$0.00	16	-	$0.000
Heating	Air Source Heat Pump	EER 10.3, COP 3.2	0.10	$0.12	16	-	$0.109
Heating	Air Source Heat Pump	EER 11.0, COP 3.3	0.19	$0.17	16	1.00	$0.081
Heating	Air Source Heat Pump	EER 11.7, COP 3.4	0.27	$0.44	16	0.95	$0.142
Heating	Air Source Heat Pump	EER 12.0, COP 3.4	0.27	$0.57	16	0.92	$0.186
Heating	Air Source Heat Pump	Ductless Minisplit	0.35	$1.09	16	0.82	$0.276
Heating	Geo Heat Pump	EER 14.1, COP 3.3	-	$0.00	16	1.00	$0.000
Heating	Geo Heat Pump	EER 16, COP 3.5	0.42	$0.37	16	0.98	$0.079
Heating	Geo Heat Pump	EER 18, COP 3.8	0.76	$0.74	16	0.96	$0.087
Heating	Geo Heat Pump	EER 30, COP 5.0	0.97	$0.98	16	0.94	$0.089
Heating	Electric Room Heat	Standard	-	$0.00	25	1.00	$0.000
Heating	Electric Furnace	Standard	-	$0.00	25	1.00	$0.000
Ventilation	Ventilation	Constant Volume	-	$0.00	10	1.00	$0.000
Ventilation	Ventilation	Variable Air Volume	0.62	-$0.18	10	1.08	-$0.036
Water Heating	Water Heating	EF .97	-	$0.00	15	1.00	$0.000
Water Heating	Water Heating	EF .98	0.01	$0.00	15	1.01	$0.024
Water Heating	Water Heating	EF 2.0	0.56	$0.01	15	2.00	$0.001
Water Heating	Water Heating	EF 2.3	0.63	$0.01	15	2.27	$0.001
Water Heating	Water Heating	EF 2.4	0.65	$0.01	15	2.36	$0.001
Int. Lighting	Screw-in	Incandescent	-	$0.00	2	1.00	$0.000
Int. Lighting	Screw-in	90W Halogen PAR-38	1.59	$0.10	3	-	$0.022
Int. Lighting	Screw-in	70W HIR PAR-38	2.45	$0.14	3	-	$0.020
Int. Lighting	Screw-in	CFL	4.58	$0.08	6	3.19	$0.003
Int. Lighting	Screw-in	LED (2010)	4.96	$2.14	20	1.41	$0.033
Int. Lighting	Screw-in	LED (2020)	5.70	$0.60	20	-	$0.008
Int. Lighting	High-Bay Fixtures	Metal Halides	-	$0.00	3	1.00	$0.000
Int. Lighting	High-Bay Fixtures	LED (2010)	0.15	$0.36	15	0.53	$0.215

End Use	Technology	Efficiency Definition	Savings (kWh/SQ FT/yr)	Incremental Cost ($/SQ FT)	Lifetime (Years)	BC Ratio	Levelized Cost of Energy ($/kWh)
Int. Lighting	High-Bay Fixtures	T8	0.16	-$0.01	10	1.88	-$0.008
Int. Lighting	High-Bay Fixtures	HP Sodium	0.17	$0.00	6	1.74	$0.002
Int. Lighting	High-Bay Fixtures	Light Emitting Plasma	0.20	$0.01	15	1.92	$0.003
Int. Lighting	High-Bay Fixtures	T5	0.20	-$0.01	10	2.26	-$0.004
Int. Lighting	High-Bay Fixtures	LED (2020)	0.30	$0.09	15	-	$0.029
Int. Lighting	Linear Fluorescent	T12	-	$0.00	10	1.00	$0.000
Int. Lighting	Linear Fluorescent	LED (2010)	0.49	$2.91	15	0.35	$0.546
Int. Lighting	Linear Fluorescent	T8	0.51	$0.00	10	1.33	$0.000
Int. Lighting	Linear Fluorescent	Super T8	0.71	$0.02	10	1.49	$0.003
Int. Lighting	Linear Fluorescent	T5	0.82	$0.03	10	1.59	$0.005
Int. Lighting	Linear Fluorescent	LED (2020)	1.50	$0.81	15	-	$0.050
Ext. Lighting	Screw-in	Incandescent	-	$0.00	2	1.00	$0.000
Ext. Lighting	Screw-in	90W Halogen PAR-38	0.03	$0.00	3	-	$0.022
Ext. Lighting	Screw-in	70W HIR PAR-38	0.04	$0.00	3	-	$0.020
Ext. Lighting	Screw-in	CFL	0.08	$0.00	6	3.08	$0.003
Ext. Lighting	Screw-in	LED (2010)	0.09	$0.04	20	1.27	$0.033
Ext. Lighting	Screw-in	LED (2020)	0.10	$0.01	20	-	$0.008
Ext. Lighting	HID	Metal Halides	-	$0.00	3	1.00	$0.000
Ext. Lighting	HID	LED (2010)	0.27	$0.53	15	0.54	$0.178
Ext. Lighting	HID	T8	0.28	-$0.01	10	1.83	-$0.006
Ext. Lighting	HID	HP Sodium	0.30	$0.00	6	1.73	$0.002
Ext. Lighting	HID	Light Emitting Plasma	0.35	$0.01	15	1.87	$0.002
Ext. Lighting	HID	T5	0.36	-$0.01	10	2.20	-$0.003
Ext. Lighting	HID	LED (2020)	0.52	$0.14	15	-	$0.024
Ext. Lighting	Linear Fluorescent	T12	-	$0.00	10	1.00	$0.000
Ext. Lighting	Linear Fluorescent	LED (2010)	0.00	$0.00	15	0.32	$0.546
Ext. Lighting	Linear Fluorescent	T8	0.00	$0.00	10	1.33	$0.000
Ext. Lighting	Linear Fluorescent	Super T8	0.00	$0.00	10	1.48	$0.003
Ext. Lighting	Linear Fluorescent	T5	0.00	$0.00	10	1.58	$0.005
Ext. Lighting	Linear Fluorescent	LED (2020)	0.00	$0.00	15	-	$0.050
Refrigeration	Walk-in Refrigerator	14600 kWh/yr	-	$0.00	12	1.00	$0.000
Refrigeration	Walk-in Refrigerator	10800 kWh/yr	0.03	$0.01	12	1.07	$0.028
Refrigeration	Walk-in Refrigerator	10000 kWh/yr	0.04	$0.01	12	1.08	$0.029
Refrigeration	Walk-in Refrigerator	9000 kWh/yr	0.05	$0.02	12	1.06	$0.043
Refrigeration	Reach-in Refrigerator	3800 kWh/yr	-	$0.00	12	1.00	$0.000
Refrigeration	Reach-in Refrigerator	3100 kWh/yr	0.01	$0.00	12	1.04	$0.042
Refrigeration	Reach-in Refrigerator	2500 kWh/yr	0.02	$0.01	12	1.07	$0.044
Refrigeration	Reach-in Refrigerator	2400 kWh/yr	0.03	$0.01	12	1.08	$0.044
Refrigeration	Reach-in Refrigerator	1500 kWh/yr	0.04	$0.01	12	1.28	$0.028
Refrigeration	Glass Door Display	14480 kWh/yr	-	$0.00	12	-	$0.000
Refrigeration	Glass Door Display	11700 kWh/yr	0.03	$0.02	12	-	$0.072
Refrigeration	Glass Door Display	8400 kWh/yr	0.06	$0.00	12	1.00	$0.000
Refrigeration	Glass Door Display	6800 kWh/yr	0.07	$0.02	12	0.91	$0.026
Refrigeration	Open Display Case	6500 kWh/yr	-	$0.00	18	-	$0.000
Refrigeration	Open Display Case	5350 kWh/yr	0.01	$0.00	18	1.00	$0.000
Refrigeration	Open Display Case	5300 kWh/yr	0.01	$0.01	18	-	$0.056
Refrigeration	Open Display Case	4330 kWh/yr	0.02	$0.01	18	1.00	$0.032
Refrigeration	Icemaker	7.0 kWh/100 lbs	-	$0.00	10	1.00	$0.000
Refrigeration	Icemaker	6.3 kWh/100 lbs	0.01	$0.00	10	1.01	$0.054
Refrigeration	Icemaker	6.0 kWh/100 lbs	0.01	$0.00	10	1.00	$0.057
Refrigeration	Icemaker	5.5 kWh/100 lbs	0.02	$0.02	10	0.88	$0.142
Refrigeration	Vending Machine	3400 kWh/year	-	$0.00	10	1.00	$0.000
Refrigeration	Vending Machine	3000 kWh/year	0.01	$0.00	10	1.05	$0.012
Refrigeration	Vending Machine	2400 kWh/year	0.02	$0.00	10	1.14	$0.012
Refrigeration	Vending Machine	1700 kWh/year	0.03	$0.01	10	1.20	$0.022
Food Prep.	Oven	Standard	-	$0.00	12	1.00	$0.000
Food Prep.	Oven	Energy Star	0.02	$0.00	12	1.13	$0.000
Food Prep.	Fryer	Standard	-	$0.00	12	1.00	$0.000
Food Prep.	Fryer	Energy Star	0.01	$0.00	12	1.03	$0.024
Food Prep.	Dishwasher	Standard	-	$0.00	12	1.00	$0.000
Food Prep.	Dishwasher	Energy Star	0.12	$0.01	12	1.33	$0.005
Food Prep.	Hot Food Container	Standard	-	$0.00	12	1.00	$0.000

End Use	Technology	Efficiency Definition	Savings (kWh/SQ FT/yr)	Incremental Cost ($/SQ FT)	Lifetime (Years)	BC Ratio	Levelized Cost of Energy ($/kWh)
Food Prep.	Hot Food Container	Energy Star	0.08	$0.02	12	1.26	$0.024
Office Equip.	Desktop Computer	Standard	-	$0.00	5	1.00	$0.000
Office Equip.	Desktop Computer	Energy Star	0.08	$0.00	5	1.04	$0.000
Office Equip.	Laptop	Standard	-	$0.00	4	1.00	$0.000
Office Equip.	Laptop	Energy Star	0.01	$0.00	4	1.01	$0.000
Office Equip.	Server	Standard	-	$0.00	3	1.00	$0.000
Office Equip.	Server	Energy Star	0.05	$0.00	3	1.03	$0.000
Office Equip.	Monitor	Standard	-	$0.00	4	1.00	$0.000
Office Equip.	Monitor	Energy Star	0.01	$0.00	4	1.02	$0.000
Office Equip.	Printer/Copier/Fax	Standard	-	$0.00	6	1.00	$0.000
Office Equip.	Printer/Copier/Fax	Energy Star	0.04	$0.00	6	1.09	$0.000
Office Equip.	POS Terminal	Standard	-	$0.00	4	1.00	$0.000
Office Equip.	POS Terminal	Energy Star	0.01	$0.01	4	0.95	$0.152
Miscellaneous	Non-HVAC Motors	Standard (EPAct)	-	$0.00	15	1.00	$0.000
Miscellaneous	Non-HVAC Motors	Standard (EPAct 2015)	0.00	$0.00	15	-	$0.000
Miscellaneous	Non-HVAC Motors	High Eff.	0.00	$0.00	15	1.01	$0.010
Miscellaneous	Non-HVAC Motors	High Eff. (2015)	0.00	$0.00	15	-	$0.007
Miscellaneous	Non-HVAC Motors	Premium (NEMA)	0.00	$0.00	15	1.02	$0.010
Miscellaneous	Non-HVAC Motors	Premium (NEMA 2015)	0.00	$0.00	15	-	$0.008
Miscellaneous	Pool Pump	Standard	-	$0.00	15	1.00	$0.000
Miscellaneous	Pool Pump	High Eff.	0.00	$0.00	15	1.04	$0.030
Miscellaneous	Pool Pump	High Eff. Multi-Speed	0.00	$0.00	15	1.06	$0.051
Miscellaneous	Pool Heater	Standard	-	$0.00	15	1.00	$0.000
Miscellaneous	Pool Heater	Heat Pump	0.00	$0.00	15	1.02	$0.059
Miscellaneous	Miscellaneous	Standard	-	$0.00	5	1.00	$0.000

Table C-16 Energy Efficiency Equipment Data, Electric— School, New Vintage

End Use	Technology	Efficiency Definition	Savings (kWh/SQ FT/yr)	Incremental Cost ($/SQ FT)	Lifetime (Years)	BC Ratio	Levelized Cost of Energy ($/kWh)
Cooling	Air-Cooled Chiller	1.5 kw/ton, COP 2.3	-	$0.00	20	1.00	$0.000
Cooling	Air-Cooled Chiller	1.3 kw/ton, COP 2.7	0.53	$0.29	20	1.15	$0.042
Cooling	Air-Cooled Chiller	1.26 kw/ton, COP 2.8	0.60	$0.37	20	1.16	$0.048
Cooling	Air-Cooled Chiller	1.0 kw/ton, COP 3.5	0.70	$0.46	20	1.20	$0.050
Cooling	Air-Cooled Chiller	0.97 kw/ton, COP 3.6	0.85	$0.54	20	1.25	$0.049
Cooling	Water-Cooled Chiller	0.75 kw/ton, COP 4.7	-	$0.00	20	1.00	$0.000
Cooling	Water-Cooled Chiller	0.60 kw/ton, COP 5.9	0.69	$0.14	20	1.19	$0.016
Cooling	Water-Cooled Chiller	0.58 kw/ton, COP 6.1	0.78	$0.28	20	1.20	$0.028
Cooling	Water-Cooled Chiller	0.55 kw/Ton, COP 6.4	0.92	$0.34	20	1.24	$0.028
Cooling	Water-Cooled Chiller	0.51 kw/ton, COP 6.9	1.11	$0.52	20	1.28	$0.036
Cooling	Water-Cooled Chiller	0.50 kw/Ton, COP 7.0	1.15	$0.58	20	1.29	$0.039
Cooling	Water-Cooled Chiller	0.48 kw/ton, COP 7.3	1.25	$0.63	20	1.32	$0.039
Cooling	Roof top AC	EER 9.2	-	$0.00	16	-	$0.000
Cooling	Roof top AC	EER 10.1	0.25	$0.28	16	-	$0.098
Cooling	Roof top AC	EER 11.2	0.51	$0.54	16	1.00	$0.094
Cooling	Roof top AC	EER 12.0	0.66	$1.03	16	0.98	$0.138
Cooling	Roof top AC	Ductless Minisplit	0.83	$3.37	16	0.77	$0.360
Cooling	Air Source Heat Pump	EER 9.3, COP 3.1	-	$0.00	16	-	$0.000
Cooling	Air Source Heat Pump	EER 10.3, COP 3.2	0.23	$0.29	16	-	$0.111
Cooling	Air Source Heat Pump	EER 11.0, COP 3.3	0.37	$0.42	16	1.00	$0.101
Cooling	Air Source Heat Pump	EER 11.7, COP 3.4	0.49	$1.07	16	0.94	$0.194
Cooling	Air Source Heat Pump	EER 12.0, COP 3.4	0.54	$1.40	16	0.91	$0.231
Cooling	Air Source Heat Pump	Ductless Minisplit	0.68	$2.68	16	0.80	$0.350
Cooling	Geo Heat Pump	EER 14.1, COP 3.3	-	$0.00	16	1.00	$0.000
Cooling	Geo Heat Pump	EER 16, COP 3.5	0.30	$1.46	16	0.95	$0.432
Cooling	Geo Heat Pump	EER 18, COP 3.8	0.55	$2.92	16	0.90	$0.473
Cooling	Geo Heat Pump	EER 30, COP 5.0	1.34	$3.86	16	0.94	$0.255

End Use	Technology	Efficiency Definition	Savings (kWh/SQ FT/yr)	Incremental Cost ($/SQ FT)	Lifetime (Years)	BC Ratio	Levelized Cost of Energy ($/kWh)
Cooling	Other Cooling	EER 9.8	-	$0.00	14	1.00	$0.000
Cooling	Other Cooling	EER 10.2	0.03	$0.03	14	1.01	$0.085
Cooling	Other Cooling	EER 10.8	0.07	$0.34	14	0.94	$0.494
Cooling	Other Cooling	EER 11	0.10	$0.36	14	0.95	$0.355
Cooling	Other Cooling	EER 11.5	0.13	$0.41	14	0.96	$0.309
Heating	Air Source Heat Pump	EER 9.3, COP 3.1	-	$0.00	16	-	$0.000
Heating	Air Source Heat Pump	EER 10.3, COP 3.2	0.09	$0.16	16	-	$0.154
Heating	Air Source Heat Pump	EER 11.0, COP 3.3	0.18	$0.23	16	1.00	$0.114
Heating	Air Source Heat Pump	EER 11.7, COP 3.4	0.25	$0.58	16	0.93	$0.202
Heating	Air Source Heat Pump	EER 12.0, COP 3.4	0.25	$0.76	16	0.89	$0.264
Heating	Air Source Heat Pump	Ductless Minisplit	0.33	$1.45	16	0.78	$0.392
Heating	Geo Heat Pump	EER 14.1, COP 3.3	-	$0.00	16	1.00	$0.000
Heating	Geo Heat Pump	EER 16, COP 3.5	0.40	$0.50	16	0.96	$0.111
Heating	Geo Heat Pump	EER 18, COP 3.8	0.73	$1.01	16	0.92	$0.122
Heating	Geo Heat Pump	EER 30, COP 5.0	0.90	$1.33	16	0.89	$0.132
Heating	Electric Room Heat	Standard	-	$0.00	25	1.00	$0.000
Heating	Electric Furnace	Standard	-	$0.00	25	1.00	$0.000
Ventilation	Ventilation	Constant Volume	-	$0.00	10	1.00	$0.000
Ventilation	Ventilation	Variable Air Volume	0.63	-$0.18	10	1.08	-$0.035
Water Heating	Water Heating	EF .97	-	$0.00	15	1.00	$0.000
Water Heating	Water Heating	EF .98	0.01	$0.00	15	1.01	$0.023
Water Heating	Water Heating	EF 2.0	0.55	$0.01	15	2.01	$0.001
Water Heating	Water Heating	EF 2.3	0.62	$0.01	15	2.28	$0.001
Water Heating	Water Heating	EF 2.4	0.64	$0.01	15	2.37	$0.001
Int. Lighting	Screw-in	Incandescent	-	$0.00	2	1.00	$0.000
Int. Lighting	Screw-in	90W Halogen PAR-38	1.59	$0.10	3	-	$0.022
Int. Lighting	Screw-in	70W HIR PAR-38	2.45	$0.14	3	-	$0.020
Int. Lighting	Screw-in	CFL	4.58	$0.08	6	3.19	$0.003
Int. Lighting	Screw-in	LED (2010)	4.96	$2.14	20	1.41	$0.033
Int. Lighting	Screw-in	LED (2020)	5.70	$0.60	20	-	$0.008
Int. Lighting	High-Bay Fixtures	Metal Halides	-	$0.00	3	1.00	$0.000
Int. Lighting	High-Bay Fixtures	LED (2010)	0.15	$0.36	15	0.53	$0.215
Int. Lighting	High-Bay Fixtures	T8	0.16	-$0.01	10	1.88	-$0.008
Int. Lighting	High-Bay Fixtures	HP Sodium	0.17	$0.00	6	1.74	$0.002
Int. Lighting	High-Bay Fixtures	Light Emitting Plasma	0.20	$0.01	15	1.92	$0.003
Int. Lighting	High-Bay Fixtures	T5	0.20	-$0.01	10	2.26	-$0.004
Int. Lighting	High-Bay Fixtures	LED (2020)	0.30	$0.09	15	-	$0.029
Int. Lighting	Linear Fluorescent	T12	-	$0.00	10	1.00	$0.000
Int. Lighting	Linear Fluorescent	LED (2010)	0.49	$2.91	15	0.35	$0.546
Int. Lighting	Linear Fluorescent	T8	0.51	$0.00	10	1.33	$0.000
Int. Lighting	Linear Fluorescent	Super T8	0.71	$0.02	10	1.49	$0.003
Int. Lighting	Linear Fluorescent	T5	0.82	$0.03	10	1.59	$0.005
Int. Lighting	Linear Fluorescent	LED (2020)	1.50	$0.81	15	-	$0.050
Ext. Lighting	Screw-in	Incandescent	-	$0.00	2	1.00	$0.000
Ext. Lighting	Screw-in	90W Halogen PAR-38	0.03	$0.00	3	-	$0.022
Ext. Lighting	Screw-in	70W HIR PAR-38	0.04	$0.00	3	-	$0.020
Ext. Lighting	Screw-in	CFL	0.08	$0.00	6	3.08	$0.003
Ext. Lighting	Screw-in	LED (2010)	0.09	$0.04	20	1.27	$0.033
Ext. Lighting	Screw-in	LED (2020)	0.10	$0.01	20	-	$0.008
Ext. Lighting	HID	Metal Halides	-	$0.00	3	1.00	$0.000
Ext. Lighting	HID	LED (2010)	0.27	$0.53	15	0.54	$0.178
Ext. Lighting	HID	T8	0.28	-$0.01	10	1.83	-$0.006
Ext. Lighting	HID	HP Sodium	0.30	$0.00	6	1.73	$0.002
Ext. Lighting	HID	Light Emitting Plasma	0.35	$0.01	15	1.87	$0.002
Ext. Lighting	HID	T5	0.36	-$0.01	10	2.20	-$0.003
Ext. Lighting	HID	LED (2020)	0.52	$0.14	15	-	$0.024
Ext. Lighting	Linear Fluorescent	T12	-	$0.00	10	1.00	$0.000
Ext. Lighting	Linear Fluorescent	LED (2010)	0.00	$0.00	15	0.32	$0.546
Ext. Lighting	Linear Fluorescent	T8	0.00	$0.00	10	1.33	$0.000
Ext. Lighting	Linear Fluorescent	Super T8	0.00	$0.00	10	1.48	$0.003
Ext. Lighting	Linear Fluorescent	T5	0.00	$0.00	10	1.58	$0.005
Ext. Lighting	Linear Fluorescent	LED (2020)	0.00	$0.00	15	-	$0.050

End Use	Technology	Efficiency Definition	Savings (kWh/SQ FT/yr)	Incremental Cost ($/SQ FT)	Lifetime (Years)	BC Ratio	Levelized Cost of Energy ($/kWh)
Refrigeration	Walk-in Refrigerator	14600 kWh/yr	-	$0.00	12	1.00	$0.000
Refrigeration	Walk-in Refrigerator	10800 kWh/yr	0.03	$0.01	12	1.04	$0.039
Refrigeration	Walk-in Refrigerator	10000 kWh/yr	0.04	$0.01	12	1.04	$0.041
Refrigeration	Walk-in Refrigerator	9000 kWh/yr	0.05	$0.03	12	1.01	$0.060
Refrigeration	Reach-in Refrigerator	3800 kWh/yr	-	$0.00	12	1.00	$0.000
Refrigeration	Reach-in Refrigerator	3100 kWh/yr	0.01	$0.01	12	1.01	$0.059
Refrigeration	Reach-in Refrigerator	2500 kWh/yr	0.02	$0.01	12	1.00	$0.062
Refrigeration	Reach-in Refrigerator	2400 kWh/yr	0.03	$0.01	12	1.01	$0.061
Refrigeration	Reach-in Refrigerator	1500 kWh/yr	0.04	$0.02	12	1.15	$0.040
Refrigeration	Glass Door Display	14480 kWh/yr	-	$0.00	12	-	$0.000
Refrigeration	Glass Door Display	11700 kWh/yr	0.03	$0.02	12	-	$0.072
Refrigeration	Glass Door Display	8400 kWh/yr	0.06	$0.00	12	1.00	$0.000
Refrigeration	Glass Door Display	6800 kWh/yr	0.07	$0.02	12	0.91	$0.026
Refrigeration	Open Display Case	6500 kWh/yr	-	$0.00	18	-	$0.000
Refrigeration	Open Display Case	5350 kWh/yr	0.01	$0.00	18	1.00	$0.000
Refrigeration	Open Display Case	5300 kWh/yr	0.01	$0.01	18	-	$0.056
Refrigeration	Open Display Case	4330 kWh/yr	0.02	$0.01	18	1.00	$0.032
Refrigeration	Icemaker	7.0 kWh/100 lbs	-	$0.00	10	1.00	$0.000
Refrigeration	Icemaker	6.3 kWh/100 lbs	0.01	$0.00	10	1.01	$0.054
Refrigeration	Icemaker	6.0 kWh/100 lbs	0.01	$0.00	10	1.00	$0.057
Refrigeration	Icemaker	5.5 kWh/100 lbs	0.02	$0.02	10	0.88	$0.142
Refrigeration	Vending Machine	3400 kWh/year	-	$0.00	10	1.00	$0.000
Refrigeration	Vending Machine	3000 kWh/year	0.01	$0.00	10	1.05	$0.012
Refrigeration	Vending Machine	2400 kWh/year	0.02	$0.00	10	1.14	$0.012
Refrigeration	Vending Machine	1700 kWh/year	0.03	$0.01	10	1.20	$0.022
Food Prep.	Oven	Standard	-	$0.00	12	1.00	$0.000
Food Prep.	Oven	Energy Star	0.02	$0.00	12	1.13	$0.000
Food Prep.	Fryer	Standard	-	$0.00	12	1.00	$0.000
Food Prep.	Fryer	Energy Star	0.01	$0.00	12	1.03	$0.024
Food Prep.	Dishwasher	Standard	-	$0.00	12	1.00	$0.000
Food Prep.	Dishwasher	Energy Star	0.12	$0.01	12	1.33	$0.005
Food Prep.	Hot Food Container	Standard	-	$0.00	12	1.00	$0.000
Food Prep.	Hot Food Container	Energy Star	0.08	$0.02	12	1.26	$0.024
Office Equip.	Desktop Computer	Standard	-	$0.00	5	1.00	$0.000
Office Equip.	Desktop Computer	Energy Star	0.08	$0.00	5	1.04	$0.000
Office Equip.	Laptop	Standard	-	$0.00	4	1.00	$0.000
Office Equip.	Laptop	Energy Star	0.01	$0.00	4	1.01	$0.000
Office Equip.	Server	Standard	-	$0.00	3	1.00	$0.000
Office Equip.	Server	Energy Star	0.05	$0.00	3	1.03	$0.000
Office Equip.	Monitor	Standard	-	$0.00	4	1.00	$0.000
Office Equip.	Monitor	Energy Star	0.01	$0.00	4	1.02	$0.000
Office Equip.	Printer/Copier/Fax	Standard	-	$0.00	6	1.00	$0.000
Office Equip.	Printer/Copier/Fax	Energy Star	0.04	$0.00	6	1.09	$0.000
Office Equip.	POS Terminal	Standard	-	$0.00	4	1.00	$0.000
Office Equip.	POS Terminal	Energy Star	0.01	$0.01	4	0.95	$0.152
Miscellaneous	Non-HVAC Motors	Standard (EPAct)	-	$0.00	15	1.00	$0.000
Miscellaneous	Non-HVAC Motors	Standard (EPAct 2015)	0.00	$0.00	15	-	$0.000
Miscellaneous	Non-HVAC Motors	High Eff.	0.00	$0.00	15	1.01	$0.010
Miscellaneous	Non-HVAC Motors	High Eff. (2015)	0.00	$0.00	15	-	$0.007
Miscellaneous	Non-HVAC Motors	Premium (NEMA)	0.00	$0.00	15	1.02	$0.010
Miscellaneous	Non-HVAC Motors	Premium (NEMA 2015)	0.00	$0.00	15	-	$0.008
Miscellaneous	Pool Pump	Standard	-	$0.00	15	1.00	$0.000
Miscellaneous	Pool Pump	High Eff.	0.00	$0.00	15	1.04	$0.030
Miscellaneous	Pool Pump	High Eff. Multi-Speed	0.00	$0.00	15	1.06	$0.051
Miscellaneous	Pool Heater	Standard	-	$0.00	15	1.00	$0.000
Miscellaneous	Pool Heater	Heat Pump	0.00	$0.00	15	1.02	$0.059
Miscellaneous	Miscellaneous	Standard	-	$0.00	5	1.00	$0.000

Table C-17 Energy Efficiency Equipment Data, Electric—Health, Existing Vintage

End Use	Technology	Efficiency Definition	Savings (kWh/SQ FT/yr)	Incremental Cost ($/SQ FT)	Lifetime (Years)	BC Ratio	Levelized Cost of Energy ($/kWh)
Cooling	Air-Cooled Chiller	1.5 kw/ton, COP 2.3	-	$0.00	20	1.00	$0.000
Cooling	Air-Cooled Chiller	1.3 kw/ton, COP 2.7	1.28	$0.52	20	1.11	$0.031
Cooling	Air-Cooled Chiller	1.26 kw/ton, COP 2.8	1.45	$0.67	20	1.11	$0.036
Cooling	Air-Cooled Chiller	1.0 kw/ton, COP 3.5	1.71	$0.83	20	1.13	$0.037
Cooling	Air-Cooled Chiller	0.97 kw/ton, COP 3.6	2.05	$0.99	20	1.16	$0.037
Cooling	Water-Cooled Chiller	0.75 kw/ton, COP 4.7	-	$0.00	20	1.00	$0.000
Cooling	Water-Cooled Chiller	0.60 kw/ton, COP 5.9	1.62	$0.25	20	1.16	$0.012
Cooling	Water-Cooled Chiller	0.58 kw/ton, COP 6.1	1.83	$0.49	20	1.16	$0.021
Cooling	Water-Cooled Chiller	0.55 kw/Ton, COP 6.4	2.16	$0.59	20	1.19	$0.021
Cooling	Water-Cooled Chiller	0.51 kw/ton, COP 6.9	2.59	$0.92	20	1.21	$0.027
Cooling	Water-Cooled Chiller	0.50 kw/Ton, COP 7.0	2.69	$1.01	20	1.21	$0.029
Cooling	Water-Cooled Chiller	0.48 kw/ton, COP 7.3	2.91	$1.11	20	1.23	$0.029
Cooling	Roof top AC	EER 9.2	-	$0.00	16	-	$0.000
Cooling	Roof top AC	EER 10.1	0.99	$0.52	16	-	$0.046
Cooling	Roof top AC	EER 11.2	1.99	$0.99	16	1.00	$0.044
Cooling	Roof top AC	EER 12.0	2.60	$1.91	16	0.97	$0.065
Cooling	Roof top AC	Ductless Minisplit	3.26	$6.26	16	0.75	$0.170
Cooling	Air Source Heat Pump	EER 9.3, COP 3.1	-	$0.00	16	-	$0.000
Cooling	Air Source Heat Pump	EER 10.3, COP 3.2	1.03	$0.61	16	-	$0.052
Cooling	Air Source Heat Pump	EER 11.0, COP 3.3	1.64	$0.88	16	1.00	$0.047
Cooling	Air Source Heat Pump	EER 11.7, COP 3.4	2.17	$2.25	16	0.94	$0.092
Cooling	Air Source Heat Pump	EER 12.0, COP 3.4	2.38	$2.93	16	0.90	$0.109
Cooling	Air Source Heat Pump	Ductless Minisplit	3.01	$5.61	16	0.79	$0.165
Cooling	Geo Heat Pump	EER 14.1, COP 3.3	-	$0.00	16	1.00	$0.000
Cooling	Geo Heat Pump	EER 16, COP 3.5	0.64	$1.46	16	0.95	$0.203
Cooling	Geo Heat Pump	EER 18, COP 3.8	1.16	$2.93	16	0.89	$0.223
Cooling	Geo Heat Pump	EER 30, COP 5.0	2.84	$3.86	16	0.93	$0.120
Cooling	Other Cooling	EER 9.8	-	$0.00	14	1.00	$0.000
Cooling	Other Cooling	EER 10.2	0.13	$0.10	14	1.00	$0.076
Cooling	Other Cooling	EER 10.8	0.25	$1.14	14	0.88	$0.443
Cooling	Other Cooling	EER 11	0.37	$1.21	14	0.89	$0.318
Cooling	Other Cooling	EER 11.5	0.48	$1.38	14	0.88	$0.277
Heating	Air Source Heat Pump	EER 9.3, COP 3.1	-	$0.00	16	-	$0.000
Heating	Air Source Heat Pump	EER 10.3, COP 3.2	0.17	$0.18	16	-	$0.094
Heating	Air Source Heat Pump	EER 11.0, COP 3.3	0.33	$0.26	16	1.00	$0.070
Heating	Air Source Heat Pump	EER 11.7, COP 3.4	0.48	$0.66	16	0.96	$0.123
Heating	Air Source Heat Pump	EER 12.0, COP 3.4	0.48	$0.86	16	0.93	$0.160
Heating	Air Source Heat Pump	Ductless Minisplit	0.62	$1.66	16	0.85	$0.238
Heating	Geo Heat Pump	EER 14.1, COP 3.3	-	$0.00	16	1.00	$0.000
Heating	Geo Heat Pump	EER 16, COP 3.5	0.61	$0.43	16	1.00	$0.062
Heating	Geo Heat Pump	EER 18, COP 3.8	1.11	$0.85	16	0.98	$0.068
Heating	Geo Heat Pump	EER 30, COP 5.0	1.36	$1.12	16	0.97	$0.073
Heating	Electric Room Heat	Standard	-	$0.00	25	1.00	$0.000
Heating	Electric Furnace	Standard	-	$0.00	25	1.00	$0.000
Ventilation	Ventilation	Constant Volume	-	$0.00	10	1.00	$0.000
Ventilation	Ventilation	Variable Air Volume	2.68	-$0.24	10	1.18	-$0.011
Water Heating	Water Heating	EF .97	-	$0.00	15	1.00	$0.000
Water Heating	Water Heating	EF .98	0.03	$0.00	15	1.01	$0.013
Water Heating	Water Heating	EF 2.0	1.54	$0.01	15	2.03	$0.001
Water Heating	Water Heating	EF 2.3	1.73	$0.01	15	2.32	$0.001
Water Heating	Water Heating	EF 2.4	1.79	$0.01	15	2.42	$0.001
Int. Lighting	Screw-in	Incandescent	-	$0.00	2	1.00	$0.000
Int. Lighting	Screw-in	90W Halogen PAR-38	1.37	$0.04	3	-	$0.010
Int. Lighting	Screw-in	70W HIR PAR-38	2.11	$0.06	3	-	$0.009
Int. Lighting	Screw-in	CFL	3.95	$0.03	6	3.53	$0.002
Int. Lighting	Screw-in	LED (2010)	4.27	$0.85	20	2.28	$0.015
Int. Lighting	Screw-in	LED (2020)	4.91	$0.24	20	-	$0.004
Int. Lighting	High-Bay Fixtures	Metal Halides	-	$0.00	3	1.00	$0.000
Int. Lighting	High-Bay Fixtures	LED (2010)	0.02	$0.02	15	0.79	$0.099

End Use	Technology	Efficiency Definition	Savings (kWh/SQ FT/yr)	Incremental Cost ($/SQ FT)	Lifetime (Years)	BC Ratio	Levelized Cost of Energy ($/kWh)
Int. Lighting	High-Bay Fixtures	T8	0.02	$0.00	10	1.71	-$0.003
Int. Lighting	High-Bay Fixtures	HP Sodium	0.02	$0.00	6	1.75	$0.001
Int. Lighting	High-Bay Fixtures	Light Emitting Plasma	0.03	$0.00	15	1.87	$0.001
Int. Lighting	High-Bay Fixtures	T5	0.03	$0.00	10	2.12	-$0.002
Int. Lighting	High-Bay Fixtures	LED (2020)	0.04	$0.01	15	-	$0.013
Int. Lighting	Linear Fluorescent	T12	-	$0.00	10	1.00	$0.000
Int. Lighting	Linear Fluorescent	LED (2010)	1.29	$3.51	15	0.59	$0.251
Int. Lighting	Linear Fluorescent	T8	1.35	$0.00	10	1.34	$0.000
Int. Lighting	Linear Fluorescent	Super T8	1.87	$0.02	10	1.53	$0.002
Int. Lighting	Linear Fluorescent	T5	2.16	$0.04	10	1.66	$0.002
Int. Lighting	Linear Fluorescent	LED (2020)	3.94	$0.97	15	-	$0.023
Ext. Lighting	Screw-in	Incandescent	-	$0.00	2	1.00	$0.000
Ext. Lighting	Screw-in	90W Halogen PAR-38	0.02	$0.00	3	-	$0.010
Ext. Lighting	Screw-in	70W HIR PAR-38	0.02	$0.00	3	-	$0.009
Ext. Lighting	Screw-in	CFL	0.04	$0.00	6	3.41	$0.002
Ext. Lighting	Screw-in	LED (2010)	0.05	$0.01	20	2.01	$0.015
Ext. Lighting	Screw-in	LED (2020)	0.06	$0.00	20	-	$0.004
Ext. Lighting	HID	Metal Halides	-	$0.00	3	1.00	$0.000
Ext. Lighting	HID	LED (2010)	0.26	$0.23	15	0.77	$0.082
Ext. Lighting	HID	T8	0.27	-$0.01	10	1.67	-$0.003
Ext. Lighting	HID	HP Sodium	0.29	$0.00	6	1.73	$0.001
Ext. Lighting	HID	Light Emitting Plasma	0.34	$0.00	15	1.80	$0.001
Ext. Lighting	HID	T5	0.34	$0.00	10	2.07	-$0.001
Ext. Lighting	HID	LED (2020)	0.51	$0.06	15	-	$0.011
Ext. Lighting	Linear Fluorescent	T12	-	$0.00	10	1.00	$0.000
Ext. Lighting	Linear Fluorescent	LED (2010)	0.00	$0.00	15	0.53	$0.251
Ext. Lighting	Linear Fluorescent	T8	0.00	$0.00	10	1.34	$0.000
Ext. Lighting	Linear Fluorescent	Super T8	0.00	$0.00	10	1.52	$0.002
Ext. Lighting	Linear Fluorescent	T5	0.00	$0.00	10	1.65	$0.002
Ext. Lighting	Linear Fluorescent	LED (2020)	0.00	$0.00	15	-	$0.023
Refrigeration	Walk-in Refrigerator	14600 kWh/yr	-	$0.00	12	1.00	$0.000
Refrigeration	Walk-in Refrigerator	10800 kWh/yr	0.04	$0.01	12	1.04	$0.037
Refrigeration	Walk-in Refrigerator	10000 kWh/yr	0.05	$0.02	12	1.05	$0.039
Refrigeration	Walk-in Refrigerator	9000 kWh/yr	0.06	$0.03	12	1.01	$0.057
Refrigeration	Reach-in Refrigerator	3800 kWh/yr	-	$0.00	12	1.00	$0.000
Refrigeration	Reach-in Refrigerator	3100 kWh/yr	0.01	$0.00	12	1.01	$0.056
Refrigeration	Reach-in Refrigerator	2500 kWh/yr	0.02	$0.01	12	1.01	$0.059
Refrigeration	Reach-in Refrigerator	2400 kWh/yr	0.02	$0.01	12	1.02	$0.058
Refrigeration	Reach-in Refrigerator	1500 kWh/yr	0.03	$0.01	12	1.17	$0.037
Refrigeration	Glass Door Display	14480 kWh/yr	-	$0.00	12	-	$0.000
Refrigeration	Glass Door Display	11700 kWh/yr	0.03	$0.02	12	-	$0.072
Refrigeration	Glass Door Display	8400 kWh/yr	0.07	$0.00	12	1.00	$0.000
Refrigeration	Glass Door Display	6800 kWh/yr	0.09	$0.02	12	0.91	$0.026
Refrigeration	Open Display Case	6500 kWh/yr	-	$0.00	18	-	$0.000
Refrigeration	Open Display Case	5350 kWh/yr	0.01	$0.00	18	1.00	$0.000
Refrigeration	Open Display Case	5300 kWh/yr	0.01	$0.01	18	-	$0.056
Refrigeration	Open Display Case	4330 kWh/yr	0.03	$0.01	18	1.00	$0.032
Refrigeration	Icemaker	7.0 kWh/100 lbs	-	$0.00	10	1.00	$0.000
Refrigeration	Icemaker	6.3 kWh/100 lbs	0.01	$0.00	10	1.01	$0.054
Refrigeration	Icemaker	6.0 kWh/100 lbs	0.01	$0.01	10	1.00	$0.057
Refrigeration	Icemaker	5.5 kWh/100 lbs	0.02	$0.02	10	0.88	$0.142
Refrigeration	Vending Machine	3400 kWh/year	-	$0.00	10	1.00	$0.000
Refrigeration	Vending Machine	3000 kWh/year	0.01	$0.00	10	1.05	$0.012
Refrigeration	Vending Machine	2400 kWh/year	0.02	$0.00	10	1.14	$0.012
Refrigeration	Vending Machine	1700 kWh/year	0.04	$0.01	10	1.20	$0.022
Food Prep.	Oven	Standard	-	$0.00	12	1.00	$0.000
Food Prep.	Oven	Energy Star	0.09	$0.00	12	1.13	$0.000
Food Prep.	Fryer	Standard	-	$0.00	12	1.00	$0.000
Food Prep.	Fryer	Energy Star	0.06	$0.01	12	1.03	$0.024
Food Prep.	Dishwasher	Standard	-	$0.00	12	1.00	$0.000
Food Prep.	Dishwasher	Energy Star	0.45	$0.02	12	1.34	$0.005
Food Prep.	Hot Food Container	Standard	-	$0.00	12	1.00	$0.000

End Use	Technology	Efficiency Definition	Savings (kWh/SQ FT/yr)	Incremental Cost ($/SQ FT)	Lifetime (Years)	BC Ratio	Levelized Cost of Energy ($/kWh)
Food Prep.	Hot Food Container	Energy Star	0.31	$0.07	12	1.29	$0.024
Office Equip.	Desktop Computer	Standard	-	$0.00	5	1.00	$0.000
Office Equip.	Desktop Computer	Energy Star	0.20	$0.00	5	1.05	$0.000
Office Equip.	Laptop	Standard	-	$0.00	4	1.00	$0.000
Office Equip.	Laptop	Energy Star	0.03	$0.00	4	1.02	$0.000
Office Equip.	Server	Standard	-	$0.00	3	1.00	$0.000
Office Equip.	Server	Energy Star	0.05	$0.00	3	1.03	$0.000
Office Equip.	Monitor	Standard	-	$0.00	4	1.00	$0.000
Office Equip.	Monitor	Energy Star	0.02	$0.00	4	1.02	$0.000
Office Equip.	Printer/Copier/Fax	Standard	-	$0.00	6	1.00	$0.000
Office Equip.	Printer/Copier/Fax	Energy Star	0.07	$0.00	6	1.09	$0.000
Office Equip.	POS Terminal	Standard	-	$0.00	4	1.00	$0.000
Office Equip.	POS Terminal	Energy Star	0.07	$0.04	4	0.95	$0.152
Miscellaneous	Non-HVAC Motors	Standard (EPAct)	-	$0.00	15	1.00	$0.000
Miscellaneous	Non-HVAC Motors	Standard (EPAct 2015)	0.01	$0.00	15	-	$0.000
Miscellaneous	Non-HVAC Motors	High Eff.	0.02	$0.00	15	1.01	$0.010
Miscellaneous	Non-HVAC Motors	High Eff. (2015)	0.02	$0.00	15	-	$0.007
Miscellaneous	Non-HVAC Motors	Premium (NEMA)	0.03	$0.00	15	1.02	$0.010
Miscellaneous	Non-HVAC Motors	Premium (NEMA 2015)	0.04	$0.00	15	-	$0.008
Miscellaneous	Pool Pump	Standard	-	$0.00	15	1.00	$0.000
Miscellaneous	Pool Pump	High Eff.	0.00	$0.00	15	1.05	$0.030
Miscellaneous	Pool Pump	High Eff. Multi-Speed	0.01	$0.00	15	1.08	$0.051
Miscellaneous	Pool Heater	Standard	-	$0.00	15	1.00	$0.000
Miscellaneous	Pool Heater	Heat Pump	0.02	$0.01	15	1.07	$0.059
Miscellaneous	Miscellaneous	Standard	-	$0.00	5	1.00	$0.000

Table C-18 Energy Efficiency Equipment Data, Electric— Health, New Vintage

End Use	Technology	Efficiency Definition	Savings (kWh/SQ FT/yr)	Incremental Cost ($/SQ FT)	Lifetime (Years)	BC Ratio	Levelized Cost of Energy ($/kWh)
Cooling	Air-Cooled Chiller	1.5 kw/ton, COP 2.3	-	$0.00	20	1.00	$0.000
Cooling	Air-Cooled Chiller	1.3 kw/ton, COP 2.7	1.14	$0.42	20	1.12	$0.028
Cooling	Air-Cooled Chiller	1.26 kw/ton, COP 2.8	1.29	$0.54	20	1.12	$0.032
Cooling	Air-Cooled Chiller	1.0 kw/ton, COP 3.5	1.52	$0.67	20	1.14	$0.034
Cooling	Air-Cooled Chiller	0.97 kw/ton, COP 3.6	1.82	$0.79	20	1.18	$0.034
Cooling	Water-Cooled Chiller	0.75 kw/ton, COP 4.7	-	$0.00	20	1.00	$0.000
Cooling	Water-Cooled Chiller	0.60 kw/ton, COP 5.9	1.48	$0.20	20	1.16	$0.011
Cooling	Water-Cooled Chiller	0.58 kw/ton, COP 6.1	1.68	$0.41	20	1.17	$0.019
Cooling	Water-Cooled Chiller	0.55 kw/Ton, COP 6.4	1.98	$0.49	20	1.20	$0.019
Cooling	Water-Cooled Chiller	0.51 kw/ton, COP 6.9	2.37	$0.76	20	1.22	$0.025
Cooling	Water-Cooled Chiller	0.50 kw/Ton, COP 7.0	2.47	$0.84	20	1.23	$0.026
Cooling	Water-Cooled Chiller	0.48 kw/ton, COP 7.3	2.67	$0.92	20	1.25	$0.027
Cooling	Roof top AC	EER 9.2	-	$0.00	16	-	$0.000
Cooling	Roof top AC	EER 10.1	0.95	$0.35	16	-	$0.032
Cooling	Roof top AC	EER 11.2	1.91	$0.67	16	1.00	$0.031
Cooling	Roof top AC	EER 12.0	2.50	$1.29	16	0.99	$0.046
Cooling	Roof top AC	Ductless Minisplit	3.13	$4.23	16	0.81	$0.120
Cooling	Air Source Heat Pump	EER 9.3, COP 3.1	-	$0.00	16	-	$0.000
Cooling	Air Source Heat Pump	EER 10.3, COP 3.2	0.93	$0.39	16	-	$0.037
Cooling	Air Source Heat Pump	EER 11.0, COP 3.3	1.47	$0.56	16	1.00	$0.033
Cooling	Air Source Heat Pump	EER 11.7, COP 3.4	1.96	$1.43	16	0.96	$0.065
Cooling	Air Source Heat Pump	EER 12.0, COP 3.4	2.14	$1.86	16	0.94	$0.077
Cooling	Air Source Heat Pump	Ductless Minisplit	2.71	$3.57	16	0.85	$0.116
Cooling	Geo Heat Pump	EER 14.1, COP 3.3	-	$0.00	16	1.00	$0.000
Cooling	Geo Heat Pump	EER 16, COP 3.5	0.87	$1.41	16	0.97	$0.143
Cooling	Geo Heat Pump	EER 18, COP 3.8	1.59	$2.82	16	0.93	$0.157
Cooling	Geo Heat Pump	EER 30, COP 5.0	3.89	$3.72	16	1.00	$0.085

End Use	Technology	Efficiency Definition	Savings (kWh/SQ FT/yr)	Incremental Cost ($/SQ FT)	Lifetime (Years)	BC Ratio	Levelized Cost of Energy ($/kWh)
Cooling	Other Cooling	EER 9.8	-	$0.00	14	1.00	$0.000
Cooling	Other Cooling	EER 10.2	0.12	$0.11	14	1.00	$0.085
Cooling	Other Cooling	EER 10.8	0.24	$1.21	14	0.87	$0.494
Cooling	Other Cooling	EER 11	0.35	$1.29	14	0.88	$0.355
Cooling	Other Cooling	EER 11.5	0.46	$1.46	14	0.87	$0.309
Heating	Air Source Heat Pump	EER 9.3, COP 3.1	-	$0.00	16	-	$0.000
Heating	Air Source Heat Pump	EER 10.3, COP 3.2	0.07	$0.17	16	-	$0.229
Heating	Air Source Heat Pump	EER 11.0, COP 3.3	0.13	$0.24	16	1.00	$0.164
Heating	Air Source Heat Pump	EER 11.7, COP 3.4	0.20	$0.62	16	0.95	$0.279
Heating	Air Source Heat Pump	EER 12.0, COP 3.4	0.20	$0.81	16	0.92	$0.365
Heating	Air Source Heat Pump	Ductless Minisplit	0.26	$1.56	16	0.84	$0.522
Heating	Geo Heat Pump	EER 14.1, COP 3.3	-	$0.00	16	1.00	$0.000
Heating	Geo Heat Pump	EER 16, COP 3.5	0.58	$0.33	16	1.01	$0.051
Heating	Geo Heat Pump	EER 18, COP 3.8	1.05	$0.66	16	1.01	$0.056
Heating	Geo Heat Pump	EER 30, COP 5.0	1.05	$0.88	16	0.97	$0.074
Heating	Electric Room Heat	Standard	-	$0.00	25	1.00	$0.000
Heating	Electric Furnace	Standard	-	$0.00	25	1.00	$0.000
Ventilation	Ventilation	Constant Volume	-	$0.00	10	1.00	$0.000
Ventilation	Ventilation	Variable Air Volume	2.95	-$0.25	10	1.19	-$0.011
Water Heating	Water Heating	EF .97	-	$0.00	15	1.00	$0.000
Water Heating	Water Heating	EF .98	0.03	$0.00	15	1.01	$0.012
Water Heating	Water Heating	EF 2.0	1.52	$0.01	15	2.03	$0.001
Water Heating	Water Heating	EF 2.3	1.71	$0.01	15	2.32	$0.001
Water Heating	Water Heating	EF 2.4	1.76	$0.01	15	2.42	$0.001
Int. Lighting	Screw-in	Incandescent	-	$0.00	2	1.00	$0.000
Int. Lighting	Screw-in	90W Halogen PAR-38	1.37	$0.04	3	-	$0.010
Int. Lighting	Screw-in	70W HIR PAR-38	2.11	$0.06	3	-	$0.009
Int. Lighting	Screw-in	CFL	3.95	$0.03	6	3.53	$0.002
Int. Lighting	Screw-in	LED (2010)	4.27	$0.85	20	2.28	$0.015
Int. Lighting	Screw-in	LED (2020)	4.91	$0.24	20	-	$0.004
Int. Lighting	High-Bay Fixtures	Metal Halides	-	$0.00	3	1.00	$0.000
Int. Lighting	High-Bay Fixtures	LED (2010)	0.02	$0.02	15	0.79	$0.099
Int. Lighting	High-Bay Fixtures	T8	0.02	$0.00	10	1.71	-$0.003
Int. Lighting	High-Bay Fixtures	HP Sodium	0.02	$0.00	6	1.75	$0.001
Int. Lighting	High-Bay Fixtures	Light Emitting Plasma	0.03	$0.00	15	1.87	$0.001
Int. Lighting	High-Bay Fixtures	T5	0.03	$0.00	10	2.12	-$0.002
Int. Lighting	High-Bay Fixtures	LED (2020)	0.04	$0.01	15	-	$0.013
Int. Lighting	Linear Fluorescent	T12	-	$0.00	10	1.00	$0.000
Int. Lighting	Linear Fluorescent	LED (2010)	1.29	$3.51	15	0.59	$0.251
Int. Lighting	Linear Fluorescent	T8	1.35	$0.00	10	1.34	$0.000
Int. Lighting	Linear Fluorescent	Super T8	1.87	$0.02	10	1.53	$0.002
Int. Lighting	Linear Fluorescent	T5	2.16	$0.04	10	1.66	$0.002
Int. Lighting	Linear Fluorescent	LED (2020)	3.94	$0.97	15	-	$0.023
Ext. Lighting	Screw-in	Incandescent	-	$0.00	2	1.00	$0.000
Ext. Lighting	Screw-in	90W Halogen PAR-38	0.02	$0.00	3	-	$0.010
Ext. Lighting	Screw-in	70W HIR PAR-38	0.02	$0.00	3	-	$0.009
Ext. Lighting	Screw-in	CFL	0.04	$0.00	6	3.41	$0.002
Ext. Lighting	Screw-in	LED (2010)	0.05	$0.01	20	2.01	$0.015
Ext. Lighting	Screw-in	LED (2020)	0.06	$0.00	20	-	$0.004
Ext. Lighting	HID	Metal Halides	-	$0.00	3	1.00	$0.000
Ext. Lighting	HID	LED (2010)	0.26	$0.23	15	0.77	$0.082
Ext. Lighting	HID	T8	0.27	-$0.01	10	1.67	-$0.003
Ext. Lighting	HID	HP Sodium	0.29	$0.00	6	1.73	$0.001
Ext. Lighting	HID	Light Emitting Plasma	0.34	$0.00	15	1.80	$0.001
Ext. Lighting	HID	T5	0.34	$0.00	10	2.07	-$0.001
Ext. Lighting	HID	LED (2020)	0.51	$0.06	15	-	$0.011
Ext. Lighting	Linear Fluorescent	T12	-	$0.00	10	1.00	$0.000
Ext. Lighting	Linear Fluorescent	LED (2010)	0.00	$0.00	15	0.53	$0.251
Ext. Lighting	Linear Fluorescent	T8	0.00	$0.00	10	1.34	$0.000
Ext. Lighting	Linear Fluorescent	Super T8	0.00	$0.00	10	1.52	$0.002
Ext. Lighting	Linear Fluorescent	T5	0.00	$0.00	10	1.65	$0.002
Ext. Lighting	Linear Fluorescent	LED (2020)	0.00	$0.00	15	-	$0.023

End Use	Technology	Efficiency Definition	Savings (kWh/SQ FT/yr)	Incremental Cost ($/SQ FT)	Lifetime (Years)	BC Ratio	Levelized Cost of Energy ($/kWh)
Refrigeration	Walk-in Refrigerator	14600 kWh/yr	-	$0.00	12	1.00	$0.000
Refrigeration	Walk-in Refrigerator	10800 kWh/yr	0.04	$0.02	12	1.02	$0.048
Refrigeration	Walk-in Refrigerator	10000 kWh/yr	0.05	$0.02	12	1.02	$0.050
Refrigeration	Walk-in Refrigerator	9000 kWh/yr	0.06	$0.04	12	0.98	$0.074
Refrigeration	Reach-in Refrigerator	3800 kWh/yr	-	$0.00	12	1.00	$0.000
Refrigeration	Reach-in Refrigerator	3100 kWh/yr	0.01	$0.01	12	0.99	$0.072
Refrigeration	Reach-in Refrigerator	2500 kWh/yr	0.02	$0.01	12	0.96	$0.077
Refrigeration	Reach-in Refrigerator	2400 kWh/yr	0.02	$0.01	12	0.97	$0.075
Refrigeration	Reach-in Refrigerator	1500 kWh/yr	0.03	$0.01	12	1.08	$0.049
Refrigeration	Glass Door Display	14480 kWh/yr	-	$0.00	12	-	$0.000
Refrigeration	Glass Door Display	11700 kWh/yr	0.03	$0.02	12	-	$0.072
Refrigeration	Glass Door Display	8400 kWh/yr	0.07	$0.00	12	1.00	$0.000
Refrigeration	Glass Door Display	6800 kWh/yr	0.09	$0.02	12	0.91	$0.026
Refrigeration	Open Display Case	6500 kWh/yr	-	$0.00	18	-	$0.000
Refrigeration	Open Display Case	5350 kWh/yr	0.01	$0.00	18	1.00	$0.000
Refrigeration	Open Display Case	5300 kWh/yr	0.01	$0.01	18	-	$0.056
Refrigeration	Open Display Case	4330 kWh/yr	0.03	$0.01	18	1.00	$0.032
Refrigeration	Icemaker	7.0 kWh/100 lbs	-	$0.00	10	1.00	$0.000
Refrigeration	Icemaker	6.3 kWh/100 lbs	0.01	$0.00	10	1.01	$0.054
Refrigeration	Icemaker	6.0 kWh/100 lbs	0.01	$0.01	10	1.00	$0.057
Refrigeration	Icemaker	5.5 kWh/100 lbs	0.02	$0.02	10	0.88	$0.142
Refrigeration	Vending Machine	3400 kWh/year	-	$0.00	10	1.00	$0.000
Refrigeration	Vending Machine	3000 kWh/year	0.01	$0.00	10	1.05	$0.012
Refrigeration	Vending Machine	2400 kWh/year	0.02	$0.00	10	1.14	$0.012
Refrigeration	Vending Machine	1700 kWh/year	0.04	$0.01	10	1.20	$0.022
Food Prep.	Oven	Standard	-	$0.00	12	1.00	$0.000
Food Prep.	Oven	Energy Star	0.09	$0.00	12	1.13	$0.000
Food Prep.	Fryer	Standard	-	$0.00	12	1.00	$0.000
Food Prep.	Fryer	Energy Star	0.06	$0.01	12	1.03	$0.024
Food Prep.	Dishwasher	Standard	-	$0.00	12	1.00	$0.000
Food Prep.	Dishwasher	Energy Star	0.45	$0.02	12	1.34	$0.005
Food Prep.	Hot Food Container	Standard	-	$0.00	12	1.00	$0.000
Food Prep.	Hot Food Container	Energy Star	0.31	$0.07	12	1.29	$0.024
Office Equip.	Desktop Computer	Standard	-	$0.00	5	1.00	$0.000
Office Equip.	Desktop Computer	Energy Star	0.20	$0.00	5	1.05	$0.000
Office Equip.	Laptop	Standard	-	$0.00	4	1.00	$0.000
Office Equip.	Laptop	Energy Star	0.03	$0.00	4	1.02	$0.000
Office Equip.	Server	Standard	-	$0.00	3	1.00	$0.000
Office Equip.	Server	Energy Star	0.05	$0.00	3	1.03	$0.000
Office Equip.	Monitor	Standard	-	$0.00	4	1.00	$0.000
Office Equip.	Monitor	Energy Star	0.02	$0.00	4	1.02	$0.000
Office Equip.	Printer/Copier/Fax	Standard	-	$0.00	6	1.00	$0.000
Office Equip.	Printer/Copier/Fax	Energy Star	0.07	$0.00	6	1.09	$0.000
Office Equip.	POS Terminal	Standard	-	$0.00	4	1.00	$0.000
Office Equip.	POS Terminal	Energy Star	0.07	$0.04	4	0.95	$0.152
Miscellaneous	Non-HVAC Motors	Standard (EPAct)	-	$0.00	15	1.00	$0.000
Miscellaneous	Non-HVAC Motors	Standard (EPAct 2015)	0.01	$0.00	15	-	$0.000
Miscellaneous	Non-HVAC Motors	High Eff.	0.02	$0.00	15	1.01	$0.010
Miscellaneous	Non-HVAC Motors	High Eff. (2015)	0.02	$0.00	15	-	$0.007
Miscellaneous	Non-HVAC Motors	Premium (NEMA)	0.03	$0.00	15	1.02	$0.010
Miscellaneous	Non-HVAC Motors	Premium (NEMA 2015)	0.04	$0.00	15	-	$0.008
Miscellaneous	Pool Pump	Standard	-	$0.00	15	1.00	$0.000
Miscellaneous	Pool Pump	High Eff.	0.00	$0.00	15	1.05	$0.030
Miscellaneous	Pool Pump	High Eff. Multi-Speed	0.01	$0.00	15	1.08	$0.051
Miscellaneous	Pool Heater	Standard	-	$0.00	15	1.00	$0.000
Miscellaneous	Pool Heater	Heat Pump	0.02	$0.01	15	1.07	$0.059
Miscellaneous	Miscellaneous	Standard	-	$0.00	5	1.00	$0.000

Table C-19 Energy Efficiency Equipment Data, Electric—Lodging, Existing Vintage

End Use	Technology	Efficiency Definition	Savings (kWh/SQ FT/yr)	Incremental Cost ($/SQ FT)	Lifetime (Years)	BC Ratio	Levelized Cost of Energy ($/kWh)
Cooling	Air-Cooled Chiller	1.5 kw/ton, COP 2.3	-	$0.00	20	1.00	$0.000
Cooling	Air-Cooled Chiller	1.3 kw/ton, COP 2.7	0.37	$0.12	20	1.14	$0.025
Cooling	Air-Cooled Chiller	1.26 kw/ton, COP 2.8	0.41	$0.16	20	1.15	$0.029
Cooling	Air-Cooled Chiller	1.0 kw/ton, COP 3.5	0.49	$0.19	20	1.17	$0.030
Cooling	Air-Cooled Chiller	0.97 kw/ton, COP 3.6	0.58	$0.23	20	1.22	$0.030
Cooling	Water-Cooled Chiller	0.75 kw/ton, COP 4.7	-	$0.00	20	1.00	$0.000
Cooling	Water-Cooled Chiller	0.60 kw/ton, COP 5.9	0.44	$0.05	20	1.18	$0.009
Cooling	Water-Cooled Chiller	0.58 kw/ton, COP 6.1	0.49	$0.11	20	1.18	$0.017
Cooling	Water-Cooled Chiller	0.55 kw/Ton, COP 6.4	0.58	$0.13	20	1.22	$0.017
Cooling	Water-Cooled Chiller	0.51 kw/ton, COP 6.9	0.70	$0.20	20	1.26	$0.022
Cooling	Water-Cooled Chiller	0.50 kw/Ton, COP 7.0	0.73	$0.22	20	1.26	$0.023
Cooling	Water-Cooled Chiller	0.48 kw/ton, COP 7.3	0.79	$0.24	20	1.29	$0.024
Cooling	Roof top AC	EER 9.2	-	$0.00	16	-	$0.000
Cooling	Roof top AC	EER 10.1	0.15	$0.07	16	-	$0.041
Cooling	Roof top AC	EER 11.2	0.29	$0.13	16	1.00	$0.040
Cooling	Roof top AC	EER 12.0	0.38	$0.25	16	0.99	$0.058
Cooling	Roof top AC	Ductless Minisplit	0.48	$0.82	16	0.90	$0.152
Cooling	Air Source Heat Pump	EER 9.3, COP 3.1	-	$0.00	16	-	$0.000
Cooling	Air Source Heat Pump	EER 10.3, COP 3.2	0.15	$0.08	16	-	$0.047
Cooling	Air Source Heat Pump	EER 11.0, COP 3.3	0.24	$0.12	16	1.00	$0.043
Cooling	Air Source Heat Pump	EER 11.7, COP 3.4	0.32	$0.30	16	0.98	$0.082
Cooling	Air Source Heat Pump	EER 12.0, COP 3.4	0.35	$0.39	16	0.97	$0.098
Cooling	Air Source Heat Pump	Ductless Minisplit	0.45	$0.75	16	0.92	$0.148
Cooling	Geo Heat Pump	EER 14.1, COP 3.3	-	$0.00	16	1.00	$0.000
Cooling	Geo Heat Pump	EER 16, COP 3.5	0.45	$0.24	16	1.05	$0.046
Cooling	Geo Heat Pump	EER 18, COP 3.8	0.83	$0.48	16	1.08	$0.051
Cooling	Geo Heat Pump	EER 30, COP 5.0	2.03	$0.63	16	1.37	$0.027
Cooling	Other Cooling	EER 9.8	-	$0.00	14	1.00	$0.000
Cooling	Other Cooling	EER 10.2	0.06	$0.05	14	1.00	$0.076
Cooling	Other Cooling	EER 10.8	0.12	$0.54	14	0.89	$0.443
Cooling	Other Cooling	EER 11	0.17	$0.57	14	0.90	$0.318
Cooling	Other Cooling	EER 11.5	0.23	$0.65	14	0.89	$0.277
Heating	Air Source Heat Pump	EER 9.3, COP 3.1	-	$0.00	16	-	$0.000
Heating	Air Source Heat Pump	EER 10.3, COP 3.2	0.03	$0.03	16	-	$0.093
Heating	Air Source Heat Pump	EER 11.0, COP 3.3	0.06	$0.05	16	1.00	$0.069
Heating	Air Source Heat Pump	EER 11.7, COP 3.4	0.09	$0.12	16	0.98	$0.122
Heating	Air Source Heat Pump	EER 12.0, COP 3.4	0.09	$0.15	16	0.97	$0.159
Heating	Air Source Heat Pump	Ductless Minisplit	0.11	$0.29	16	0.93	$0.237
Heating	Geo Heat Pump	EER 14.1, COP 3.3	-	$0.00	16	1.00	$0.000
Heating	Geo Heat Pump	EER 16, COP 3.5	0.25	$0.04	16	1.09	$0.013
Heating	Geo Heat Pump	EER 18, COP 3.8	0.45	$0.07	16	1.16	$0.014
Heating	Geo Heat Pump	EER 30, COP 5.0	-0.33	$0.09	16	0.84	-$0.025
Heating	Electric Room Heat	Standard	-	$0.00	25	1.00	$0.000
Heating	Electric Furnace	Standard	-	$0.00	25	1.00	$0.000
Ventilation	Ventilation	Constant Volume	-	$0.00	10	1.00	$0.000
Ventilation	Ventilation	Variable Air Volume	0.62	-$0.10	10	1.12	-$0.020
Water Heating	Water Heating	EF .97	-	$0.00	15	1.00	$0.000
Water Heating	Water Heating	EF .98	0.04	$0.02	15	1.00	$0.034
Water Heating	Water Heating	EF 2.0	2.10	$0.03	15	1.98	$0.001
Water Heating	Water Heating	EF 2.3	2.36	$0.04	15	2.24	$0.002
Water Heating	Water Heating	EF 2.4	2.43	$0.05	15	2.32	$0.002
Int. Lighting	Screw-in	Incandescent	-	$0.00	2	1.00	$0.000
Int. Lighting	Screw-in	90W Halogen PAR-38	2.55	$0.13	3	-	$0.017
Int. Lighting	Screw-in	70W HIR PAR-38	3.92	$0.17	3	-	$0.015
Int. Lighting	Screw-in	CFL	7.34	$0.10	6	3.32	$0.003
Int. Lighting	Screw-in	LED (2010)	7.94	$2.64	20	1.67	$0.026
Int. Lighting	Screw-in	LED (2020)	9.13	$0.75	20	-	$0.006
Int. Lighting	High-Bay Fixtures	Metal Halides	-	$0.00	3	1.00	$0.000
Int. Lighting	High-Bay Fixtures	LED (2010)	0.04	$0.08	15	0.61	$0.166

End Use	Technology	Efficiency Definition	Savings (kWh/SQ FT/yr)	Incremental Cost ($/SQ FT)	Lifetime (Years)	BC Ratio	Levelized Cost of Energy ($/kWh)
Int. Lighting	High-Bay Fixtures	T8	0.04	$0.00	10	1.81	-$0.006
Int. Lighting	High-Bay Fixtures	HP Sodium	0.05	$0.00	6	1.74	$0.001
Int. Lighting	High-Bay Fixtures	Light Emitting Plasma	0.05	$0.00	15	1.90	$0.002
Int. Lighting	High-Bay Fixtures	T5	0.06	$0.00	10	2.20	-$0.003
Int. Lighting	High-Bay Fixtures	LED (2020)	0.08	$0.02	15	-	$0.022
Int. Lighting	Linear Fluorescent	T12	-	$0.00	10	1.00	$0.000
Int. Lighting	Linear Fluorescent	LED (2010)	0.17	$0.77	15	0.42	$0.421
Int. Lighting	Linear Fluorescent	T8	0.18	$0.00	10	1.34	$0.000
Int. Lighting	Linear Fluorescent	Super T8	0.24	$0.01	10	1.50	$0.003
Int. Lighting	Linear Fluorescent	T5	0.28	$0.01	10	1.62	$0.004
Int. Lighting	Linear Fluorescent	LED (2020)	0.52	$0.21	15	-	$0.038
Ext. Lighting	Screw-in	Incandescent	-	$0.00	2	1.00	$0.000
Ext. Lighting	Screw-in	90W Halogen PAR-38	0.12	$0.01	3	-	$0.017
Ext. Lighting	Screw-in	70W HIR PAR-38	0.18	$0.01	3	-	$0.015
Ext. Lighting	Screw-in	CFL	0.33	$0.00	6	3.21	$0.003
Ext. Lighting	Screw-in	LED (2010)	0.36	$0.12	20	1.50	$0.026
Ext. Lighting	Screw-in	LED (2020)	0.41	$0.03	20	-	$0.006
Ext. Lighting	HID	Metal Halides	-	$0.00	3	1.00	$0.000
Ext. Lighting	HID	LED (2010)	0.26	$0.39	15	0.61	$0.137
Ext. Lighting	HID	T8	0.27	-$0.01	10	1.76	-$0.005
Ext. Lighting	HID	HP Sodium	0.28	$0.00	6	1.73	$0.001
Ext. Lighting	HID	Light Emitting Plasma	0.33	$0.01	15	1.84	$0.002
Ext. Lighting	HID	T5	0.34	-$0.01	10	2.15	-$0.002
Ext. Lighting	HID	LED (2020)	0.50	$0.10	15	-	$0.018
Ext. Lighting	Linear Fluorescent	T12	-	$0.00	10	1.00	$0.000
Ext. Lighting	Linear Fluorescent	LED (2010)	0.00	$0.00	15	0.39	$0.421
Ext. Lighting	Linear Fluorescent	T8	0.00	$0.00	10	1.34	$0.000
Ext. Lighting	Linear Fluorescent	Super T8	0.00	$0.00	10	1.50	$0.003
Ext. Lighting	Linear Fluorescent	T5	0.00	$0.00	10	1.61	$0.004
Ext. Lighting	Linear Fluorescent	LED (2020)	0.00	$0.00	15	-	$0.038
Refrigeration	Walk-in Refrigerator	14600 kWh/yr	-	$0.00	12	1.00	$0.000
Refrigeration	Walk-in Refrigerator	10800 kWh/yr	0.07	$0.02	12	1.08	$0.025
Refrigeration	Walk-in Refrigerator	10000 kWh/yr	0.08	$0.02	12	1.09	$0.026
Refrigeration	Walk-in Refrigerator	9000 kWh/yr	0.10	$0.03	12	1.07	$0.039
Refrigeration	Reach-in Refrigerator	3800 kWh/yr	-	$0.00	12	1.00	$0.000
Refrigeration	Reach-in Refrigerator	3100 kWh/yr	0.01	$0.00	12	1.05	$0.038
Refrigeration	Reach-in Refrigerator	2500 kWh/yr	0.02	$0.01	12	1.09	$0.040
Refrigeration	Reach-in Refrigerator	2400 kWh/yr	0.03	$0.01	12	1.10	$0.039
Refrigeration	Reach-in Refrigerator	1500 kWh/yr	0.04	$0.01	12	1.32	$0.025
Refrigeration	Glass Door Display	14480 kWh/yr	-	$0.00	12	-	$0.000
Refrigeration	Glass Door Display	11700 kWh/yr	0.05	$0.04	12	-	$0.072
Refrigeration	Glass Door Display	8400 kWh/yr	0.12	$0.00	12	1.00	$0.000
Refrigeration	Glass Door Display	6800 kWh/yr	0.15	$0.04	12	0.91	$0.026
Refrigeration	Open Display Case	6500 kWh/yr	-	$0.00	18	-	$0.000
Refrigeration	Open Display Case	5350 kWh/yr	0.02	$0.00	18	1.00	$0.000
Refrigeration	Open Display Case	5300 kWh/yr	0.02	$0.02	18	-	$0.056
Refrigeration	Open Display Case	4330 kWh/yr	0.04	$0.02	18	1.00	$0.032
Refrigeration	Icemaker	7.0 kWh/100 lbs	-	$0.00	10	1.00	$0.000
Refrigeration	Icemaker	6.3 kWh/100 lbs	0.01	$0.00	10	1.01	$0.054
Refrigeration	Icemaker	6.0 kWh/100 lbs	0.01	$0.01	10	1.00	$0.057
Refrigeration	Icemaker	5.5 kWh/100 lbs	0.02	$0.02	10	0.88	$0.142
Refrigeration	Vending Machine	3400 kWh/year	-	$0.00	10	1.00	$0.000
Refrigeration	Vending Machine	3000 kWh/year	0.02	$0.00	10	1.05	$0.012
Refrigeration	Vending Machine	2400 kWh/year	0.04	$0.00	10	1.14	$0.012
Refrigeration	Vending Machine	1700 kWh/year	0.07	$0.01	10	1.20	$0.022
Food Prep.	Oven	Standard	-	$0.00	12	1.00	$0.000
Food Prep.	Oven	Energy Star	0.05	$0.00	12	1.13	$0.000
Food Prep.	Fryer	Standard	-	$0.00	12	1.00	$0.000
Food Prep.	Fryer	Energy Star	0.03	$0.01	12	1.03	$0.024
Food Prep.	Dishwasher	Standard	-	$0.00	12	1.00	$0.000
Food Prep.	Dishwasher	Energy Star	0.23	$0.01	12	1.35	$0.005
Food Prep.	Hot Food Container	Standard	-	$0.00	12	1.00	$0.000

End Use	Technology	Efficiency Definition	Savings (kWh/SQ FT/yr)	Incremental Cost ($/SQ FT)	Lifetime (Years)	BC Ratio	Levelized Cost of Energy ($/kWh)
Food Prep.	Hot Food Container	Energy Star	0.15	$0.03	12	1.30	$0.024
Office Equip.	Desktop Computer	Standard	-	$0.00	5	1.00	$0.000
Office Equip.	Desktop Computer	Energy Star	0.03	$0.00	5	1.05	$0.000
Office Equip.	Laptop	Standard	-	$0.00	4	1.00	$0.000
Office Equip.	Laptop	Energy Star	0.00	$0.00	4	1.01	$0.000
Office Equip.	Server	Standard	-	$0.00	3	1.00	$0.000
Office Equip.	Server	Energy Star	0.02	$0.00	3	1.03	$0.000
Office Equip.	Monitor	Standard	-	$0.00	4	1.00	$0.000
Office Equip.	Monitor	Energy Star	0.00	$0.00	4	1.02	$0.000
Office Equip.	Printer/Copier/Fax	Standard	-	$0.00	6	1.00	$0.000
Office Equip.	Printer/Copier/Fax	Energy Star	0.00	$0.00	6	1.09	$0.000
Office Equip.	POS Terminal	Standard	-	$0.00	4	1.00	$0.000
Office Equip.	POS Terminal	Energy Star	0.00	$0.00	4	0.95	$0.152
Miscellaneous	Non-HVAC Motors	Standard (EPAct)	-	$0.00	15	1.00	$0.000
Miscellaneous	Non-HVAC Motors	Standard (EPAct 2015)	0.00	$0.00	15	-	$0.000
Miscellaneous	Non-HVAC Motors	High Eff.	0.00	$0.00	15	1.01	$0.010
Miscellaneous	Non-HVAC Motors	High Eff. (2015)	0.00	$0.00	15	-	$0.007
Miscellaneous	Non-HVAC Motors	Premium (NEMA)	0.00	$0.00	15	1.02	$0.010
Miscellaneous	Non-HVAC Motors	Premium (NEMA 2015)	0.00	$0.00	15	-	$0.008
Miscellaneous	Pool Pump	Standard	-	$0.00	15	1.00	$0.000
Miscellaneous	Pool Pump	High Eff.	0.00	$0.00	15	1.05	$0.030
Miscellaneous	Pool Pump	High Eff. Multi-Speed	0.01	$0.00	15	1.08	$0.051
Miscellaneous	Pool Heater	Standard	-	$0.00	15	1.00	$0.000
Miscellaneous	Pool Heater	Heat Pump	0.02	$0.01	15	1.06	$0.059
Miscellaneous	Miscellaneous	Standard	-	$0.00	5	1.00	$0.000

Table C-20 Energy Efficiency Equipment Data, Electric— Lodging, New Vintage

End Use	Technology	Efficiency Definition	Savings (kWh/SQ FT/yr)	Incremental Cost ($/SQ FT)	Lifetime (Years)	BC Ratio	Levelized Cost of Energy ($/kWh)
Cooling	Air-Cooled Chiller	1.5 kw/ton, COP 2.3	-	$0.00	20	1.00	$0.000
Cooling	Air-Cooled Chiller	1.3 kw/ton, COP 2.7	0.34	$0.10	20	1.14	$0.024
Cooling	Air-Cooled Chiller	1.26 kw/ton, COP 2.8	0.38	$0.14	20	1.15	$0.027
Cooling	Air-Cooled Chiller	1.0 kw/ton, COP 3.5	0.45	$0.17	20	1.18	$0.029
Cooling	Air-Cooled Chiller	0.97 kw/ton, COP 3.6	0.54	$0.20	20	1.23	$0.028
Cooling	Water-Cooled Chiller	0.75 kw/ton, COP 4.7	-	$0.00	20	1.00	$0.000
Cooling	Water-Cooled Chiller	0.60 kw/ton, COP 5.9	0.41	$0.05	20	1.18	$0.009
Cooling	Water-Cooled Chiller	0.58 kw/ton, COP 6.1	0.46	$0.09	20	1.19	$0.016
Cooling	Water-Cooled Chiller	0.55 kw/Ton, COP 6.4	0.54	$0.11	20	1.23	$0.016
Cooling	Water-Cooled Chiller	0.51 kw/ton, COP 6.9	0.65	$0.18	20	1.27	$0.021
Cooling	Water-Cooled Chiller	0.50 kw/Ton, COP 7.0	0.68	$0.19	20	1.27	$0.022
Cooling	Water-Cooled Chiller	0.48 kw/ton, COP 7.3	0.73	$0.21	20	1.30	$0.023
Cooling	Roof top AC	EER 9.2	-	$0.00	16	-	$0.000
Cooling	Roof top AC	EER 10.1	0.13	$0.06	16	-	$0.039
Cooling	Roof top AC	EER 11.2	0.27	$0.11	16	1.00	$0.037
Cooling	Roof top AC	EER 12.0	0.35	$0.22	16	1.00	$0.055
Cooling	Roof top AC	Ductless Minisplit	0.44	$0.72	16	0.91	$0.144
Cooling	Air Source Heat Pump	EER 9.3, COP 3.1	-	$0.00	16	-	$0.000
Cooling	Air Source Heat Pump	EER 10.3, COP 3.2	0.14	$0.07	16	-	$0.045
Cooling	Air Source Heat Pump	EER 11.0, COP 3.3	0.22	$0.10	16	1.00	$0.040
Cooling	Air Source Heat Pump	EER 11.7, COP 3.4	0.30	$0.26	16	0.98	$0.078
Cooling	Air Source Heat Pump	EER 12.0, COP 3.4	0.33	$0.34	16	0.97	$0.092
Cooling	Air Source Heat Pump	Ductless Minisplit	0.41	$0.66	16	0.92	$0.140
Cooling	Geo Heat Pump	EER 14.1, COP 3.3	-	$0.00	16	1.00	$0.000
Cooling	Geo Heat Pump	EER 16, COP 3.5	0.47	$0.23	16	1.05	$0.044
Cooling	Geo Heat Pump	EER 18, COP 3.8	0.85	$0.47	16	1.08	$0.048
Cooling	Geo Heat Pump	EER 30, COP 5.0	2.09	$0.61	16	1.39	$0.026

End Use	Technology	Efficiency Definition	Savings (kWh/SQ FT/yr)	Incremental Cost ($/SQ FT)	Lifetime (Years)	BC Ratio	Levelized Cost of Energy ($/kWh)
Cooling	Other Cooling	EER 9.8	-	$0.00	14	1.00	$0.000
Cooling	Other Cooling	EER 10.2	0.06	$0.05	14	1.00	$0.085
Cooling	Other Cooling	EER 10.8	0.11	$0.58	14	0.88	$0.494
Cooling	Other Cooling	EER 11	0.17	$0.61	14	0.89	$0.355
Cooling	Other Cooling	EER 11.5	0.22	$0.69	14	0.88	$0.309
Heating	Air Source Heat Pump	EER 9.3, COP 3.1	-	$0.00	16	-	$0.000
Heating	Air Source Heat Pump	EER 10.3, COP 3.2	0.03	$0.04	16	-	$0.113
Heating	Air Source Heat Pump	EER 11.0, COP 3.3	0.06	$0.06	16	1.00	$0.083
Heating	Air Source Heat Pump	EER 11.7, COP 3.4	0.09	$0.15	16	0.97	$0.146
Heating	Air Source Heat Pump	EER 12.0, COP 3.4	0.09	$0.19	16	0.96	$0.190
Heating	Air Source Heat Pump	Ductless Minisplit	0.12	$0.37	16	0.90	$0.280
Heating	Geo Heat Pump	EER 14.1, COP 3.3	-	$0.00	16	1.00	$0.000
Heating	Geo Heat Pump	EER 16, COP 3.5	0.23	$0.03	16	1.09	$0.012
Heating	Geo Heat Pump	EER 18, COP 3.8	0.42	$0.06	16	1.17	$0.013
Heating	Geo Heat Pump	EER 30, COP 5.0	-0.39	$0.08	16	0.81	-$0.018
Heating	Electric Room Heat	Standard	-	$0.00	25	1.00	$0.000
Heating	Electric Furnace	Standard	-	$0.00	25	1.00	$0.000
Ventilation	Ventilation	Constant Volume	-	$0.00	10	1.00	$0.000
Ventilation	Ventilation	Variable Air Volume	0.17	-$0.10	10	1.05	-$0.068
Water Heating	Water Heating	EF .97	-	$0.00	15	1.00	$0.000
Water Heating	Water Heating	EF .98	0.04	$0.01	15	1.00	$0.034
Water Heating	Water Heating	EF 2.0	2.04	$0.03	15	1.98	$0.001
Water Heating	Water Heating	EF 2.3	2.29	$0.04	15	2.24	$0.002
Water Heating	Water Heating	EF 2.4	2.36	$0.05	15	2.32	$0.002
Int. Lighting	Screw-in	Incandescent	-	$0.00	2	1.00	$0.000
Int. Lighting	Screw-in	90W Halogen PAR-38	2.55	$0.13	3	-	$0.017
Int. Lighting	Screw-in	70W HIR PAR-38	3.92	$0.17	3	-	$0.015
Int. Lighting	Screw-in	CFL	7.34	$0.10	6	3.32	$0.003
Int. Lighting	Screw-in	LED (2010)	7.94	$2.64	20	1.67	$0.026
Int. Lighting	Screw-in	LED (2020)	9.13	$0.75	20	-	$0.006
Int. Lighting	High-Bay Fixtures	Metal Halides	-	$0.00	3	1.00	$0.000
Int. Lighting	High-Bay Fixtures	LED (2010)	0.04	$0.08	15	0.61	$0.166
Int. Lighting	High-Bay Fixtures	T8	0.04	$0.00	10	1.81	-$0.006
Int. Lighting	High-Bay Fixtures	HP Sodium	0.05	$0.00	6	1.74	$0.001
Int. Lighting	High-Bay Fixtures	Light Emitting Plasma	0.05	$0.00	15	1.90	$0.002
Int. Lighting	High-Bay Fixtures	T5	0.06	$0.00	10	2.20	-$0.003
Int. Lighting	High-Bay Fixtures	LED (2020)	0.08	$0.02	15	-	$0.022
Int. Lighting	Linear Fluorescent	T12	-	$0.00	10	1.00	$0.000
Int. Lighting	Linear Fluorescent	LED (2010)	0.17	$0.77	15	0.42	$0.421
Int. Lighting	Linear Fluorescent	T8	0.18	$0.00	10	1.34	$0.000
Int. Lighting	Linear Fluorescent	Super T8	0.24	$0.01	10	1.50	$0.003
Int. Lighting	Linear Fluorescent	T5	0.28	$0.01	10	1.62	$0.004
Int. Lighting	Linear Fluorescent	LED (2020)	0.52	$0.21	15	-	$0.038
Ext. Lighting	Screw-in	Incandescent	-	$0.00	2	1.00	$0.000
Ext. Lighting	Screw-in	90W Halogen PAR-38	0.12	$0.01	3	-	$0.017
Ext. Lighting	Screw-in	70W HIR PAR-38	0.18	$0.01	3	-	$0.015
Ext. Lighting	Screw-in	CFL	0.33	$0.00	6	3.21	$0.003
Ext. Lighting	Screw-in	LED (2010)	0.36	$0.12	20	1.50	$0.026
Ext. Lighting	Screw-in	LED (2020)	0.41	$0.03	20	-	$0.006
Ext. Lighting	HID	Metal Halides	-	$0.00	3	1.00	$0.000
Ext. Lighting	HID	LED (2010)	0.26	$0.39	15	0.61	$0.137
Ext. Lighting	HID	T8	0.27	-$0.01	10	1.76	-$0.005
Ext. Lighting	HID	HP Sodium	0.28	$0.00	6	1.73	$0.001
Ext. Lighting	HID	Light Emitting Plasma	0.33	$0.01	15	1.84	$0.002
Ext. Lighting	HID	T5	0.34	-$0.01	10	2.15	-$0.002
Ext. Lighting	HID	LED (2020)	0.50	$0.10	15	-	$0.018
Ext. Lighting	Linear Fluorescent	T12	-	$0.00	10	1.00	$0.000
Ext. Lighting	Linear Fluorescent	LED (2010)	0.00	$0.00	15	0.39	$0.421
Ext. Lighting	Linear Fluorescent	T8	0.00	$0.00	10	1.34	$0.000
Ext. Lighting	Linear Fluorescent	Super T8	0.00	$0.00	10	1.50	$0.003
Ext. Lighting	Linear Fluorescent	T5	0.00	$0.00	10	1.61	$0.004
Ext. Lighting	Linear Fluorescent	LED (2020)	0.00	$0.00	15	-	$0.038

End Use	Technology	Efficiency Definition	Savings (kWh/SQ FT/yr)	Incremental Cost ($/SQ FT)	Lifetime (Years)	BC Ratio	Levelized Cost of Energy ($/kWh)
Refrigeration	Walk-in Refrigerator	14600 kWh/yr	-	$0.00	12	1.00	$0.000
Refrigeration	Walk-in Refrigerator	10800 kWh/yr	0.07	$0.02	12	1.06	$0.030
Refrigeration	Walk-in Refrigerator	10000 kWh/yr	0.08	$0.02	12	1.07	$0.032
Refrigeration	Walk-in Refrigerator	9000 kWh/yr	0.10	$0.04	12	1.04	$0.046
Refrigeration	Reach-in Refrigerator	3800 kWh/yr	-	$0.00	12	1.00	$0.000
Refrigeration	Reach-in Refrigerator	3100 kWh/yr	0.01	$0.01	12	1.03	$0.045
Refrigeration	Reach-in Refrigerator	2500 kWh/yr	0.02	$0.01	12	1.06	$0.048
Refrigeration	Reach-in Refrigerator	2400 kWh/yr	0.03	$0.01	12	1.06	$0.047
Refrigeration	Reach-in Refrigerator	1500 kWh/yr	0.04	$0.01	12	1.25	$0.030
Refrigeration	Glass Door Display	14480 kWh/yr	-	$0.00	12	-	$0.000
Refrigeration	Glass Door Display	11700 kWh/yr	0.05	$0.04	12	-	$0.072
Refrigeration	Glass Door Display	8400 kWh/yr	0.12	$0.00	12	1.00	$0.000
Refrigeration	Glass Door Display	6800 kWh/yr	0.15	$0.04	12	0.91	$0.026
Refrigeration	Open Display Case	6500 kWh/yr	-	$0.00	18	-	$0.000
Refrigeration	Open Display Case	5350 kWh/yr	0.02	$0.00	18	1.00	$0.000
Refrigeration	Open Display Case	5300 kWh/yr	0.02	$0.02	18	-	$0.056
Refrigeration	Open Display Case	4330 kWh/yr	0.04	$0.02	18	1.00	$0.032
Refrigeration	Icemaker	7.0 kWh/100 lbs	-	$0.00	10	1.00	$0.000
Refrigeration	Icemaker	6.3 kWh/100 lbs	0.01	$0.00	10	1.01	$0.054
Refrigeration	Icemaker	6.0 kWh/100 lbs	0.01	$0.01	10	1.00	$0.057
Refrigeration	Icemaker	5.5 kWh/100 lbs	0.02	$0.02	10	0.88	$0.142
Refrigeration	Vending Machine	3400 kWh/year	-	$0.00	10	1.00	$0.000
Refrigeration	Vending Machine	3000 kWh/year	0.02	$0.00	10	1.05	$0.012
Refrigeration	Vending Machine	2400 kWh/year	0.04	$0.00	10	1.14	$0.012
Refrigeration	Vending Machine	1700 kWh/year	0.07	$0.01	10	1.20	$0.022
Food Prep.	Oven	Standard	-	$0.00	12	1.00	$0.000
Food Prep.	Oven	Energy Star	0.05	$0.00	12	1.13	$0.000
Food Prep.	Fryer	Standard	-	$0.00	12	1.00	$0.000
Food Prep.	Fryer	Energy Star	0.03	$0.01	12	1.03	$0.024
Food Prep.	Dishwasher	Standard	-	$0.00	12	1.00	$0.000
Food Prep.	Dishwasher	Energy Star	0.23	$0.01	12	1.35	$0.005
Food Prep.	Hot Food Container	Standard	-	$0.00	12	1.00	$0.000
Food Prep.	Hot Food Container	Energy Star	0.15	$0.03	12	1.30	$0.024
Office Equip.	Desktop Computer	Standard	-	$0.00	5	1.00	$0.000
Office Equip.	Desktop Computer	Energy Star	0.03	$0.00	5	1.05	$0.000
Office Equip.	Laptop	Standard	-	$0.00	4	1.00	$0.000
Office Equip.	Laptop	Energy Star	0.00	$0.00	4	1.01	$0.000
Office Equip.	Server	Standard	-	$0.00	3	1.00	$0.000
Office Equip.	Server	Energy Star	0.02	$0.00	3	1.03	$0.000
Office Equip.	Monitor	Standard	-	$0.00	4	1.00	$0.000
Office Equip.	Monitor	Energy Star	0.00	$0.00	4	1.02	$0.000
Office Equip.	Printer/Copier/Fax	Standard	-	$0.00	6	1.00	$0.000
Office Equip.	Printer/Copier/Fax	Energy Star	0.00	$0.00	6	1.09	$0.000
Office Equip.	POS Terminal	Standard	-	$0.00	4	1.00	$0.000
Office Equip.	POS Terminal	Energy Star	0.00	$0.00	4	0.95	$0.152
Miscellaneous	Non-HVAC Motors	Standard (EPAct)	-	$0.00	15	1.00	$0.000
Miscellaneous	Non-HVAC Motors	Standard (EPAct 2015)	0.00	$0.00	15	-	$0.000
Miscellaneous	Non-HVAC Motors	High Eff.	0.00	$0.00	15	1.01	$0.010
Miscellaneous	Non-HVAC Motors	High Eff. (2015)	0.00	$0.00	15	-	$0.007
Miscellaneous	Non-HVAC Motors	Premium (NEMA)	0.00	$0.00	15	1.02	$0.010
Miscellaneous	Non-HVAC Motors	Premium (NEMA 2015)	0.00	$0.00	15	-	$0.008
Miscellaneous	Pool Pump	Standard	-	$0.00	15	1.00	$0.000
Miscellaneous	Pool Pump	High Eff.	0.00	$0.00	15	1.05	$0.030
Miscellaneous	Pool Pump	High Eff. Multi-Speed	0.01	$0.00	15	1.08	$0.051
Miscellaneous	Pool Heater	Standard	-	$0.00	15	1.00	$0.000
Miscellaneous	Pool Heater	Heat Pump	0.02	$0.01	15	1.06	$0.059
Miscellaneous	Miscellaneous	Standard	-	$0.00	5	1.00	$0.000

Table C-21 Energy Efficiency Equipment Data, Electric—Warehouse, Existing Vintage

End Use	Technology	Efficiency Definition	Savings (kWh/SQ FT/yr)	Incremental Cost ($/SQ FT)	Lifetime (Years)	BC Ratio	Levelized Cost of Energy ($/kWh)
Cooling	Air-Cooled Chiller	1.5 kw/ton, COP 2.3	-	$0.00	20	1.00	$0.000
Cooling	Air-Cooled Chiller	1.3 kw/ton, COP 2.7	0.45	$0.12	20	1.20	$0.020
Cooling	Air-Cooled Chiller	1.26 kw/ton, COP 2.8	0.51	$0.15	20	1.23	$0.023
Cooling	Air-Cooled Chiller	1.0 kw/ton, COP 3.5	0.60	$0.19	20	1.28	$0.024
Cooling	Air-Cooled Chiller	0.97 kw/ton, COP 3.6	0.72	$0.22	20	1.36	$0.024
Cooling	Water-Cooled Chiller	0.75 kw/ton, COP 4.7	-	$0.00	20	1.00	$0.000
Cooling	Water-Cooled Chiller	0.60 kw/ton, COP 5.9	0.58	$0.06	20	1.22	$0.007
Cooling	Water-Cooled Chiller	0.58 kw/ton, COP 6.1	0.66	$0.11	20	1.25	$0.013
Cooling	Water-Cooled Chiller	0.55 kw/Ton, COP 6.4	0.78	$0.14	20	1.31	$0.013
Cooling	Water-Cooled Chiller	0.51 kw/ton, COP 6.9	0.93	$0.21	20	1.38	$0.017
Cooling	Water-Cooled Chiller	0.50 kw/Ton, COP 7.0	0.97	$0.23	20	1.40	$0.018
Cooling	Water-Cooled Chiller	0.48 kw/ton, COP 7.3	1.05	$0.26	20	1.45	$0.019
Cooling	Roof top AC	EER 9.2	-	$0.00	16	-	$0.000
Cooling	Roof top AC	EER 10.1	0.38	$0.20	16	-	$0.046
Cooling	Roof top AC	EER 11.2	0.76	$0.38	16	1.00	$0.044
Cooling	Roof top AC	EER 12.0	0.99	$0.72	16	1.03	$0.065
Cooling	Roof top AC	Ductless Minisplit	1.24	$2.37	16	0.93	$0.169
Cooling	Air Source Heat Pump	EER 9.3, COP 3.1	-	$0.00	16	-	$0.000
Cooling	Air Source Heat Pump	EER 10.3, COP 3.2	0.41	$0.24	16	-	$0.052
Cooling	Air Source Heat Pump	EER 11.0, COP 3.3	0.66	$0.35	16	1.00	$0.047
Cooling	Air Source Heat Pump	EER 11.7, COP 3.4	0.87	$0.90	16	1.00	$0.091
Cooling	Air Source Heat Pump	EER 12.0, COP 3.4	0.96	$1.17	16	1.00	$0.109
Cooling	Air Source Heat Pump	Ductless Minisplit	1.21	$2.24	16	0.97	$0.164
Cooling	Geo Heat Pump	EER 14.1, COP 3.3	-	$0.00	16	1.00	$0.000
Cooling	Geo Heat Pump	EER 16, COP 3.5	0.26	$0.58	16	1.01	$0.203
Cooling	Geo Heat Pump	EER 18, COP 3.8	0.47	$1.17	16	1.01	$0.222
Cooling	Geo Heat Pump	EER 30, COP 5.0	1.14	$1.54	16	1.19	$0.120
Cooling	Other Cooling	EER 9.8	-	$0.00	14	1.00	$0.000
Cooling	Other Cooling	EER 10.2	0.05	$0.04	14	1.01	$0.076
Cooling	Other Cooling	EER 10.8	0.10	$0.45	14	0.97	$0.443
Cooling	Other Cooling	EER 11	0.15	$0.48	14	0.98	$0.318
Cooling	Other Cooling	EER 11.5	0.19	$0.55	14	0.99	$0.277
Heating	Air Source Heat Pump	EER 9.3, COP 3.1	-	$0.00	16	-	$0.000
Heating	Air Source Heat Pump	EER 10.3, COP 3.2	0.03	$0.54	16	-	$1.430
Heating	Air Source Heat Pump	EER 11.0, COP 3.3	0.06	$0.78	16	1.00	$1.075
Heating	Air Source Heat Pump	EER 11.7, COP 3.4	0.09	$2.00	16	0.90	$1.929
Heating	Air Source Heat Pump	EER 12.0, COP 3.4	0.09	$2.61	16	0.85	$2.517
Heating	Air Source Heat Pump	Ductless Minisplit	0.12	$5.00	16	0.71	$3.781
Heating	Geo Heat Pump	EER 14.1, COP 3.3	-	$0.00	16	1.00	$0.000
Heating	Geo Heat Pump	EER 16, COP 3.5	0.63	$1.04	16	0.95	$0.145
Heating	Geo Heat Pump	EER 18, COP 3.8	1.16	$2.08	16	0.89	$0.159
Heating	Geo Heat Pump	EER 30, COP 5.0	0.15	$2.74	16	0.80	$1.569
Heating	Electric Room Heat	Standard	-	$0.00	25	1.00	$0.000
Heating	Electric Furnace	Standard	-	$0.00	25	1.00	$0.000
Ventilation	Ventilation	Constant Volume	-	$0.00	10	1.00	$0.000
Ventilation	Ventilation	Variable Air Volume	0.29	-$0.59	10	1.04	-$0.252
Water Heating	Water Heating	EF .97	-	$0.00	15	1.00	$0.000
Water Heating	Water Heating	EF .98	0.00	$0.00	15	1.01	$0.018
Water Heating	Water Heating	EF 2.0	0.17	$0.00	15	2.02	$0.001
Water Heating	Water Heating	EF 2.3	0.19	$0.00	15	2.30	$0.001
Water Heating	Water Heating	EF 2.4	0.19	$0.00	15	2.39	$0.001
Int. Lighting	Screw-in	Incandescent	-	$0.00	2	1.00	$0.000
Int. Lighting	Screw-in	90W Halogen PAR-38	0.47	$0.03	3	-	$0.019
Int. Lighting	Screw-in	70W HIR PAR-38	0.72	$0.04	3	-	$0.017
Int. Lighting	Screw-in	CFL	1.34	$0.02	6	3.39	$0.003
Int. Lighting	Screw-in	LED (2010)	1.45	$0.55	20	1.76	$0.029
Int. Lighting	Screw-in	LED (2020)	1.67	$0.15	20	-	$0.007
Int. Lighting	High-Bay Fixtures	Metal Halides	-	$0.00	3	1.00	$0.000
Int. Lighting	High-Bay Fixtures	LED (2010)	0.08	$0.15	15	0.63	$0.187

End Use	Technology	Efficiency Definition	Savings (kWh/SQ FT/yr)	Incremental Cost ($/SQ FT)	Lifetime (Years)	BC Ratio	Levelized Cost of Energy ($/kWh)
Int. Lighting	High-Bay Fixtures	T8	0.08	$0.00	10	1.84	-$0.007
Int. Lighting	High-Bay Fixtures	HP Sodium	0.08	$0.00	6	1.76	$0.002
Int. Lighting	High-Bay Fixtures	Light Emitting Plasma	0.10	$0.00	15	1.95	$0.002
Int. Lighting	High-Bay Fixtures	T5	0.10	$0.00	10	2.23	-$0.003
Int. Lighting	High-Bay Fixtures	LED (2020)	0.15	$0.04	15	-	$0.025
Int. Lighting	Linear Fluorescent	T12	-	$0.00	10	1.00	$0.000
Int. Lighting	Linear Fluorescent	LED (2010)	0.76	$3.91	15	0.43	$0.476
Int. Lighting	Linear Fluorescent	T8	0.79	$0.00	10	1.34	$0.000
Int. Lighting	Linear Fluorescent	Super T8	1.10	$0.03	10	1.51	$0.003
Int. Lighting	Linear Fluorescent	T5	1.27	$0.04	10	1.62	$0.004
Int. Lighting	Linear Fluorescent	LED (2020)	2.32	$1.08	15	-	$0.043
Ext. Lighting	Screw-in	Incandescent	-	$0.00	2	1.00	$0.000
Ext. Lighting	Screw-in	90W Halogen PAR-38	0.00	$0.00	3	-	$0.019
Ext. Lighting	Screw-in	70W HIR PAR-38	0.00	$0.00	3	-	$0.017
Ext. Lighting	Screw-in	CFL	0.00	$0.00	6	3.16	$0.003
Ext. Lighting	Screw-in	LED (2010)	0.00	$0.00	20	1.39	$0.029
Ext. Lighting	Screw-in	LED (2020)	0.00	$0.00	20	-	$0.007
Ext. Lighting	HID	Metal Halides	-	$0.00	3	1.00	$0.000
Ext. Lighting	HID	LED (2010)	0.34	$0.57	15	0.58	$0.155
Ext. Lighting	HID	T8	0.35	-$0.02	10	1.79	-$0.005
Ext. Lighting	HID	HP Sodium	0.37	$0.00	6	1.73	$0.001
Ext. Lighting	HID	Light Emitting Plasma	0.43	$0.01	15	1.85	$0.002
Ext. Lighting	HID	T5	0.44	-$0.01	10	2.17	-$0.003
Ext. Lighting	HID	LED (2020)	0.65	$0.15	15	-	$0.021
Ext. Lighting	Linear Fluorescent	T12	-	$0.00	10	1.00	$0.000
Ext. Lighting	Linear Fluorescent	LED (2010)	0.00	$0.00	15	0.36	$0.476
Ext. Lighting	Linear Fluorescent	T8	0.00	$0.00	10	1.33	$0.000
Ext. Lighting	Linear Fluorescent	Super T8	0.00	$0.00	10	1.49	$0.003
Ext. Lighting	Linear Fluorescent	T5	0.00	$0.00	10	1.59	$0.004
Ext. Lighting	Linear Fluorescent	LED (2020)	0.00	$0.00	15	-	$0.043
Refrigeration	Walk-in Refrigerator	14600 kWh/yr	-	$0.00	12	1.00	$0.000
Refrigeration	Walk-in Refrigerator	10800 kWh/yr	0.21	$0.01	12	1.20	$0.008
Refrigeration	Walk-in Refrigerator	10000 kWh/yr	0.25	$0.02	12	1.25	$0.008
Refrigeration	Walk-in Refrigerator	9000 kWh/yr	0.31	$0.03	12	1.30	$0.012
Refrigeration	Reach-in Refrigerator	3800 kWh/yr	-	$0.00	12	1.00	$0.000
Refrigeration	Reach-in Refrigerator	3100 kWh/yr	-	$0.00	12	1.00	$0.000
Refrigeration	Reach-in Refrigerator	2500 kWh/yr	-	$0.00	12	1.00	$0.000
Refrigeration	Reach-in Refrigerator	2400 kWh/yr	-	$0.00	12	1.00	$0.000
Refrigeration	Reach-in Refrigerator	1500 kWh/yr	-	$0.00	12	1.00	$0.000
Refrigeration	Glass Door Display	14480 kWh/yr	-	$0.00	12	-	$0.000
Refrigeration	Glass Door Display	11700 kWh/yr	-	$0.00	12	-	$0.000
Refrigeration	Glass Door Display	8400 kWh/yr	-	$0.00	12	1.00	$0.000
Refrigeration	Glass Door Display	6800 kWh/yr	-	$0.00	12	1.00	$0.000
Refrigeration	Open Display Case	6500 kWh/yr	-	$0.00	18	-	$0.000
Refrigeration	Open Display Case	5350 kWh/yr	-	$0.00	18	1.00	$0.000
Refrigeration	Open Display Case	5300 kWh/yr	-	$0.00	18	-	$0.000
Refrigeration	Open Display Case	4330 kWh/yr	-	$0.00	18	1.00	$0.000
Refrigeration	Icemaker	7.0 kWh/100 lbs	-	$0.00	10	1.00	$0.000
Refrigeration	Icemaker	6.3 kWh/100 lbs	0.10	$0.04	10	1.01	$0.054
Refrigeration	Icemaker	6.0 kWh/100 lbs	0.14	$0.07	10	1.01	$0.057
Refrigeration	Icemaker	5.5 kWh/100 lbs	0.21	$0.24	10	0.88	$0.142
Refrigeration	Vending Machine	3400 kWh/year	-	$0.00	10	1.00	$0.000
Refrigeration	Vending Machine	3000 kWh/year	0.10	$0.01	10	1.05	$0.012
Refrigeration	Vending Machine	2400 kWh/year	0.24	$0.02	10	1.14	$0.012
Refrigeration	Vending Machine	1700 kWh/year	0.41	$0.07	10	1.20	$0.022
Food Prep.	Oven	Standard	-	$0.00	12	1.00	$0.000
Food Prep.	Oven	Energy Star	0.04	$0.00	12	1.14	$0.000
Food Prep.	Fryer	Standard	-	$0.00	12	1.00	$0.000
Food Prep.	Fryer	Energy Star	-	$0.00	12	1.00	$0.000
Food Prep.	Dishwasher	Standard	-	$0.00	12	1.00	$0.000
Food Prep.	Dishwasher	Energy Star	-	$0.00	12	1.00	$0.000
Food Prep.	Hot Food Container	Standard	-	$0.00	12	1.00	$0.000

End Use	Technology	Efficiency Definition	Savings (kWh/SQ FT/yr)	Incremental Cost ($/SQ FT)	Lifetime (Years)	BC Ratio	Levelized Cost of Energy ($/kWh)
Food Prep.	Hot Food Container	Energy Star	-	$0.00	12	1.00	$0.000
Office Equip.	Desktop Computer	Standard	-	$0.00	5	1.00	$0.000
Office Equip.	Desktop Computer	Energy Star	0.04	$0.00	5	1.05	$0.000
Office Equip.	Laptop	Standard	-	$0.00	4	1.00	$0.000
Office Equip.	Laptop	Energy Star	0.00	$0.00	4	1.02	$0.000
Office Equip.	Server	Standard	-	$0.00	3	1.00	$0.000
Office Equip.	Server	Energy Star	0.03	$0.00	3	1.04	$0.000
Office Equip.	Monitor	Standard	-	$0.00	4	1.00	$0.000
Office Equip.	Monitor	Energy Star	0.00	$0.00	4	1.02	$0.000
Office Equip.	Printer/Copier/Fax	Standard	-	$0.00	6	1.00	$0.000
Office Equip.	Printer/Copier/Fax	Energy Star	0.01	$0.00	6	1.10	$0.000
Office Equip.	POS Terminal	Standard	-	$0.00	4	1.00	$0.000
Office Equip.	POS Terminal	Energy Star	0.01	$0.01	4	0.95	$0.152
Miscellaneous	Non-HVAC Motors	Standard (EPAct)	-	$0.00	15	1.00	$0.000
Miscellaneous	Non-HVAC Motors	Standard (EPAct 2015)	0.00	$0.00	15	-	$0.000
Miscellaneous	Non-HVAC Motors	High Eff.	0.00	$0.00	15	1.01	$0.010
Miscellaneous	Non-HVAC Motors	High Eff. (2015)	0.01	$0.00	15	-	$0.007
Miscellaneous	Non-HVAC Motors	Premium (NEMA)	0.01	$0.00	15	1.02	$0.010
Miscellaneous	Non-HVAC Motors	Premium (NEMA 2015)	0.01	$0.00	15	-	$0.008
Miscellaneous	Pool Pump	Standard	-	$0.00	15	1.00	$0.000
Miscellaneous	Pool Pump	High Eff.	-	$0.00	15	1.00	$0.000
Miscellaneous	Pool Pump	High Eff. Multi-Speed	-	$0.00	15	1.00	$0.000
Miscellaneous	Pool Heater	Standard	-	$0.00	15	1.00	$0.000
Miscellaneous	Pool Heater	Heat Pump	-	$0.00	15	1.00	$0.000
Miscellaneous	Miscellaneous	Standard	-	$0.00	5	1.00	$0.000

Table C-22 Energy Efficiency Equipment Data, Electric— Warehouse, New Vintage

End Use	Technology	Efficiency Definition	Savings (kWh/SQ FT/yr)	Incremental Cost ($/SQ FT)	Lifetime (Years)	BC Ratio	Levelized Cost of Energy ($/kWh)
Cooling	Air-Cooled Chiller	1.5 kw/ton, COP 2.3	-	$0.00	20	1.00	$0.000
Cooling	Air-Cooled Chiller	1.3 kw/ton, COP 2.7	0.38	$0.13	20	1.19	$0.027
Cooling	Air-Cooled Chiller	1.26 kw/ton, COP 2.8	0.43	$0.17	20	1.22	$0.031
Cooling	Air-Cooled Chiller	1.0 kw/ton, COP 3.5	0.51	$0.21	20	1.26	$0.032
Cooling	Air-Cooled Chiller	0.97 kw/ton, COP 3.6	0.61	$0.25	20	1.33	$0.032
Cooling	Water-Cooled Chiller	0.75 kw/ton, COP 4.7	-	$0.00	20	1.00	$0.000
Cooling	Water-Cooled Chiller	0.60 kw/ton, COP 5.9	0.58	$0.08	20	1.21	$0.010
Cooling	Water-Cooled Chiller	0.58 kw/ton, COP 6.1	0.65	$0.15	20	1.24	$0.018
Cooling	Water-Cooled Chiller	0.55 kw/Ton, COP 6.4	0.77	$0.18	20	1.29	$0.018
Cooling	Water-Cooled Chiller	0.51 kw/ton, COP 6.9	0.92	$0.28	20	1.36	$0.023
Cooling	Water-Cooled Chiller	0.50 kw/Ton, COP 7.0	0.96	$0.31	20	1.37	$0.025
Cooling	Water-Cooled Chiller	0.48 kw/ton, COP 7.3	1.04	$0.34	20	1.42	$0.025
Cooling	Roof top AC	EER 9.2	-	$0.00	16	-	$0.000
Cooling	Roof top AC	EER 10.1	0.36	$0.18	16	-	$0.045
Cooling	Roof top AC	EER 11.2	0.72	$0.35	16	1.00	$0.043
Cooling	Roof top AC	EER 12.0	0.94	$0.67	16	1.03	$0.063
Cooling	Roof top AC	Ductless Minisplit	1.18	$2.21	16	0.94	$0.166
Cooling	Air Source Heat Pump	EER 9.3, COP 3.1	-	$0.00	16	-	$0.000
Cooling	Air Source Heat Pump	EER 10.3, COP 3.2	0.38	$0.22	16	-	$0.051
Cooling	Air Source Heat Pump	EER 11.0, COP 3.3	0.60	$0.31	16	1.00	$0.046
Cooling	Air Source Heat Pump	EER 11.7, COP 3.4	0.79	$0.80	16	1.01	$0.090
Cooling	Air Source Heat Pump	EER 12.0, COP 3.4	0.87	$1.05	16	1.00	$0.107
Cooling	Air Source Heat Pump	Ductless Minisplit	1.10	$2.01	16	0.97	$0.162
Cooling	Geo Heat Pump	EER 14.1, COP 3.3	-	$0.00	16	1.00	$0.000
Cooling	Geo Heat Pump	EER 16, COP 3.5	0.23	$0.53	16	1.01	$0.199
Cooling	Geo Heat Pump	EER 18, COP 3.8	0.43	$1.05	16	1.01	$0.218
Cooling	Geo Heat Pump	EER 30, COP 5.0	1.05	$1.39	16	1.20	$0.118

End Use	Technology	Efficiency Definition	Savings (kWh/SQ FT/yr)	Incremental Cost ($/SQ FT)	Lifetime (Years)	BC Ratio	Levelized Cost of Energy ($/kWh)
Cooling	Other Cooling	EER 9.8	-	$0.00	14	1.00	$0.000
Cooling	Other Cooling	EER 10.2	0.05	$0.04	14	1.01	$0.085
Cooling	Other Cooling	EER 10.8	0.09	$0.48	14	0.96	$0.494
Cooling	Other Cooling	EER 11	0.14	$0.51	14	0.97	$0.355
Cooling	Other Cooling	EER 11.5	0.18	$0.58	14	0.98	$0.309
Heating	Air Source Heat Pump	EER 9.3, COP 3.1	-	$0.00	16	-	$0.000
Heating	Air Source Heat Pump	EER 10.3, COP 3.2	0.09	$0.62	16	-	$0.582
Heating	Air Source Heat Pump	EER 11.0, COP 3.3	0.19	$0.89	16	1.00	$0.420
Heating	Air Source Heat Pump	EER 11.7, COP 3.4	0.28	$2.27	16	0.89	$0.720
Heating	Air Source Heat Pump	EER 12.0, COP 3.4	0.28	$2.97	16	0.84	$0.939
Heating	Air Source Heat Pump	Ductless Minisplit	0.37	$5.68	16	0.69	$1.354
Heating	Geo Heat Pump	EER 14.1, COP 3.3	-	$0.00	16	1.00	$0.000
Heating	Geo Heat Pump	EER 16, COP 3.5	0.57	$1.23	16	0.93	$0.190
Heating	Geo Heat Pump	EER 18, COP 3.8	1.04	$2.45	16	0.87	$0.208
Heating	Geo Heat Pump	EER 30, COP 5.0	1.23	$3.24	16	0.83	$0.233
Heating	Electric Room Heat	Standard	-	$0.00	25	1.00	$0.000
Heating	Electric Furnace	Standard	-	$0.00	25	1.00	$0.000
Ventilation	Ventilation	Constant Volume	-	$0.00	10	1.00	$0.000
Ventilation	Ventilation	Variable Air Volume	0.25	-$0.60	10	1.04	-$0.299
Water Heating	Water Heating	EF .97	-	$0.00	15	1.00	$0.000
Water Heating	Water Heating	EF .98	0.00	$0.00	15	1.01	$0.017
Water Heating	Water Heating	EF 2.0	0.16	$0.00	15	2.02	$0.001
Water Heating	Water Heating	EF 2.3	0.18	$0.00	15	2.30	$0.001
Water Heating	Water Heating	EF 2.4	0.19	$0.00	15	2.40	$0.001
Int. Lighting	Screw-in	Incandescent	-	$0.00	2	1.00	$0.000
Int. Lighting	Screw-in	90W Halogen PAR-38	0.47	$0.03	3	-	$0.019
Int. Lighting	Screw-in	70W HIR PAR-38	0.72	$0.04	3	-	$0.017
Int. Lighting	Screw-in	CFL	1.34	$0.02	6	3.39	$0.003
Int. Lighting	Screw-in	LED (2010)	1.45	$0.55	20	1.76	$0.029
Int. Lighting	Screw-in	LED (2020)	1.67	$0.15	20	-	$0.007
Int. Lighting	High-Bay Fixtures	Metal Halides	-	$0.00	3	1.00	$0.000
Int. Lighting	High-Bay Fixtures	LED (2010)	0.08	$0.15	15	0.63	$0.187
Int. Lighting	High-Bay Fixtures	T8	0.08	$0.00	10	1.84	-$0.007
Int. Lighting	High-Bay Fixtures	HP Sodium	0.08	$0.00	6	1.76	$0.002
Int. Lighting	High-Bay Fixtures	Light Emitting Plasma	0.10	$0.00	15	1.95	$0.002
Int. Lighting	High-Bay Fixtures	T5	0.10	$0.00	10	2.23	-$0.003
Int. Lighting	High-Bay Fixtures	LED (2020)	0.15	$0.04	15	-	$0.025
Int. Lighting	Linear Fluorescent	T12	-	$0.00	10	1.00	$0.000
Int. Lighting	Linear Fluorescent	LED (2010)	0.76	$3.91	15	0.43	$0.476
Int. Lighting	Linear Fluorescent	T8	0.79	$0.00	10	1.34	$0.000
Int. Lighting	Linear Fluorescent	Super T8	1.10	$0.03	10	1.51	$0.003
Int. Lighting	Linear Fluorescent	T5	1.27	$0.04	10	1.62	$0.004
Int. Lighting	Linear Fluorescent	LED (2020)	2.32	$1.08	15	-	$0.043
Ext. Lighting	Screw-in	Incandescent	-	$0.00	2	1.00	$0.000
Ext. Lighting	Screw-in	90W Halogen PAR-38	0.00	$0.00	3	-	$0.019
Ext. Lighting	Screw-in	70W HIR PAR-38	0.00	$0.00	3	-	$0.017
Ext. Lighting	Screw-in	CFL	0.00	$0.00	6	3.16	$0.003
Ext. Lighting	Screw-in	LED (2010)	0.00	$0.00	20	1.39	$0.029
Ext. Lighting	Screw-in	LED (2020)	0.00	$0.00	20	-	$0.007
Ext. Lighting	HID	Metal Halides	-	$0.00	3	1.00	$0.000
Ext. Lighting	HID	LED (2010)	0.34	$0.57	15	0.58	$0.155
Ext. Lighting	HID	T8	0.35	-$0.02	10	1.79	-$0.005
Ext. Lighting	HID	HP Sodium	0.37	$0.00	6	1.73	$0.001
Ext. Lighting	HID	Light Emitting Plasma	0.43	$0.01	15	1.85	$0.002
Ext. Lighting	HID	T5	0.44	-$0.01	10	2.17	-$0.003
Ext. Lighting	HID	LED (2020)	0.65	$0.15	15	-	$0.021
Ext. Lighting	Linear Fluorescent	T12	-	$0.00	10	1.00	$0.000
Ext. Lighting	Linear Fluorescent	LED (2010)	0.00	$0.00	15	0.36	$0.476
Ext. Lighting	Linear Fluorescent	T8	0.00	$0.00	10	1.33	$0.000
Ext. Lighting	Linear Fluorescent	Super T8	0.00	$0.00	10	1.49	$0.003
Ext. Lighting	Linear Fluorescent	T5	0.00	$0.00	10	1.59	$0.004
Ext. Lighting	Linear Fluorescent	LED (2020)	0.00	$0.00	15	-	$0.043

End Use	Technology	Efficiency Definition	Savings (kWh/SQ FT/yr)	Incremental Cost ($/SQ FT)	Lifetime (Years)	BC Ratio	Levelized Cost of Energy ($/kWh)
Refrigeration	Walk-in Refrigerator	14600 kWh/yr	-	$0.00	12	1.00	$0.000
Refrigeration	Walk-in Refrigerator	10800 kWh/yr	0.21	$0.02	12	1.18	$0.009
Refrigeration	Walk-in Refrigerator	10000 kWh/yr	0.25	$0.02	12	1.23	$0.010
Refrigeration	Walk-in Refrigerator	9000 kWh/yr	0.31	$0.04	12	1.26	$0.014
Refrigeration	Reach-in Refrigerator	3800 kWh/yr	-	$0.00	12	1.00	$0.000
Refrigeration	Reach-in Refrigerator	3100 kWh/yr	-	$0.00	12	1.00	$0.000
Refrigeration	Reach-in Refrigerator	2500 kWh/yr	-	$0.00	12	1.00	$0.000
Refrigeration	Reach-in Refrigerator	2400 kWh/yr	-	$0.00	12	1.00	$0.000
Refrigeration	Reach-in Refrigerator	1500 kWh/yr	-	$0.00	12	1.00	$0.000
Refrigeration	Glass Door Display	14480 kWh/yr	-	$0.00	12	-	$0.000
Refrigeration	Glass Door Display	11700 kWh/yr	-	$0.00	12	-	$0.000
Refrigeration	Glass Door Display	8400 kWh/yr	-	$0.00	12	1.00	$0.000
Refrigeration	Glass Door Display	6800 kWh/yr	-	$0.00	12	1.00	$0.000
Refrigeration	Open Display Case	6500 kWh/yr	-	$0.00	18	-	$0.000
Refrigeration	Open Display Case	5350 kWh/yr	-	$0.00	18	1.00	$0.000
Refrigeration	Open Display Case	5300 kWh/yr	-	$0.00	18	-	$0.000
Refrigeration	Open Display Case	4330 kWh/yr	-	$0.00	18	1.00	$0.000
Refrigeration	Icemaker	7.0 kWh/100 lbs	-	$0.00	10	1.00	$0.000
Refrigeration	Icemaker	6.3 kWh/100 lbs	0.10	$0.04	10	1.01	$0.054
Refrigeration	Icemaker	6.0 kWh/100 lbs	0.14	$0.07	10	1.01	$0.057
Refrigeration	Icemaker	5.5 kWh/100 lbs	0.21	$0.24	10	0.88	$0.142
Refrigeration	Vending Machine	3400 kWh/year	-	$0.00	10	1.00	$0.000
Refrigeration	Vending Machine	3000 kWh/year	0.10	$0.01	10	1.05	$0.012
Refrigeration	Vending Machine	2400 kWh/year	0.24	$0.02	10	1.14	$0.012
Refrigeration	Vending Machine	1700 kWh/year	0.41	$0.07	10	1.20	$0.022
Food Prep.	Oven	Standard	-	$0.00	12	1.00	$0.000
Food Prep.	Oven	Energy Star	0.04	$0.00	12	1.14	$0.000
Food Prep.	Fryer	Standard	-	$0.00	12	1.00	$0.000
Food Prep.	Fryer	Energy Star	-	$0.00	12	1.00	$0.000
Food Prep.	Dishwasher	Standard	-	$0.00	12	1.00	$0.000
Food Prep.	Dishwasher	Energy Star	-	$0.00	12	1.00	$0.000
Food Prep.	Hot Food Container	Standard	-	$0.00	12	1.00	$0.000
Food Prep.	Hot Food Container	Energy Star	-	$0.00	12	1.00	$0.000
Office Equip.	Desktop Computer	Standard	-	$0.00	5	1.00	$0.000
Office Equip.	Desktop Computer	Energy Star	0.04	$0.00	5	1.05	$0.000
Office Equip.	Laptop	Standard	-	$0.00	4	1.00	$0.000
Office Equip.	Laptop	Energy Star	0.00	$0.00	4	1.02	$0.000
Office Equip.	Server	Standard	-	$0.00	3	1.00	$0.000
Office Equip.	Server	Energy Star	0.03	$0.00	3	1.04	$0.000
Office Equip.	Monitor	Standard	-	$0.00	4	1.00	$0.000
Office Equip.	Monitor	Energy Star	0.00	$0.00	4	1.02	$0.000
Office Equip.	Printer/Copier/Fax	Standard	-	$0.00	6	1.00	$0.000
Office Equip.	Printer/Copier/Fax	Energy Star	0.01	$0.00	6	1.10	$0.000
Office Equip.	POS Terminal	Standard	-	$0.00	4	1.00	$0.000
Office Equip.	POS Terminal	Energy Star	0.01	$0.01	4	0.95	$0.152
Miscellaneous	Non-HVAC Motors	Standard (EPAct)	-	$0.00	15	1.00	$0.000
Miscellaneous	Non-HVAC Motors	Standard (EPAct 2015)	0.00	$0.00	15	-	$0.000
Miscellaneous	Non-HVAC Motors	High Eff.	0.00	$0.00	15	1.01	$0.010
Miscellaneous	Non-HVAC Motors	High Eff. (2015)	0.01	$0.00	15	-	$0.007
Miscellaneous	Non-HVAC Motors	Premium (NEMA)	0.01	$0.00	15	1.02	$0.010
Miscellaneous	Non-HVAC Motors	Premium (NEMA 2015)	0.01	$0.00	15	-	$0.008
Miscellaneous	Pool Pump	Standard	-	$0.00	15	1.00	$0.000
Miscellaneous	Pool Pump	High Eff.	-	$0.00	15	1.00	$0.000
Miscellaneous	Pool Pump	High Eff. Multi-Speed	-	$0.00	15	1.00	$0.000
Miscellaneous	Pool Heater	Standard	-	$0.00	15	1.00	$0.000
Miscellaneous	Pool Heater	Heat Pump	-	$0.00	15	1.00	$0.000
Miscellaneous	Miscellaneous	Standard	-	$0.00	5	1.00	$0.000

Table C-23 Energy Efficiency Equipment Data, Electric—Miscellaneous Commercial, Existing Vintage

End Use	Technology	Efficiency Definition	Savings (kWh/SQ FT/yr)	Incremental Cost ($/SQ FT)	Lifetime (Years)	BC Ratio	Levelized Cost of Energy ($/kWh)
Cooling	Air-Cooled Chiller	1.5 kw/ton, COP 2.3	-	$0.00	20	1.00	$0.000
Cooling	Air-Cooled Chiller	1.3 kw/ton, COP 2.7	0.34	$0.07	20	1.19	$0.015
Cooling	Air-Cooled Chiller	1.26 kw/ton, COP 2.8	0.38	$0.09	20	1.22	$0.017
Cooling	Air-Cooled Chiller	1.0 kw/ton, COP 3.5	0.45	$0.11	20	1.26	$0.018
Cooling	Air-Cooled Chiller	0.97 kw/ton, COP 3.6	0.54	$0.13	20	1.33	$0.018
Cooling	Water-Cooled Chiller	0.75 kw/ton, COP 4.7	-	$0.00	20	1.00	$0.000
Cooling	Water-Cooled Chiller	0.60 kw/ton, COP 5.9	0.44	$0.03	20	1.21	$0.006
Cooling	Water-Cooled Chiller	0.58 kw/ton, COP 6.1	0.50	$0.06	20	1.24	$0.010
Cooling	Water-Cooled Chiller	0.55 kw/Ton, COP 6.4	0.58	$0.08	20	1.29	$0.010
Cooling	Water-Cooled Chiller	0.51 kw/ton, COP 6.9	0.70	$0.12	20	1.36	$0.013
Cooling	Water-Cooled Chiller	0.50 kw/Ton, COP 7.0	0.73	$0.13	20	1.37	$0.014
Cooling	Water-Cooled Chiller	0.48 kw/ton, COP 7.3	0.79	$0.15	20	1.41	$0.014
Cooling	Roof top AC	EER 9.2	-	$0.00	16	-	$0.000
Cooling	Roof top AC	EER 10.1	0.28	$0.09	16	-	$0.029
Cooling	Roof top AC	EER 11.2	0.57	$0.18	16	1.00	$0.028
Cooling	Roof top AC	EER 12.0	0.75	$0.34	16	1.02	$0.041
Cooling	Roof top AC	Ductless Minisplit	0.93	$1.13	16	0.91	$0.107
Cooling	Air Source Heat Pump	EER 9.3, COP 3.1	-	$0.00	16	-	$0.000
Cooling	Air Source Heat Pump	EER 10.3, COP 3.2	0.31	$0.12	16	-	$0.033
Cooling	Air Source Heat Pump	EER 11.0, COP 3.3	0.49	$0.17	16	1.00	$0.030
Cooling	Air Source Heat Pump	EER 11.7, COP 3.4	0.65	$0.43	16	1.00	$0.058
Cooling	Air Source Heat Pump	EER 12.0, COP 3.4	0.72	$0.56	16	0.99	$0.069
Cooling	Air Source Heat Pump	Ductless Minisplit	0.91	$1.07	16	0.94	$0.104
Cooling	Geo Heat Pump	EER 14.1, COP 3.3	-	$0.00	16	1.00	$0.000
Cooling	Geo Heat Pump	EER 16, COP 3.5	0.19	$0.28	16	1.00	$0.128
Cooling	Geo Heat Pump	EER 18, COP 3.8	0.35	$0.56	16	0.99	$0.141
Cooling	Geo Heat Pump	EER 30, COP 5.0	0.86	$0.73	16	1.14	$0.076
Cooling	Other Cooling	EER 9.8	-	$0.00	14	1.00	$0.000
Cooling	Other Cooling	EER 10.2	0.04	$0.01	14	1.02	$0.027
Cooling	Other Cooling	EER 10.8	0.07	$0.12	14	0.99	$0.156
Cooling	Other Cooling	EER 11	0.11	$0.13	14	1.01	$0.112
Cooling	Other Cooling	EER 11.5	0.14	$0.14	14	1.02	$0.097
Heating	Air Source Heat Pump	EER 9.3, COP 3.1	-	$0.00	16	-	$0.000
Heating	Air Source Heat Pump	EER 10.3, COP 3.2	0.00	$1.38	16	-	$48.418
Heating	Air Source Heat Pump	EER 11.0, COP 3.3	0.00	$1.98	16	1.00	$40.414
Heating	Air Source Heat Pump	EER 11.7, COP 3.4	0.01	$5.08	16	0.82	$82.404
Heating	Air Source Heat Pump	EER 12.0, COP 3.4	0.01	$6.63	16	0.75	$107.545
Heating	Air Source Heat Pump	Ductless Minisplit	0.01	$12.71	16	0.57	$191.296
Heating	Geo Heat Pump	EER 14.1, COP 3.3	-	$0.00	16	1.00	$0.000
Heating	Geo Heat Pump	EER 16, COP 3.5	0.26	$2.68	16	0.89	$0.912
Heating	Geo Heat Pump	EER 18, COP 3.8	0.47	$5.35	16	0.80	$1.000
Heating	Geo Heat Pump	EER 30, COP 5.0	-0.03	$7.06	16	0.74	-$23.528
Heating	Electric Room Heat	Standard	-	$0.00	25	1.00	$0.000
Heating	Electric Furnace	Standard	-	$0.00	25	1.00	$0.000
Ventilation	Ventilation	Constant Volume	-	$0.00	10	1.00	$0.000
Ventilation	Ventilation	Variable Air Volume	0.27	-$0.12	10	1.06	-$0.057
Water Heating	Water Heating	EF .97	-	$0.00	15	1.00	$0.000
Water Heating	Water Heating	EF .98	0.01	$0.00	15	1.01	$0.018
Water Heating	Water Heating	EF 2.0	0.53	$0.00	15	2.02	$0.001
Water Heating	Water Heating	EF 2.3	0.59	$0.01	15	2.31	$0.001
Water Heating	Water Heating	EF 2.4	0.61	$0.01	15	2.40	$0.001
Int. Lighting	Screw-in	Incandescent	-	$0.00	2	1.00	$0.000
Int. Lighting	Screw-in	90W Halogen PAR-38	0.59	$0.03	3	-	$0.020
Int. Lighting	Screw-in	70W HIR PAR-38	0.90	$0.05	3	-	$0.018
Int. Lighting	Screw-in	CFL	1.69	$0.03	6	3.30	$0.003
Int. Lighting	Screw-in	LED (2010)	1.83	$0.72	20	1.60	$0.030
Int. Lighting	Screw-in	LED (2020)	2.10	$0.20	20	-	$0.007
Int. Lighting	High-Bay Fixtures	Metal Halides	-	$0.00	3	1.00	$0.000

End Use	Technology	Efficiency Definition	Savings (kWh/SQ FT/yr)	Incremental Cost ($/SQ FT)	Lifetime (Years)	BC Ratio	Levelized Cost of Energy ($/kWh)
Int. Lighting	High-Bay Fixtures	LED (2010)	0.80	$1.71	15	0.59	$0.196
Int. Lighting	High-Bay Fixtures	T8	0.82	-$0.05	10	1.85	-$0.007
Int. Lighting	High-Bay Fixtures	HP Sodium	0.87	$0.01	6	1.75	$0.002
Int. Lighting	High-Bay Fixtures	Light Emitting Plasma	1.02	$0.03	15	1.94	$0.002
Int. Lighting	High-Bay Fixtures	T5	1.04	-$0.03	10	2.24	-$0.003
Int. Lighting	High-Bay Fixtures	LED (2020)	1.53	$0.44	15	-	$0.026
Int. Lighting	Linear Fluorescent	T12	-	$0.00	10	1.00	$0.000
Int. Lighting	Linear Fluorescent	LED (2010)	0.19	$1.01	15	0.40	$0.499
Int. Lighting	Linear Fluorescent	T8	0.20	$0.00	10	1.34	$0.000
Int. Lighting	Linear Fluorescent	Super T8	0.27	$0.01	10	1.50	$0.003
Int. Lighting	Linear Fluorescent	T5	0.31	$0.01	10	1.61	$0.004
Int. Lighting	Linear Fluorescent	LED (2020)	0.57	$0.28	15	-	$0.045
Ext. Lighting	Screw-in	Incandescent	-	$0.00	2	1.00	$0.000
Ext. Lighting	Screw-in	90W Halogen PAR-38	0.19	$0.01	3	-	$0.020
Ext. Lighting	Screw-in	70W HIR PAR-38	0.29	$0.02	3	-	$0.018
Ext. Lighting	Screw-in	CFL	0.54	$0.01	6	3.13	$0.003
Ext. Lighting	Screw-in	LED (2010)	0.59	$0.23	20	1.35	$0.030
Ext. Lighting	Screw-in	LED (2020)	0.67	$0.07	20	-	$0.007
Ext. Lighting	HID	Metal Halides	-	$0.00	3	1.00	$0.000
Ext. Lighting	HID	LED (2010)	0.29	$0.50	15	0.57	$0.162
Ext. Lighting	HID	T8	0.29	-$0.01	10	1.80	-$0.006
Ext. Lighting	HID	HP Sodium	0.31	$0.00	6	1.73	$0.001
Ext. Lighting	HID	Light Emitting Plasma	0.36	$0.01	15	1.86	$0.002
Ext. Lighting	HID	T5	0.37	-$0.01	10	2.18	-$0.003
Ext. Lighting	HID	LED (2020)	0.55	$0.13	15	-	$0.022
Ext. Lighting	Linear Fluorescent	T12	-	$0.00	10	1.00	$0.000
Ext. Lighting	Linear Fluorescent	LED (2010)	0.10	$0.54	15	0.35	$0.499
Ext. Lighting	Linear Fluorescent	T8	0.10	$0.00	10	1.33	$0.000
Ext. Lighting	Linear Fluorescent	Super T8	0.15	$0.00	10	1.49	$0.003
Ext. Lighting	Linear Fluorescent	T5	0.17	$0.01	10	1.59	$0.004
Ext. Lighting	Linear Fluorescent	LED (2020)	0.31	$0.15	15	-	$0.045
Refrigeration	Walk-in Refrigerator	14600 kWh/yr	-	$0.00	12	1.00	$0.000
Refrigeration	Walk-in Refrigerator	10800 kWh/yr	0.05	$0.00	12	1.18	$0.009
Refrigeration	Walk-in Refrigerator	10000 kWh/yr	0.06	$0.01	12	1.23	$0.010
Refrigeration	Walk-in Refrigerator	9000 kWh/yr	0.07	$0.01	12	1.26	$0.014
Refrigeration	Reach-in Refrigerator	3800 kWh/yr	-	$0.00	12	1.00	$0.000
Refrigeration	Reach-in Refrigerator	3100 kWh/yr	0.01	$0.00	12	1.14	$0.014
Refrigeration	Reach-in Refrigerator	2500 kWh/yr	0.02	$0.00	12	1.29	$0.015
Refrigeration	Reach-in Refrigerator	2400 kWh/yr	0.02	$0.00	12	1.32	$0.014
Refrigeration	Reach-in Refrigerator	1500 kWh/yr	0.03	$0.00	12	1.78	$0.009
Refrigeration	Glass Door Display	14480 kWh/yr	-	$0.00	12	-	$0.000
Refrigeration	Glass Door Display	11700 kWh/yr	0.04	$0.03	12	-	$0.072
Refrigeration	Glass Door Display	8400 kWh/yr	0.08	$0.00	12	1.00	$0.000
Refrigeration	Glass Door Display	6800 kWh/yr	0.11	$0.03	12	0.91	$0.026
Refrigeration	Open Display Case	6500 kWh/yr	-	$0.00	18	-	$0.000
Refrigeration	Open Display Case	5350 kWh/yr	0.02	$0.00	18	1.00	$0.000
Refrigeration	Open Display Case	5300 kWh/yr	0.02	$0.01	18	-	$0.056
Refrigeration	Open Display Case	4330 kWh/yr	0.03	$0.01	18	1.00	$0.032
Refrigeration	Icemaker	7.0 kWh/100 lbs	-	$0.00	10	1.00	$0.000
Refrigeration	Icemaker	6.3 kWh/100 lbs	0.01	$0.00	10	1.01	$0.054
Refrigeration	Icemaker	6.0 kWh/100 lbs	0.01	$0.00	10	1.00	$0.057
Refrigeration	Icemaker	5.5 kWh/100 lbs	0.01	$0.01	10	0.88	$0.142
Refrigeration	Vending Machine	3400 kWh/year	-	$0.00	10	1.00	$0.000
Refrigeration	Vending Machine	3000 kWh/year	0.01	$0.00	10	1.05	$0.012
Refrigeration	Vending Machine	2400 kWh/year	0.03	$0.00	10	1.14	$0.012
Refrigeration	Vending Machine	1700 kWh/year	0.05	$0.01	10	1.20	$0.022
Food Prep.	Oven	Standard	-	$0.00	12	1.00	$0.000
Food Prep.	Oven	Energy Star	0.02	$0.00	12	1.12	$0.000
Food Prep.	Fryer	Standard	-	$0.00	12	1.00	$0.000
Food Prep.	Fryer	Energy Star	0.01	$0.00	12	1.03	$0.024
Food Prep.	Dishwasher	Standard	-	$0.00	12	1.00	$0.000
Food Prep.	Dishwasher	Energy Star	0.10	$0.00	12	1.32	$0.005

End Use	Technology	Efficiency Definition	Savings (kWh/SQ FT/yr)	Incremental Cost ($/SQ FT)	Lifetime (Years)	BC Ratio	Levelized Cost of Energy ($/kWh)
Food Prep.	Hot Food Container	Standard	-	$0.00	12	1.00	$0.000
Food Prep.	Hot Food Container	Energy Star	0.07	$0.01	12	1.22	$0.024
Office Equip.	Desktop Computer	Standard	-	$0.00	5	1.00	$0.000
Office Equip.	Desktop Computer	Energy Star	0.06	$0.00	5	1.05	$0.000
Office Equip.	Laptop	Standard	-	$0.00	4	1.00	$0.000
Office Equip.	Laptop	Energy Star	0.01	$0.00	4	1.02	$0.000
Office Equip.	Server	Standard	-	$0.00	3	1.00	$0.000
Office Equip.	Server	Energy Star	0.03	$0.00	3	1.04	$0.000
Office Equip.	Monitor	Standard	-	$0.00	4	1.00	$0.000
Office Equip.	Monitor	Energy Star	0.01	$0.00	4	1.02	$0.000
Office Equip.	Printer/Copier/Fax	Standard	-	$0.00	6	1.00	$0.000
Office Equip.	Printer/Copier/Fax	Energy Star	0.02	$0.00	6	1.10	$0.000
Office Equip.	POS Terminal	Standard	-	$0.00	4	1.00	$0.000
Office Equip.	POS Terminal	Energy Star	0.03	$0.02	4	0.95	$0.152
Miscellaneous	Non-HVAC Motors	Standard (EPAct)	-	$0.00	15	1.00	$0.000
Miscellaneous	Non-HVAC Motors	Standard (EPAct 2015)	0.00	$0.00	15	-	$0.000
Miscellaneous	Non-HVAC Motors	High Eff.	0.00	$0.00	15	1.01	$0.010
Miscellaneous	Non-HVAC Motors	High Eff. (2015)	0.01	$0.00	15	-	$0.007
Miscellaneous	Non-HVAC Motors	Premium (NEMA)	0.01	$0.00	15	1.02	$0.010
Miscellaneous	Non-HVAC Motors	Premium (NEMA 2015)	0.01	$0.00	15	-	$0.008
Miscellaneous	Pool Pump	Standard	-	$0.00	15	1.00	$0.000
Miscellaneous	Pool Pump	High Eff.	0.00	$0.00	15	1.05	$0.030
Miscellaneous	Pool Pump	High Eff. Multi-Speed	0.00	$0.00	15	1.11	$0.051
Miscellaneous	Pool Heater	Standard	-	$0.00	15	1.00	$0.000
Miscellaneous	Pool Heater	Heat Pump	0.00	$0.00	15	1.12	$0.059
Miscellaneous	Miscellaneous	Standard	-	$0.00	5	1.00	$0.000

Table C-24 Energy Efficiency Equipment Data, Electric— Miscellaneous Commercial, New Vintage

End Use	Technology	Efficiency Definition	Savings (kWh/SQ FT/yr)	Incremental Cost ($/SQ FT)	Lifetime (Years)	BC Ratio	Levelized Cost of Energy ($/kWh)
Cooling	Air-Cooled Chiller	1.5 kw/ton, COP 2.3	-	$0.00	20	1.00	$0.000
Cooling	Air-Cooled Chiller	1.3 kw/ton, COP 2.7	0.29	$0.09	20	1.17	$0.023
Cooling	Air-Cooled Chiller	1.26 kw/ton, COP 2.8	0.33	$0.11	20	1.18	$0.026
Cooling	Air-Cooled Chiller	1.0 kw/ton, COP 3.5	0.39	$0.14	20	1.22	$0.028
Cooling	Air-Cooled Chiller	0.97 kw/ton, COP 3.6	0.46	$0.16	20	1.28	$0.027
Cooling	Water-Cooled Chiller	0.75 kw/ton, COP 4.7	-	$0.00	20	1.00	$0.000
Cooling	Water-Cooled Chiller	0.60 kw/ton, COP 5.9	0.40	$0.04	20	1.20	$0.009
Cooling	Water-Cooled Chiller	0.58 kw/ton, COP 6.1	0.45	$0.09	20	1.21	$0.015
Cooling	Water-Cooled Chiller	0.55 kw/Ton, COP 6.4	0.53	$0.11	20	1.26	$0.016
Cooling	Water-Cooled Chiller	0.51 kw/ton, COP 6.9	0.64	$0.17	20	1.31	$0.020
Cooling	Water-Cooled Chiller	0.50 kw/Ton, COP 7.0	0.67	$0.19	20	1.32	$0.021
Cooling	Water-Cooled Chiller	0.48 kw/ton, COP 7.3	0.72	$0.20	20	1.36	$0.022
Cooling	Roof top AC	EER 9.2	-	$0.00	16	-	$0.000
Cooling	Roof top AC	EER 10.1	0.26	$0.10	16	-	$0.033
Cooling	Roof top AC	EER 11.2	0.52	$0.18	16	1.00	$0.031
Cooling	Roof top AC	EER 12.0	0.69	$0.36	16	1.02	$0.046
Cooling	Roof top AC	Ductless Minisplit	0.86	$1.16	16	0.89	$0.120
Cooling	Air Source Heat Pump	EER 9.3, COP 3.1	-	$0.00	16	-	$0.000
Cooling	Air Source Heat Pump	EER 10.3, COP 3.2	0.26	$0.11	16	-	$0.037
Cooling	Air Source Heat Pump	EER 11.0, COP 3.3	0.42	$0.16	16	1.00	$0.034
Cooling	Air Source Heat Pump	EER 11.7, COP 3.4	0.56	$0.41	16	0.99	$0.065
Cooling	Air Source Heat Pump	EER 12.0, COP 3.4	0.61	$0.53	16	0.98	$0.077
Cooling	Air Source Heat Pump	Ductless Minisplit	0.77	$1.02	16	0.92	$0.117
Cooling	Geo Heat Pump	EER 14.1, COP 3.3	-	$0.00	16	1.00	$0.000
Cooling	Geo Heat Pump	EER 16, COP 3.5	0.17	$0.28	16	0.99	$0.144
Cooling	Geo Heat Pump	EER 18, COP 3.8	0.31	$0.56	16	0.98	$0.158
Cooling	Geo Heat Pump	EER 30, COP 5.0	0.77	$0.74	16	1.11	$0.085

End Use	Technology	Efficiency Definition	Savings (kWh/SQ FT/yr)	Incremental Cost ($/SQ FT)	Lifetime (Years)	BC Ratio	Levelized Cost of Energy ($/kWh)
Cooling	Other Cooling	EER 9.8	-	$0.00	14	1.00	$0.000
Cooling	Other Cooling	EER 10.2	0.04	$0.01	14	1.02	$0.027
Cooling	Other Cooling	EER 10.8	0.07	$0.12	14	0.99	$0.155
Cooling	Other Cooling	EER 11	0.11	$0.12	14	1.01	$0.111
Cooling	Other Cooling	EER 11.5	0.14	$0.14	14	1.02	$0.097
Heating	Air Source Heat Pump	EER 9.3, COP 3.1	-	$0.00	16	-	$0.000
Heating	Air Source Heat Pump	EER 10.3, COP 3.2	0.02	$0.72	16	-	$2.617
Heating	Air Source Heat Pump	EER 11.0, COP 3.3	0.05	$1.04	16	1.00	$1.881
Heating	Air Source Heat Pump	EER 11.7, COP 3.4	0.07	$2.67	16	0.84	$3.223
Heating	Air Source Heat Pump	EER 12.0, COP 3.4	0.07	$3.49	16	0.78	$4.206
Heating	Air Source Heat Pump	Ductless Minisplit	0.10	$6.68	16	0.60	$6.044
Heating	Geo Heat Pump	EER 14.1, COP 3.3	-	$0.00	16	1.00	$0.000
Heating	Geo Heat Pump	EER 16, COP 3.5	0.24	$1.41	16	0.90	$0.508
Heating	Geo Heat Pump	EER 18, COP 3.8	0.45	$2.81	16	0.82	$0.557
Heating	Geo Heat Pump	EER 30, COP 5.0	0.48	$3.71	16	0.77	$0.682
Heating	Electric Room Heat	Standard	-	$0.00	25	1.00	$0.000
Heating	Electric Furnace	Standard	-	$0.00	25	1.00	$0.000
Ventilation	Ventilation	Constant Volume	-	$0.00	10	1.00	$0.000
Ventilation	Ventilation	Variable Air Volume	0.02	-$0.17	10	1.03	-$1.189
Water Heating	Water Heating	EF .97	-	$0.00	15	1.00	$0.000
Water Heating	Water Heating	EF .98	0.01	$0.00	15	1.01	$0.017
Water Heating	Water Heating	EF 2.0	0.52	$0.00	15	2.02	$0.001
Water Heating	Water Heating	EF 2.3	0.58	$0.01	15	2.31	$0.001
Water Heating	Water Heating	EF 2.4	0.60	$0.01	15	2.40	$0.001
Int. Lighting	Screw-in	Incandescent	-	$0.00	2	1.00	$0.000
Int. Lighting	Screw-in	90W Halogen PAR-38	0.59	$0.03	3	-	$0.020
Int. Lighting	Screw-in	70W HIR PAR-38	0.90	$0.05	3	-	$0.018
Int. Lighting	Screw-in	CFL	1.69	$0.03	6	3.30	$0.003
Int. Lighting	Screw-in	LED (2010)	1.83	$0.72	20	1.60	$0.030
Int. Lighting	Screw-in	LED (2020)	2.10	$0.20	20	-	$0.007
Int. Lighting	High-Bay Fixtures	Metal Halides	-	$0.00	3	1.00	$0.000
Int. Lighting	High-Bay Fixtures	LED (2010)	0.80	$1.71	15	0.59	$0.196
Int. Lighting	High-Bay Fixtures	T8	0.82	-$0.05	10	1.85	-$0.007
Int. Lighting	High-Bay Fixtures	HP Sodium	0.87	$0.01	6	1.75	$0.002
Int. Lighting	High-Bay Fixtures	Light Emitting Plasma	1.02	$0.03	15	1.94	$0.002
Int. Lighting	High-Bay Fixtures	T5	1.04	-$0.03	10	2.24	-$0.003
Int. Lighting	High-Bay Fixtures	LED (2020)	1.53	$0.44	15	-	$0.026
Int. Lighting	Linear Fluorescent	T12	-	$0.00	10	1.00	$0.000
Int. Lighting	Linear Fluorescent	LED (2010)	0.19	$1.01	15	0.40	$0.499
Int. Lighting	Linear Fluorescent	T8	0.20	$0.00	10	1.34	$0.000
Int. Lighting	Linear Fluorescent	Super T8	0.27	$0.01	10	1.50	$0.003
Int. Lighting	Linear Fluorescent	T5	0.31	$0.01	10	1.61	$0.004
Int. Lighting	Linear Fluorescent	LED (2020)	0.57	$0.28	15	-	$0.045
Ext. Lighting	Screw-in	Incandescent	-	$0.00	2	1.00	$0.000
Ext. Lighting	Screw-in	90W Halogen PAR-38	0.19	$0.01	3	-	$0.020
Ext. Lighting	Screw-in	70W HIR PAR-38	0.29	$0.02	3	-	$0.018
Ext. Lighting	Screw-in	CFL	0.54	$0.01	6	3.13	$0.003
Ext. Lighting	Screw-in	LED (2010)	0.59	$0.23	20	1.35	$0.030
Ext. Lighting	Screw-in	LED (2020)	0.67	$0.07	20	-	$0.007
Ext. Lighting	HID	Metal Halides	-	$0.00	3	1.00	$0.000
Ext. Lighting	HID	LED (2010)	0.29	$0.50	15	0.57	$0.162
Ext. Lighting	HID	T8	0.29	-$0.01	10	1.80	-$0.006
Ext. Lighting	HID	HP Sodium	0.31	$0.00	6	1.73	$0.001
Ext. Lighting	HID	Light Emitting Plasma	0.36	$0.01	15	1.86	$0.002
Ext. Lighting	HID	T5	0.37	-$0.01	10	2.18	-$0.003
Ext. Lighting	HID	LED (2020)	0.55	$0.13	15	-	$0.022
Ext. Lighting	Linear Fluorescent	T12	-	$0.00	10	1.00	$0.000
Ext. Lighting	Linear Fluorescent	LED (2010)	0.10	$0.54	15	0.35	$0.499
Ext. Lighting	Linear Fluorescent	T8	0.10	$0.00	10	1.33	$0.000
Ext. Lighting	Linear Fluorescent	Super T8	0.15	$0.00	10	1.49	$0.003
Ext. Lighting	Linear Fluorescent	T5	0.17	$0.01	10	1.59	$0.004
Ext. Lighting	Linear Fluorescent	LED (2020)	0.31	$0.15	15	-	$0.045

End Use	Technology	Efficiency Definition	Savings (kWh/SQ FT/yr)	Incremental Cost ($/SQ FT)	Lifetime (Years)	BC Ratio	Levelized Cost of Energy ($/kWh)
Refrigeration	Walk-in Refrigerator	14600 kWh/yr	-	$0.00	12	1.00	$0.000
Refrigeration	Walk-in Refrigerator	10800 kWh/yr	0.05	$0.00	12	1.16	$0.011
Refrigeration	Walk-in Refrigerator	10000 kWh/yr	0.06	$0.01	12	1.20	$0.012
Refrigeration	Walk-in Refrigerator	9000 kWh/yr	0.07	$0.01	12	1.22	$0.017
Refrigeration	Reach-in Refrigerator	3800 kWh/yr	-	$0.00	12	1.00	$0.000
Refrigeration	Reach-in Refrigerator	3100 kWh/yr	0.01	$0.00	12	1.13	$0.017
Refrigeration	Reach-in Refrigerator	2500 kWh/yr	0.02	$0.00	12	1.26	$0.018
Refrigeration	Reach-in Refrigerator	2400 kWh/yr	0.02	$0.00	12	1.28	$0.017
Refrigeration	Reach-in Refrigerator	1500 kWh/yr	0.03	$0.00	12	1.70	$0.011
Refrigeration	Glass Door Display	14480 kWh/yr	-	$0.00	12	-	$0.000
Refrigeration	Glass Door Display	11700 kWh/yr	0.04	$0.03	12	-	$0.072
Refrigeration	Glass Door Display	8400 kWh/yr	0.08	$0.00	12	1.00	$0.000
Refrigeration	Glass Door Display	6800 kWh/yr	0.11	$0.03	12	0.91	$0.026
Refrigeration	Open Display Case	6500 kWh/yr	-	$0.00	18	-	$0.000
Refrigeration	Open Display Case	5350 kWh/yr	0.02	$0.00	18	1.00	$0.000
Refrigeration	Open Display Case	5300 kWh/yr	0.02	$0.01	18	-	$0.056
Refrigeration	Open Display Case	4330 kWh/yr	0.03	$0.01	18	1.00	$0.032
Refrigeration	Icemaker	7.0 kWh/100 lbs	-	$0.00	10	1.00	$0.000
Refrigeration	Icemaker	6.3 kWh/100 lbs	0.01	$0.00	10	1.01	$0.054
Refrigeration	Icemaker	6.0 kWh/100 lbs	0.01	$0.00	10	1.00	$0.057
Refrigeration	Icemaker	5.5 kWh/100 lbs	0.01	$0.01	10	0.88	$0.142
Refrigeration	Vending Machine	3400 kWh/year	-	$0.00	10	1.00	$0.000
Refrigeration	Vending Machine	3000 kWh/year	0.01	$0.00	10	1.05	$0.012
Refrigeration	Vending Machine	2400 kWh/year	0.03	$0.00	10	1.14	$0.012
Refrigeration	Vending Machine	1700 kWh/year	0.05	$0.01	10	1.20	$0.022
Food Prep.	Oven	Standard	-	$0.00	12	1.00	$0.000
Food Prep.	Oven	Energy Star	0.02	$0.00	12	1.12	$0.000
Food Prep.	Fryer	Standard	-	$0.00	12	1.00	$0.000
Food Prep.	Fryer	Energy Star	0.01	$0.00	12	1.03	$0.024
Food Prep.	Dishwasher	Standard	-	$0.00	12	1.00	$0.000
Food Prep.	Dishwasher	Energy Star	0.10	$0.00	12	1.32	$0.005
Food Prep.	Hot Food Container	Standard	-	$0.00	12	1.00	$0.000
Food Prep.	Hot Food Container	Energy Star	0.07	$0.01	12	1.22	$0.024
Office Equip.	Desktop Computer	Standard	-	$0.00	5	1.00	$0.000
Office Equip.	Desktop Computer	Energy Star	0.06	$0.00	5	1.05	$0.000
Office Equip.	Laptop	Standard	-	$0.00	4	1.00	$0.000
Office Equip.	Laptop	Energy Star	0.01	$0.00	4	1.02	$0.000
Office Equip.	Server	Standard	-	$0.00	3	1.00	$0.000
Office Equip.	Server	Energy Star	0.03	$0.00	3	1.04	$0.000
Office Equip.	Monitor	Standard	-	$0.00	4	1.00	$0.000
Office Equip.	Monitor	Energy Star	0.01	$0.00	4	1.02	$0.000
Office Equip.	Printer/Copier/Fax	Standard	-	$0.00	6	1.00	$0.000
Office Equip.	Printer/Copier/Fax	Energy Star	0.02	$0.00	6	1.10	$0.000
Office Equip.	POS Terminal	Standard	-	$0.00	4	1.00	$0.000
Office Equip.	POS Terminal	Energy Star	0.03	$0.02	4	0.95	$0.152
Miscellaneous	Non-HVAC Motors	Standard (EPAct)	-	$0.00	15	1.00	$0.000
Miscellaneous	Non-HVAC Motors	Standard (EPAct 2015)	0.00	$0.00	15	-	$0.000
Miscellaneous	Non-HVAC Motors	High Eff.	0.00	$0.00	15	1.01	$0.010
Miscellaneous	Non-HVAC Motors	High Eff. (2015)	0.01	$0.00	15	-	$0.007
Miscellaneous	Non-HVAC Motors	Premium (NEMA)	0.01	$0.00	15	1.02	$0.010
Miscellaneous	Non-HVAC Motors	Premium (NEMA 2015)	0.01	$0.00	15	-	$0.008
Miscellaneous	Pool Pump	Standard	-	$0.00	15	1.00	$0.000
Miscellaneous	Pool Pump	High Eff.	0.00	$0.00	15	1.05	$0.030
Miscellaneous	Pool Pump	High Eff. Multi-Speed	0.00	$0.00	15	1.11	$0.051
Miscellaneous	Pool Heater	Standard	-	$0.00	15	1.00	$0.000
Miscellaneous	Pool Heater	Heat Pump	0.00	$0.00	15	1.12	$0.059
Miscellaneous	Miscellaneous	Standard	-	$0.00	5	1.00	$0.000

Table C-25 Energy Efficiency Equpiment Data — Traffic Signals, Existing Vintage

End Use	Technology	Efficiency Definition	Savings (kWh/SQ FT/yr)	Incremental Cost ($/SQ FT)	Lifetime (Years)	BC Ratio	Levelized Cost of Energy ($/kWh)
Exterior Lighting	Traffic Lights	Incandescent	-	$0.00	2	1.00	$0.000
Exterior Lighting	Traffic Lights	LED	369.13	$47.00	6	6.55	$0.024
Exterior Lighting	Crosswalk Lights	Incandescent	-	$0.00	2	1.00	$0.000
Exterior Lighting	Crosswalk Lights	LED	201.33	$97.00	8	5.95	$0.071

Table C-26 Energy Efficiency Equpiment Data — Traffic Lights, New Vintage

End Use	Technology	Efficiency Definition	Savings (kWh/SQ FT/yr)	Incremental Cost ($/SQ FT)	Lifetime (Years)	BC Ratio	Levelized Cost of Energy ($/kWh)
Exterior Lighting	Traffic Lights	Incandescent	-	$0.00	2	1.00	$0.000
Exterior Lighting	Traffic Lights	LED	369.13	$47.00	6	6.55	$0.024
Exterior Lighting	Crosswalk Lights	Incandescent	-	$0.00	2	1.00	$0.000
Exterior Lighting	Crosswalk Lights	LED	201.33	$97.00	8	5.95	$0.071

Table C-27 Energy Efficiency Non-Equipment Data—Small Office, Existing Vintage

Measure	Base Saturation	Applicability	Lifetime (Years)	Incremental Cost ($/SqFt)	Savings (kWh/Sq Ft)	BC Ratio	Levelized Cost of Energy ($/kWh)
Insulation - Ceiling	7.0%	12.5%	20	$1.04	0.569	0.71	$0.141
Insulation - Ducting	14.7%	50.0%	20	$0.77	0.269	0.43	$0.220
Insulation - Radiant Barrier	7.0%	12.5%	15	$0.00	0.222	3.00	$0.000
Insulation - Wall Cavity	15.9%	67.5%	20	$1.12	0.865	1.23	$0.099
HVAC - Duct Repair and Sealing	5.0%	25.0%	18	$0.50	0.625	2.01	$0.066
Doors - High Efficiency	0.0%	0.0%	0	$0.00	-	3.00	$0.000
Windows - High Efficiency	66.5%	75.0%	20	$13.19	1.241	0.17	$0.820
Roof - High Reflectivity	41.6%	95.0%	15	$0.64	0.323	0.71	$0.183
Air-Cooled Chiller - Condenser Water Temperature Reset	0.0%	0.0%	10	$0.86	0.638	0.72	$0.167
Air-Cooled Chiller - Economizer	4.1%	48.8%	10	$0.05	0.686	12.74	$0.009
Air-Cooled Chiller - Thermal Energy Storage	44.5%	48.8%	15	$0.15	-	-	$0.000
Air-Cooled Chiller - VSD on Fans	0.0%	0.0%	15	$1.17	1.553	2.02	$0.070
Air-Cooled Chiller - Chilled Water Reset	5.0%	75.0%	10	$1.66	1.031	0.61	$0.199
Air-Cooled Chiller - Chilled Water Variable-Flow System	0.0%	0.0%	15	$0.08	0.203	3.89	$0.036
Air-Cooled Chiller - High Efficiency Cooling Tower Fans	0.0%	0.0%	15	$2.86	0.683	0.36	$0.387
Air-Cooled Chiller - Maintenance	48.6%	90.0%	3	$0.22	0.848	1.08	$0.090
Air-Cooled Chiller - Chiller Heat Recovery	0.0%	50.0%	14	$0.04	0.074	1.65	$0.053
Water-Cooled Chiller - Condenser Water Temperature Reset	0.0%	0.0%	10	$0.86	0.386	0.41	$0.276
Water-Cooled Chiller - Economizer	4.1%	48.8%	10	$0.05	1.956	34.22	$0.003
Water-Cooled Chiller - Thermal Energy Storage	44.5%	48.8%	15	$0.15	-	-	$0.000
Water-Cooled Chiller - VSD on Fans	0.0%	0.0%	15	$1.17	1.706	2.08	$0.063
Water-Cooled Chiller - Chilled Water Reset	5.0%	75.0%	10	$1.66	1.113	0.62	$0.184
Water-Cooled Chiller - Chilled Water Variable-Flow System	0.0%	0.0%	15	$0.08	0.219	3.93	$0.033
Water-Cooled Chiller - High Efficiency Cooling Tower Fans	0.0%	0.0%	15	$2.86	0.003	0.00	$76.504
Water-Cooled Chiller - Maintenance	48.6%	90.0%	3	$0.22	0.915	1.12	$0.083
Water-Cooled Chiller - Chiller Heat	0.0%	50.0%	14	$0.04	0.074	1.65	$0.053

Measure	Base Saturation	Applicability	Lifetime (Years)	Incremental Cost ($/SqFt)	Savings (kWh/Sq Ft)	BC Ratio	Levelized Cost of Energy ($/kWh)
Recovery							
RTU - Evaporative Precooler	0.0%	17.0%	20	$3.00	2.598	1.68	$0.089
RTU - Maintenance	48.6%	90.0%	18	$0.15	0.745	8.60	$0.017
Space Heating - Heat Recovery Ventilator	44.5%	48.8%	15	$1,150.00	0.624	0.00	$170.343
Heat Pump - Maintenance	3.7%	95.0%	4	$0.03	2.519	21.06	$0.003
Ventilation - ECM on VAV Boxes	0.0%	0.0%	18	$0.22	0.043	0.20	$0.420
Ventilation - Variable Speed Control	0.8%	81.0%	15	$0.36	0.390	0.91	$0.085
Water Heater - Drainwater Heat Recovery	0.0%	50.0%	5	$0.04	0.074	0.50	$0.120
Water Heater - Faucet Aerators/Low Flow Nozzles	25.7%	90.0%	10	$0.02	0.033	1.26	$0.059
Water Heater - High Efficiency Circulation Pump	0.0%	0.0%	0	$0.00	-	1.00	$0.000
Water Heater - Desuperheater	0.0%	50.0%	5	$0.04	0.164	1.12	$0.054
Water Heater - Solar System	0.0%	50.0%	20	$0.83	0.410	0.68	$0.157
Water Heater - Install Timer	15.5%	50.0%	15	$0.28	0.164	0.57	$0.158
Water Heater - Pipe Insulation	15.5%	50.0%	13	$5.22	0.046	0.01	$11.570
Water Heater - Tank Blanket/Insulation	40.4%	50.0%	7	$0.03	0.041	0.61	$0.107
Interior Lighting - Daylighting Controls	10.6%	50.0%	8	$12.50	0.469	0.02	$3.946
Interior Lighting - LED Exit Lighting	50.0%	85.5%	16	$0.04	0.003	0.08	$1.108
Interior Lighting - Occupancy Sensors	5.3%	56.3%	8	$0.19	0.156	0.38	$0.176
Interior Lighting - Timeclocks and Timers	4.9%	56.3%	8	$0.21	0.078	0.17	$0.395
Interior Lighting - Task Lighting	17.1%	75.0%	5	$0.24	0.162	0.15	$0.326
Interior Fluorescent - Bi-Level Fixture	10.0%	22.5%	8	$0.50	0.249	0.26	$0.298
Interior Fluorescent - Delamp and Install Reflectors	15.1%	45.0%	11	$0.50	0.211	0.31	$0.273
Exterior Lighting - Bi-Level Fixture	10.0%	30.0%	8	$0.20	0.015	0.02	$1.961
Exterior Lighting - Daylighting Controls	18.0%	37.5%	8	$0.02	0.075	1.21	$0.039
Exterior Lighting - Photovoltaic Installation	0.0%	12.5%	5	$0.92	0.045	0.01	$4.482
Refrigerator - Anti-Sweat Heater	0.0%	75.0%	12	$0.66	-	-	$0.000
Refrigerator - Decommissioning	50.0%	51.7%	9	$0.09	-	-	$0.000
Refrigerator - Demand Defrost	0.0%	75.0%	16	$0.20	-	-	$0.000
Refrigerator - Door Gasket Replacement	5.0%	75.0%	4	$6.50	0.007	0.00	$237.870
Refrigerator - Evaporator Fan Controls	0.0%	7.5%	16	$0.11	-	-	$0.000
Refrigerator - Floating Head Pressure	17.9%	37.5%	15	$0.08	-	-	$0.000
Refrigerator - Strip Curtain	5.0%	56.3%	4	$2.30	-	-	$0.000
Refrigerator - High Efficiency Compressor	10.0%	37.5%	15	$0.29	-	-	$0.000
Refrigerator - Variable Speed Compressor	10.0%	37.5%	15	$0.20	-	-	$0.000
Refrigerator - eCube	5.0%	75.0%	12	$0.00	-	-	$0.000
Vending Machine - Controller	2.0%	10.0%	5	$0.27	0.028	0.02	$2.103
Office Equipment - ENERGY STAR Power Supplies	10.0%	95.0%	4	$0.00	0.009	18.24	$0.003
Office Equipment - Plug Load Occupancy Sensors	7.1%	56.3%	8	$0.20	0.096	0.22	$0.309
Pool Heater - Solar	0.0%	33.8%	20	$0.83	-	-	$0.000
Pool Pump - Timer	2.0%	33.8%	10	$0.44	-	-	$0.000
Ventilation - CO2 Controlled	1.0%	15.0%	15	$0.65	0.273	0.35	$0.220
Non-HVAC Motors - Variable Speed Control	1.6%	37.5%	10	$0.10	-	-	$0.000
Energy Management System	6.1%	50.0%	15	$0.35	1.493	4.68	$0.022
Thermostat - Clock/Programmable	57.6%	62.6%	11	$0.13	0.509	2.75	$0.029
HVAC - Occupancy Sensors	14.3%	56.3%	8	$0.14	0.699	2.34	$0.030
Commissioning - HVAC	0.0%	0.0%	0	$0.00	-	3.00	$0.000
Commissioning - Lighting	0.0%	0.0%	0	$0.00	-	2.00	$0.000
Retrocommissioning - HVAC	5.0%	24.0%	10	$0.75	1.221	1.10	$0.076
Retrocommissioning - Lighting	25.7%	30.7%	5	$0.10	0.164	0.45	$0.135

Measure	Base Saturation	Applicability	Lifetime (Years)	Incremental Cost ($/SqFt)	Savings (kWh/Sq Ft)	BC Ratio	Levelized Cost of Energy ($/kWh)
Advanced New Construction Designs	0.0%	0.0%	0	$0.00	-	6.00	$0.000
Custom Measures	10.0%	45.0%	15	$1.50	-	-	$0.000
PC Power Management Software	13.0%	90.0%	5	$0.05	0.666	4.03	$0.015
Pre-rinse Sprayer	21.0%	5.0%	5	$0.00	0.049	7.25	$0.008

Table C-28 Energy Efficiency Non-Equipment Data— Small Office, New Vintage

Measure	Base Saturation	Applicability	Lifetime (Years)	Incremental Cost ($/SqFt)	Savings (kWh/SqFt)	BC Ratio	Levelized Cost of Energy ($/kWh)
Insulation - Ceiling	7.0%	12.5%	20	$1.36	0.276	0.25	$0.380
Insulation - Ducting	11.1%	50.0%	20	$0.77	0.595	0.94	$0.100
Insulation - Radiant Barrier	7.0%	12.5%	15	$0.00	0.102	3.00	$0.000
Insulation - Wall Cavity	12.7%	67.5%	20	$0.67	0.167	0.33	$0.308
HVAC - Duct Repair and Sealing	25.0%	25.0%	18	$0.50	1.010	2.15	$0.041
Doors - High Efficiency	100.0%	100.0%	0	$0.00	-	3.00	$0.000
Windows - High Efficiency	77.8%	82.8%	20	$12.36	0.996	0.10	$0.957
Roof - High Reflectivity	41.3%	95.0%	15	$0.64	0.172	0.24	$0.344
Air-Cooled Chiller - Condenser Water Temperature Reset	0.0%	0.0%	10	$0.86	0.382	0.24	$0.279
Air-Cooled Chiller - Economizer	37.4%	48.8%	10	$0.05	0.667	7.63	$0.009
Air-Cooled Chiller - Thermal Energy Storage	44.5%	48.8%	15	$0.15	-	0.03	$0.000
Air-Cooled Chiller - VSD on Fans	0.0%	0.0%	15	$1.17	1.096	0.81	$0.099
Air-Cooled Chiller - Chilled Water Reset	25.0%	75.0%	10	$1.45	0.637	0.23	$0.283
Air-Cooled Chiller - Chilled Water Variable-Flow System	0.0%	0.0%	15	$0.07	0.211	2.74	$0.030
Air-Cooled Chiller - High Efficiency Cooling Tower Fans	0.0%	0.0%	15	$2.51	0.526	0.18	$0.441
Air-Cooled Chiller - Maintenance	41.3%	90.0%	3	$0.19	0.514	0.37	$0.127
Air-Cooled Chiller - Chiller Heat Recovery	0.0%	50.0%	14	$0.04	0.071	1.51	$0.055
Water-Cooled Chiller - Condenser Water Temperature Reset	0.0%	0.0%	10	$0.86	0.167	0.11	$0.637
Water-Cooled Chiller - Economizer	37.4%	48.8%	10	$0.05	1.421	16.18	$0.004
Water-Cooled Chiller - Thermal Energy Storage	44.5%	48.8%	15	$0.15	-	0.03	$0.000
Water-Cooled Chiller - VSD on Fans	0.0%	0.0%	15	$1.17	0.222	0.17	$0.488
Water-Cooled Chiller - Chilled Water Reset	25.0%	75.0%	10	$1.45	0.725	0.26	$0.249
Water-Cooled Chiller - Chilled Water Variable-Flow System	0.0%	0.0%	15	$0.07	0.240	3.10	$0.026
Water-Cooled Chiller - High Efficiency Cooling Tower Fans	0.0%	0.0%	15	$2.51	0.006	0.00	$39.913
Water-Cooled Chiller - Maintenance	41.3%	90.0%	3	$0.19	0.585	0.42	$0.112
Water-Cooled Chiller - Chiller Heat Recovery	0.0%	50.0%	14	$0.04	0.071	1.51	$0.055
RTU - Evaporative Precooler	0.0%	19.0%	20	$3.00	2.037	0.84	$0.114
RTU - Maintenance	41.3%	90.0%	18	$0.15	0.459	3.35	$0.027
Space Heating - Heat Recovery Ventilator	44.5%	48.8%	15	$1,150.00	0.550	0.00	$192.995
Heat Pump - Maintenance	1.6%	95.0%	4	$0.03	0.833	5.22	$0.010
Ventilation - ECM on VAV Boxes	0.0%	0.0%	18	$0.22	0.269	1.33	$0.067
Ventilation - Variable Speed Control	3.2%	81.0%	15	$0.32	0.297	0.82	$0.098
Water Heater - Drainwater Heat Recovery	0.0%	50.0%	5	$0.04	0.071	0.45	$0.124
Water Heater - Faucet Aerators/Low Flow Nozzles	25.4%	90.0%	10	$0.01	0.032	1.43	$0.054
Water Heater - High Efficiency	0.0%	0.0%	0	$0.00	-	1.00	$0.000

Measure	Base Saturation	Applicability	Lifetime (Years)	Incremental Cost ($/SqFt)	Savings (kWh/SqFt)	BC Ratio	Levelized Cost of Energy ($/kWh)
Circulation Pump							
Water Heater - Desuperheater	0.0%	50.0%	5	$0.04	0.157	0.96	$0.056
Water Heater - Solar System	0.0%	50.0%	20	$0.73	0.394	0.67	$0.143
Water Heater - Install Timer	50.0%	50.0%	15	$0.28	0.157	0.50	$0.164
Water Heater - Pipe Insulation	50.0%	50.0%	13	$5.22	0.044	0.01	$12.021
Water Heater - Tank Blanket/Insulation	40.4%	50.0%	7	$0.02	0.037	0.63	$0.105
Interior Lighting - Daylighting Controls	75.0%	75.0%	8	$11.72	0.348	0.01	$4.983
Interior Lighting - LED Exit Lighting	85.5%	85.5%	16	$0.03	0.002	0.20	$1.312
Interior Lighting - Occupancy Sensors	56.3%	56.3%	8	$0.16	0.116	0.29	$0.208
Interior Lighting - Timeclocks and Timers	56.3%	56.3%	8	$0.18	0.058	0.14	$0.468
Interior Lighting - Task Lighting	14.3%	75.0%	5	$0.24	0.120	0.12	$0.440
Interior Fluorescent - Bi-Level Fixture	10.0%	22.5%	8	$0.50	0.224	0.18	$0.329
Interior Fluorescent - Delamp and Install Reflectors	14.3%	45.0%	11	$0.50	-	0.01	$0.000
Exterior Lighting - Bi-Level Fixture	10.0%	30.0%	8	$0.20	0.009	0.03	$3.305
Exterior Lighting - Daylighting Controls	18.0%	37.5%	8	$0.02	0.045	1.02	$0.066
Exterior Lighting - Photovoltaic Installation	0.0%	12.5%	5	$0.92	0.027	0.01	$7.554
Refrigerator - Anti-Sweat Heater	0.0%	75.0%	12	$0.58	-	0.01	$0.000
Refrigerator - Decommissioning	50.0%	51.7%	9	$0.08	-	0.03	$0.000
Refrigerator - Demand Defrost	0.0%	75.0%	16	$0.20	-	0.02	$0.000
Refrigerator - Door Gasket Replacement	5.0%	75.0%	4	$6.09	0.004	0.00	$419.015
Refrigerator - Evaporator Fan Controls	0.0%	7.5%	16	$0.10	-	0.05	$0.000
Refrigerator - Floating Head Pressure	17.9%	37.5%	15	$0.07	-	0.06	$0.000
Refrigerator - Strip Curtain	5.0%	56.3%	4	$2.16	-	0.00	$0.000
Refrigerator - High Efficiency Compressor	10.0%	37.5%	15	$0.29	-	0.01	$0.000
Refrigerator - Variable Speed Compressor	10.0%	37.5%	15	$0.17	-	0.02	$0.000
Refrigerator - eCube	5.0%	75.0%	12	$0.00	-	2.33	$0.000
Vending Machine - Controller	2.0%	10.0%	5	$0.27	0.020	0.02	$2.961
Office Equipment - ENERGY STAR Power Supplies	10.0%	95.0%	4	$0.00	0.009	27.71	$0.003
Office Equipment - Plug Load Occupancy Sensors	7.1%	56.3%	8	$0.20	0.095	0.20	$0.312
Pool Heater - Solar	0.0%	33.8%	20	$0.73	-	0.01	$0.000
Pool Pump - Timer	33.8%	33.8%	10	$0.44	-	0.01	$0.000
Ventilation - CO2 Controlled	11.5%	15.0%	15	$0.65	0.220	0.30	$0.273
Non-HVAC Motors - Variable Speed Control	1.6%	37.5%	10	$0.10	-	0.03	$0.000
Energy Management System	6.4%	50.0%	15	$0.35	1.019	2.50	$0.032
Thermostat - Clock/Programmable	78.0%	78.0%	11	$0.13	0.354	1.63	$0.042
HVAC - Occupancy Sensors	56.3%	56.3%	8	$0.14	0.595	1.71	$0.035
Commissioning - HVAC	0.0%	0.0%	25	$1.25	1.020	1.31	$0.084
Commissioning - Lighting	0.0%	0.0%	25	$0.20	0.120	1.02	$0.113
Retrocommissioning - HVAC	0.0%	0.0%	10	$0.75	-	0.01	$0.000
Retrocommissioning - Lighting	0.0%	0.0%	0	$0.00	-	2.00	$0.000
Advanced New Construction Designs	0.0%	0.0%	25	$2.00	4.415	3.52	$0.031
Custom Measures	10.0%	45.0%	15	$1.50	-	0.01	$0.000
PC Power Management Software	13.0%	90.0%	5	$0.05	0.666	4.11	$0.015
Pre-rinse Sprayer	25.0%	5.0%	5	$0.00	0.049	7.39	$0.008

Table C-29 Energy Efficiency Non-Equipment Data— Large Office, Existing Vintage

Measure	Base Saturation	Applicability	Lifetime (Years)	Incremental Cost ($/SqFt)	Savings (kWh/SqFt)	BC Ratio	Levelized Cost of Energy ($/kWh)
Insulation - Ceiling	7.0%	12.5%	20	$0.26	0.199	0.89	$0.101
Insulation - Ducting	16.7%	50.0%	20	$0.77	0.220	0.33	$0.270
Insulation - Radiant Barrier	7.0%	12.5%	15	$0.00	0.069	3.00	$0.000
Insulation - Wall Cavity	16.7%	67.5%	20	$0.60	0.405	0.79	$0.114
HVAC - Duct Repair and Sealing	5.0%	25.0%	18	$0.50	0.142	0.29	$0.290
Doors - High Efficiency	0.0%	0.0%	0	$0.00	-	3.00	$0.000
Windows - High Efficiency	75.0%	80.0%	20	$7.08	1.034	0.17	$0.528
Roof - High Reflectivity	41.7%	75.0%	15	$0.16	0.084	0.42	$0.176
Air-Cooled Chiller - Condenser Water Temperature Reset	30.0%	75.0%	10	$0.18	0.488	1.31	$0.046
Air-Cooled Chiller - Economizer	25.0%	48.8%	10	$0.00	1.123	142.90	$0.000
Air-Cooled Chiller - Thermal Energy Storage	44.3%	48.8%	15	$0.15	-	0.01	$0.000
Air-Cooled Chiller - VSD on Fans	15.0%	66.2%	15	$1.17	1.169	0.79	$0.092
Air-Cooled Chiller - Chilled Water Reset	5.0%	75.0%	10	$0.12	0.768	3.10	$0.019
Air-Cooled Chiller - Chilled Water Variable-Flow System	30.0%	75.0%	15	$0.06	0.162	2.12	$0.035
Air-Cooled Chiller - High Efficiency Cooling Tower Fans	15.0%	41.3%	15	$0.21	0.003	0.02	$6.152
Air-Cooled Chiller - Maintenance	41.7%	90.0%	3	$0.17	0.638	0.48	$0.091
Air-Cooled Chiller - Chiller Heat Recovery	0.0%	50.0%	14	$0.04	0.081	1.60	$0.048
Water-Cooled Chiller - Condenser Water Temperature Reset	30.0%	75.0%	10	$0.18	0.269	0.74	$0.083
Water-Cooled Chiller - Economizer	25.0%	48.8%	10	$0.00	1.384	178.83	$0.000
Water-Cooled Chiller - Thermal Energy Storage	44.3%	48.8%	15	$0.15	-	0.01	$0.000
Water-Cooled Chiller - VSD on Fans	15.0%	66.2%	15	$1.17	0.352	0.24	$0.307
Water-Cooled Chiller - Chilled Water Reset	5.0%	75.0%	10	$0.12	0.750	3.08	$0.020
Water-Cooled Chiller - Chilled Water Variable-Flow System	30.0%	75.0%	15	$0.06	0.156	2.07	$0.036
Water-Cooled Chiller - High Efficiency Cooling Tower Fans	15.0%	41.3%	15	$0.21	0.002	0.02	$8.244
Water-Cooled Chiller - Maintenance	41.7%	90.0%	3	$0.17	0.612	0.47	$0.095
Water-Cooled Chiller - Chiller Heat Recovery	0.0%	50.0%	14	$0.04	0.081	1.60	$0.048
RTU - Evaporative Precooler	0.0%	3.0%	20	$3.00	2.535	0.93	$0.091
RTU - Maintenance	41.7%	90.0%	18	$0.04	0.727	18.78	$0.004
Space Heating - Heat Recovery Ventilator	44.3%	48.8%	15	$1,150.00	0.533	0.00	$199.186
Heat Pump - Maintenance	8.3%	95.0%	4	$0.06	2.342	6.70	$0.007
Ventilation - ECM on VAV Boxes	0.0%	0.0%	18	$0.22	0.394	1.74	$0.046
Ventilation - Variable Speed Control	0.0%	81.0%	15	$0.03	0.744	22.35	$0.003
Water Heater - Drainwater Heat Recovery	0.0%	50.0%	5	$0.04	0.081	0.48	$0.109
Water Heater - Faucet Aerators/Low Flow Nozzles	41.7%	90.0%	10	$0.00	0.036	17.39	$0.004
Water Heater - High Efficiency Circulation Pump	0.0%	0.0%	0	$0.00	-	1.00	$0.000
Water Heater - Desuperheater	0.0%	50.0%	5	$0.04	0.180	1.04	$0.049
Water Heater - Solar System	0.0%	50.0%	20	$0.06	0.451	9.09	$0.010
Water Heater - Install Timer	33.3%	38.3%	15	$0.28	0.180	0.55	$0.144
Water Heater - Pipe Insulation	33.3%	38.3%	13	$5.22	0.051	0.01	$10.446
Water Heater - Tank Blanket/Insulation	0.0%	0.0%	7	$0.00	0.045	8.32	$0.007
Interior Lighting - Daylighting Controls	8.3%	12.5%	8	$6.71	0.362	0.02	$2.740
Interior Lighting - LED Exit Lighting	50.0%	85.5%	16	$0.00	0.002	1.24	$0.103

Measure	Base Saturation	Applicability	Lifetime (Years)	Incremental Cost ($/SqFt)	Savings (kWh/SqFt)	BC Ratio	Levelized Cost of Energy ($/kWh)
Interior Lighting - Occupancy Sensors	25.0%	56.3%	8	$0.01	0.121	3.27	$0.016
Interior Lighting - Timeclocks and Timers	8.3%	56.3%	8	$0.02	0.060	1.48	$0.037
Interior Lighting - Task Lighting	41.7%	75.0%	5	$0.24	0.125	0.09	$0.422
Interior Fluorescent - Bi-Level Fixture	10.0%	22.5%	8	$0.40	0.328	0.32	$0.180
Interior Fluorescent - Delamp and Install Reflectors	33.3%	67.5%	11	$0.50	0.279	0.32	$0.207
Exterior Lighting - Bi-Level Fixture	10.0%	30.0%	8	$0.20	0.011	0.02	$2.609
Exterior Lighting - Daylighting Controls	18.0%	37.5%	8	$0.02	0.057	0.91	$0.052
Exterior Lighting - Photovoltaic Installation	0.0%	12.5%	5	$0.92	0.034	0.01	$5.963
Refrigerator - Anti-Sweat Heater	0.0%	75.0%	12	$0.05	0.010	0.12	$0.533
Refrigerator - Decommissioning	50.0%	51.7%	9	$0.01	-	0.13	$0.000
Refrigerator - Demand Defrost	0.0%	75.0%	16	$0.20	-	0.01	$0.000
Refrigerator - Door Gasket Replacement	5.0%	75.0%	4	$3.49	0.009	0.00	$98.853
Refrigerator - Evaporator Fan Controls	0.0%	7.5%	16	$0.01	-	0.17	$0.000
Refrigerator - Floating Head Pressure	38.0%	45.0%	15	$0.01	-	0.21	$0.000
Refrigerator - Strip Curtain	5.0%	56.3%	4	$1.24	-	0.00	$0.000
Refrigerator - High Efficiency Compressor	10.0%	37.5%	15	$0.29	-	0.00	$0.000
Refrigerator - Variable Speed Compressor	10.0%	37.5%	15	$0.01	-	0.09	$0.000
Refrigerator - eCube	5.0%	75.0%	12	$0.00	-	0.52	$0.000
Vending Machine - Controller	2.0%	10.0%	5	$0.27	0.014	0.01	$4.228
Office Equipment - ENERGY STAR Power Supplies	10.0%	95.0%	4	$0.00	0.021	40.81	$0.001
Office Equipment - Plug Load Occupancy Sensors	12.6%	56.3%	8	$0.28	0.233	0.32	$0.178
Pool Heater - Solar	0.0%	33.8%	20	$0.06	-	0.04	$0.000
Pool Pump - Timer	8.3%	33.8%	10	$0.13	-	0.01	$0.000
Ventilation - CO2 Controlled	1.0%	11.3%	15	$0.65	0.338	0.40	$0.178
Non-HVAC Motors - Variable Speed Control	8.3%	37.5%	10	$0.10	-	0.01	$0.000
Energy Management System	8.3%	90.0%	15	$0.35	1.343	3.03	$0.024
Thermostat - Clock/Programmable	58.3%	63.3%	11	$0.13	0.414	1.77	$0.036
HVAC - Occupancy Sensors	14.3%	56.3%	8	$0.14	0.626	1.71	$0.033
Commissioning - HVAC	0.0%	0.0%	0	$0.00	-	3.00	$0.000
Commissioning - Lighting	0.0%	0.0%	0	$0.00	-	2.00	$0.000
Retrocommissioning - HVAC	9.0%	36.0%	10	$0.75	1.199	0.78	$0.077
Retrocommissioning - Lighting	66.7%	71.7%	5	$0.05	0.126	0.55	$0.087
Advanced New Construction Designs	0.0%	0.0%	0	$0.00	-	6.00	$0.000
Custom Measures	10.0%	45.0%	15	$0.90	-	0.01	$0.000
PC Power Management Software	13.0%	90.0%	5	$0.03	1.621	11.84	$0.004
Pre-rinse Sprayer	42.0%	5.0%	5	$0.00	0.018	7.25	$0.008

Table C-30 Energy Efficiency Non-Equipment Data— Large Office, New Vintage

Measure	Base Saturation	Applicability	Lifetime (Years)	Incremental Cost ($/SqFt)	Savings (kWh/SqFt)	BC Ratio	Levelized Cost of Energy ($/kWh)
Insulation - Ceiling	7.0%	12.5%	20	$0.34	0.103	0.38	$0.255
Insulation - Ducting	0.0%	50.0%	20	$0.77	0.340	0.55	$0.175
Insulation - Radiant Barrier	7.0%	12.5%	15	$0.00	0.036	3.00	$0.000
Insulation - Wall Cavity	50.0%	67.5%	20	$0.36	0.205	0.68	$0.137
HVAC - Duct Repair and Sealing	25.0%	25.0%	18	$0.50	0.530	1.11	$0.078
Doors - High Efficiency	100.0%	100.0%	0	$0.00	-	3.00	$0.000
Windows - High Efficiency	100.0%	100.0%	20	$6.75	0.884	0.16	$0.589

Measure	Base Saturation	Applicability	Lifetime (Years)	Incremental Cost ($/SqFt)	Savings (kWh/SqFt)	BC Ratio	Levelized Cost of Energy ($/kWh)
Roof - High Reflectivity	50.0%	95.0%	15	$0.16	0.256	1.40	$0.058
Air-Cooled Chiller - Condenser Water Temperature Reset	60.0%	75.0%	10	$0.18	0.265	0.78	$0.084
Air-Cooled Chiller - Economizer	53.8%	55.0%	10	$0.00	1.256	191.04	$0.000
Air-Cooled Chiller - Thermal Energy Storage	44.3%	48.8%	15	$0.15	-	0.01	$0.000
Air-Cooled Chiller - VSD on Fans	15.0%	66.2%	15	$1.17	0.760	0.56	$0.142
Air-Cooled Chiller - Chilled Water Reset	25.0%	75.0%	10	$0.11	0.452	2.19	$0.030
Air-Cooled Chiller - Chilled Water Variable-Flow System	30.0%	75.0%	15	$0.05	0.161	2.70	$0.030
Air-Cooled Chiller - High Efficiency Cooling Tower Fans	15.0%	41.3%	15	$0.19	0.002	0.02	$11.123
Air-Cooled Chiller - Maintenance	50.0%	90.0%	3	$0.14	0.334	0.32	$0.149
Air-Cooled Chiller - Chiller Heat Recovery	0.0%	50.0%	14	$0.04	0.078	1.58	$0.050
Water-Cooled Chiller - Condenser Water Temperature Reset	60.0%	75.0%	10	$0.18	0.191	0.56	$0.117
Water-Cooled Chiller - Economizer	53.8%	55.0%	10	$0.00	0.877	133.81	$0.000
Water-Cooled Chiller - Thermal Energy Storage	44.3%	48.8%	15	$0.15	-	0.01	$0.000
Water-Cooled Chiller - VSD on Fans	15.0%	66.2%	15	$1.17	0.302	0.22	$0.358
Water-Cooled Chiller - Chilled Water Reset	25.0%	75.0%	10	$0.11	0.480	2.32	$0.028
Water-Cooled Chiller - Chilled Water Variable-Flow System	30.0%	75.0%	15	$0.05	0.205	3.44	$0.023
Water-Cooled Chiller - High Efficiency Cooling Tower Fans	15.0%	41.3%	15	$0.19	0.004	0.03	$4.566
Water-Cooled Chiller - Maintenance	50.0%	90.0%	3	$0.14	0.357	0.34	$0.139
Water-Cooled Chiller - Chiller Heat Recovery	0.0%	50.0%	14	$0.04	0.078	1.58	$0.050
RTU - Evaporative Precooler	0.0%	1.0%	20	$3.00	1.945	0.80	$0.119
RTU - Maintenance	50.0%	90.0%	18	$0.04	0.411	11.94	$0.007
Space Heating - Heat Recovery Ventilator	44.3%	48.8%	15	$1,150.00	0.487	0.00	$218.190
Heat Pump - Maintenance	0.0%	95.0%	4	$0.06	0.768	2.36	$0.021
Ventilation - ECM on VAV Boxes	0.0%	0.0%	18	$0.22	0.296	1.47	$0.061
Ventilation - Variable Speed Control	0.0%	81.0%	15	$0.02	0.559	20.65	$0.004
Water Heater - Drainwater Heat Recovery	0.0%	50.0%	5	$0.04	0.078	0.47	$0.113
Water Heater - Faucet Aerators/Low Flow Nozzles	50.0%	90.0%	10	$0.00	0.035	18.86	$0.004
Water Heater - High Efficiency Circulation Pump	0.0%	0.0%	0	$0.00	-	1.00	$0.000
Water Heater - Desuperheater	0.0%	50.0%	5	$0.04	0.173	1.02	$0.051
Water Heater - Solar System	0.0%	50.0%	20	$0.05	0.432	9.86	$0.010
Water Heater - Install Timer	100.0%	100.0%	15	$0.28	0.173	0.54	$0.150
Water Heater - Pipe Insulation	100.0%	100.0%	13	$5.22	0.049	0.01	$10.870
Water Heater - Tank Blanket/Insulation	0.0%	0.0%	7	$0.00	0.040	8.40	$0.007
Interior Lighting - Daylighting Controls	18.8%	18.8%	8	$6.40	0.271	0.02	$3.497
Interior Lighting - LED Exit Lighting	85.5%	85.5%	16	$0.00	0.002	1.30	$0.126
Interior Lighting - Occupancy Sensors	56.3%	56.3%	8	$0.01	0.090	2.97	$0.020
Interior Lighting - Timeclocks and Timers	56.3%	56.3%	8	$0.01	0.045	1.35	$0.045
Interior Lighting - Task Lighting	50.0%	75.0%	5	$0.24	0.094	0.09	$0.565
Interior Fluorescent - Bi-Level Fixture	10.0%	22.5%	8	$0.40	0.296	0.29	$0.200
Interior Fluorescent - Delamp and Install Reflectors	100.0%	100.0%	11	$0.50	-	0.00	$0.000
Exterior Lighting - Bi-Level Fixture	10.0%	30.0%	8	$0.20	0.007	0.02	$4.367
Exterior Lighting - Daylighting Controls	18.0%	37.5%	8	$0.02	0.034	0.72	$0.087

Measure	Base Saturation	Applicability	Lifetime (Years)	Incremental Cost ($/SqFt)	Savings (kWh/SqFt)	BC Ratio	Levelized Cost of Energy ($/kWh)
Exterior Lighting - Photovoltaic Installation	0.0%	12.5%	5	$0.92	0.020	0.01	$9.982
Refrigerator - Anti-Sweat Heater	0.0%	75.0%	12	$0.04	0.010	0.18	$0.484
Refrigerator - Decommissioning	50.0%	51.7%	9	$0.01	-	0.17	$0.000
Refrigerator - Demand Defrost	0.0%	75.0%	16	$0.20	-	0.01	$0.000
Refrigerator - Door Gasket Replacement	5.0%	75.0%	4	$3.33	0.009	0.00	$103.588
Refrigerator - Evaporator Fan Controls	0.0%	7.5%	16	$0.01	-	0.23	$0.000
Refrigerator - Floating Head Pressure	38.0%	45.0%	15	$0.01	-	0.29	$0.000
Refrigerator - Strip Curtain	5.0%	56.3%	4	$1.18	-	0.00	$0.000
Refrigerator - High Efficiency Compressor	10.0%	37.5%	15	$0.29	-	0.01	$0.000
Refrigerator - Variable Speed Compressor	10.0%	37.5%	15	$0.01	-	0.12	$0.000
Refrigerator - eCube	5.0%	75.0%	12	$0.00	-	0.46	$0.000
Vending Machine - Controller	2.0%	10.0%	5	$0.27	0.010	0.01	$6.185
Office Equipment - ENERGY STAR Power Supplies	10.0%	95.0%	4	$0.00	0.021	41.72	$0.001
Office Equipment - Plug Load Occupancy Sensors	12.6%	56.3%	8	$0.25	0.231	0.37	$0.160
Pool Heater - Solar	0.0%	33.8%	20	$0.05	-	0.04	$0.000
Pool Pump - Timer	33.8%	33.8%	10	$0.13	-	0.01	$0.000
Ventilation - CO2 Controlled	8.7%	11.3%	15	$0.65	0.276	0.37	$0.218
Non-HVAC Motors - Variable Speed Control	50.0%	55.0%	10	$0.10	-	0.01	$0.000
Energy Management System	50.0%	90.0%	15	$0.35	0.907	2.20	$0.036
Thermostat - Clock/Programmable	50.0%	50.0%	11	$0.13	0.395	1.74	$0.038
HVAC - Occupancy Sensors	56.3%	56.3%	8	$0.14	0.550	1.56	$0.038
Commissioning - HVAC	0.0%	0.0%	25	$1.00	1.019	1.64	$0.067
Commissioning - Lighting	0.0%	0.0%	25	$0.15	0.094	1.03	$0.109
Retrocommissioning - HVAC	0.0%	0.0%	10	$0.75	-	0.00	$0.000
Retrocommissioning - Lighting	0.0%	0.0%	0	$0.00	-	2.00	$0.000
Advanced New Construction Designs	0.0%	0.0%	25	$2.00	4.108	3.28	$0.033
Custom Measures	10.0%	45.0%	15	$0.90	-	0.01	$0.000
PC Power Management Software	13.0%	90.0%	5	$0.03	1.621	12.08	$0.004
Pre-rinse Sprayer	50.0%	5.0%	5	$0.00	0.018	7.39	$0.008

Table C-31 Energy Efficiency Non-Equipment Data— Restaurant, Existing Vintage

Measure	Base Saturation	Applicability	Lifetime (Years)	Incremental Cost ($/SqFt)	Savings (kWh/SqFt)	BC Ratio	Levelized Cost of Energy ($/kWh)
Insulation - Ceiling	7.0%	12.5%	20	$1.04	0.478	0.65	$0.168
Insulation - Ducting	10.7%	50.0%	20	$0.77	0.286	0.61	$0.207
Insulation - Radiant Barrier	4.0%	12.5%	15	$0.00	0.179	3.00	$0.000
Insulation - Wall Cavity	10.7%	67.5%	20	$0.96	1.098	1.41	$0.068
HVAC - Duct Repair and Sealing	5.0%	25.0%	18	$0.50	1.001	2.21	$0.041
Doors - High Efficiency	0.0%	0.0%	0	$0.00	-	3.00	$0.000
Windows - High Efficiency	53.6%	75.0%	20	$8.22	1.256	0.18	$0.505
Roof - High Reflectivity	35.7%	95.0%	15	$0.64	0.260	0.44	$0.227
Air-Cooled Chiller - Condenser Water Temperature Reset	0.0%	0.0%	10	$0.86	0.727	0.46	$0.147
Air-Cooled Chiller - Economizer	0.0%	48.8%	10	$0.03	2.853	54.21	$0.001
Air-Cooled Chiller - Thermal Energy Storage	44.5%	48.8%	15	$0.15	-	0.30	$0.000
Air-Cooled Chiller - VSD on Fans	0.0%	0.0%	15	$1.17	3.023	2.16	$0.036
Air-Cooled Chiller - Chilled Water Reset	0.0%	75.0%	10	$0.84	1.306	0.81	$0.080
Air-Cooled Chiller - Chilled Water	0.0%	0.0%	15	$0.09	0.194	2.29	$0.042

Measure	Base Saturation	Applicability	Lifetime (Years)	Incremental Cost ($/SqFt)	Savings (kWh/SqFt)	BC Ratio	Levelized Cost of Energy ($/kWh)
Variable-Flow System							
Air-Cooled Chiller - High Efficiency Cooling Tower Fans	0.0%	0.0%	15	$1.46	-	0.03	$0.000
Air-Cooled Chiller - Maintenance	64.3%	90.0%	3	$0.24	1.079	0.61	$0.079
Air-Cooled Chiller - Chiller Heat Recovery	0.0%	50.0%	14	$0.04	0.786	16.34	$0.005
Water-Cooled Chiller - Condenser Water Temperature Reset	0.0%	0.0%	10	$0.86	0.188	0.13	$0.566
Water-Cooled Chiller - Economizer	0.0%	48.8%	10	$0.03	2.353	42.09	$0.001
Water-Cooled Chiller - Thermal Energy Storage	44.5%	48.8%	15	$0.15	-	0.28	$0.000
Water-Cooled Chiller - VSD on Fans	0.0%	0.0%	15	$1.17	0.354	0.27	$0.305
Water-Cooled Chiller - Chilled Water Reset	0.0%	75.0%	10	$0.84	1.196	0.70	$0.087
Water-Cooled Chiller - Chilled Water Variable-Flow System	0.0%	0.0%	15	$0.09	-	0.46	$0.000
Water-Cooled Chiller - High Efficiency Cooling Tower Fans	0.0%	0.0%	15	$1.46	0.004	0.03	$32.503
Water-Cooled Chiller - Maintenance	64.3%	90.0%	3	$0.24	1.090	0.58	$0.078
Water-Cooled Chiller - Chiller Heat Recovery	0.0%	50.0%	14	$0.04	0.786	16.34	$0.005
RTU - Evaporative Precooler	0.0%	13.0%	20	$3.00	3.836	1.40	$0.060
RTU - Maintenance	64.3%	90.0%	18	$0.15	1.093	7.27	$0.011
Space Heating - Heat Recovery Ventilator	44.5%	48.8%	15	$1,150.00	0.613	0.00	$173.313
Heat Pump - Maintenance	3.6%	95.0%	4	$0.03	2.851	18.90	$0.003
Ventilation - ECM on VAV Boxes	0.0%	0.0%	18	$0.22	0.429	2.05	$0.042
Ventilation - Variable Speed Control	0.0%	81.0%	15	$0.18	0.820	3.61	$0.021
Water Heater - Drainwater Heat Recovery	0.0%	50.0%	5	$0.04	0.786	4.90	$0.011
Water Heater - Faucet Aerators/Low Flow Nozzles	28.6%	90.0%	10	$0.01	0.349	26.53	$0.003
Water Heater - High Efficiency Circulation Pump	0.0%	0.0%	0	$0.00	-	1.00	$0.000
Water Heater - Desuperheater	0.0%	50.0%	5	$0.04	1.746	10.41	$0.005
Water Heater - Solar System	0.0%	50.0%	20	$1.96	4.364	2.74	$0.035
Water Heater - Install Timer	10.7%	50.0%	15	$0.28	1.746	5.45	$0.015
Water Heater - Pipe Insulation	10.7%	50.0%	13	$5.22	0.494	0.07	$1.077
Water Heater - Tank Blanket/Insulation	40.4%	50.0%	7	$0.01	0.436	12.52	$0.005
Interior Lighting - Daylighting Controls	0.0%	50.0%	8	$7.80	1.830	0.05	$0.630
Interior Lighting - LED Exit Lighting	50.0%	85.5%	16	$0.02	0.012	1.42	$0.144
Interior Lighting - Occupancy Sensors	0.0%	56.3%	8	$0.09	0.610	1.38	$0.023
Interior Lighting - Timeclocks and Timers	3.6%	56.3%	8	$0.11	0.305	0.67	$0.052
Interior Lighting - Task Lighting	3.6%	75.0%	5	$0.24	0.633	0.28	$0.084
Interior Fluorescent - Bi-Level Fixture	10.0%	22.5%	8	$0.50	0.136	0.14	$0.544
Interior Fluorescent - Delamp and Install Reflectors	7.1%	37.5%	11	$0.50	0.115	0.18	$0.499
Exterior Lighting - Bi-Level Fixture	10.0%	30.0%	8	$0.20	0.019	0.13	$1.526
Exterior Lighting - Daylighting Controls	19.0%	37.5%	8	$0.02	0.097	2.56	$0.031
Exterior Lighting - Photovoltaic Installation	0.0%	12.5%	5	$0.92	0.058	0.03	$3.488
Refrigerator - Anti-Sweat Heater	0.0%	75.0%	12	$0.33	0.132	0.27	$0.273
Refrigerator - Decommissioning	50.0%	51.7%	9	$0.04	3.690	29.56	$0.002
Refrigerator - Demand Defrost	0.0%	75.0%	16	$0.20	0.205	0.86	$0.086
Refrigerator - Door Gasket Replacement	5.0%	75.0%	4	$5.61	0.295	0.01	$5.114
Refrigerator - Evaporator Fan Controls	0.0%	7.5%	16	$0.06	0.041	1.13	$0.120
Refrigerator - Floating Head Pressure	17.9%	37.5%	15	$0.04	0.287	5.13	$0.013

Measure	Base Saturation	Applicability	Lifetime (Years)	Incremental Cost ($/SqFt)	Savings (kWh/SqFt)	BC Ratio	Levelized Cost of Energy ($/kWh)
Refrigerator - Strip Curtain	5.0%	56.3%	4	$1.43	0.164	0.02	$2.353
Refrigerator - High Efficiency Compressor	10.0%	37.5%	15	$0.29	0.287	0.73	$0.093
Refrigerator - Variable Speed Compressor	10.0%	37.5%	15	$0.10	0.287	2.13	$0.032
Refrigerator - eCube	5.0%	75.0%	12	$0.17	0.820	2.49	$0.022
Vending Machine - Controller	2.0%	10.0%	5	$0.27	0.097	0.11	$0.612
Office Equipment - ENERGY STAR Power Supplies	10.0%	95.0%	4	$0.00	0.002	123.72	$0.014
Office Equipment - Plug Load Occupancy Sensors	7.1%	56.3%	8	$0.30	0.021	0.11	$2.072
Pool Heater - Solar	0.0%	33.8%	20	$1.96	-	0.03	$0.000
Pool Pump - Timer	0.0%	33.8%	10	$0.44	-	0.07	$0.000
Ventilation - CO2 Controlled	1.0%	15.0%	15	$0.65	0.614	0.78	$0.098
Non-HVAC Motors - Variable Speed Control	0.0%	37.5%	10	$0.10	-	0.30	$0.000
Energy Management System	7.1%	50.0%	15	$0.35	2.985	6.37	$0.011
Thermostat - Clock/Programmable	50.0%	50.0%	11	$0.13	0.487	2.69	$0.031
HVAC - Occupancy Sensors	14.3%	56.3%	8	$0.14	0.793	2.57	$0.026
Commissioning - HVAC	0.0%	0.0%	0	$0.00	-	3.00	$0.000
Commissioning - Lighting	0.0%	0.0%	0	$0.00	-	2.00	$0.000
Retrocommissioning - HVAC	5.0%	24.0%	10	$0.75	1.585	1.11	$0.059
Retrocommissioning - Lighting	10.7%	15.7%	5	$0.10	0.620	0.94	$0.036
Advanced New Construction Designs	0.0%	0.0%	0	$0.00	-	6.00	$0.000
Custom Measures	10.0%	45.0%	15	$1.50	-	0.10	$0.000
PC Power Management Software	7.0%	90.0%	5	$0.01	0.146	4.98	$0.012
Pre-rinse Sprayer	29.0%	90.0%	5	$0.02	0.497	7.28	$0.008

Table C-32 Energy Efficiency Non-Equipment Data— Restaurant, New Vintage

Measure	Base Saturation	Applicability	Lifetime (Years)	Incremental Cost ($/SqFt)	Savings (kWh/SqFt)	BC Ratio	Levelized Cost of Energy ($/kWh)
Insulation - Ceiling	7.0%	12.5%	20	$1.36	0.383	0.45	$0.274
Insulation - Ducting	0.0%	50.0%	20	$0.77	0.599	1.10	$0.099
Insulation - Radiant Barrier	4.0%	12.5%	15	$0.00	0.124	3.00	$0.000
Insulation - Wall Cavity	0.0%	67.5%	20	$0.55	0.816	2.13	$0.052
HVAC - Duct Repair and Sealing	25.0%	25.0%	18	$0.50	0.743	1.94	$0.055
Doors - High Efficiency	100.0%	100.0%	0	$0.00	-	3.00	$0.000
Windows - High Efficiency	0.0%	75.0%	20	$7.43	0.938	0.17	$0.611
Roof - High Reflectivity	50.0%	95.0%	15	$0.64	0.189	0.40	$0.312
Air-Cooled Chiller - Condenser Water Temperature Reset	0.0%	0.0%	10	$0.86	0.476	0.33	$0.224
Air-Cooled Chiller - Economizer	36.6%	48.8%	10	$0.02	0.887	22.77	$0.003
Air-Cooled Chiller - Thermal Energy Storage	44.5%	48.8%	15	$0.15	-	0.32	$0.000
Air-Cooled Chiller - VSD on Fans	0.0%	0.0%	15	$1.17	1.719	1.32	$0.063
Air-Cooled Chiller - Chilled Water Reset	5.0%	75.0%	10	$0.69	0.865	0.71	$0.099
Air-Cooled Chiller - Chilled Water Variable-Flow System	0.0%	0.0%	15	$0.08	0.217	2.81	$0.036
Air-Cooled Chiller - High Efficiency Cooling Tower Fans	0.0%	0.0%	15	$1.19	-	0.04	$0.000
Air-Cooled Chiller - Maintenance	100.0%	100.0%	3	$0.23	0.606	0.40	$0.132
Air-Cooled Chiller - Chiller Heat Recovery	0.0%	50.0%	14	$0.04	0.754	16.03	$0.005
Water-Cooled Chiller - Condenser Water Temperature Reset	0.0%	0.0%	10	$0.86	0.092	0.09	$1.159
Water-Cooled Chiller - Economizer	36.6%	48.8%	10	$0.02	1.919	47.41	$0.001
Water-Cooled Chiller - Thermal	44.5%	48.8%	15	$0.15	-	0.32	$0.000

Measure	Base Saturation	Applicability	Lifetime (Years)	Incremental Cost ($/SqFt)	Savings (kWh/SqFt)	BC Ratio	Levelized Cost of Energy ($/kWh)
Energy Storage							
Water-Cooled Chiller - VSD on Fans	0.0%	0.0%	15	$1.17	0.268	0.24	$0.403
Water-Cooled Chiller - Chilled Water Reset	5.0%	75.0%	10	$0.69	0.919	0.74	$0.093
Water-Cooled Chiller - Chilled Water Variable-Flow System	0.0%	0.0%	15	$0.08	-	0.55	$0.000
Water-Cooled Chiller - High Efficiency Cooling Tower Fans	0.0%	0.0%	15	$1.19	0.007	0.04	$15.856
Water-Cooled Chiller - Maintenance	100.0%	100.0%	3	$0.23	0.620	0.40	$0.129
Water-Cooled Chiller - Chiller Heat Recovery	0.0%	50.0%	14	$0.04	0.754	16.03	$0.005
RTU - Evaporative Precooler	0.0%	13.0%	20	$3.00	2.944	1.24	$0.079
RTU - Maintenance	100.0%	100.0%	18	$0.15	0.590	4.63	$0.021
Space Heating - Heat Recovery Ventilator	44.5%	48.8%	15	$1,150.00	0.542	0.00	$196.099
Heat Pump - Maintenance	0.0%	95.0%	4	$0.03	0.500	4.75	$0.016
Ventilation - ECM on VAV Boxes	0.0%	0.0%	18	$0.22	0.232	1.39	$0.078
Ventilation - Variable Speed Control	0.0%	81.0%	15	$0.15	0.466	3.01	$0.030
Water Heater - Drainwater Heat Recovery	0.0%	50.0%	5	$0.04	0.754	4.79	$0.012
Water Heater - Faucet Aerators/Low Flow Nozzles	0.0%	90.0%	10	$0.01	0.335	31.94	$0.002
Water Heater - High Efficiency Circulation Pump	0.0%	0.0%	0	$0.00	-	1.00	$0.000
Water Heater - Desuperheater	0.0%	50.0%	5	$0.04	1.676	10.16	$0.005
Water Heater - Solar System	0.0%	50.0%	20	$1.96	4.190	2.68	$0.036
Water Heater - Install Timer	50.0%	50.0%	15	$0.28	1.676	5.34	$0.015
Water Heater - Pipe Insulation	50.0%	50.0%	13	$5.22	0.474	0.07	$1.122
Water Heater - Tank Blanket/Insulation	40.4%	50.0%	7	$0.01	0.382	13.88	$0.005
Interior Lighting - Daylighting Controls	75.0%	75.0%	8	$7.05	0.717	0.04	$1.453
Interior Lighting - LED Exit Lighting	85.5%	85.5%	16	$0.02	0.005	3.10	$0.301
Interior Lighting - Occupancy Sensors	56.3%	56.3%	8	$0.08	0.239	1.49	$0.048
Interior Lighting - Timeclocks and Timers	56.3%	56.3%	8	$0.09	0.120	0.80	$0.107
Interior Lighting - Task Lighting	0.0%	75.0%	5	$0.24	0.248	0.29	$0.213
Interior Fluorescent - Bi-Level Fixture	10.0%	22.5%	8	$0.50	0.113	0.14	$0.654
Interior Fluorescent - Delamp and Install Reflectors	0.0%	37.5%	11	$0.50	-	0.07	$0.000
Exterior Lighting - Bi-Level Fixture	10.0%	30.0%	8	$0.20	0.012	0.15	$2.368
Exterior Lighting - Daylighting Controls	19.0%	37.5%	8	$0.02	0.062	2.54	$0.047
Exterior Lighting - Photovoltaic Installation	0.0%	12.5%	5	$0.92	0.037	0.03	$5.411
Refrigerator - Anti-Sweat Heater	0.0%	75.0%	12	$0.27	0.132	0.45	$0.223
Refrigerator - Decommissioning	50.0%	51.7%	9	$0.04	2.183	27.94	$0.002
Refrigerator - Demand Defrost	0.0%	75.0%	16	$0.20	0.121	0.80	$0.146
Refrigerator - Door Gasket Replacement	5.0%	75.0%	4	$5.07	0.216	0.02	$6.303
Refrigerator - Evaporator Fan Controls	0.0%	7.5%	16	$0.05	0.024	1.56	$0.166
Refrigerator - Floating Head Pressure	17.9%	37.5%	15	$0.03	0.170	5.65	$0.018
Refrigerator - Strip Curtain	5.0%	56.3%	4	$1.30	0.097	0.02	$3.595
Refrigerator - High Efficiency Compressor	10.0%	37.5%	15	$0.29	0.170	0.66	$0.158
Refrigerator - Variable Speed Compressor	10.0%	37.5%	15	$0.08	0.170	2.34	$0.044
Refrigerator - eCube	5.0%	75.0%	12	$0.24	0.485	1.48	$0.053
Vending Machine - Controller	2.0%	10.0%	5	$0.27	0.062	0.09	$0.958
Office Equipment - ENERGY STAR Power Supplies	10.0%	95.0%	4	$0.00	0.002	129.98	$0.014

Measure	Base Saturation	Applicability	Lifetime (Years)	Incremental Cost ($/SqFt)	Savings (kWh/SqFt)	BC Ratio	Levelized Cost of Energy ($/kWh)
Office Equipment - Plug Load Occupancy Sensors	7.1%	56.3%	8	$0.25	0.021	0.13	$1.739
Pool Heater - Solar	0.0%	33.8%	20	$1.96	-	0.03	$0.000
Pool Pump - Timer	33.8%	33.8%	10	$0.44	-	0.07	$0.000
Ventilation - CO2 Controlled	11.5%	15.0%	15	$0.65	0.393	0.59	$0.153
Non-HVAC Motors - Variable Speed Control	0.0%	37.5%	10	$0.10	-	0.31	$0.000
Energy Management System	0.0%	50.0%	15	$0.35	1.856	4.97	$0.017
Thermostat - Clock/Programmable	50.0%	50.0%	11	$0.13	0.325	2.16	$0.046
HVAC - Occupancy Sensors	56.3%	56.3%	8	$0.14	0.656	2.34	$0.032
Commissioning - HVAC	0.0%	0.0%	25	$1.25	1.255	1.75	$0.068
Commissioning - Lighting	0.0%	0.0%	25	$0.20	0.245	2.60	$0.056
Retrocommissioning - HVAC	0.0%	0.0%	10	$0.75	-	0.13	$0.000
Retrocommissioning - Lighting	0.0%	0.0%	0	$0.00	-	2.00	$0.000
Advanced New Construction Designs	0.0%	0.0%	25	$2.00	7.015	5.77	$0.019
Custom Measures	10.0%	45.0%	15	$1.50	-	0.12	$0.000
PC Power Management Software	7.0%	90.0%	5	$0.01	0.146	5.08	$0.012
Pre-rinse Sprayer	0.0%	90.0%	5	$0.02	0.497	7.39	$0.008

Table C-33 Energy Efficiency Non-Equipment Data— Retail, Existing Vintage

Measure	Base Saturation	Applicability	Lifetime (Years)	Incremental Cost ($/SqFt)	Savings (kWh/SqFt)	BC Ratio	Levelized Cost of Energy ($/kWh)
Insulation - Ceiling	7.0%	12.5%	20	$1.04	1.090	1.18	$0.074
Insulation - Ducting	20.5%	50.0%	20	$0.77	0.315	0.45	$0.189
Insulation - Radiant Barrier	7.0%	12.5%	15	$0.00	0.425	3.00	$0.000
Insulation - Wall Cavity	13.7%	67.5%	20	$0.73	1.041	1.57	$0.054
HVAC - Duct Repair and Sealing	5.0%	25.0%	18	$0.50	0.661	1.31	$0.062
Doors - High Efficiency	0.0%	0.0%	0	$0.00	-	3.00	$0.000
Windows - High Efficiency	45.2%	75.0%	20	$3.45	0.943	0.30	$0.282
Roof - High Reflectivity	57.5%	95.0%	15	$0.64	0.345	0.40	$0.171
Air-Cooled Chiller - Condenser Water Temperature Reset	0.0%	0.0%	10	$0.86	0.293	0.17	$0.364
Air-Cooled Chiller - Economizer	4.1%	48.8%	10	$0.02	0.232	5.20	$0.012
Air-Cooled Chiller - Thermal Energy Storage	44.5%	48.8%	15	$0.15	-	0.00	$0.000
Air-Cooled Chiller - VSD on Fans	0.0%	0.0%	15	$1.17	1.073	0.76	$0.101
Air-Cooled Chiller - Chilled Water Reset	5.0%	75.0%	10	$0.70	0.491	0.35	$0.178
Air-Cooled Chiller - Chilled Water Variable-Flow System	0.0%	0.0%	15	$0.35	0.079	0.19	$0.413
Air-Cooled Chiller - High Efficiency Cooling Tower Fans	0.0%	0.0%	15	$1.22	-	0.00	$0.000
Air-Cooled Chiller - Maintenance	45.2%	90.0%	3	$0.97	0.437	0.06	$0.773
Air-Cooled Chiller - Chiller Heat Recovery	0.0%	50.0%	14	$0.04	0.080	1.57	$0.048
Water-Cooled Chiller - Condenser Water Temperature Reset	0.0%	0.0%	10	$0.86	0.072	0.04	$1.479
Water-Cooled Chiller - Economizer	4.1%	48.8%	10	$0.02	0.767	15.95	$0.004
Water-Cooled Chiller - Thermal Energy Storage	44.5%	48.8%	15	$0.15	-	0.00	$0.000
Water-Cooled Chiller - VSD on Fans	0.0%	0.0%	15	$1.17	-	0.00	$0.000
Water-Cooled Chiller - Chilled Water Reset	5.0%	75.0%	10	$0.70	0.729	0.48	$0.120
Water-Cooled Chiller - Chilled Water Variable-Flow System	0.0%	0.0%	15	$0.35	-	0.00	$0.000
Water-Cooled Chiller - High Efficiency Cooling Tower Fans	0.0%	0.0%	15	$1.22	0.002	0.00	$71.064

Measure	Base Saturation	Applicability	Lifetime (Years)	Incremental Cost ($/SqFt)	Savings (kWh/SqFt)	BC Ratio	Levelized Cost of Energy ($/kWh)
Water-Cooled Chiller - Maintenance	45.2%	90.0%	3	$0.97	0.419	0.05	$0.806
Water-Cooled Chiller - Chiller Heat Recovery	0.0%	50.0%	14	$0.04	0.080	1.57	$0.048
RTU - Evaporative Precooler	0.0%	13.0%	20	$3.00	2.347	0.86	$0.099
RTU - Maintenance	45.2%	90.0%	18	$0.15	0.673	4.34	$0.018
Space Heating - Heat Recovery Ventilator	44.5%	48.8%	15	$1,150.00	0.644	0.00	$164.853
Heat Pump - Maintenance	4.1%	95.0%	4	$0.03	2.405	13.57	$0.003
Ventilation - ECM on VAV Boxes	0.0%	0.0%	18	$0.22	0.387	1.69	$0.047
Ventilation - Variable Speed Control	0.0%	81.0%	15	$0.15	0.259	1.30	$0.054
Water Heater - Drainwater Heat Recovery	0.0%	50.0%	5	$0.04	0.080	0.47	$0.110
Water Heater - Faucet Aerators/Low Flow Nozzles	23.3%	90.0%	10	$0.01	0.036	2.81	$0.023
Water Heater - High Efficiency Circulation Pump	0.0%	0.0%	0	$0.00	-	1.00	$0.000
Water Heater - Desuperheater	0.0%	50.0%	5	$0.04	0.179	1.03	$0.049
Water Heater - Solar System	0.0%	50.0%	20	$0.24	0.447	2.22	$0.042
Water Heater - Install Timer	9.6%	50.0%	15	$0.28	0.179	0.54	$0.145
Water Heater - Pipe Insulation	9.6%	50.0%	13	$5.22	0.050	0.01	$10.554
Water Heater - Tank Blanket/Insulation	40.4%	50.0%	7	$0.01	0.045	1.35	$0.042
Interior Lighting - Daylighting Controls	13.7%	50.0%	8	$3.27	0.873	0.08	$0.553
Interior Lighting - LED Exit Lighting	50.0%	85.5%	16	$0.02	0.006	0.25	$0.253
Interior Lighting - Occupancy Sensors	4.1%	56.3%	8	$0.08	0.291	1.04	$0.040
Interior Lighting - Timeclocks and Timers	4.1%	56.3%	8	$0.09	0.146	0.46	$0.090
Interior Lighting - Task Lighting	12.3%	75.0%	5	$0.24	0.302	0.15	$0.175
Interior Fluorescent - Bi-Level Fixture	10.0%	22.5%	8	$0.50	0.234	0.18	$0.316
Interior Fluorescent - Delamp and Install Reflectors	9.6%	30.0%	11	$0.50	0.199	0.23	$0.290
Exterior Lighting - Bi-Level Fixture	10.0%	30.0%	8	$0.20	0.058	0.11	$0.514
Exterior Lighting - Daylighting Controls	17.0%	37.5%	8	$0.02	0.288	5.67	$0.010
Exterior Lighting - Photovoltaic Installation	0.0%	12.5%	5	$0.92	0.173	0.04	$1.175
Refrigerator - Anti-Sweat Heater	0.0%	75.0%	12	$0.28	0.016	0.03	$1.932
Refrigerator - Decommissioning	50.0%	51.7%	9	$0.04	0.435	4.12	$0.012
Refrigerator - Demand Defrost	0.0%	75.0%	16	$0.20	0.024	0.08	$0.732
Refrigerator - Door Gasket Replacement	5.0%	75.0%	4	$4.24	0.035	0.00	$32.754
Refrigerator - Evaporator Fan Controls	0.0%	7.5%	16	$0.05	0.005	0.08	$0.853
Refrigerator - Floating Head Pressure	17.9%	37.5%	15	$0.03	0.034	0.62	$0.094
Refrigerator - Strip Curtain	5.0%	56.3%	4	$0.60	0.019	0.00	$8.358
Refrigerator - High Efficiency Compressor	10.0%	37.5%	15	$0.29	0.034	0.07	$0.791
Refrigerator - Variable Speed Compressor	10.0%	37.5%	15	$0.08	0.034	0.26	$0.227
Refrigerator - eCube	5.0%	75.0%	12	$0.01	0.097	3.51	$0.015
Vending Machine - Controller	2.0%	10.0%	5	$0.27	0.023	0.02	$2.595
Office Equipment - ENERGY STAR Power Supplies	10.0%	95.0%	4	$0.00	0.001	3.53	$0.020
Office Equipment - Plug Load Occupancy Sensors	7.1%	56.3%	8	$0.30	0.015	0.02	$2.939
Pool Heater - Solar	0.0%	33.8%	20	$0.24	-	0.00	$0.000
Pool Pump - Timer	0.0%	33.8%	10	$0.44	-	0.00	$0.000
Ventilation - CO2 Controlled	1.0%	15.0%	15	$0.65	0.276	0.33	$0.217
Non-HVAC Motors - Variable Speed Control	0.0%	37.5%	10	$0.10	-	0.00	$0.000
Energy Management System	8.2%	75.0%	15	$0.35	2.099	4.52	$0.015

Measure	Base Saturation	Applicability	Lifetime (Years)	Incremental Cost ($/SqFt)	Savings (kWh/SqFt)	BC Ratio	Levelized Cost of Energy ($/kWh)
Thermostat - Clock/Programmable	43.8%	50.0%	11	$0.13	0.661	2.74	$0.023
HVAC - Occupancy Sensors	14.3%	56.3%	8	$0.14	0.701	1.88	$0.030
Commissioning - HVAC	0.0%	0.0%	0	$0.00	-	3.00	$0.000
Commissioning - Lighting	0.0%	0.0%	0	$0.00	-	2.00	$0.000
Retrocommissioning - HVAC	5.0%	36.0%	10	$0.75	1.194	0.76	$0.078
Retrocommissioning - Lighting	31.5%	36.5%	5	$0.10	0.320	0.56	$0.069
Advanced New Construction Designs	0.0%	0.0%	0	$0.00	-	6.00	$0.000
Custom Measures	10.0%	45.0%	15	$1.50	-	0.00	$0.000
PC Power Management Software	7.0%	90.0%	5	$0.02	0.105	1.84	$0.046
Pre-rinse Sprayer	23.0%	0.0%	5	$0.00	0.005	7.28	$0.008

Table C-34 Energy Efficiency Non-Equipment Data— Retail, New Vintage

Measure	Base Saturation	Applicability	Lifetime (Years)	Incremental Cost ($/SqFt)	Savings (kWh/SqFt)	BC Ratio	Levelized Cost of Energy ($/kWh)
Insulation - Ceiling	7.0%	12.5%	20	$1.36	0.690	0.60	$0.152
Insulation - Ducting	0.0%	50.0%	20	$0.77	0.366	0.57	$0.162
Insulation - Radiant Barrier	7.0%	12.5%	15	$0.00	0.166	3.00	$0.000
Insulation - Wall Cavity	0.0%	67.5%	20	$0.40	0.318	0.94	$0.097
HVAC - Duct Repair and Sealing	25.0%	25.0%	18	$0.50	0.052	0.11	$0.786
Doors - High Efficiency	100.0%	100.0%	0	$0.00	-	3.00	$0.000
Windows - High Efficiency	72.7%	75.0%	20	$2.97	0.576	0.23	$0.398
Roof - High Reflectivity	63.6%	95.0%	15	$0.64	0.183	0.24	$0.323
Air-Cooled Chiller - Condenser Water Temperature Reset	0.0%	0.0%	10	$0.86	0.190	0.12	$0.561
Air-Cooled Chiller - Economizer	36.6%	48.8%	10	$0.02	0.353	11.15	$0.006
Air-Cooled Chiller - Thermal Energy Storage	44.5%	48.8%	15	$0.15	-	0.00	$0.000
Air-Cooled Chiller - VSD on Fans	0.0%	0.0%	15	$1.17	0.800	0.59	$0.135
Air-Cooled Chiller - Chilled Water Reset	10.0%	75.0%	10	$0.52	0.327	0.33	$0.199
Air-Cooled Chiller - Chilled Water Variable-Flow System	0.0%	0.0%	15	$0.23	0.111	0.41	$0.195
Air-Cooled Chiller - High Efficiency Cooling Tower Fans	0.0%	0.0%	15	$0.91	-	0.00	$0.000
Air-Cooled Chiller - Maintenance	45.4%	90.0%	3	$0.64	0.264	0.06	$0.849
Air-Cooled Chiller - Chiller Heat Recovery	0.0%	50.0%	14	$0.04	0.077	1.57	$0.050
Water-Cooled Chiller - Condenser Water Temperature Reset	0.0%	0.0%	10	$0.86	0.036	0.02	$2.979
Water-Cooled Chiller - Economizer	36.6%	48.8%	10	$0.02	0.302	9.49	$0.007
Water-Cooled Chiller - Thermal Energy Storage	44.5%	48.8%	15	$0.15	-	0.00	$0.000
Water-Cooled Chiller - VSD on Fans	0.0%	0.0%	15	$1.17	-	0.00	$0.000
Water-Cooled Chiller - Chilled Water Reset	10.0%	75.0%	10	$0.52	0.449	0.45	$0.145
Water-Cooled Chiller - Chilled Water Variable-Flow System	0.0%	0.0%	15	$0.23	-	0.00	$0.000
Water-Cooled Chiller - High Efficiency Cooling Tower Fans	0.0%	0.0%	15	$0.91	0.003	0.00	$31.064
Water-Cooled Chiller - Maintenance	45.4%	90.0%	3	$0.64	0.264	0.06	$0.851
Water-Cooled Chiller - Chiller Heat Recovery	0.0%	50.0%	14	$0.04	0.077	1.57	$0.050
RTU - Evaporative Precooler	0.0%	13.0%	20	$3.00	1.851	0.76	$0.125
RTU - Maintenance	45.4%	90.0%	18	$0.15	0.405	2.93	$0.030
Space Heating - Heat Recovery Ventilator	44.5%	48.8%	15	$1,150.00	0.590	0.00	$180.017
Heat Pump - Maintenance	0.0%	95.0%	4	$0.03	0.410	2.53	$0.020
Ventilation - ECM on VAV Boxes	0.0%	0.0%	18	$0.22	0.319	1.57	$0.057

Measure	Base Saturation	Applicability	Lifetime (Years)	Incremental Cost ($/SqFt)	Savings (kWh/SqFt)	BC Ratio	Levelized Cost of Energy ($/kWh)
Ventilation - Variable Speed Control	0.0%	81.0%	15	$0.11	0.188	1.42	$0.056
Water Heater - Drainwater Heat Recovery	0.0%	50.0%	5	$0.04	0.077	0.46	$0.114
Water Heater - Faucet Aerators/Low Flow Nozzles	36.4%	90.0%	10	$0.00	0.034	3.75	$0.018
Water Heater - High Efficiency Circulation Pump	0.0%	0.0%	0	$0.00	-	1.00	$0.000
Water Heater - Desuperheater	0.0%	50.0%	5	$0.04	0.171	1.02	$0.052
Water Heater - Solar System	0.0%	50.0%	20	$0.24	0.428	2.22	$0.044
Water Heater - Install Timer	50.0%	50.0%	15	$0.28	0.171	0.54	$0.151
Water Heater - Pipe Insulation	50.0%	50.0%	13	$5.22	0.048	0.01	$11.007
Water Heater - Tank Blanket/Insulation	40.4%	50.0%	7	$0.01	0.039	1.63	$0.036
Interior Lighting - Daylighting Controls	75.0%	75.0%	8	$2.82	0.447	0.06	$0.932
Interior Lighting - LED Exit Lighting	85.5%	85.5%	16	$0.01	0.003	0.26	$0.368
Interior Lighting - Occupancy Sensors	56.3%	56.3%	8	$0.06	0.149	1.00	$0.058
Interior Lighting - Timeclocks and Timers	56.3%	56.3%	8	$0.07	0.075	0.45	$0.131
Interior Lighting - Task Lighting	18.2%	75.0%	5	$0.24	0.155	0.14	$0.342
Interior Fluorescent - Bi-Level Fixture	10.0%	22.5%	8	$0.50	0.209	0.17	$0.354
Interior Fluorescent - Delamp and Install Reflectors	9.1%	30.0%	11	$0.50	-	0.00	$0.000
Exterior Lighting - Bi-Level Fixture	10.0%	30.0%	8	$0.20	0.070	0.13	$0.425
Exterior Lighting - Daylighting Controls	17.0%	37.5%	8	$0.02	0.348	6.56	$0.008
Exterior Lighting - Photovoltaic Installation	0.0%	12.5%	5	$0.92	0.209	0.05	$0.970
Refrigerator - Anti-Sweat Heater	0.0%	75.0%	12	$0.21	0.016	0.05	$1.439
Refrigerator - Decommissioning	50.0%	51.7%	9	$0.03	0.258	4.11	$0.015
Refrigerator - Demand Defrost	0.0%	75.0%	16	$0.20	0.014	0.07	$1.237
Refrigerator - Door Gasket Replacement	5.0%	75.0%	4	$3.66	0.026	0.00	$38.546
Refrigerator - Evaporator Fan Controls	0.0%	7.5%	16	$0.03	0.003	0.09	$1.074
Refrigerator - Floating Head Pressure	17.9%	37.5%	15	$0.03	0.020	0.66	$0.119
Refrigerator - Strip Curtain	5.0%	56.3%	4	$0.52	0.011	0.00	$12.191
Refrigerator - High Efficiency Compressor	10.0%	37.5%	15	$0.29	0.020	0.06	$1.337
Refrigerator - Variable Speed Compressor	10.0%	37.5%	15	$0.06	0.020	0.28	$0.286
Refrigerator - eCube	5.0%	75.0%	12	$0.01	0.057	2.47	$0.028
Vending Machine - Controller	2.0%	10.0%	5	$0.27	0.016	0.01	$3.655
Office Equipment - ENERGY STAR Power Supplies	10.0%	95.0%	4	$0.00	0.001	3.74	$0.020
Office Equipment - Plug Load Occupancy Sensors	7.1%	56.3%	8	$0.25	0.015	0.02	$2.467
Pool Heater - Solar	0.0%	33.8%	20	$0.24	-	0.00	$0.000
Pool Pump - Timer	33.8%	33.8%	10	$0.44	-	0.00	$0.000
Ventilation - CO2 Controlled	11.5%	15.0%	15	$0.65	0.223	0.30	$0.269
Non-HVAC Motors - Variable Speed Control	0.0%	37.5%	10	$0.10	-	0.00	$0.000
Energy Management System	0.0%	75.0%	15	$0.35	1.463	3.45	$0.022
Thermostat - Clock/Programmable	50.0%	50.0%	11	$0.13	0.711	3.09	$0.021
HVAC - Occupancy Sensors	56.3%	56.3%	8	$0.14	0.616	1.72	$0.034
Commissioning - HVAC	0.0%	0.0%	25	$1.25	1.023	1.28	$0.083
Commissioning - Lighting	0.0%	0.0%	25	$0.20	0.184	1.46	$0.074
Retrocommissioning - HVAC	0.0%	0.0%	10	$0.75	-	0.00	$0.000
Retrocommissioning - Lighting	0.0%	0.0%	0	$0.00	-	2.00	$0.000
Advanced New Construction Designs	0.0%	0.0%	25	$2.00	4.628	3.63	$0.030
Custom Measures	10.0%	45.0%	15	$1.50	-	0.00	$0.000
PC Power Management Software	7.0%	90.0%	5	$0.02	0.105	1.87	$0.046

Measure	Base Saturation	Applicability	Lifetime (Years)	Incremental Cost ($/SqFt)	Savings (kWh/SqFt)	BC Ratio	Levelized Cost of Energy ($/kWh)
Pre-rinse Sprayer	36.0%	0.0%	5	$0.00	0.005	7.51	$0.008

Table C-35 Energy Efficiency Non-Equipment Data— Grocery, Existing Vintage

Measure	Base Saturation	Applicability	Lifetime (Years)	Incremental Cost ($/SqFt)	Savings (kWh/SqFt)	BC Ratio	Levelized Cost of Energy ($/kWh)
Insulation - Ceiling	7.0%	12.5%	20	$0.85	1.567	2.06	$0.042
Insulation - Ducting	33.3%	50.0%	20	$0.77	0.124	0.25	$0.477
Insulation - Radiant Barrier	0.0%	12.5%	15	$0.00	0.615	3.00	$0.000
Insulation - Wall Cavity	11.1%	67.5%	20	$0.86	8.468	11.00	$0.008
HVAC - Duct Repair and Sealing	5.0%	25.0%	18	$0.50	0.046	0.20	$0.895
Doors - High Efficiency	0.0%	0.0%	0	$0.00	-	3.00	$0.000
Windows - High Efficiency	33.3%	75.0%	20	$2.24	0.643	0.33	$0.269
Roof - High Reflectivity	66.7%	95.0%	15	$0.64	1.344	1.59	$0.044
Air-Cooled Chiller - Condenser Water Temperature Reset	0.0%	0.0%	10	$0.86	0.527	0.31	$0.202
Air-Cooled Chiller - Economizer	0.0%	48.8%	10	$0.01	0.794	59.26	$0.001
Air-Cooled Chiller - Thermal Energy Storage	44.5%	48.8%	15	$0.15	-	0.11	$0.000
Air-Cooled Chiller - VSD on Fans	0.0%	0.0%	15	$1.17	1.931	1.31	$0.056
Air-Cooled Chiller - Chilled Water Reset	5.0%	75.0%	10	$0.21	0.884	2.09	$0.029
Air-Cooled Chiller - Chilled Water Variable-Flow System	0.0%	0.0%	15	$0.10	0.142	1.22	$0.068
Air-Cooled Chiller - High Efficiency Cooling Tower Fans	0.0%	0.0%	15	$0.36	-	0.04	$0.000
Air-Cooled Chiller - Maintenance	33.3%	90.0%	3	$0.28	0.783	0.36	$0.127
Air-Cooled Chiller - Chiller Heat Recovery	0.0%	50.0%	14	$0.04	0.219	4.63	$0.018
Water-Cooled Chiller - Condenser Water Temperature Reset	0.0%	0.0%	10	$0.86	0.130	0.08	$0.822
Water-Cooled Chiller - Economizer	0.0%	48.8%	10	$0.01	1.620	117.34	$0.001
Water-Cooled Chiller - Thermal Energy Storage	44.5%	48.8%	15	$0.15	-	0.11	$0.000
Water-Cooled Chiller - VSD on Fans	0.0%	0.0%	15	$1.17	-	0.01	$0.000
Water-Cooled Chiller - Chilled Water Reset	5.0%	75.0%	10	$0.21	1.313	3.03	$0.020
Water-Cooled Chiller - Chilled Water Variable-Flow System	0.0%	0.0%	15	$0.10	-	0.15	$0.000
Water-Cooled Chiller - High Efficiency Cooling Tower Fans	0.0%	0.0%	15	$0.36	0.003	0.05	$11.652
Water-Cooled Chiller - Maintenance	33.3%	90.0%	3	$0.28	0.751	0.34	$0.133
Water-Cooled Chiller - Chiller Heat Recovery	0.0%	50.0%	14	$0.04	0.219	4.63	$0.018
RTU - Evaporative Precooler	0.0%	18.0%	20	$3.00	4.224	1.53	$0.055
RTU - Maintenance	33.3%	90.0%	18	$0.15	1.204	7.76	$0.010
Space Heating - Heat Recovery Ventilator	44.5%	48.8%	15	$1,150.00	0.771	0.00	$137.868
Heat Pump - Maintenance	0.0%	95.0%	4	$0.03	1.710	10.19	$0.005
Ventilation - ECM on VAV Boxes	0.0%	0.0%	18	$0.22	0.058	0.34	$0.309
Ventilation - Variable Speed Control	0.0%	81.0%	15	$0.05	0.950	16.46	$0.004
Water Heater - Drainwater Heat Recovery	0.0%	50.0%	5	$0.04	0.219	1.40	$0.040
Water Heater - Faucet Aerators/Low Flow Nozzles	22.2%	90.0%	10	$0.00	0.097	31.29	$0.002
Water Heater - High Efficiency Circulation Pump	0.0%	0.0%	0	$0.00	-	1.00	$0.000
Water Heater - Desuperheater	0.0%	50.0%	5	$0.04	0.486	2.93	$0.018
Water Heater - Solar System	0.0%	50.0%	20	$0.19	1.214	7.79	$0.012

Measure	Base Saturation	Applicability	Lifetime (Years)	Incremental Cost ($/SqFt)	Savings (kWh/SqFt)	BC Ratio	Levelized Cost of Energy ($/kWh)
Water Heater - Install Timer	22.2%	50.0%	15	$0.28	0.486	1.53	$0.053
Water Heater - Pipe Insulation	22.2%	50.0%	13	$5.22	0.137	0.02	$3.872
Water Heater - Tank Blanket/Insulation	40.4%	50.0%	7	$0.00	0.121	14.69	$0.005
Interior Lighting - Daylighting Controls	22.2%	50.0%	8	$2.13	0.926	0.14	$0.340
Interior Lighting - LED Exit Lighting	50.0%	85.5%	16	$0.00	0.006	3.85	$0.070
Interior Lighting - Occupancy Sensors	0.0%	56.3%	8	$0.02	0.309	4.58	$0.011
Interior Lighting - Timeclocks and Timers	11.1%	56.3%	8	$0.03	0.154	2.18	$0.025
Interior Lighting - Task Lighting	0.0%	75.0%	5	$0.24	0.320	0.17	$0.165
Interior Fluorescent - Bi-Level Fixture	10.0%	22.5%	8	$0.50	0.621	0.50	$0.119
Interior Fluorescent - Delamp and Install Reflectors	44.4%	49.4%	11	$0.55	0.527	0.56	$0.120
Exterior Lighting - Bi-Level Fixture	10.0%	30.0%	8	$0.20	0.028	0.08	$1.075
Exterior Lighting - Daylighting Controls	31.0%	37.5%	8	$0.02	0.138	2.44	$0.021
Exterior Lighting - Photovoltaic Installation	0.0%	12.5%	5	$0.92	0.083	0.02	$2.456
Refrigerator - Anti-Sweat Heater	0.0%	75.0%	12	$0.08	0.635	3.82	$0.014
Refrigerator - Decommissioning	50.0%	51.7%	9	$0.01	6.194	206.04	$0.000
Refrigerator - Demand Defrost	0.0%	75.0%	16	$0.20	0.344	1.26	$0.051
Refrigerator - Door Gasket Replacement	5.0%	75.0%	4	$5.01	0.795	0.03	$1.694
Refrigerator - Evaporator Fan Controls	0.0%	7.5%	16	$0.01	0.069	4.46	$0.018
Refrigerator - Floating Head Pressure	17.9%	37.5%	15	$0.01	0.482	31.69	$0.002
Refrigerator - Strip Curtain	5.0%	56.3%	4	$0.39	0.275	0.11	$0.382
Refrigerator - High Efficiency Compressor	10.0%	37.5%	15	$0.29	0.482	1.11	$0.056
Refrigerator - Variable Speed Compressor	10.0%	37.5%	15	$0.02	0.482	13.13	$0.005
Refrigerator - eCube	5.0%	75.0%	12	$0.17	1.376	4.08	$0.013
Vending Machine - Controller	2.0%	10.0%	5	$0.27	0.047	0.05	$1.277
Office Equipment - ENERGY STAR Power Supplies	10.0%	95.0%	4	$0.00	0.001	46.08	$0.021
Office Equipment - Plug Load Occupancy Sensors	7.1%	56.3%	8	$0.30	0.014	0.05	$3.079
Pool Heater - Solar	0.0%	33.8%	20	$0.19	-	0.12	$0.000
Pool Pump - Timer	0.0%	33.8%	10	$0.44	-	0.03	$0.000
Ventilation - CO2 Controlled	1.0%	15.0%	15	$0.65	0.579	0.70	$0.104
Non-HVAC Motors - Variable Speed Control	0.0%	37.5%	10	$0.10	-	0.11	$0.000
Energy Management System	0.0%	50.0%	15	$0.35	3.263	7.21	$0.010
Thermostat - Clock/Programmable	33.3%	50.0%	11	$0.13	1.236	5.29	$0.012
HVAC - Occupancy Sensors	14.3%	56.3%	8	$0.14	0.945	2.69	$0.022
Commissioning - HVAC	0.0%	0.0%	0	$0.00	-	3.00	$0.000
Commissioning - Lighting	0.0%	0.0%	0	$0.00	-	2.00	$0.000
Retrocommissioning - HVAC	5.0%	24.0%	10	$0.75	1.801	1.17	$0.052
Retrocommissioning - Lighting	55.6%	60.6%	5	$0.10	0.322	0.70	$0.068
Advanced New Construction Designs	0.0%	0.0%	0	$0.00	-	6.00	$0.000
Custom Measures	10.0%	45.0%	15	$1.50	-	0.04	$0.000
PC Power Management Software	7.0%	90.0%	5	$0.02	0.100	1.93	$0.042
Pre-rinse Sprayer	22.0%	10.0%	5	$0.01	0.184	7.27	$0.008

Table C-36 Energy Efficiency Non-Equipment Data— Grocery, New Vintage

Measure	Base Saturation	Applicability	Lifetime (Years)	Incremental Cost ($/SqFt)	Savings (kWh/SqFt)	BC Ratio	Levelized Cost of Energy ($/kWh)

Measure	Base Saturation	Applicability	Lifetime (Years)	Incremental Cost ($/SqFt)	Savings (kWh/SqFt)	BC Ratio	Levelized Cost of Energy ($/kWh)
Insulation - Ceiling	7.0%	12.5%	20	$0.85	1.503	2.15	$0.044
Insulation - Ducting	33.3%	50.0%	20	$0.77	0.776	1.26	$0.077
Insulation - Radiant Barrier	0.0%	12.5%	15	$0.00	0.511	3.00	$0.000
Insulation - Wall Cavity	11.1%	67.5%	20	$0.97	2.828	3.47	$0.026
HVAC - Duct Repair and Sealing	25.0%	25.0%	18	$0.50	0.026	0.17	$1.607
Doors - High Efficiency	100.0%	100.0%	0	$0.00	-	3.00	$0.000
Windows - High Efficiency	33.3%	75.0%	20	$2.24	1.142	0.63	$0.151
Roof - High Reflectivity	66.7%	95.0%	15	$0.64	0.832	1.13	$0.071
Air-Cooled Chiller - Condenser Water Temperature Reset	0.0%	0.0%	10	$0.86	0.331	0.22	$0.322
Air-Cooled Chiller - Economizer	36.6%	48.8%	10	$0.01	0.625	51.45	$0.001
Air-Cooled Chiller - Thermal Energy Storage	44.5%	48.8%	15	$0.15	-	0.12	$0.000
Air-Cooled Chiller - VSD on Fans	0.0%	0.0%	15	$1.17	1.395	1.05	$0.077
Air-Cooled Chiller - Chilled Water Reset	5.0%	75.0%	10	$0.21	0.570	1.49	$0.045
Air-Cooled Chiller - Chilled Water Variable-Flow System	0.0%	0.0%	15	$0.09	0.194	2.00	$0.044
Air-Cooled Chiller - High Efficiency Cooling Tower Fans	0.0%	0.0%	15	$0.36	-	0.05	$0.000
Air-Cooled Chiller - Maintenance	33.3%	90.0%	3	$0.25	0.450	0.25	$0.198
Air-Cooled Chiller - Chiller Heat Recovery	0.0%	50.0%	14	$0.04	0.210	4.56	$0.018
Water-Cooled Chiller - Condenser Water Temperature Reset	0.0%	0.0%	10	$0.86	0.064	0.05	$1.655
Water-Cooled Chiller - Economizer	36.6%	48.8%	10	$0.01	1.345	108.37	$0.001
Water-Cooled Chiller - Thermal Energy Storage	44.5%	48.8%	15	$0.15	-	0.12	$0.000
Water-Cooled Chiller - VSD on Fans	0.0%	0.0%	15	$1.17	-	0.01	$0.000
Water-Cooled Chiller - Chilled Water Reset	5.0%	75.0%	10	$0.21	0.808	2.09	$0.032
Water-Cooled Chiller - Chilled Water Variable-Flow System	0.0%	0.0%	15	$0.09	-	0.18	$0.000
Water-Cooled Chiller - High Efficiency Cooling Tower Fans	0.0%	0.0%	15	$0.36	0.005	0.06	$6.838
Water-Cooled Chiller - Maintenance	33.3%	90.0%	3	$0.25	0.463	0.26	$0.192
Water-Cooled Chiller - Chiller Heat Recovery	0.0%	50.0%	14	$0.04	0.210	4.56	$0.018
RTU - Evaporative Precooler	0.0%	14.0%	20	$3.00	3.272	1.36	$0.071
RTU - Maintenance	33.3%	90.0%	18	$0.15	0.699	5.19	$0.018
Space Heating - Heat Recovery Ventilator	44.5%	48.8%	15	$1,150.00	0.676	0.00	$157.086
Heat Pump - Maintenance	0.0%	95.0%	4	$0.03	1.499	9.74	$0.005
Ventilation - ECM on VAV Boxes	0.0%	0.0%	18	$0.22	0.004	0.11	$4.933
Ventilation - Variable Speed Control	0.0%	81.0%	15	$0.05	0.651	12.85	$0.006
Water Heater - Drainwater Heat Recovery	0.0%	50.0%	5	$0.04	0.210	1.37	$0.042
Water Heater - Faucet Aerators/Low Flow Nozzles	22.2%	90.0%	10	$0.00	0.093	30.90	$0.003
Water Heater - High Efficiency Circulation Pump	0.0%	0.0%	0	$0.00	-	1.00	$0.000
Water Heater - Desuperheater	0.0%	50.0%	5	$0.04	0.466	2.86	$0.019
Water Heater - Solar System	0.0%	50.0%	20	$0.19	1.166	7.65	$0.013
Water Heater - Install Timer	50.0%	50.0%	15	$0.28	0.466	1.50	$0.055
Water Heater - Pipe Insulation	50.0%	50.0%	13	$5.22	0.132	0.02	$4.034
Water Heater - Tank Blanket/Insulation	40.4%	50.0%	7	$0.00	0.105	13.25	$0.005
Interior Lighting - Daylighting Controls	75.0%	75.0%	8	$2.13	0.429	0.08	$0.732
Interior Lighting - LED Exit Lighting	85.5%	85.5%	16	$0.00	0.003	4.05	$0.152
Interior Lighting - Occupancy Sensors	56.3%	56.3%	8	$0.02	0.143	2.74	$0.024
Interior Lighting - Timeclocks and	56.3%	56.3%	8	$0.03	0.072	1.39	$0.054

Measure	Base Saturation	Applicability	Lifetime (Years)	Incremental Cost ($/SqFt)	Savings (kWh/SqFt)	BC Ratio	Levelized Cost of Energy ($/kWh)
Timers							
Interior Lighting - Task Lighting	0.0%	75.0%	5	$0.24	0.148	0.16	$0.356
Interior Fluorescent - Bi-Level Fixture	10.0%	22.5%	8	$0.50	0.578	0.46	$0.128
Interior Fluorescent - Delamp and Install Reflectors	44.4%	49.4%	11	$0.55	-	0.02	$0.000
Exterior Lighting - Bi-Level Fixture	10.0%	30.0%	8	$0.20	0.014	0.08	$2.090
Exterior Lighting - Daylighting Controls	31.0%	37.5%	8	$0.02	0.071	1.89	$0.042
Exterior Lighting - Photovoltaic Installation	0.0%	12.5%	5	$0.92	0.042	0.02	$4.777
Refrigerator - Anti-Sweat Heater	0.0%	75.0%	12	$0.08	0.635	5.20	$0.014
Refrigerator - Decommissioning	50.0%	51.7%	9	$0.01	3.665	153.88	$0.000
Refrigerator - Demand Defrost	0.0%	75.0%	16	$0.20	0.204	1.05	$0.087
Refrigerator - Door Gasket Replacement	5.0%	75.0%	4	$5.01	0.677	0.03	$1.989
Refrigerator - Evaporator Fan Controls	0.0%	7.5%	16	$0.01	0.041	4.10	$0.030
Refrigerator - Floating Head Pressure	17.9%	37.5%	15	$0.01	0.285	25.91	$0.003
Refrigerator - Strip Curtain	5.0%	56.3%	4	$0.39	0.163	0.09	$0.646
Refrigerator - High Efficiency Compressor	10.0%	37.5%	15	$0.29	0.285	0.91	$0.094
Refrigerator - Variable Speed Compressor	10.0%	37.5%	15	$0.02	0.285	10.74	$0.008
Refrigerator - eCube	5.0%	75.0%	12	$0.24	0.814	2.29	$0.032
Vending Machine - Controller	2.0%	10.0%	5	$0.27	0.022	0.04	$2.663
Office Equipment - ENERGY STAR Power Supplies	10.0%	95.0%	4	$0.00	0.001	48.99	$0.021
Office Equipment - Plug Load Occupancy Sensors	7.1%	56.3%	8	$0.25	0.014	0.06	$2.584
Pool Heater - Solar	0.0%	33.8%	20	$0.19	-	0.12	$0.000
Pool Pump - Timer	33.8%	33.8%	10	$0.44	-	0.03	$0.000
Ventilation - CO2 Controlled	11.5%	15.0%	15	$0.65	0.427	0.59	$0.141
Non-HVAC Motors - Variable Speed Control	0.0%	37.5%	10	$0.10	-	0.12	$0.000
Energy Management System	0.0%	50.0%	15	$0.35	2.273	5.60	$0.014
Thermostat - Clock/Programmable	50.0%	50.0%	11	$0.13	0.638	3.07	$0.023
HVAC - Occupancy Sensors	56.3%	56.3%	8	$0.14	0.793	2.40	$0.026
Commissioning - HVAC	0.0%	0.0%	25	$1.25	1.464	1.90	$0.058
Commissioning - Lighting	0.0%	0.0%	25	$0.20	0.150	1.44	$0.091
Retrocommissioning - HVAC	0.0%	0.0%	10	$0.75	-	0.05	$0.000
Retrocommissioning - Lighting	0.0%	0.0%	0	$0.00	-	2.00	$0.000
Advanced New Construction Designs	0.0%	0.0%	25	$2.00	6.445	5.14	$0.021
Custom Measures	10.0%	45.0%	15	$1.50	-	0.04	$0.000
PC Power Management Software	7.0%	90.0%	5	$0.02	0.100	1.97	$0.042
Pre-rinse Sprayer	22.0%	10.0%	5	$0.01	0.184	7.39	$0.008

Table C-37 Energy Efficiency Non-Equipment Data— College, Existing Vintage

Measure	Base Saturation	Applicability	Lifetime (Years)	Incremental Cost ($/SqFt)	Savings (kWh/SqFt)	BC Ratio	Levelized Cost of Energy ($/kWh)
Insulation - Ceiling	2.0%	12.5%	20	$1.04	0.377	0.42	$0.212
Insulation - Ducting	55.5%	60.5%	20	$0.77	0.520	0.77	$0.114
Insulation - Radiant Barrier	2.0%	12.5%	15	$0.00	0.140	3.00	$0.000
Insulation - Wall Cavity	44.5%	67.5%	20	$0.53	0.587	1.26	$0.069
HVAC - Duct Repair and Sealing	5.0%	25.0%	18	$0.50	0.940	1.84	$0.044
Doors - High Efficiency	0.0%	0.0%	0	$0.00	-	3.00	$0.000
Windows - High Efficiency	44.5%	100.0%	20	$3.39	0.622	0.21	$0.420
Roof - High Reflectivity	22.2%	95.0%	15	$0.64	0.231	0.30	$0.256
Air-Cooled Chiller - Condenser Water	30.0%	75.0%	10	$0.09	0.357	1.98	$0.031

Measure	Base Saturation	Applicability	Lifetime (Years)	Incremental Cost ($/SqFt)	Savings (kWh/SqFt)	BC Ratio	Levelized Cost of Energy ($/kWh)
Temperature Reset							
Air-Cooled Chiller - Economizer	11.1%	81.0%	10	$0.01	0.065	6.86	$0.010
Air-Cooled Chiller - Thermal Energy Storage	73.4%	81.0%	15	$0.15	-	0.06	$0.000
Air-Cooled Chiller - VSD on Fans	3.0%	75.0%	15	$1.17	1.717	1.16	$0.063
Air-Cooled Chiller - Chilled Water Reset	5.0%	75.0%	10	$0.17	0.468	1.35	$0.046
Air-Cooled Chiller - Chilled Water Variable-Flow System	30.0%	75.0%	15	$0.07	0.098	1.22	$0.067
Air-Cooled Chiller - High Efficiency Cooling Tower Fans	25.0%	36.9%	15	$0.30	0.087	0.26	$0.317
Air-Cooled Chiller - Maintenance	44.5%	90.0%	3	$0.19	0.700	0.47	$0.096
Air-Cooled Chiller - Chiller Heat Recovery	0.0%	50.0%	14	$0.04	0.160	3.32	$0.024
Water-Cooled Chiller - Condenser Water Temperature Reset	30.0%	75.0%	10	$0.09	0.288	1.63	$0.039
Water-Cooled Chiller - Economizer	11.1%	81.0%	10	$0.01	0.190	18.13	$0.004
Water-Cooled Chiller - Thermal Energy Storage	73.4%	81.0%	15	$0.15	-	0.06	$0.000
Water-Cooled Chiller - VSD on Fans	3.0%	75.0%	15	$1.17	0.320	0.23	$0.338
Water-Cooled Chiller - Chilled Water Reset	5.0%	75.0%	10	$0.17	0.449	1.31	$0.047
Water-Cooled Chiller - Chilled Water Variable-Flow System	30.0%	75.0%	15	$0.07	0.094	1.19	$0.069
Water-Cooled Chiller - High Efficiency Cooling Tower Fans	25.0%	36.9%	15	$0.30	0.003	0.04	$10.828
Water-Cooled Chiller - Maintenance	44.5%	90.0%	3	$0.19	0.672	0.46	$0.100
Water-Cooled Chiller - Chiller Heat Recovery	0.0%	50.0%	14	$0.04	0.160	3.32	$0.024
RTU - Evaporative Precooler	0.0%	5.4%	20	$3.00	2.054	0.76	$0.113
RTU - Maintenance	44.5%	90.0%	18	$0.15	0.589	3.86	$0.021
Space Heating - Heat Recovery Ventilator	73.4%	81.0%	15	$1,150.00	0.884	0.00	$120.173
Heat Pump - Maintenance	33.3%	95.0%	4	$0.06	2.432	6.88	$0.007
Ventilation - ECM on VAV Boxes	0.0%	0.0%	18	$0.22	0.397	1.80	$0.046
Ventilation - Variable Speed Control	0.0%	81.0%	15	$0.04	0.521	11.08	$0.007
Water Heater - Drainwater Heat Recovery	0.0%	50.0%	5	$0.04	0.160	1.00	$0.055
Water Heater - Faucet Aerators/Low Flow Nozzles	55.5%	90.0%	10	$0.00	0.071	26.44	$0.003
Water Heater - High Efficiency Circulation Pump	0.0%	0.0%	0	$0.00	-	1.00	$0.000
Water Heater - Desuperheater	0.0%	50.0%	5	$0.04	0.356	2.12	$0.025
Water Heater - Solar System	0.0%	50.0%	20	$0.06	0.890	17.13	$0.006
Water Heater - Install Timer	44.5%	49.5%	15	$0.28	0.356	1.11	$0.073
Water Heater - Pipe Insulation	44.5%	49.5%	13	$5.22	0.101	0.02	$5.285
Water Heater - Tank Blanket/Insulation	0.0%	0.0%	7	$0.00	0.089	12.48	$0.005
Interior Lighting - Daylighting Controls	0.0%	10.0%	8	$3.22	0.502	0.06	$0.947
Interior Lighting - LED Exit Lighting	50.0%	85.5%	16	$0.00	0.003	2.94	$0.108
Interior Lighting - Occupancy Sensors	11.1%	56.3%	8	$0.02	0.167	3.44	$0.017
Interior Lighting - Timeclocks and Timers	0.0%	56.3%	8	$0.02	0.084	1.64	$0.038
Interior Lighting - Task Lighting	11.1%	75.0%	5	$0.24	0.174	0.15	$0.305
Interior Fluorescent - Bi-Level Fixture	10.0%	22.5%	8	$0.20	0.277	0.57	$0.107
Interior Fluorescent - Delamp and Install Reflectors	55.5%	60.5%	11	$0.50	0.235	0.29	$0.245
Exterior Lighting - Bi-Level Fixture	10.0%	30.0%	8	$0.20	0.012	0.04	$2.373
Exterior Lighting - Daylighting Controls	6.0%	37.5%	8	$0.02	0.062	1.12	$0.047
Exterior Lighting - Photovoltaic Installation	0.0%	12.5%	5	$0.92	0.037	0.01	$5.423

Measure	Base Saturation	Applicability	Lifetime (Years)	Incremental Cost ($/SqFt)	Savings (kWh/SqFt)	BC Ratio	Levelized Cost of Energy ($/kWh)
Refrigerator - Anti-Sweat Heater	0.0%	75.0%	12	$0.07	0.006	0.12	$1.305
Refrigerator - Decommissioning	50.0%	51.7%	9	$0.01	0.157	6.56	$0.008
Refrigerator - Demand Defrost	0.0%	75.0%	16	$0.20	0.009	0.07	$2.023
Refrigerator - Door Gasket Replacement	5.0%	75.0%	4	$3.07	0.014	0.00	$60.457
Refrigerator - Evaporator Fan Controls	0.0%	7.5%	16	$0.01	0.002	0.74	$0.576
Refrigerator - Floating Head Pressure	38.0%	45.0%	15	$0.01	0.012	1.72	$0.064
Refrigerator - Strip Curtain	5.0%	56.3%	4	$0.59	0.007	0.01	$22.746
Refrigerator - High Efficiency Compressor	10.0%	37.5%	15	$0.29	0.012	0.05	$2.187
Refrigerator - Variable Speed Compressor	10.0%	37.5%	15	$0.02	0.012	0.71	$0.153
Refrigerator - eCube	5.0%	75.0%	12	$0.00	0.035	8.68	$0.008
Vending Machine - Controller	2.0%	10.0%	5	$0.27	0.008	0.02	$7.174
Office Equipment - ENERGY STAR Power Supplies	10.0%	95.0%	4	$0.00	0.004	31.08	$0.008
Office Equipment - Plug Load Occupancy Sensors	41.7%	56.3%	8	$0.28	0.039	0.07	$1.048
Pool Heater - Solar	0.0%	33.8%	20	$0.06	0.003	0.25	$1.883
Pool Pump - Timer	11.1%	33.8%	10	$0.44	0.003	0.02	$17.453
Ventilation - CO2 Controlled	1.0%	7.5%	15	$0.65	0.163	0.21	$0.368
Non-HVAC Motors - Variable Speed Control	11.1%	37.5%	10	$0.10	-	0.06	$0.000
Energy Management System	44.5%	90.0%	15	$0.35	1.396	3.15	$0.023
Thermostat - Clock/Programmable	44.5%	50.0%	11	$0.13	0.447	1.95	$0.034
HVAC - Occupancy Sensors	14.3%	56.3%	8	$0.14	0.881	2.40	$0.024
Commissioning - HVAC	0.0%	0.0%	0	$0.00	-	3.00	$0.000
Commissioning - Lighting	0.0%	0.0%	0	$0.00	-	2.00	$0.000
Retrocommissioning - HVAC	5.0%	36.0%	10	$0.75	1.390	0.89	$0.067
Retrocommissioning - Lighting	66.7%	71.7%	5	$0.05	0.174	0.86	$0.063
Advanced New Construction Designs	0.0%	0.0%	0	$0.00	-	6.00	$0.000
Custom Measures	10.0%	45.0%	15	$0.67	-	0.05	$0.000
PC Power Management Software	42.0%	90.0%	5	$0.13	0.275	1.24	$0.102
Pre-rinse Sprayer	56.0%	10.0%	5	$0.00	0.102	7.27	$0.008

Table C-38 Energy Efficiency Non-Equipment Data— College, New Vintage

Measure	Base Saturation	Applicability	Lifetime (Years)	Incremental Cost ($/SqFt)	Savings (kWh/SqFt)	BC Ratio	Levelized Cost of Energy ($/kWh)
Insulation - Ceiling	2.0%	12.5%	20	$1.36	0.259	0.24	$0.405
Insulation - Ducting	55.5%	60.5%	20	$0.77	0.909	1.38	$0.065
Insulation - Radiant Barrier	2.0%	12.5%	15	$0.00	0.084	3.00	$0.000
Insulation - Wall Cavity	44.5%	67.5%	20	$0.34	0.385	1.47	$0.067
HVAC - Duct Repair and Sealing	25.0%	25.0%	18	$0.50	0.830	1.70	$0.049
Doors - High Efficiency	100.0%	100.0%	0	$0.00	-	3.00	$0.000
Windows - High Efficiency	44.5%	100.0%	20	$3.39	0.945	0.33	$0.277
Roof - High Reflectivity	22.2%	95.0%	15	$0.64	0.158	0.24	$0.373
Air-Cooled Chiller - Condenser Water Temperature Reset	60.0%	75.0%	10	$0.09	0.226	1.39	$0.049
Air-Cooled Chiller - Economizer	63.5%	81.0%	10	$0.01	0.566	55.45	$0.001
Air-Cooled Chiller - Thermal Energy Storage	73.4%	81.0%	15	$0.15	-	0.06	$0.000
Air-Cooled Chiller - VSD on Fans	3.0%	75.0%	15	$1.17	1.284	0.96	$0.084
Air-Cooled Chiller - Chilled Water Reset	25.0%	75.0%	10	$0.17	0.297	0.94	$0.072
Air-Cooled Chiller - Chilled Water Variable-Flow System	30.0%	75.0%	15	$0.15	0.099	0.65	$0.137
Air-Cooled Chiller - High Efficiency	25.0%	36.9%	15	$0.30	0.175	0.54	$0.157

Measure	Base Saturation	Applicability	Lifetime (Years)	Incremental Cost ($/SqFt)	Savings (kWh/SqFt)	BC Ratio	Levelized Cost of Energy ($/kWh)
Cooling Tower Fans							
Air-Cooled Chiller - Maintenance	44.5%	90.0%	3	$0.40	0.440	0.15	$0.318
Air-Cooled Chiller - Chiller Heat Recovery	0.0%	50.0%	14	$0.04	0.154	3.27	$0.025
Water-Cooled Chiller - Condenser Water Temperature Reset	60.0%	75.0%	10	$0.09	0.130	0.82	$0.086
Water-Cooled Chiller - Economizer	63.5%	81.0%	10	$0.01	0.127	13.38	$0.005
Water-Cooled Chiller - Thermal Energy Storage	73.4%	81.0%	15	$0.15	-	0.06	$0.000
Water-Cooled Chiller - VSD on Fans	3.0%	75.0%	15	$1.17	0.276	0.21	$0.391
Water-Cooled Chiller - Chilled Water Reset	25.0%	75.0%	10	$0.17	0.374	1.17	$0.057
Water-Cooled Chiller - Chilled Water Variable-Flow System	30.0%	75.0%	15	$0.15	0.095	0.63	$0.142
Water-Cooled Chiller - High Efficiency Cooling Tower Fans	25.0%	36.9%	15	$0.30	0.004	0.04	$6.584
Water-Cooled Chiller - Maintenance	44.5%	90.0%	3	$0.40	0.423	0.15	$0.331
Water-Cooled Chiller - Chiller Heat Recovery	0.0%	50.0%	14	$0.04	0.154	3.27	$0.025
RTU - Evaporative Precooler	0.0%	3.2%	20	$3.00	1.641	0.68	$0.141
RTU - Maintenance	44.5%	90.0%	18	$0.15	0.373	2.77	$0.033
Space Heating - Heat Recovery Ventilator	73.4%	81.0%	15	$1,150.00	0.802	0.00	$132.535
Heat Pump - Maintenance	33.3%	95.0%	4	$0.06	0.799	2.60	$0.020
Ventilation - ECM on VAV Boxes	0.0%	0.0%	18	$0.22	0.274	1.40	$0.066
Ventilation - Variable Speed Control	0.0%	81.0%	15	$0.04	0.366	8.74	$0.009
Water Heater - Drainwater Heat Recovery	0.0%	50.0%	5	$0.04	0.154	0.98	$0.057
Water Heater - Faucet Aerators/Low Flow Nozzles	55.5%	90.0%	10	$0.00	0.068	26.05	$0.003
Water Heater - High Efficiency Circulation Pump	0.0%	0.0%	0	$0.00	-	1.00	$0.000
Water Heater - Desuperheater	0.0%	50.0%	5	$0.04	0.342	2.07	$0.026
Water Heater - Solar System	0.0%	50.0%	20	$0.06	0.854	16.84	$0.006
Water Heater - Install Timer	49.5%	49.5%	15	$0.28	0.342	1.09	$0.076
Water Heater - Pipe Insulation	49.5%	49.5%	13	$5.22	0.097	0.01	$5.506
Water Heater - Tank Blanket/Insulation	0.0%	0.0%	7	$0.00	0.079	11.53	$0.006
Interior Lighting - Daylighting Controls	15.0%	15.0%	8	$3.22	0.444	0.06	$1.071
Interior Lighting - LED Exit Lighting	85.5%	85.5%	16	$0.00	0.003	3.04	$0.122
Interior Lighting - Occupancy Sensors	56.3%	56.3%	8	$0.02	0.148	3.24	$0.019
Interior Lighting - Timeclocks and Timers	56.3%	56.3%	8	$0.02	0.074	1.56	$0.043
Interior Lighting - Task Lighting	11.1%	75.0%	5	$0.24	0.154	0.15	$0.345
Interior Fluorescent - Bi-Level Fixture	10.0%	22.5%	8	$0.20	0.252	0.52	$0.118
Interior Fluorescent - Delamp and Install Reflectors	55.5%	60.5%	11	$0.50	-	0.01	$0.000
Exterior Lighting - Bi-Level Fixture	10.0%	30.0%	8	$0.20	0.005	0.04	$5.747
Exterior Lighting - Daylighting Controls	6.0%	37.5%	8	$0.02	0.026	0.78	$0.115
Exterior Lighting - Photovoltaic Installation	0.0%	12.5%	5	$0.92	0.015	0.01	$13.135
Refrigerator - Anti-Sweat Heater	0.0%	75.0%	12	$0.07	0.006	0.17	$1.305
Refrigerator - Decommissioning	50.0%	51.7%	9	$0.01	0.093	5.15	$0.013
Refrigerator - Demand Defrost	0.0%	75.0%	16	$0.20	0.005	0.07	$3.420
Refrigerator - Door Gasket Replacement	5.0%	75.0%	4	$3.07	0.010	0.00	$84.296
Refrigerator - Evaporator Fan Controls	0.0%	7.5%	16	$0.01	0.001	0.93	$0.974
Refrigerator - Floating Head Pressure	38.0%	45.0%	15	$0.01	0.007	1.80	$0.107
Refrigerator - Strip Curtain	5.0%	56.3%	4	$0.59	0.004	0.01	$38.442

Measure	Base Saturation	Applicability	Lifetime (Years)	Incremental Cost ($/SqFt)	Savings (kWh/SqFt)	BC Ratio	Levelized Cost of Energy ($/kWh)
Refrigerator - High Efficiency Compressor	10.0%	37.5%	15	$0.29	0.007	0.05	$3.697
Refrigerator - Variable Speed Compressor	10.0%	37.5%	15	$0.02	0.007	0.75	$0.259
Refrigerator - eCube	5.0%	75.0%	12	$0.00	0.021	7.16	$0.015
Vending Machine - Controller	2.0%	10.0%	5	$0.27	0.006	0.01	$10.130
Office Equipment - ENERGY STAR Power Supplies	10.0%	95.0%	4	$0.00	0.004	32.13	$0.008
Office Equipment - Plug Load Occupancy Sensors	41.7%	56.3%	8	$0.25	0.039	0.08	$0.943
Pool Heater - Solar	0.0%	33.8%	20	$0.06	0.003	0.25	$1.826
Pool Pump - Timer	33.8%	33.8%	10	$0.44	0.003	0.02	$16.930
Ventilation - CO2 Controlled	5.9%	7.5%	15	$0.65	0.132	0.19	$0.453
Non-HVAC Motors - Variable Speed Control	11.1%	37.5%	10	$0.10	-	0.06	$0.000
Energy Management System	44.5%	90.0%	15	$0.35	1.256	3.06	$0.026
Thermostat - Clock/Programmable	50.0%	50.0%	11	$0.13	0.380	1.77	$0.039
HVAC - Occupancy Sensors	56.3%	56.3%	8	$0.14	0.775	2.21	$0.027
Commissioning - HVAC	0.0%	0.0%	25	$0.80	1.205	2.34	$0.045
Commissioning - Lighting	0.0%	0.0%	25	$0.10	0.151	2.68	$0.045
Retrocommissioning - HVAC	0.0%	0.0%	10	$0.75	-	0.03	$0.000
Retrocommissioning - Lighting	0.0%	0.0%	0	$0.00	-	2.00	$0.000
Advanced New Construction Designs	0.0%	0.0%	25	$2.00	5.379	4.15	$0.025
Custom Measures	10.0%	45.0%	15	$0.67	-	0.06	$0.000
PC Power Management Software	42.0%	90.0%	5	$0.13	0.275	1.26	$0.102
Pre-rinse Sprayer	56.0%	10.0%	5	$0.00	0.102	7.39	$0.008

Table C-39 Energy Efficiency Non-Equipment Data— School, Existing Vintage

Measure	Base Saturation	Applicability	Lifetime (Years)	Incremental Cost ($/SqFt)	Savings (kWh/SqFt)	BC Ratio	Levelized Cost of Energy ($/kWh)
Insulation - Ceiling	7.0%	12.5%	20	$1.04	0.257	0.27	$0.312
Insulation - Ducting	26.9%	50.0%	20	$0.77	0.348	0.48	$0.170
Insulation - Radiant Barrier	2.0%	12.5%	15	$0.00	0.096	3.00	$0.000
Insulation - Wall Cavity	19.2%	67.5%	20	$0.53	0.376	0.77	$0.108
HVAC - Duct Repair and Sealing	5.0%	25.0%	18	$0.50	0.652	1.18	$0.063
Doors - High Efficiency	0.0%	0.0%	0	$0.00	-	3.00	$0.000
Windows - High Efficiency	73.1%	75.0%	20	$3.39	0.407	0.13	$0.643
Roof - High Reflectivity	50.0%	75.0%	15	$0.64	0.141	0.18	$0.418
Air-Cooled Chiller - Condenser Water Temperature Reset	30.0%	75.0%	10	$0.18	0.219	0.61	$0.102
Air-Cooled Chiller - Economizer	3.9%	48.8%	10	$0.01	0.040	4.13	$0.017
Air-Cooled Chiller - Thermal Energy Storage	44.3%	48.8%	15	$0.15	-	0.03	$0.000
Air-Cooled Chiller - VSD on Fans	15.0%	66.2%	15	$1.17	0.572	0.39	$0.189
Air-Cooled Chiller - Chilled Water Reset	5.0%	75.0%	10	$0.17	0.287	0.83	$0.074
Air-Cooled Chiller - Chilled Water Variable-Flow System	30.0%	75.0%	15	$0.07	0.060	0.74	$0.109
Air-Cooled Chiller - High Efficiency Cooling Tower Fans	15.0%	41.3%	15	$0.30	0.053	0.16	$0.517
Air-Cooled Chiller - Maintenance	73.1%	90.0%	3	$0.19	0.429	0.29	$0.157
Air-Cooled Chiller - Chiller Heat Recovery	0.0%	50.0%	14	$0.04	0.100	2.05	$0.039
Water-Cooled Chiller - Condenser Water Temperature Reset	30.0%	75.0%	10	$0.18	0.176	0.49	$0.127
Water-Cooled Chiller - Economizer	3.9%	48.8%	10	$0.01	0.126	11.73	$0.005
Water-Cooled Chiller - Thermal Energy Storage	44.3%	48.8%	15	$0.15	-	0.03	$0.000

Measure	Base Saturation	Applicability	Lifetime (Years)	Incremental Cost ($/SqFt)	Savings (kWh/SqFt)	BC Ratio	Levelized Cost of Energy ($/kWh)
Water-Cooled Chiller - VSD on Fans	15.0%	66.2%	15	$1.17	0.196	0.14	$0.551
Water-Cooled Chiller - Chilled Water Reset	5.0%	75.0%	10	$0.17	0.275	0.79	$0.077
Water-Cooled Chiller - Chilled Water Variable-Flow System	30.0%	75.0%	15	$0.07	0.057	0.71	$0.113
Water-Cooled Chiller - High Efficiency Cooling Tower Fans	15.0%	41.3%	15	$0.30	0.002	0.02	$17.669
Water-Cooled Chiller - Maintenance	73.1%	90.0%	3	$0.19	0.412	0.28	$0.163
Water-Cooled Chiller - Chiller Heat Recovery	0.0%	50.0%	14	$0.04	0.100	2.05	$0.039
RTU - Evaporative Precooler	0.0%	7.5%	20	$3.00	1.259	0.46	$0.184
RTU - Maintenance	73.1%	90.0%	18	$0.15	0.361	2.35	$0.034
Space Heating - Heat Recovery Ventilator	44.3%	48.8%	15	$1,150.00	0.622	0.00	$170.915
Heat Pump - Maintenance	0.0%	95.0%	4	$0.06	1.631	4.56	$0.010
Ventilation - ECM on VAV Boxes	0.0%	0.0%	18	$0.22	0.279	1.26	$0.065
Ventilation - Variable Speed Control	0.0%	81.0%	15	$0.04	0.319	6.76	$0.011
Water Heater - Drainwater Heat Recovery	0.0%	50.0%	5	$0.04	0.100	0.61	$0.088
Water Heater - Faucet Aerators/Low Flow Nozzles	30.8%	90.0%	10	$0.00	0.044	16.02	$0.005
Water Heater - High Efficiency Circulation Pump	0.0%	0.0%	0	$0.00	-	1.00	$0.000
Water Heater - Desuperheater	0.0%	50.0%	5	$0.04	0.222	1.31	$0.040
Water Heater - Solar System	0.0%	50.0%	20	$0.06	0.555	10.67	$0.009
Water Heater - Install Timer	15.4%	20.4%	15	$0.28	0.222	0.69	$0.116
Water Heater - Pipe Insulation	15.4%	20.4%	13	$5.22	0.063	0.01	$8.468
Water Heater - Tank Blanket/Insulation	0.0%	0.0%	7	$0.00	0.056	7.59	$0.008
Interior Lighting - Daylighting Controls	11.5%	12.5%	8	$3.22	0.605	0.07	$0.787
Interior Lighting - LED Exit Lighting	50.0%	85.5%	16	$0.00	0.004	1.86	$0.089
Interior Lighting - Occupancy Sensors	15.4%	56.3%	8	$0.02	0.202	3.78	$0.014
Interior Lighting - Timeclocks and Timers	3.9%	56.3%	8	$0.02	0.101	1.73	$0.032
Interior Lighting - Task Lighting	3.9%	75.0%	5	$0.24	0.209	0.18	$0.253
Interior Fluorescent - Bi-Level Fixture	10.0%	22.5%	8	$0.40	0.149	0.15	$0.398
Interior Fluorescent - Delamp and Install Reflectors	19.2%	56.3%	11	$0.50	0.126	0.15	$0.456
Exterior Lighting - Bi-Level Fixture	10.0%	30.0%	8	$0.20	0.007	0.02	$3.986
Exterior Lighting - Daylighting Controls	6.0%	37.5%	8	$0.02	0.037	0.66	$0.080
Exterior Lighting - Photovoltaic Installation	0.0%	12.5%	5	$0.92	0.022	0.01	$9.110
Refrigerator - Anti-Sweat Heater	0.0%	75.0%	12	$0.07	0.007	0.09	$1.111
Refrigerator - Decommissioning	50.0%	51.7%	9	$0.01	0.185	7.37	$0.007
Refrigerator - Demand Defrost	0.0%	75.0%	16	$0.20	0.010	0.05	$1.724
Refrigerator - Door Gasket Replacement	5.0%	75.0%	4	$3.07	0.016	0.00	$51.505
Refrigerator - Evaporator Fan Controls	0.0%	7.5%	16	$0.01	0.002	0.44	$0.491
Refrigerator - Floating Head Pressure	38.0%	45.0%	15	$0.01	0.014	1.47	$0.054
Refrigerator - Strip Curtain	5.0%	56.3%	4	$0.59	0.008	0.00	$19.378
Refrigerator - High Efficiency Compressor	10.0%	37.5%	15	$0.29	0.014	0.04	$1.863
Refrigerator - Variable Speed Compressor	10.0%	37.5%	15	$0.02	0.014	0.61	$0.131
Refrigerator - eCube	5.0%	75.0%	12	$0.01	0.041	3.40	$0.017
Vending Machine - Controller	2.0%	10.0%	5	$0.27	0.010	0.01	$6.112
Office Equipment - ENERGY STAR Power Supplies	10.0%	95.0%	4	$0.00	0.002	15.49	$0.015
Office Equipment - Plug Load Occupancy Sensors	12.6%	56.3%	8	$0.28	0.020	0.04	$2.082

Measure	Base Saturation	Applicability	Lifetime (Years)	Incremental Cost ($/SqFt)	Savings (kWh/SqFt)	BC Ratio	Levelized Cost of Energy ($/kWh)
Pool Heater - Solar	0.0%	33.8%	20	$0.06	0.001	0.11	$8.003
Pool Pump - Timer	0.0%	33.8%	10	$0.13	0.001	0.03	$21.921
Ventilation - CO2 Controlled	1.0%	11.3%	15	$0.65	0.100	0.13	$0.602
Non-HVAC Motors - Variable Speed Control	3.9%	37.5%	10	$0.10	-	0.03	$0.000
Energy Management System	19.2%	75.0%	15	$0.35	1.029	2.18	$0.031
Thermostat - Clock/Programmable	50.0%	50.0%	11	$0.13	0.301	1.23	$0.050
HVAC - Occupancy Sensors	14.3%	56.3%	8	$0.14	0.606	1.54	$0.034
Commissioning - HVAC	0.0%	0.0%	0	$0.00	-	3.00	$0.000
Commissioning - Lighting	0.0%	0.0%	0	$0.00	-	2.00	$0.000
Retrocommissioning - HVAC	9.0%	36.0%	10	$0.75	0.929	0.57	$0.100
Retrocommissioning - Lighting	30.8%	35.8%	5	$0.05	0.205	0.90	$0.054
Advanced New Construction Designs	0.0%	0.0%	0	$0.00	-	6.00	$0.000
Custom Measures	10.0%	45.0%	15	$0.90	-	0.02	$0.000
PC Power Management Software	13.0%	90.0%	5	$0.05	0.133	1.38	$0.079
Pre-rinse Sprayer	31.0%	10.0%	5	$0.00	0.051	7.27	$0.008

Table C-40 Energy Efficiency Non-Equipment Data— School, New Vintage

Measure	Base Saturation	Applicability	Lifetime (Years)	Incremental Cost ($/SqFt)	Savings (kWh/SqFt)	BC Ratio	Levelized Cost of Energy ($/kWh)
Insulation - Ceiling	7.0%	12.5%	20	$1.36	0.176	0.15	$0.595
Insulation - Ducting	33.5%	50.0%	20	$0.77	0.626	0.90	$0.095
Insulation - Radiant Barrier	2.0%	12.5%	15	$0.00	0.057	3.00	$0.000
Insulation - Wall Cavity	33.5%	67.5%	20	$0.34	0.241	0.89	$0.107
HVAC - Duct Repair and Sealing	25.0%	25.0%	18	$0.50	0.577	1.12	$0.071
Doors - High Efficiency	100.0%	100.0%	0	$0.00	-	3.00	$0.000
Windows - High Efficiency	66.5%	75.0%	20	$3.39	0.648	0.21	$0.403
Roof - High Reflectivity	33.5%	95.0%	15	$0.64	0.097	0.14	$0.609
Air-Cooled Chiller - Condenser Water Temperature Reset	60.0%	75.0%	10	$0.18	0.139	0.42	$0.161
Air-Cooled Chiller - Economizer	36.6%	48.8%	10	$0.01	0.347	33.85	$0.002
Air-Cooled Chiller - Thermal Energy Storage	44.3%	48.8%	15	$0.15	-	0.03	$0.000
Air-Cooled Chiller - VSD on Fans	15.0%	66.2%	15	$1.17	0.787	0.59	$0.137
Air-Cooled Chiller - Chilled Water Reset	25.0%	75.0%	10	$0.17	0.182	0.57	$0.117
Air-Cooled Chiller - Chilled Water Variable-Flow System	30.0%	75.0%	15	$0.15	0.061	0.39	$0.223
Air-Cooled Chiller - High Efficiency Cooling Tower Fans	15.0%	41.3%	15	$0.30	0.107	0.33	$0.256
Air-Cooled Chiller - Maintenance	66.5%	90.0%	3	$0.40	0.270	0.09	$0.519
Air-Cooled Chiller - Chiller Heat Recovery	0.0%	50.0%	14	$0.04	0.096	2.01	$0.040
Water-Cooled Chiller - Condenser Water Temperature Reset	60.0%	75.0%	10	$0.18	0.079	0.25	$0.281
Water-Cooled Chiller - Economizer	36.6%	48.8%	10	$0.01	0.086	8.86	$0.008
Water-Cooled Chiller - Thermal Energy Storage	44.3%	48.8%	15	$0.15	-	0.03	$0.000
Water-Cooled Chiller - VSD on Fans	15.0%	66.2%	15	$1.17	0.029	0.03	$3.781
Water-Cooled Chiller - Chilled Water Reset	25.0%	75.0%	10	$0.17	0.229	0.71	$0.093
Water-Cooled Chiller - Chilled Water Variable-Flow System	30.0%	75.0%	15	$0.15	0.058	0.38	$0.232
Water-Cooled Chiller - High Efficiency Cooling Tower Fans	15.0%	41.3%	15	$0.30	0.003	0.02	$10.744
Water-Cooled Chiller - Maintenance	66.5%	90.0%	3	$0.40	0.259	0.09	$0.540
Water-Cooled Chiller - Chiller Heat Recovery	0.0%	50.0%	14	$0.04	0.096	2.01	$0.040

Measure	Base Saturation	Applicability	Lifetime (Years)	Incremental Cost ($/SqFt)	Savings (kWh/SqFt)	BC Ratio	Levelized Cost of Energy ($/kWh)
RTU - Evaporative Precooler	0.0%	2.6%	20	$3.00	1.006	0.42	$0.230
RTU - Maintenance	66.5%	90.0%	18	$0.15	0.228	1.69	$0.054
Space Heating - Heat Recovery Ventilator	44.3%	48.8%	15	$1,150.00	0.564	0.00	$188.496
Heat Pump - Maintenance	0.0%	95.0%	4	$0.06	0.535	1.71	$0.030
Ventilation - ECM on VAV Boxes	0.0%	0.0%	18	$0.22	0.227	1.14	$0.080
Ventilation - Variable Speed Control	0.0%	81.0%	15	$0.04	0.224	5.32	$0.015
Water Heater - Drainwater Heat Recovery	0.0%	50.0%	5	$0.04	0.096	0.60	$0.092
Water Heater - Faucet Aerators/Low Flow Nozzles	33.5%	90.0%	10	$0.00	0.043	15.76	$0.005
Water Heater - High Efficiency Circulation Pump	0.0%	0.0%	0	$0.00	-	1.00	$0.000
Water Heater - Desuperheater	0.0%	50.0%	5	$0.04	0.213	1.28	$0.041
Water Heater - Solar System	0.0%	50.0%	20	$0.06	0.533	10.48	$0.009
Water Heater - Install Timer	0.0%	0.0%	15	$0.28	0.213	0.68	$0.121
Water Heater - Pipe Insulation	0.0%	0.0%	13	$5.22	0.060	0.01	$8.824
Water Heater - Tank Blanket/Insulation	0.0%	0.0%	7	$0.00	0.050	6.99	$0.009
Interior Lighting - Daylighting Controls	18.8%	18.8%	8	$3.22	0.535	0.06	$0.889
Interior Lighting - LED Exit Lighting	85.5%	85.5%	16	$0.00	0.004	1.96	$0.101
Interior Lighting - Occupancy Sensors	56.3%	56.3%	8	$0.02	0.178	3.69	$0.016
Interior Lighting - Timeclocks and Timers	56.3%	56.3%	8	$0.02	0.089	1.70	$0.036
Interior Lighting - Task Lighting	0.0%	75.0%	5	$0.24	0.185	0.18	$0.286
Interior Fluorescent - Bi-Level Fixture	10.0%	22.5%	8	$0.40	0.135	0.14	$0.438
Interior Fluorescent - Delamp and Install Reflectors	66.5%	71.5%	11	$0.50	-	0.01	$0.000
Exterior Lighting - Bi-Level Fixture	10.0%	30.0%	8	$0.20	0.003	0.02	$9.654
Exterior Lighting - Daylighting Controls	6.0%	37.5%	8	$0.02	0.015	0.44	$0.193
Exterior Lighting - Photovoltaic Installation	0.0%	12.5%	5	$0.92	0.009	0.00	$22.064
Refrigerator - Anti-Sweat Heater	0.0%	75.0%	12	$0.07	0.007	0.12	$1.111
Refrigerator - Decommissioning	50.0%	51.7%	9	$0.01	0.109	5.68	$0.011
Refrigerator - Demand Defrost	0.0%	75.0%	16	$0.20	0.006	0.05	$2.913
Refrigerator - Door Gasket Replacement	5.0%	75.0%	4	$3.07	0.012	0.00	$71.814
Refrigerator - Evaporator Fan Controls	0.0%	7.5%	16	$0.01	0.001	0.53	$0.830
Refrigerator - Floating Head Pressure	38.0%	45.0%	15	$0.01	0.009	1.39	$0.092
Refrigerator - Strip Curtain	5.0%	56.3%	4	$0.59	0.005	0.00	$32.750
Refrigerator - High Efficiency Compressor	10.0%	37.5%	15	$0.29	0.009	0.04	$3.149
Refrigerator - Variable Speed Compressor	10.0%	37.5%	15	$0.02	0.009	0.58	$0.221
Refrigerator - eCube	5.0%	75.0%	12	$0.01	0.024	2.06	$0.041
Vending Machine - Controller	2.0%	10.0%	5	$0.27	0.007	0.01	$8.630
Office Equipment - ENERGY STAR Power Supplies	10.0%	95.0%	4	$0.00	0.002	16.07	$0.015
Office Equipment - Plug Load Occupancy Sensors	12.6%	56.3%	8	$0.25	0.020	0.04	$1.873
Pool Heater - Solar	0.0%	33.8%	20	$0.06	0.001	0.11	$7.763
Pool Pump - Timer	33.8%	33.8%	10	$0.13	0.001	0.03	$21.264
Ventilation - CO2 Controlled	8.7%	11.3%	15	$0.65	0.081	0.12	$0.741
Non-HVAC Motors - Variable Speed Control	0.0%	37.5%	10	$0.10	-	0.03	$0.000
Energy Management System	0.0%	75.0%	15	$0.35	0.905	2.13	$0.036
Thermostat - Clock/Programmable	71.5%	71.5%	11	$0.13	0.257	1.13	$0.058
HVAC - Occupancy Sensors	56.3%	56.3%	8	$0.14	0.534	1.45	$0.039
Commissioning - HVAC	0.0%	0.0%	25	$1.00	0.809	1.20	$0.084

Measure	Base Saturation	Applicability	Lifetime (Years)	Incremental Cost ($/SqFt)	Savings (kWh/SqFt)	BC Ratio	Levelized Cost of Energy ($/kWh)
Commissioning - Lighting	0.0%	0.0%	25	$0.15	0.180	1.97	$0.057
Retrocommissioning - HVAC	0.0%	0.0%	10	$0.75	-	0.01	$0.000
Retrocommissioning - Lighting	0.0%	0.0%	0	$0.00	-	2.00	$0.000
Advanced New Construction Designs	0.0%	0.0%	25	$2.00	3.765	2.80	$0.036
Custom Measures	10.0%	45.0%	15	$0.90	-	0.02	$0.000
PC Power Management Software	13.0%	90.0%	5	$0.05	0.133	1.41	$0.079
Pre-rinse Sprayer	34.0%	10.0%	5	$0.00	0.051	7.39	$0.008

Table C-41 Energy Efficiency Non-Equipment Data— Health, Existing Vintage

Measure	Base Saturation	Applicability	Lifetime (Years)	Incremental Cost ($/SqFt)	Savings (kWh/SqFt)	BC Ratio	Levelized Cost of Energy ($/kWh)
Insulation - Ceiling	2.0%	12.5%	20	$0.52	0.371	0.83	$0.108
Insulation - Ducting	9.8%	50.0%	20	$0.77	0.581	0.86	$0.102
Insulation - Radiant Barrier	5.0%	12.5%	15	$0.00	0.132	3.00	$0.000
Insulation - Wall Cavity	14.6%	67.5%	20	$0.84	1.436	1.90	$0.045
HVAC - Duct Repair and Sealing	5.0%	25.0%	18	$0.50	1.238	2.45	$0.033
Doors - High Efficiency	0.0%	0.0%	0	$0.00	-	3.00	$0.000
Windows - High Efficiency	65.9%	100.0%	20	$0.89	1.249	1.57	$0.055
Roof - High Reflectivity	39.0%	95.0%	15	$0.32	0.259	0.67	$0.114
Air-Cooled Chiller - Condenser Water Temperature Reset	30.0%	75.0%	10	$0.09	0.510	2.83	$0.022
Air-Cooled Chiller - Economizer	2.4%	81.0%	10	$0.01	0.141	10.43	$0.006
Air-Cooled Chiller - Thermal Energy Storage	73.4%	81.0%	15	$0.15	-	0.04	$0.000
Air-Cooled Chiller - VSD on Fans	3.0%	75.0%	15	$1.17	1.986	1.37	$0.054
Air-Cooled Chiller - Chilled Water Reset	25.0%	75.0%	10	$0.22	0.784	1.75	$0.035
Air-Cooled Chiller - Chilled Water Variable-Flow System	30.0%	75.0%	15	$0.07	0.177	2.11	$0.037
Air-Cooled Chiller - High Efficiency Cooling Tower Fans	25.0%	36.9%	15	$0.38	0.084	0.19	$0.422
Air-Cooled Chiller - Maintenance	48.8%	90.0%	3	$0.19	0.921	0.63	$0.073
Air-Cooled Chiller - Chiller Heat Recovery	0.0%	50.0%	14	$0.04	0.277	5.50	$0.014
Water-Cooled Chiller - Condenser Water Temperature Reset	30.0%	75.0%	10	$0.09	0.114	0.66	$0.098
Water-Cooled Chiller - Economizer	2.4%	81.0%	10	$0.01	0.766	53.38	$0.001
Water-Cooled Chiller - Thermal Energy Storage	73.4%	81.0%	15	$0.15	-	0.04	$0.000
Water-Cooled Chiller - VSD on Fans	3.0%	75.0%	15	$1.17	0.223	0.16	$0.484
Water-Cooled Chiller - Chilled Water Reset	25.0%	75.0%	10	$0.22	0.752	1.66	$0.037
Water-Cooled Chiller - Chilled Water Variable-Flow System	30.0%	75.0%	15	$0.07	0.170	2.00	$0.038
Water-Cooled Chiller - High Efficiency Cooling Tower Fans	25.0%	36.9%	15	$0.38	0.003	0.02	$10.645
Water-Cooled Chiller - Maintenance	48.8%	90.0%	3	$0.19	0.883	0.59	$0.076
Water-Cooled Chiller - Chiller Heat Recovery	0.0%	50.0%	14	$0.04	0.277	5.50	$0.014
RTU - Evaporative Precooler	0.0%	2.0%	20	$3.00	4.510	1.71	$0.051
RTU - Maintenance	48.8%	90.0%	18	$0.08	1.293	17.22	$0.005
Space Heating - Heat Recovery Ventilator	73.4%	81.0%	15	$1,150.00	1.124	0.00	$94.549
Heat Pump - Maintenance	4.9%	95.0%	4	$0.06	3.994	11.33	$0.004
Ventilation - ECM on VAV Boxes	0.0%	0.0%	18	$0.22	0.353	1.57	$0.051
Ventilation - Variable Speed Control	2.4%	81.0%	15	$0.05	1.483	23.81	$0.003
Water Heater - Drainwater Heat Recovery	0.0%	50.0%	5	$0.04	0.277	1.63	$0.032

Measure	Base Saturation	Applicability	Lifetime (Years)	Incremental Cost ($/SqFt)	Savings (kWh/SqFt)	BC Ratio	Levelized Cost of Energy ($/kWh)
Water Heater - Faucet Aerators/Low Flow Nozzles	19.5%	90.0%	10	$0.00	0.123	32.06	$0.002
Water Heater - High Efficiency Circulation Pump	0.0%	0.0%	0	$0.00	-	1.00	$0.000
Water Heater - Desuperheater	0.0%	50.0%	5	$0.04	0.615	3.57	$0.014
Water Heater - Solar System	0.0%	50.0%	20	$0.13	1.537	13.90	$0.007
Water Heater - Install Timer	14.6%	19.6%	15	$0.28	0.615	1.88	$0.042
Water Heater - Pipe Insulation	14.6%	19.6%	13	$5.22	0.174	0.02	$3.061
Water Heater - Tank Blanket/Insulation	0.0%	0.0%	7	$0.00	0.154	15.32	$0.004
Interior Lighting - Daylighting Controls	14.6%	19.6%	8	$0.85	0.515	0.23	$0.243
Interior Lighting - LED Exit Lighting	50.0%	85.5%	16	$0.01	0.003	1.69	$0.135
Interior Lighting - Occupancy Sensors	4.9%	56.3%	8	$0.02	0.172	2.69	$0.021
Interior Lighting - Timeclocks and Timers	7.3%	56.3%	8	$0.03	0.086	1.25	$0.048
Interior Lighting - Task Lighting	9.8%	75.0%	5	$0.24	0.178	0.15	$0.297
Interior Fluorescent - Bi-Level Fixture	10.0%	22.5%	8	$0.20	0.388	0.77	$0.076
Interior Fluorescent - Delamp and Install Reflectors	12.2%	25.0%	11	$0.50	0.330	0.38	$0.175
Exterior Lighting - Bi-Level Fixture	10.0%	30.0%	8	$0.20	0.004	0.02	$8.171
Exterior Lighting - Daylighting Controls	11.0%	37.5%	8	$0.02	0.018	0.42	$0.163
Exterior Lighting - Photovoltaic Installation	0.0%	12.5%	5	$0.92	0.011	0.00	$18.675
Refrigerator - Anti-Sweat Heater	0.0%	75.0%	12	$0.09	0.009	0.09	$1.093
Refrigerator - Decommissioning	50.0%	51.7%	9	$0.01	0.243	7.53	$0.007
Refrigerator - Demand Defrost	0.0%	75.0%	16	$0.20	0.013	0.07	$1.313
Refrigerator - Door Gasket Replacement	5.0%	75.0%	4	$4.91	0.019	0.00	$68.019
Refrigerator - Evaporator Fan Controls	0.0%	7.5%	16	$0.01	0.003	0.45	$0.483
Refrigerator - Floating Head Pressure	38.0%	45.0%	15	$0.01	0.019	1.50	$0.053
Refrigerator - Strip Curtain	5.0%	56.3%	4	$0.16	0.011	0.02	$3.881
Refrigerator - High Efficiency Compressor	10.0%	37.5%	15	$0.29	0.019	0.06	$1.419
Refrigerator - Variable Speed Compressor	10.0%	37.5%	15	$0.03	0.019	0.62	$0.129
Refrigerator - eCube	5.0%	75.0%	12	$0.01	0.054	3.39	$0.018
Vending Machine - Controller	2.0%	10.0%	5	$0.27	0.013	0.01	$4.655
Office Equipment - ENERGY STAR Power Supplies	10.0%	95.0%	4	$0.00	0.004	23.64	$0.006
Office Equipment - Plug Load Occupancy Sensors	41.7%	56.3%	8	$0.28	0.049	0.08	$0.852
Pool Heater - Solar	0.0%	33.8%	20	$0.13	0.006	0.12	$1.658
Pool Pump - Timer	2.4%	33.8%	10	$0.44	0.007	0.02	$7.273
Ventilation - CO2 Controlled	1.0%	7.5%	15	$0.65	0.444	0.53	$0.135
Non-HVAC Motors - Variable Speed Control	2.4%	37.5%	10	$0.10	-	0.04	$0.000
Energy Management System	0.0%	90.0%	15	$0.35	3.897	8.74	$0.008
Thermostat - Clock/Programmable	63.4%	68.4%	11	$0.13	1.157	4.84	$0.013
HVAC - Occupancy Sensors	14.3%	56.3%	8	$0.14	1.283	3.47	$0.016
Commissioning - HVAC	0.0%	0.0%	0	$0.00	-	3.00	$0.000
Commissioning - Lighting	0.0%	0.0%	0	$0.00	-	2.00	$0.000
Retrocommissioning - HVAC	5.0%	36.0%	10	$0.75	2.321	1.50	$0.040
Retrocommissioning - Lighting	12.2%	17.2%	5	$0.05	0.173	0.83	$0.064
Advanced New Construction Designs	0.0%	0.0%	0	$0.00	-	6.00	$0.000
Custom Measures	10.0%	45.0%	15	$0.67	-	0.03	$0.000
PC Power Management Software	42.0%	90.0%	5	$0.16	0.339	1.21	$0.107
Pre-rinse Sprayer	20.0%	10.0%	5	$0.00	0.066	7.26	$0.008

Table C-42 Energy Efficiency Non-Equipment Data— Health, New Vintage

Measure	Base Saturation	Applicability	Lifetime (Years)	Incremental Cost ($/SqFt)	Savings (kWh/SqFt)	BC Ratio	Levelized Cost of Energy ($/kWh)
Insulation - Ceiling	2.0%	12.5%	20	$0.68	0.902	1.56	$0.058
Insulation - Ducting	9.1%	50.0%	20	$0.77	0.756	1.20	$0.079
Insulation - Radiant Barrier	5.0%	12.5%	15	$0.00	0.272	3.00	$0.000
Insulation - Wall Cavity	9.1%	67.5%	20	$0.42	1.958	5.33	$0.017
HVAC - Duct Repair and Sealing	25.0%	25.0%	18	$0.50	1.392	2.85	$0.030
Doors - High Efficiency	100.0%	100.0%	0	$0.00	-	3.00	$0.000
Windows - High Efficiency	90.9%	100.0%	20	$0.71	1.366	2.26	$0.040
Roof - High Reflectivity	45.5%	95.0%	15	$0.32	0.458	1.27	$0.065
Air-Cooled Chiller - Condenser Water Temperature Reset	60.0%	75.0%	10	$0.09	0.330	1.94	$0.034
Air-Cooled Chiller - Economizer	60.8%	81.0%	10	$0.00	0.211	25.62	$0.003
Air-Cooled Chiller - Thermal Energy Storage	73.4%	81.0%	15	$0.15	-	0.04	$0.000
Air-Cooled Chiller - VSD on Fans	3.0%	75.0%	15	$1.17	1.534	1.12	$0.070
Air-Cooled Chiller - Chilled Water Reset	50.0%	75.0%	10	$0.14	0.564	2.12	$0.031
Air-Cooled Chiller - Chilled Water Variable-Flow System	30.0%	75.0%	15	$0.05	0.157	2.73	$0.030
Air-Cooled Chiller - High Efficiency Cooling Tower Fans	25.0%	36.9%	15	$0.24	0.003	0.03	$8.680
Air-Cooled Chiller - Maintenance	72.7%	90.0%	3	$0.14	0.581	0.56	$0.084
Air-Cooled Chiller - Chiller Heat Recovery	0.0%	50.0%	14	$0.04	0.266	5.41	$0.015
Water-Cooled Chiller - Condenser Water Temperature Reset	60.0%	75.0%	10	$0.09	0.086	0.55	$0.129
Water-Cooled Chiller - Economizer	60.8%	81.0%	10	$0.00	0.428	51.72	$0.001
Water-Cooled Chiller - Thermal Energy Storage	73.4%	81.0%	15	$0.15	-	0.04	$0.000
Water-Cooled Chiller - VSD on Fans	3.0%	75.0%	15	$1.17	0.174	0.13	$0.622
Water-Cooled Chiller - Chilled Water Reset	50.0%	75.0%	10	$0.14	0.505	1.93	$0.034
Water-Cooled Chiller - Chilled Water Variable-Flow System	30.0%	75.0%	15	$0.05	0.177	3.11	$0.027
Water-Cooled Chiller - High Efficiency Cooling Tower Fans	25.0%	36.9%	15	$0.24	0.005	0.05	$4.070
Water-Cooled Chiller - Maintenance	72.7%	90.0%	3	$0.14	0.552	0.54	$0.089
Water-Cooled Chiller - Chiller Heat Recovery	0.0%	50.0%	14	$0.04	0.266	5.41	$0.015
RTU - Evaporative Precooler	0.0%	1.0%	20	$3.00	3.796	1.57	$0.061
RTU - Maintenance	72.7%	90.0%	18	$0.08	0.862	12.56	$0.007
Space Heating - Heat Recovery Ventilator	73.4%	81.0%	15	$1,150.00	0.998	0.00	$106.474
Heat Pump - Maintenance	9.1%	95.0%	4	$0.06	1.064	3.34	$0.015
Ventilation - ECM on VAV Boxes	0.0%	0.0%	18	$0.22	0.229	1.16	$0.079
Ventilation - Variable Speed Control	0.0%	81.0%	15	$0.03	0.889	25.65	$0.003
Water Heater - Drainwater Heat Recovery	0.0%	50.0%	5	$0.04	0.266	1.60	$0.033
Water Heater - Faucet Aerators/Low Flow Nozzles	27.3%	90.0%	10	$0.00	0.118	50.45	$0.001
Water Heater - High Efficiency Circulation Pump	0.0%	0.0%	0	$0.00	-	1.00	$0.000
Water Heater - Desuperheater	0.0%	50.0%	5	$0.04	0.590	3.49	$0.015
Water Heater - Solar System	0.0%	50.0%	20	$0.08	1.475	21.85	$0.004
Water Heater - Install Timer	14.1%	14.1%	15	$0.28	0.590	1.84	$0.044
Water Heater - Pipe Insulation	14.1%	14.1%	13	$5.22	0.167	0.02	$3.188
Water Heater - Tank Blanket/Insulation	0.0%	0.0%	7	$0.00	0.136	22.25	$0.003
Interior Lighting - Daylighting Controls	32.3%	32.3%	8	$0.67	0.449	0.27	$0.220
Interior Lighting - LED Exit Lighting	85.5%	85.5%	16	$0.00	0.003	2.73	$0.097

Measure	Base Saturation	Applicability	Lifetime (Years)	Incremental Cost ($/SqFt)	Savings (kWh/SqFt)	BC Ratio	Levelized Cost of Energy ($/kWh)
Interior Lighting - Occupancy Sensors	56.3%	56.3%	8	$0.02	0.150	3.95	$0.015
Interior Lighting - Timeclocks and Timers	56.3%	56.3%	8	$0.02	0.075	1.85	$0.035
Interior Lighting - Task Lighting	27.3%	75.0%	5	$0.24	0.155	0.15	$0.341
Interior Fluorescent - Bi-Level Fixture	10.0%	22.5%	8	$0.20	0.361	0.73	$0.082
Interior Fluorescent - Delamp and Install Reflectors	18.2%	25.0%	11	$0.50	-	0.01	$0.000
Exterior Lighting - Bi-Level Fixture	10.0%	30.0%	8	$0.20	0.002	0.02	$17.381
Exterior Lighting - Daylighting Controls	11.0%	37.5%	8	$0.02	0.009	0.34	$0.348
Exterior Lighting - Photovoltaic Installation	0.0%	12.5%	5	$0.92	0.005	0.00	$39.727
Refrigerator - Anti-Sweat Heater	0.0%	75.0%	12	$0.06	0.009	0.19	$0.683
Refrigerator - Decommissioning	50.0%	51.7%	9	$0.01	0.144	8.94	$0.007
Refrigerator - Demand Defrost	0.0%	75.0%	16	$0.20	0.008	0.07	$2.219
Refrigerator - Door Gasket Replacement	5.0%	75.0%	4	$3.88	0.014	0.00	$73.356
Refrigerator - Evaporator Fan Controls	0.0%	7.5%	16	$0.01	0.002	0.82	$0.510
Refrigerator - Floating Head Pressure	38.0%	45.0%	15	$0.01	0.011	2.18	$0.056
Refrigerator - Strip Curtain	5.0%	56.3%	4	$0.12	0.006	0.02	$5.186
Refrigerator - High Efficiency Compressor	10.0%	37.5%	15	$0.29	0.011	0.05	$2.399
Refrigerator - Variable Speed Compressor	10.0%	37.5%	15	$0.02	0.011	0.90	$0.136
Refrigerator - eCube	5.0%	75.0%	12	$0.01	0.032	2.13	$0.039
Vending Machine - Controller	2.0%	10.0%	5	$0.27	0.011	0.01	$5.340
Office Equipment - ENERGY STAR Power Supplies	10.0%	95.0%	4	$0.00	0.004	24.42	$0.006
Office Equipment - Plug Load Occupancy Sensors	41.7%	56.3%	8	$0.25	0.048	0.09	$0.766
Pool Heater - Solar	0.0%	33.8%	20	$0.08	0.006	0.19	$1.005
Pool Pump - Timer	33.8%	33.8%	10	$0.44	0.008	0.02	$7.055
Ventilation - CO2 Controlled	5.9%	7.5%	15	$0.65	0.339	0.46	$0.177
Non-HVAC Motors - Variable Speed Control	0.0%	37.5%	10	$0.10	-	0.04	$0.000
Energy Management System	0.0%	90.0%	15	$0.35	2.961	7.07	$0.011
Thermostat - Clock/Programmable	86.8%	86.8%	11	$0.13	1.313	5.78	$0.011
HVAC - Occupancy Sensors	56.3%	56.3%	8	$0.14	1.112	3.13	$0.019
Commissioning - HVAC	0.0%	0.0%	25	$0.80	1.977	3.92	$0.028
Commissioning - Lighting	0.0%	0.0%	25	$0.10	0.151	2.58	$0.045
Retrocommissioning - HVAC	0.0%	0.0%	10	$0.75	-	0.02	$0.000
Retrocommissioning - Lighting	0.0%	0.0%	0	$0.00	-	2.00	$0.000
Advanced New Construction Designs	0.0%	0.0%	25	$2.00	8.463	6.68	$0.016
Custom Measures	10.0%	45.0%	15	$0.67	-	0.04	$0.000
PC Power Management Software	42.0%	90.0%	5	$0.16	0.339	1.24	$0.107
Pre-rinse Sprayer	27.0%	10.0%	5	$0.00	0.066	7.39	$0.008

Table C-43 Energy Efficiency Non-Equipment Data— Lodging, Existing Vintage

Measure	Base Saturation	Applicability	Lifetime (Years)	Incremental Cost ($/SqFt)	Savings (kWh/SqFt)	BC Ratio	Levelized Cost of Energy ($/kWh)
Insulation - Ceiling	7.0%	12.5%	20	$0.31	0.136	0.51	$0.173
Insulation - Ducting	4.8%	50.0%	20	$0.77	0.210	0.32	$0.283
Insulation - Radiant Barrier	5.0%	12.5%	15	$0.00	0.067	3.00	$0.000
Insulation - Wall Cavity	9.5%	67.5%	20	$0.44	0.253	0.67	$0.134
HVAC - Duct Repair and Sealing	5.0%	25.0%	18	$0.50	0.710	1.45	$0.058
Doors - High Efficiency	0.0%	0.0%	0	$0.00	-	3.00	$0.000
Windows - High Efficiency	61.9%	75.0%	20	$5.74	0.177	0.03	$2.496

Measure	Base Saturation	Applicability	Lifetime (Years)	Incremental Cost ($/SqFt)	Savings (kWh/SqFt)	BC Ratio	Levelized Cost of Energy ($/kWh)
Roof - High Reflectivity	33.3%	75.0%	15	$0.23	-	0.00	$0.000
Air-Cooled Chiller - Condenser Water Temperature Reset	30.0%	75.0%	10	$0.18	0.141	0.38	$0.158
Air-Cooled Chiller - Economizer	0.0%	48.8%	10	$0.00	0.039	24.38	$0.002
Air-Cooled Chiller - Thermal Energy Storage	44.3%	48.8%	15	$0.15	-	0.00	$0.000
Air-Cooled Chiller - VSD on Fans	15.0%	66.2%	15	$1.17	0.665	0.45	$0.162
Air-Cooled Chiller - Chilled Water Reset	5.0%	75.0%	10	$0.02	0.291	5.72	$0.010
Air-Cooled Chiller - Chilled Water Variable-Flow System	30.0%	75.0%	15	$0.02	0.053	1.88	$0.039
Air-Cooled Chiller - High Efficiency Cooling Tower Fans	15.0%	41.3%	15	$0.04	0.271	5.10	$0.014
Air-Cooled Chiller - Maintenance	14.3%	90.0%	3	$0.06	0.103	0.21	$0.210
Air-Cooled Chiller - Chiller Heat Recovery	0.0%	50.0%	14	$0.04	0.371	7.20	$0.010
Water-Cooled Chiller - Condenser Water Temperature Reset	30.0%	75.0%	10	$0.18	0.032	0.08	$0.707
Water-Cooled Chiller - Economizer	0.0%	48.8%	10	$0.00	0.073	44.84	$0.001
Water-Cooled Chiller - Thermal Energy Storage	44.3%	48.8%	15	$0.15	-	0.00	$0.000
Water-Cooled Chiller - VSD on Fans	15.0%	66.2%	15	$1.17	0.503	0.33	$0.215
Water-Cooled Chiller - Chilled Water Reset	5.0%	75.0%	10	$0.02	0.265	5.17	$0.011
Water-Cooled Chiller - Chilled Water Variable-Flow System	30.0%	75.0%	15	$0.02	0.058	2.01	$0.036
Water-Cooled Chiller - High Efficiency Cooling Tower Fans	15.0%	41.3%	15	$0.04	0.003	0.05	$1.516
Water-Cooled Chiller - Maintenance	14.3%	90.0%	3	$0.06	0.099	0.20	$0.220
Water-Cooled Chiller - Chiller Heat Recovery	0.0%	50.0%	14	$0.04	0.371	7.20	$0.010
RTU - Evaporative Precooler	0.0%	8.0%	20	$3.00	2.145	0.81	$0.108
RTU - Maintenance	14.3%	90.0%	18	$0.05	0.248	4.56	$0.018
Space Heating - Heat Recovery Ventilator	44.3%	48.8%	15	$1,150.00	0.425	0.00	$250.214
Heat Pump - Maintenance	4.8%	95.0%	4	$0.06	0.465	1.33	$0.035
Ventilation - ECM on VAV Boxes	0.0%	0.0%	18	$0.22	0.050	0.22	$0.358
Ventilation - Variable Speed Control	0.0%	81.0%	15	$0.01	0.208	30.43	$0.002
Water Heater - Drainwater Heat Recovery	0.0%	50.0%	5	$0.04	0.371	2.13	$0.024
Water Heater - Faucet Aerators/Low Flow Nozzles	33.3%	90.0%	10	$0.00	0.165	368.72	$0.000
Water Heater - High Efficiency Circulation Pump	0.0%	0.0%	0	$0.00	-	1.00	$0.000
Water Heater - Desuperheater	0.0%	50.0%	5	$0.04	0.824	4.72	$0.011
Water Heater - Solar System	0.0%	50.0%	20	$0.02	2.060	110.92	$0.001
Water Heater - Install Timer	23.8%	28.8%	15	$0.28	0.824	2.49	$0.031
Water Heater - Pipe Insulation	23.8%	28.8%	13	$5.22	0.233	0.03	$2.283
Water Heater - Tank Blanket/Insulation	0.0%	0.0%	7	$0.00	0.206	177.57	$0.000
Interior Lighting - Daylighting Controls	9.5%	12.5%	8	$5.45	1.340	0.06	$0.601
Interior Lighting - LED Exit Lighting	50.0%	85.5%	16	$0.00	0.009	9.29	$0.006
Interior Lighting - Occupancy Sensors	14.3%	56.3%	8	$0.00	0.447	41.42	$0.001
Interior Lighting - Timeclocks and Timers	4.8%	56.3%	8	$0.00	0.223	18.41	$0.002
Interior Lighting - Task Lighting	9.5%	75.0%	5	$0.24	0.463	0.28	$0.114
Interior Fluorescent - Bi-Level Fixture	10.0%	22.5%	8	$0.50	0.057	0.04	$1.301
Interior Fluorescent - Delamp and Install Reflectors	0.0%	56.3%	11	$0.50	0.048	0.05	$1.194
Exterior Lighting - Bi-Level Fixture	10.0%	30.0%	8	$0.20	0.024	0.03	$1.247
Exterior Lighting - Daylighting Controls	20.0%	37.5%	8	$0.02	0.119	1.69	$0.025

Measure	Base Saturation	Applicability	Lifetime (Years)	Incremental Cost ($/SqFt)	Savings (kWh/SqFt)	BC Ratio	Levelized Cost of Energy ($/kWh)
Exterior Lighting - Photovoltaic Installation	0.0%	12.5%	5	$0.92	0.071	0.01	$2.849
Refrigerator - Anti-Sweat Heater	0.0%	75.0%	12	$0.01	0.014	0.71	$0.075
Refrigerator - Decommissioning	50.0%	51.7%	9	$0.00	0.387	104.70	$0.000
Refrigerator - Demand Defrost	0.0%	75.0%	16	$0.20	0.021	0.07	$0.823
Refrigerator - Door Gasket Replacement	5.0%	75.0%	4	$2.57	0.031	0.00	$22.320
Refrigerator - Evaporator Fan Controls	0.0%	7.5%	16	$0.00	0.004	1.92	$0.033
Refrigerator - Floating Head Pressure	38.0%	45.0%	15	$0.00	0.030	15.66	$0.004
Refrigerator - Strip Curtain	5.0%	56.3%	4	$1.00	0.017	0.00	$15.675
Refrigerator - High Efficiency Compressor	10.0%	37.5%	15	$0.29	0.030	0.06	$0.890
Refrigerator - Variable Speed Compressor	10.0%	37.5%	15	$0.00	0.030	6.49	$0.009
Refrigerator - eCube	5.0%	75.0%	12	$0.01	0.086	4.86	$0.011
Vending Machine - Controller	2.0%	10.0%	5	$0.27	0.020	0.01	$2.919
Office Equipment - ENERGY STAR Power Supplies	10.0%	95.0%	4	$0.00	0.001	2.12	$0.038
Office Equipment - Plug Load Occupancy Sensors	12.6%	56.3%	8	$0.28	0.008	0.01	$5.245
Pool Heater - Solar	0.0%	47.8%	20	$0.02	0.007	0.39	$0.265
Pool Pump - Timer	42.8%	47.8%	10	$0.13	0.008	0.03	$2.051
Ventilation - CO2 Controlled	1.0%	15.0%	15	$0.65	0.304	0.36	$0.198
Non-HVAC Motors - Variable Speed Control	0.0%	37.5%	10	$0.10	-	0.00	$0.000
Energy Management System	9.5%	90.0%	15	$0.35	1.859	3.90	$0.017
Thermostat - Clock/Programmable	52.4%	57.4%	11	$0.13	0.426	1.83	$0.035
HVAC - Occupancy Sensors	56.3%	56.3%	8	$0.14	0.463	1.27	$0.045
Commissioning - HVAC	0.0%	0.0%	0	$0.00	-	3.00	$0.000
Commissioning - Lighting	0.0%	0.0%	0	$0.00	-	2.00	$0.000
Retrocommissioning - HVAC	9.0%	24.0%	10	$0.75	0.809	0.53	$0.115
Retrocommissioning - Lighting	42.8%	47.8%	5	$0.05	0.459	1.40	$0.024
Advanced New Construction Designs	0.0%	0.0%	0	$0.00	-	6.00	$0.000
Custom Measures	10.0%	45.0%	15	$1.50	-	0.00	$0.000
PC Power Management Software	13.0%	90.0%	5	$0.00	0.055	19.10	$0.003
Pre-rinse Sprayer	33.0%	5.0%	5	$0.00	0.004	7.28	$0.008

Table C-44 Energy Efficiency Non-Equipment Data— Lodging, New Vintage

Measure	Base Saturation	Applicability	Lifetime (Years)	Incremental Cost ($/SqFt)	Savings (kWh/SqFt)	BC Ratio	Levelized Cost of Energy ($/kWh)
Insulation - Ceiling	7.0%	12.5%	20	$0.31	0.388	1.52	$0.061
Insulation - Ducting	0.0%	50.0%	20	$0.77	0.470	0.73	$0.126
Insulation - Radiant Barrier	5.0%	12.5%	15	$0.00	0.254	3.00	$0.000
Insulation - Wall Cavity	0.0%	67.5%	20	$0.50	0.286	0.70	$0.134
HVAC - Duct Repair and Sealing	25.0%	25.0%	18	$0.50	0.546	1.15	$0.075
Doors - High Efficiency	100.0%	100.0%	0	$0.00	-	3.00	$0.000
Windows - High Efficiency	74.9%	75.0%	20	$5.74	0.084	0.02	$5.257
Roof - High Reflectivity	50.0%	95.0%	15	$0.23	-	0.00	$0.000
Air-Cooled Chiller - Condenser Water Temperature Reset	60.0%	75.0%	10	$0.18	0.096	0.28	$0.232
Air-Cooled Chiller - Economizer	36.6%	48.8%	10	$0.00	0.056	38.67	$0.002
Air-Cooled Chiller - Thermal Energy Storage	44.3%	48.8%	15	$0.15	-	0.00	$0.000
Air-Cooled Chiller - VSD on Fans	15.0%	66.2%	15	$1.17	0.549	0.41	$0.197
Air-Cooled Chiller - Chilled Water Reset	10.0%	75.0%	10	$0.02	0.220	4.75	$0.014
Air-Cooled Chiller - Chilled Water	30.0%	75.0%	15	$0.02	0.052	2.58	$0.031

Measure	Base Saturation	Applicability	Lifetime (Years)	Incremental Cost ($/SqFt)	Savings (kWh/SqFt)	BC Ratio	Levelized Cost of Energy ($/kWh)
Variable-Flow System							
Air-Cooled Chiller - High Efficiency Cooling Tower Fans	15.0%	41.3%	15	$0.04	0.344	7.11	$0.011
Air-Cooled Chiller - Maintenance	25.1%	90.0%	3	$0.05	0.063	0.18	$0.267
Air-Cooled Chiller - Chiller Heat Recovery	0.0%	50.0%	14	$0.04	0.356	7.06	$0.011
Water-Cooled Chiller - Condenser Water Temperature Reset	60.0%	75.0%	10	$0.18	0.024	0.07	$0.921
Water-Cooled Chiller - Economizer	36.6%	48.8%	10	$0.00	0.035	23.79	$0.003
Water-Cooled Chiller - Thermal Energy Storage	44.3%	48.8%	15	$0.15	-	0.00	$0.000
Water-Cooled Chiller - VSD on Fans	15.0%	66.2%	15	$1.17	0.401	0.30	$0.269
Water-Cooled Chiller - Chilled Water Reset	10.0%	75.0%	10	$0.02	0.189	4.05	$0.016
Water-Cooled Chiller - Chilled Water Variable-Flow System	30.0%	75.0%	15	$0.02	0.064	3.18	$0.025
Water-Cooled Chiller - High Efficiency Cooling Tower Fans	15.0%	41.3%	15	$0.04	0.003	0.06	$1.509
Water-Cooled Chiller - Maintenance	25.1%	90.0%	3	$0.05	0.057	0.16	$0.292
Water-Cooled Chiller - Chiller Heat Recovery	0.0%	50.0%	14	$0.04	0.356	7.06	$0.011
RTU - Evaporative Precooler	0.0%	8.0%	20	$3.00	1.728	0.71	$0.134
RTU - Maintenance	25.1%	90.0%	18	$0.05	0.146	2.93	$0.030
Space Heating - Heat Recovery Ventilator	44.3%	48.8%	15	$1,150.00	0.377	0.00	$281.773
Heat Pump - Maintenance	0.0%	95.0%	4	$0.06	0.411	1.24	$0.039
Ventilation - ECM on VAV Boxes	0.0%	0.0%	18	$0.22	0.321	1.58	$0.056
Ventilation - Variable Speed Control	0.0%	81.0%	15	$0.01	0.143	23.34	$0.003
Water Heater - Drainwater Heat Recovery	0.0%	50.0%	5	$0.04	0.356	2.08	$0.025
Water Heater - Faucet Aerators/Low Flow Nozzles	0.0%	90.0%	10	$0.00	0.158	360.93	$0.000
Water Heater - High Efficiency Circulation Pump	0.0%	0.0%	0	$0.00	-	1.00	$0.000
Water Heater - Desuperheater	0.0%	50.0%	5	$0.04	0.791	4.61	$0.011
Water Heater - Solar System	0.0%	50.0%	20	$0.02	1.978	108.84	$0.001
Water Heater - Install Timer	30.1%	30.1%	15	$0.28	0.791	2.44	$0.033
Water Heater - Pipe Insulation	30.1%	30.1%	13	$5.22	0.224	0.03	$2.378
Water Heater - Tank Blanket/Insulation	0.0%	0.0%	7	$0.00	0.182	159.82	$0.000
Interior Lighting - Daylighting Controls	18.8%	18.8%	8	$5.45	0.834	0.06	$0.965
Interior Lighting - LED Exit Lighting	85.5%	85.5%	16	$0.00	0.006	9.00	$0.009
Interior Lighting - Occupancy Sensors	56.3%	56.3%	8	$0.00	0.278	38.63	$0.001
Interior Lighting - Timeclocks and Timers	56.3%	56.3%	8	$0.00	0.139	17.18	$0.003
Interior Lighting - Task Lighting	0.0%	75.0%	5	$0.24	0.288	0.27	$0.183
Interior Fluorescent - Bi-Level Fixture	10.0%	22.5%	8	$0.50	0.047	0.04	$1.560
Interior Fluorescent - Delamp and Install Reflectors	0.0%	56.3%	11	$0.50	-	0.00	$0.000
Exterior Lighting - Bi-Level Fixture	10.0%	30.0%	8	$0.20	0.013	0.03	$2.350
Exterior Lighting - Daylighting Controls	20.0%	37.5%	8	$0.02	0.063	1.26	$0.047
Exterior Lighting - Photovoltaic Installation	0.0%	12.5%	5	$0.92	0.038	0.01	$5.372
Refrigerator - Anti-Sweat Heater	0.0%	75.0%	12	$0.01	0.014	0.96	$0.075
Refrigerator - Decommissioning	50.0%	51.7%	9	$0.00	0.229	75.62	$0.001
Refrigerator - Demand Defrost	0.0%	75.0%	16	$0.20	0.013	0.06	$1.392
Refrigerator - Door Gasket Replacement	5.0%	75.0%	4	$2.57	0.023	0.00	$30.447
Refrigerator - Evaporator Fan Controls	0.0%	7.5%	16	$0.00	0.003	1.56	$0.056
Refrigerator - Floating Head Pressure	38.0%	45.0%	15	$0.00	0.018	12.11	$0.006

Measure	Base Saturation	Applicability	Lifetime (Years)	Incremental Cost ($/SqFt)	Savings (kWh/SqFt)	BC Ratio	Levelized Cost of Energy ($/kWh)
Refrigerator - Strip Curtain	5.0%	56.3%	4	$1.00	0.010	0.00	$26.492
Refrigerator - High Efficiency Compressor	10.0%	37.5%	15	$0.29	0.018	0.05	$1.504
Refrigerator - Variable Speed Compressor	10.0%	37.5%	15	$0.00	0.018	5.02	$0.015
Refrigerator - eCube	5.0%	75.0%	12	$0.01	0.051	3.05	$0.022
Vending Machine - Controller	2.0%	10.0%	5	$0.27	0.013	0.01	$4.566
Office Equipment - ENERGY STAR Power Supplies	10.0%	95.0%	4	$0.00	0.001	2.19	$0.038
Office Equipment - Plug Load Occupancy Sensors	12.6%	56.3%	8	$0.25	0.008	0.01	$4.717
Pool Heater - Solar	0.0%	55.0%	20	$0.02	0.007	0.39	$0.257
Pool Pump - Timer	55.0%	55.0%	10	$0.13	0.008	0.03	$1.990
Ventilation - CO2 Controlled	11.5%	15.0%	15	$0.65	0.245	0.33	$0.245
Non-HVAC Motors - Variable Speed Control	0.0%	37.5%	10	$0.10	-	0.00	$0.000
Energy Management System	0.0%	90.0%	15	$0.35	1.491	3.55	$0.022
Thermostat - Clock/Programmable	100.0%	100.0%	11	$0.13	0.482	2.13	$0.031
HVAC - Occupancy Sensors	56.3%	56.3%	8	$0.14	0.406	1.14	$0.051
Commissioning - HVAC	0.0%	0.0%	25	$1.00	0.710	1.13	$0.096
Commissioning - Lighting	0.0%	0.0%	25	$0.15	0.284	2.91	$0.036
Retrocommissioning - HVAC	0.0%	0.0%	10	$0.75	-	0.00	$0.000
Retrocommissioning - Lighting	0.0%	0.0%	0	$0.00	-	2.00	$0.000
Advanced New Construction Designs	0.0%	0.0%	25	$2.00	4.087	3.26	$0.033
Custom Measures	10.0%	45.0%	15	$1.50	-	0.00	$0.000
PC Power Management Software	13.0%	90.0%	5	$0.00	0.055	19.49	$0.003
Pre-rinse Sprayer	0.0%	5.0%	5	$0.00	0.004	7.39	$0.008

Table C-45 Energy Efficiency Non-Equipment Data— Warehouse, Existing Vintage

Measure	Base Saturation	Applicability	Lifetime (Years)	Incremental Cost ($/SqFt)	Savings (kWh/SqFt)	BC Ratio	Levelized Cost of Energy ($/kWh)
Insulation - Ceiling	7.0%	12.5%	20	$0.52	3.563	6.84	$0.011
Insulation - Ducting	15.3%	50.0%	20	$0.77	0.443	0.58	$0.134
Insulation - Radiant Barrier	7.0%	12.5%	15	$0.00	1.418	3.00	$0.000
Insulation - Wall Cavity	10.3%	67.5%	20	$0.49	2.560	5.26	$0.015
HVAC - Duct Repair and Sealing	5.0%	25.0%	18	$0.50	1.030	1.81	$0.040
Doors - High Efficiency	0.0%	0.0%	0	$0.00	-	3.00	$0.000
Windows - High Efficiency	46.9%	75.0%	20	$0.00	0.506	3.00	$0.000
Roof - High Reflectivity	50.0%	75.0%	15	$0.32	0.373	0.81	$0.079
Air-Cooled Chiller - Condenser Water Temperature Reset	30.0%	75.0%	10	$0.18	0.207	0.59	$0.108
Air-Cooled Chiller - Economizer	0.0%	48.8%	10	$0.00	0.571	155.07	$0.000
Air-Cooled Chiller - Thermal Energy Storage	44.3%	48.8%	15	$0.15	-	0.01	$0.000
Air-Cooled Chiller - VSD on Fans	15.0%	66.2%	15	$1.17	0.808	0.58	$0.134
Air-Cooled Chiller - Chilled Water Reset	5.0%	75.0%	10	$0.06	0.375	3.24	$0.020
Air-Cooled Chiller - Chilled Water Variable-Flow System	30.0%	75.0%	15	$0.01	0.070	4.30	$0.018
Air-Cooled Chiller - High Efficiency Cooling Tower Fans	15.0%	41.3%	15	$0.10	0.680	5.60	$0.014
Air-Cooled Chiller - Maintenance	62.2%	90.0%	3	$0.04	0.334	1.15	$0.040
Air-Cooled Chiller - Chiller Heat Recovery	0.0%	50.0%	14	$0.04	0.030	0.62	$0.129
Water-Cooled Chiller - Condenser Water Temperature Reset	30.0%	75.0%	10	$0.18	0.043	0.11	$0.523
Water-Cooled Chiller - Economizer	0.0%	48.8%	10	$0.00	0.565	138.48	$0.000
Water-Cooled Chiller - Thermal	44.3%	48.8%	15	$0.15	-	0.01	$0.000

Measure	Base Saturation	Applicability	Lifetime (Years)	Incremental Cost ($/SqFt)	Savings (kWh/SqFt)	BC Ratio	Levelized Cost of Energy ($/kWh)
Energy Storage							
Water-Cooled Chiller - VSD on Fans	15.0%	66.2%	15	$1.17	0.193	0.13	$0.559
Water-Cooled Chiller - Chilled Water Reset	5.0%	75.0%	10	$0.06	0.467	3.64	$0.016
Water-Cooled Chiller - Chilled Water Variable-Flow System	30.0%	75.0%	15	$0.01	0.080	4.45	$0.016
Water-Cooled Chiller - High Efficiency Cooling Tower Fans	15.0%	41.3%	15	$0.10	0.001	0.02	$6.616
Water-Cooled Chiller - Maintenance	62.2%	90.0%	3	$0.04	0.321	1.00	$0.042
Water-Cooled Chiller - Chiller Heat Recovery	0.0%	50.0%	14	$0.04	0.030	0.62	$0.129
RTU - Evaporative Precooler	0.0%	6.0%	20	$3.00	1.794	0.66	$0.129
RTU - Maintenance	62.2%	90.0%	18	$0.08	0.514	6.65	$0.012
Space Heating - Heat Recovery Ventilator	44.3%	48.8%	15	$1,150.00	0.995	0.00	$106.726
Heat Pump - Maintenance	3.1%	95.0%	4	$0.06	0.257	0.72	$0.063
Ventilation - ECM on VAV Boxes	0.0%	0.0%	18	$0.22	0.127	0.57	$0.142
Ventilation - Variable Speed Control	4.2%	81.0%	15	$0.01	0.177	10.88	$0.007
Water Heater - Drainwater Heat Recovery	0.0%	50.0%	5	$0.04	0.030	0.19	$0.294
Water Heater - Faucet Aerators/Low Flow Nozzles	19.5%	90.0%	10	$0.00	0.013	14.22	$0.005
Water Heater - High Efficiency Circulation Pump	0.0%	0.0%	0	$0.00	-	1.00	$0.000
Water Heater - Desuperheater	0.0%	50.0%	5	$0.04	0.067	0.40	$0.132
Water Heater - Solar System	0.0%	50.0%	20	$0.24	0.167	0.83	$0.113
Water Heater - Install Timer	6.1%	11.1%	15	$0.28	0.067	0.21	$0.388
Water Heater - Pipe Insulation	6.1%	11.1%	13	$5.22	0.019	0.00	$28.234
Water Heater - Tank Blanket/Insulation	0.0%	0.0%	7	$0.00	0.017	6.72	$0.009
Interior Lighting - Daylighting Controls	15.3%	20.3%	8	$0.00	0.228	1.00	$0.000
Interior Lighting - LED Exit Lighting	50.0%	85.5%	16	$0.00	0.002	1.99	$0.081
Interior Lighting - Occupancy Sensors	6.1%	56.3%	8	$0.01	0.305	16.57	$0.003
Interior Lighting - Timeclocks and Timers	3.1%	56.3%	8	$0.01	0.038	1.93	$0.029
Interior Lighting - Task Lighting	6.1%	75.0%	5	$0.24	0.079	0.05	$0.670
Interior Fluorescent - Bi-Level Fixture	10.0%	22.5%	8	$0.20	0.222	0.45	$0.133
Interior Fluorescent - Delamp and Install Reflectors	18.3%	56.3%	11	$0.50	0.188	0.22	$0.306
Exterior Lighting - Bi-Level Fixture	10.0%	30.0%	8	$0.20	0.000	0.00	$207.804
Exterior Lighting - Daylighting Controls	18.0%	37.5%	8	$0.02	0.001	0.05	$4.156
Exterior Lighting - Photovoltaic Installation	0.0%	12.5%	5	$0.92	0.000	0.00	$474.955
Refrigerator - Anti-Sweat Heater	0.0%	75.0%	12	$0.02	-	0.06	$0.000
Refrigerator - Decommissioning	50.0%	51.7%	9	$0.00	1.217	134.67	$0.000
Refrigerator - Demand Defrost	0.0%	75.0%	16	$0.20	0.068	0.23	$0.262
Refrigerator - Door Gasket Replacement	5.0%	75.0%	4	$2.84	0.054	0.00	$14.101
Refrigerator - Evaporator Fan Controls	0.0%	7.5%	16	$0.00	0.014	2.59	$0.026
Refrigerator - Floating Head Pressure	38.0%	45.0%	15	$0.00	0.095	20.38	$0.003
Refrigerator - Strip Curtain	5.0%	56.3%	4	$0.00	0.054	1.00	$0.000
Refrigerator - High Efficiency Compressor	10.0%	37.5%	15	$0.29	0.095	0.20	$0.283
Refrigerator - Variable Speed Compressor	10.0%	37.5%	15	$0.01	0.095	8.45	$0.007
Refrigerator - eCube	5.0%	75.0%	12	$0.00	0.271	1.00	$0.000
Vending Machine - Controller	2.0%	10.0%	5	$0.27	0.128	0.09	$0.464
Office Equipment - ENERGY STAR Power Supplies	10.0%	95.0%	4	$0.00	0.001	5.69	$0.033

Measure	Base Saturation	Applicability	Lifetime (Years)	Incremental Cost ($/SqFt)	Savings (kWh/SqFt)	BC Ratio	Levelized Cost of Energy ($/kWh)
Office Equipment - Plug Load Occupancy Sensors	12.6%	56.3%	8	$0.28	0.009	0.02	$4.577
Pool Heater - Solar	0.0%	33.8%	20	$0.24	-	0.01	$0.000
Pool Pump - Timer	0.0%	33.8%	10	$0.13	-	0.01	$0.000
Ventilation - CO2 Controlled	1.0%	7.5%	15	$0.65	0.045	0.06	$1.321
Non-HVAC Motors - Variable Speed Control	0.0%	37.5%	10	$0.10	-	0.01	$0.000
Energy Management System	7.2%	75.0%	15	$0.35	2.398	4.82	$0.013
Thermostat - Clock/Programmable	31.7%	50.0%	11	$0.13	0.221	0.85	$0.068
HVAC - Occupancy Sensors	14.3%	56.3%	8	$0.14	0.946	2.30	$0.022
Commissioning - HVAC	0.0%	0.0%	0	$0.00	-	3.00	$0.000
Commissioning - Lighting	0.0%	0.0%	0	$0.00	-	2.00	$0.000
Retrocommissioning - HVAC	9.0%	24.0%	10	$0.75	1.356	0.79	$0.069
Retrocommissioning - Lighting	25.6%	30.6%	5	$0.05	0.076	0.34	$0.145
Advanced New Construction Designs	0.0%	0.0%	0	$0.00	-	6.00	$0.000
Custom Measures	10.0%	45.0%	15	$0.67	-	0.01	$0.000
PC Power Management Software	13.0%	90.0%	5	$0.02	0.062	1.60	$0.058
Pre-rinse Sprayer	19.0%	5.0%	5	$0.00	0.017	7.27	$0.008

Table C-46 Energy Efficiency Non-Equipment Data— Warehouse, New Vintage

Measure	Base Saturation	Applicability	Lifetime (Years)	Incremental Cost ($/SqFt)	Savings (kWh/SqFt)	BC Ratio	Levelized Cost of Energy ($/kWh)
Insulation - Ceiling	7.0%	12.5%	20	$0.68	1.325	2.06	$0.040
Insulation - Ducting	0.0%	50.0%	20	$0.77	0.488	0.68	$0.122
Insulation - Radiant Barrier	7.0%	12.5%	15	$0.00	0.418	3.00	$0.000
Insulation - Wall Cavity	25.5%	67.5%	20	$0.32	0.554	1.83	$0.045
HVAC - Duct Repair and Sealing	25.0%	25.0%	18	$0.50	0.434	0.82	$0.095
Doors - High Efficiency	100.0%	100.0%	0	$0.00	-	3.00	$0.000
Windows - High Efficiency	78.0%	100.0%	20	$0.00	0.466	3.00	$0.000
Roof - High Reflectivity	55.9%	95.0%	15	$0.32	0.245	0.62	$0.121
Air-Cooled Chiller - Condenser Water Temperature Reset	60.0%	75.0%	10	$0.18	0.147	0.43	$0.152
Air-Cooled Chiller - Economizer	36.6%	48.8%	10	$0.00	0.355	92.86	$0.001
Air-Cooled Chiller - Thermal Energy Storage	44.3%	48.8%	15	$0.15	-	0.01	$0.000
Air-Cooled Chiller - VSD on Fans	15.0%	66.2%	15	$1.17	0.598	0.44	$0.181
Air-Cooled Chiller - Chilled Water Reset	25.0%	75.0%	10	$0.06	0.248	2.06	$0.032
Air-Cooled Chiller - Chilled Water Variable-Flow System	30.0%	75.0%	15	$0.01	0.079	5.33	$0.015
Air-Cooled Chiller - High Efficiency Cooling Tower Fans	15.0%	41.3%	15	$0.11	0.520	4.13	$0.019
Air-Cooled Chiller - Maintenance	62.8%	90.0%	3	$0.04	0.210	0.79	$0.060
Air-Cooled Chiller - Chiller Heat Recovery	0.0%	50.0%	14	$0.04	0.029	0.61	$0.135
Water-Cooled Chiller - Condenser Water Temperature Reset	60.0%	75.0%	10	$0.18	0.011	0.04	$2.054
Water-Cooled Chiller - Economizer	36.6%	48.8%	10	$0.00	0.244	63.89	$0.001
Water-Cooled Chiller - Thermal Energy Storage	44.3%	48.8%	15	$0.15	-	0.01	$0.000
Water-Cooled Chiller - VSD on Fans	15.0%	66.2%	15	$1.17	0.086	0.06	$1.260
Water-Cooled Chiller - Chilled Water Reset	25.0%	75.0%	10	$0.06	0.288	2.39	$0.027
Water-Cooled Chiller - Chilled Water Variable-Flow System	30.0%	75.0%	15	$0.01	0.107	7.10	$0.011
Water-Cooled Chiller - High Efficiency Cooling Tower Fans	15.0%	41.3%	15	$0.11	0.002	0.03	$4.498
Water-Cooled Chiller - Maintenance	62.8%	90.0%	3	$0.04	0.222	0.83	$0.057

Measure	Base Saturation	Applicability	Lifetime (Years)	Incremental Cost ($/SqFt)	Savings (kWh/SqFt)	BC Ratio	Levelized Cost of Energy ($/kWh)
Water-Cooled Chiller - Chiller Heat Recovery	0.0%	50.0%	14	$0.04	0.029	0.61	$0.135
RTU - Evaporative Precooler	0.0%	7.0%	20	$3.00	1.429	0.59	$0.162
RTU - Maintenance	62.8%	90.0%	18	$0.08	0.328	4.77	$0.019
Space Heating - Heat Recovery Ventilator	44.3%	48.8%	15	$1,150.00	0.919	0.00	$115.586
Heat Pump - Maintenance	0.0%	95.0%	4	$0.06	0.207	0.66	$0.078
Ventilation - ECM on VAV Boxes	0.0%	0.0%	18	$0.22	0.102	0.51	$0.178
Ventilation - Variable Speed Control	0.0%	81.0%	15	$0.01	0.136	8.69	$0.009
Water Heater - Drainwater Heat Recovery	0.0%	50.0%	5	$0.04	0.029	0.18	$0.306
Water Heater - Faucet Aerators/Low Flow Nozzles	0.0%	90.0%	10	$0.00	0.013	13.04	$0.006
Water Heater - High Efficiency Circulation Pump	0.0%	0.0%	0	$0.00	-	1.00	$0.000
Water Heater - Desuperheater	0.0%	50.0%	5	$0.04	0.064	0.39	$0.138
Water Heater - Solar System	0.0%	50.0%	20	$0.24	0.160	0.82	$0.118
Water Heater - Install Timer	0.0%	0.0%	15	$0.28	0.064	0.20	$0.405
Water Heater - Pipe Insulation	0.0%	0.0%	13	$5.22	0.018	0.00	$29.422
Water Heater - Tank Blanket/Insulation	0.0%	0.0%	7	$0.00	0.015	5.72	$0.011
Interior Lighting - Daylighting Controls	42.2%	42.2%	8	$0.00	0.157	1.00	$0.000
Interior Lighting - LED Exit Lighting	85.5%	85.5%	16	$0.00	0.001	1.75	$0.127
Interior Lighting - Occupancy Sensors	56.3%	56.3%	8	$0.01	0.210	11.64	$0.005
Interior Lighting - Timeclocks and Timers	56.3%	56.3%	8	$0.01	0.026	1.39	$0.045
Interior Lighting - Task Lighting	0.0%	75.0%	5	$0.24	0.054	0.05	$0.972
Interior Fluorescent - Bi-Level Fixture	10.0%	22.5%	8	$0.20	0.208	0.41	$0.142
Interior Fluorescent - Delamp and Install Reflectors	18.7%	56.3%	11	$0.50	-	0.00	$0.000
Exterior Lighting - Bi-Level Fixture	10.0%	30.0%	8	$0.20	0.000	0.00	$363.410
Exterior Lighting - Daylighting Controls	18.0%	37.5%	8	$0.02	0.000	0.05	$7.268
Exterior Lighting - Photovoltaic Installation	0.0%	12.5%	5	$0.92	0.000	0.00	$830.607
Refrigerator - Anti-Sweat Heater	0.0%	75.0%	12	$0.03	-	0.05	$0.000
Refrigerator - Decommissioning	50.0%	51.7%	9	$0.00	0.720	90.81	$0.001
Refrigerator - Demand Defrost	0.0%	75.0%	16	$0.20	0.040	0.18	$0.442
Refrigerator - Door Gasket Replacement	5.0%	75.0%	4	$2.94	0.032	0.00	$24.699
Refrigerator - Evaporator Fan Controls	0.0%	7.5%	16	$0.00	0.008	2.00	$0.046
Refrigerator - Floating Head Pressure	38.0%	45.0%	15	$0.00	0.056	14.64	$0.005
Refrigerator - Strip Curtain	5.0%	56.3%	4	$0.00	0.032	1.00	$0.000
Refrigerator - High Efficiency Compressor	10.0%	37.5%	15	$0.29	0.056	0.16	$0.478
Refrigerator - Variable Speed Compressor	10.0%	37.5%	15	$0.01	0.056	6.07	$0.012
Refrigerator - eCube	5.0%	75.0%	12	$0.00	0.160	1.00	$0.000
Vending Machine - Controller	2.0%	10.0%	5	$0.27	0.091	0.06	$0.655
Office Equipment - ENERGY STAR Power Supplies	10.0%	95.0%	4	$0.00	0.001	5.89	$0.033
Office Equipment - Plug Load Occupancy Sensors	12.6%	56.3%	8	$0.25	0.009	0.02	$4.117
Pool Heater - Solar	0.0%	33.8%	20	$0.24	-	0.01	$0.000
Pool Pump - Timer	33.8%	33.8%	10	$0.13	-	0.01	$0.000
Ventilation - CO2 Controlled	5.9%	7.5%	15	$0.65	0.036	0.05	$1.653
Non-HVAC Motors - Variable Speed Control	0.0%	37.5%	10	$0.10	-	0.01	$0.000
Energy Management System	0.0%	75.0%	15	$0.35	1.834	3.99	$0.018
Thermostat - Clock/Programmable	86.3%	86.3%	11	$0.13	1.095	4.40	$0.014

Measure	Base Saturation	Applicability	Lifetime (Years)	Incremental Cost ($/SqFt)	Savings (kWh/SqFt)	BC Ratio	Levelized Cost of Energy ($/kWh)
HVAC - Occupancy Sensors	56.3%	56.3%	8	$0.14	0.848	2.19	$0.024
Commissioning - HVAC	0.0%	0.0%	25	$1.00	1.203	1.71	$0.057
Commissioning - Lighting	0.0%	0.0%	25	$0.15	0.053	0.59	$0.195
Retrocommissioning - HVAC	0.0%	0.0%	10	$0.75	-	0.00	$0.000
Retrocommissioning - Lighting	0.0%	0.0%	0	$0.00	-	2.00	$0.000
Advanced New Construction Designs	0.0%	0.0%	25	$2.00	5.047	3.60	$0.027
Custom Measures	10.0%	45.0%	15	$0.67	-	0.01	$0.000
PC Power Management Software	13.0%	90.0%	5	$0.02	0.062	1.63	$0.058
Pre-rinse Sprayer	0.0%	5.0%	5	$0.00	0.017	7.39	$0.008

Table C-47 Energy Efficiency Non-Equipment Data— Miscellaneous Commercial, Existing Vintage

Measure	Base Saturation	Applicability	Lifetime (Years)	Incremental Cost ($/SqFt)	Savings (kWh/SqFt)	BC Ratio	Levelized Cost of Energy ($/kWh)
Insulation - Ceiling	7.0%	12.5%	20	$0.52	2.046	4.24	$0.020
Insulation - Ducting	17.8%	50.0%	20	$0.77	0.082	0.12	$0.728
Insulation - Radiant Barrier	7.0%	12.5%	15	$0.00	1.073	3.00	$0.000
Insulation - Wall Cavity	22.6%	67.5%	20	$0.49	2.121	4.70	$0.018
HVAC - Duct Repair and Sealing	5.0%	25.0%	18	$0.50	0.433	0.83	$0.095
Doors - High Efficiency	0.0%	0.0%	0	$0.00	-	3.00	$0.000
Windows - High Efficiency	63.0%	75.0%	20	$0.00	0.633	3.00	$0.000
Roof - High Reflectivity	36.3%	75.0%	15	$0.32	0.120	0.29	$0.246
Air-Cooled Chiller - Condenser Water Temperature Reset	30.0%	75.0%	10	$0.18	0.168	0.44	$0.133
Air-Cooled Chiller - Economizer	2.1%	48.8%	10	$0.00	0.472	118.82	$0.000
Air-Cooled Chiller - Thermal Energy Storage	44.3%	48.8%	15	$0.15	-	0.00	$0.000
Air-Cooled Chiller - VSD on Fans	15.0%	66.2%	15	$1.17	0.587	0.39	$0.184
Air-Cooled Chiller - Chilled Water Reset	5.0%	75.0%	10	$0.06	0.302	2.41	$0.024
Air-Cooled Chiller - Chilled Water Variable-Flow System	30.0%	75.0%	15	$0.03	0.045	1.21	$0.060
Air-Cooled Chiller - High Efficiency Cooling Tower Fans	15.0%	41.3%	15	$0.10	0.525	3.99	$0.018
Air-Cooled Chiller - Maintenance	44.5%	90.0%	3	$0.08	0.251	0.38	$0.113
Air-Cooled Chiller - Chiller Heat Recovery	0.0%	50.0%	14	$0.04	0.094	1.84	$0.041
Water-Cooled Chiller - Condenser Water Temperature Reset	30.0%	75.0%	10	$0.18	0.041	0.11	$0.540
Water-Cooled Chiller - Economizer	2.1%	48.8%	10	$0.00	0.514	133.13	$0.000
Water-Cooled Chiller - Thermal Energy Storage	44.3%	48.8%	15	$0.15	-	0.00	$0.000
Water-Cooled Chiller - VSD on Fans	15.0%	66.2%	15	$1.17	0.144	0.10	$0.753
Water-Cooled Chiller - Chilled Water Reset	5.0%	75.0%	10	$0.06	0.418	3.44	$0.018
Water-Cooled Chiller - Chilled Water Variable-Flow System	30.0%	75.0%	15	$0.03	0.041	1.11	$0.067
Water-Cooled Chiller - High Efficiency Cooling Tower Fans	15.0%	41.3%	15	$0.10	0.001	0.01	$10.401
Water-Cooled Chiller - Maintenance	44.5%	90.0%	3	$0.08	0.240	0.38	$0.118
Water-Cooled Chiller - Chiller Heat Recovery	0.0%	50.0%	14	$0.04	0.094	1.84	$0.041
RTU - Evaporative Precooler	0.0%	10.0%	20	$3.00	1.345	0.50	$0.172
RTU - Maintenance	44.5%	90.0%	18	$0.07	0.386	5.01	$0.016
Space Heating - Heat Recovery Ventilator	44.3%	48.8%	15	$1,150.00	0.421	0.00	$252.429
Heat Pump - Maintenance	6.2%	95.0%	4	$0.06	0.712	2.05	$0.023
Ventilation - ECM on VAV Boxes	0.0%	0.0%	18	$0.22	0.193	0.87	$0.094

Measure	Base Saturation	Applicability	Lifetime (Years)	Incremental Cost ($/SqFt)	Savings (kWh/SqFt)	BC Ratio	Levelized Cost of Energy ($/kWh)
Ventilation - Variable Speed Control	1.4%	81.0%	15	$0.01	0.244	15.06	$0.005
Water Heater - Drainwater Heat Recovery	0.0%	50.0%	5	$0.04	0.094	0.55	$0.094
Water Heater - Faucet Aerators/Low Flow Nozzles	27.4%	90.0%	10	$0.00	0.042	39.56	$0.002
Water Heater - High Efficiency Circulation Pump	0.0%	0.0%	0	$0.00	-	1.00	$0.000
Water Heater - Desuperheater	0.0%	50.0%	5	$0.04	0.209	1.21	$0.042
Water Heater - Solar System	0.0%	50.0%	20	$0.24	0.523	2.60	$0.036
Water Heater - Install Timer	24.0%	29.0%	15	$0.28	0.209	0.63	$0.124
Water Heater - Pipe Insulation	24.0%	29.0%	13	$5.22	0.059	0.01	$8.981
Water Heater - Tank Blanket/Insulation	0.0%	0.0%	7	$0.00	0.052	18.99	$0.003
Interior Lighting - Daylighting Controls	7.5%	12.5%	8	$0.00	0.283	1.00	$0.000
Interior Lighting - LED Exit Lighting	50.0%	85.5%	16	$0.00	0.002	1.28	$0.066
Interior Lighting - Occupancy Sensors	6.8%	56.3%	8	$0.01	0.094	4.09	$0.010
Interior Lighting - Timeclocks and Timers	4.8%	56.3%	8	$0.01	0.047	1.84	$0.023
Interior Lighting - Task Lighting	17.8%	75.0%	5	$0.24	0.098	0.06	$0.540
Interior Fluorescent - Bi-Level Fixture	10.0%	22.5%	8	$0.50	0.058	0.05	$1.282
Interior Fluorescent - Delamp and Install Reflectors	15.1%	67.5%	11	$0.50	0.049	0.06	$1.176
Exterior Lighting - Bi-Level Fixture	10.0%	30.0%	8	$0.20	0.024	0.04	$1.237
Exterior Lighting - Daylighting Controls	18.0%	37.5%	8	$0.02	0.120	2.12	$0.025
Exterior Lighting - Photovoltaic Installation	0.0%	12.5%	5	$0.92	0.072	0.02	$2.828
Refrigerator - Anti-Sweat Heater	0.0%	75.0%	12	$0.02	0.010	0.23	$0.252
Refrigerator - Decommissioning	50.0%	51.7%	9	$0.00	0.281	31.19	$0.002
Refrigerator - Demand Defrost	0.0%	75.0%	16	$0.20	0.016	0.05	$1.136
Refrigerator - Door Gasket Replacement	5.0%	75.0%	4	$2.84	0.022	0.00	$33.999
Refrigerator - Evaporator Fan Controls	0.0%	7.5%	16	$0.00	0.003	0.68	$0.111
Refrigerator - Floating Head Pressure	38.0%	45.0%	15	$0.00	0.022	4.78	$0.012
Refrigerator - Strip Curtain	5.0%	56.3%	4	$0.00	0.012	1.00	$0.000
Refrigerator - High Efficiency Compressor	10.0%	37.5%	15	$0.29	0.022	0.05	$1.227
Refrigerator - Variable Speed Compressor	10.0%	37.5%	15	$0.01	0.022	1.98	$0.030
Refrigerator - eCube	5.0%	75.0%	12	$0.00	0.062	10.21	$0.005
Vending Machine - Controller	2.0%	10.0%	5	$0.27	0.015	0.01	$4.026
Office Equipment - ENERGY STAR Power Supplies	10.0%	95.0%	4	$0.00	0.001	4.52	$0.019
Office Equipment - Plug Load Occupancy Sensors	12.6%	56.3%	8	$0.28	0.016	0.02	$2.640
Pool Heater - Solar	0.0%	33.8%	20	$0.24	0.001	0.01	$20.650
Pool Pump - Timer	0.7%	33.8%	10	$0.13	0.001	0.01	$14.745
Ventilation - CO2 Controlled	1.0%	15.0%	15	$0.65	0.138	0.17	$0.436
Non-HVAC Motors - Variable Speed Control	0.7%	37.5%	10	$0.10	-	0.01	$0.000
Energy Management System	9.6%	75.0%	15	$0.35	1.339	2.86	$0.024
Thermostat - Clock/Programmable	44.5%	50.0%	11	$0.13	0.158	0.65	$0.095
HVAC - Occupancy Sensors	14.3%	56.3%	8	$0.14	0.443	1.16	$0.047
Commissioning - HVAC	0.0%	0.0%	0	$0.00	-	3.00	$0.000
Commissioning - Lighting	0.0%	0.0%	0	$0.00	-	2.00	$0.000
Retrocommissioning - HVAC	9.0%	24.0%	10	$0.75	0.726	0.46	$0.128
Retrocommissioning - Lighting	34.2%	39.2%	5	$0.10	0.106	0.19	$0.207
Advanced New Construction Designs	0.0%	0.0%	0	$0.00	-	6.00	$0.000
Custom Measures	10.0%	45.0%	15	$1.50	-	0.00	$0.000
PC Power Management Software	13.0%	90.0%	5	$0.01	0.109	5.27	$0.011

Measure	Base Saturation	Applicability	Lifetime (Years)	Incremental Cost ($/SqFt)	Savings (kWh/SqFt)	BC Ratio	Levelized Cost of Energy ($/kWh)
Pre-rinse Sprayer	27.0%	5.0%	5	$0.00	0.009	7.27	$0.008

Table C-48 Energy Efficiency Non-Equipment Data— Miscellaneous Commercial, New Vintage

Measure	Base Saturation	Applicability	Lifetime (Years)	Incremental Cost ($/SqFt)	Savings (kWh/SqFt)	BC Ratio	Levelized Cost of Energy ($/kWh)
Insulation - Ceiling	7.0%	12.5%	20	$0.68	1.152	1.92	$0.046
Insulation - Ducting	8.3%	50.0%	20	$0.77	0.226	0.34	$0.262
Insulation - Radiant Barrier	7.0%	12.5%	15	$0.00	0.464	3.00	$0.000
Insulation - Wall Cavity	19.5%	67.5%	20	$0.32	0.698	2.47	$0.035
HVAC - Duct Repair and Sealing	25.0%	25.0%	18	$0.50	0.153	0.31	$0.269
Doors - High Efficiency	100.0%	100.0%	0	$0.00	-	3.00	$0.000
Windows - High Efficiency	77.8%	82.8%	20	$0.00	0.802	3.00	$0.000
Roof - High Reflectivity	33.3%	95.0%	15	$0.32	0.067	0.18	$0.442
Air-Cooled Chiller - Condenser Water Temperature Reset	60.0%	75.0%	10	$0.18	0.110	0.32	$0.204
Air-Cooled Chiller - Economizer	37.9%	48.8%	10	$0.00	0.135	35.30	$0.002
Air-Cooled Chiller - Thermal Energy Storage	44.3%	48.8%	15	$0.15	-	0.01	$0.000
Air-Cooled Chiller - VSD on Fans	15.0%	66.2%	15	$1.17	0.439	0.33	$0.246
Air-Cooled Chiller - Chilled Water Reset	25.0%	75.0%	10	$0.06	0.199	1.65	$0.040
Air-Cooled Chiller - Chilled Water Variable-Flow System	30.0%	75.0%	15	$0.03	0.064	1.99	$0.041
Air-Cooled Chiller - High Efficiency Cooling Tower Fans	15.0%	41.3%	15	$0.11	0.406	3.22	$0.025
Air-Cooled Chiller - Maintenance	36.1%	90.0%	3	$0.08	0.154	0.27	$0.176
Air-Cooled Chiller - Chiller Heat Recovery	0.0%	50.0%	14	$0.04	0.090	1.81	$0.043
Water-Cooled Chiller - Condenser Water Temperature Reset	60.0%	75.0%	10	$0.18	0.020	0.06	$1.115
Water-Cooled Chiller - Economizer	37.9%	48.8%	10	$0.00	0.369	95.99	$0.001
Water-Cooled Chiller - Thermal Energy Storage	44.3%	48.8%	15	$0.15	-	0.01	$0.000
Water-Cooled Chiller - VSD on Fans	15.0%	66.2%	15	$1.17	0.034	0.03	$3.179
Water-Cooled Chiller - Chilled Water Reset	25.0%	75.0%	10	$0.06	0.251	2.08	$0.031
Water-Cooled Chiller - Chilled Water Variable-Flow System	30.0%	75.0%	15	$0.03	0.067	2.06	$0.039
Water-Cooled Chiller - High Efficiency Cooling Tower Fans	15.0%	41.3%	15	$0.11	0.002	0.02	$6.724
Water-Cooled Chiller - Maintenance	36.1%	90.0%	3	$0.08	0.149	0.26	$0.182
Water-Cooled Chiller - Chiller Heat Recovery	0.0%	50.0%	14	$0.04	0.090	1.81	$0.043
RTU - Evaporative Precooler	0.0%	7.0%	20	$3.00	1.039	0.43	$0.223
RTU - Maintenance	36.1%	90.0%	18	$0.08	0.230	3.34	$0.027
Space Heating - Heat Recovery Ventilator	44.3%	48.8%	15	$1,150.00	0.385	0.00	$275.785
Heat Pump - Maintenance	8.3%	95.0%	4	$0.06	0.630	1.93	$0.026
Ventilation - ECM on VAV Boxes	0.0%	0.0%	18	$0.22	0.154	0.76	$0.117
Ventilation - Variable Speed Control	2.8%	81.0%	15	$0.01	0.189	11.89	$0.007
Water Heater - Drainwater Heat Recovery	0.0%	50.0%	5	$0.04	0.090	0.53	$0.097
Water Heater - Faucet Aerators/Low Flow Nozzles	30.6%	90.0%	10	$0.00	0.040	36.10	$0.002
Water Heater - High Efficiency Circulation Pump	0.0%	0.0%	0	$0.00	-	1.00	$0.000
Water Heater - Desuperheater	0.0%	50.0%	5	$0.04	0.201	1.18	$0.044
Water Heater - Solar System	0.0%	50.0%	20	$0.24	0.503	2.56	$0.037

Measure	Base Saturation	Applicability	Lifetime (Years)	Incremental Cost ($/SqFt)	Savings (kWh/SqFt)	BC Ratio	Levelized Cost of Energy ($/kWh)
Water Heater - Install Timer	30.0%	30.0%	15	$0.28	0.201	0.62	$0.129
Water Heater - Pipe Insulation	30.0%	30.0%	13	$5.22	0.057	0.01	$9.359
Water Heater - Tank Blanket/Insulation	0.0%	0.0%	7	$0.00	0.047	16.13	$0.004
Interior Lighting - Daylighting Controls	18.8%	18.8%	8	$0.00	0.197	1.00	$0.000
Interior Lighting - LED Exit Lighting	85.5%	85.5%	16	$0.00	0.001	1.36	$0.101
Interior Lighting - Occupancy Sensors	56.3%	56.3%	8	$0.01	0.066	3.68	$0.016
Interior Lighting - Timeclocks and Timers	56.3%	56.3%	8	$0.01	0.033	1.66	$0.036
Interior Lighting - Task Lighting	16.7%	75.0%	5	$0.24	0.068	0.06	$0.776
Interior Fluorescent - Bi-Level Fixture	10.0%	22.5%	8	$0.50	0.052	0.04	$1.435
Interior Fluorescent - Delamp and Install Reflectors	11.1%	67.5%	11	$0.50	-	0.00	$0.000
Exterior Lighting - Bi-Level Fixture	10.0%	30.0%	8	$0.20	0.021	0.04	$1.402
Exterior Lighting - Daylighting Controls	18.0%	37.5%	8	$0.02	0.106	2.11	$0.028
Exterior Lighting - Photovoltaic Installation	0.0%	12.5%	5	$0.92	0.063	0.02	$3.204
Refrigerator - Anti-Sweat Heater	0.0%	75.0%	12	$0.03	0.010	0.29	$0.270
Refrigerator - Decommissioning	50.0%	51.7%	9	$0.00	0.166	21.95	$0.003
Refrigerator - Demand Defrost	0.0%	75.0%	16	$0.20	0.009	0.05	$1.919
Refrigerator - Door Gasket Replacement	5.0%	75.0%	4	$2.94	0.016	0.00	$48.030
Refrigerator - Evaporator Fan Controls	0.0%	7.5%	16	$0.00	0.002	0.59	$0.202
Refrigerator - Floating Head Pressure	38.0%	45.0%	15	$0.00	0.013	3.68	$0.022
Refrigerator - Strip Curtain	5.0%	56.3%	4	$0.00	0.007	1.00	$0.000
Refrigerator - High Efficiency Compressor	10.0%	37.5%	15	$0.29	0.013	0.04	$2.074
Refrigerator - Variable Speed Compressor	10.0%	37.5%	15	$0.01	0.013	1.53	$0.054
Refrigerator - eCube	5.0%	75.0%	12	$0.00	0.037	6.75	$0.010
Vending Machine - Controller	2.0%	10.0%	5	$0.27	0.010	0.01	$5.685
Office Equipment - ENERGY STAR Power Supplies	10.0%	95.0%	4	$0.00	0.001	4.72	$0.019
Office Equipment - Plug Load Occupancy Sensors	12.6%	56.3%	8	$0.25	0.016	0.03	$2.374
Pool Heater - Solar	0.0%	33.8%	20	$0.24	0.001	0.01	$20.026
Pool Pump - Timer	33.8%	33.8%	10	$0.13	0.001	0.01	$14.303
Ventilation - CO2 Controlled	11.5%	15.0%	15	$0.65	0.110	0.15	$0.546
Non-HVAC Motors - Variable Speed Control	0.0%	37.5%	10	$0.10	-	0.01	$0.000
Energy Management System	13.9%	75.0%	15	$0.35	1.002	2.34	$0.032
Thermostat - Clock/Programmable	50.0%	50.0%	11	$0.13	0.551	2.32	$0.027
HVAC - Occupancy Sensors	56.3%	56.3%	8	$0.14	0.389	1.06	$0.053
Commissioning - HVAC	0.0%	0.0%	25	$1.00	0.621	0.96	$0.110
Commissioning - Lighting	0.0%	0.0%	25	$0.15	0.076	0.83	$0.134
Retrocommissioning - HVAC	0.0%	0.0%	10	$0.75	-	0.00	$0.000
Retrocommissioning - Lighting	0.0%	0.0%	0	$0.00	-	2.00	$0.000
Advanced New Construction Designs	0.0%	0.0%	25	$2.00	2.835	2.19	$0.048
Custom Measures	10.0%	45.0%	15	$1.50	-	0.00	$0.000
PC Power Management Software	13.0%	90.0%	5	$0.01	0.109	5.38	$0.011
Pre-rinse Sprayer	31.0%	5.0%	5	$0.00	0.009	7.39	$0.008

INDUSTRIAL ENERGY EFFICIENCY EQUIPMENT AND MEASURE DATA

This appendix presents detailed information for industrial energy-efficiency measures (*equipment* and *other* measures per the LoadMAP taxonomy) that were evaluated in this study.

Table D-1 and Table D-2 provide brief narrative descriptions for the measures.[2]

Table D-3 through Table D-10 list the detailed unit-level data (including economic screen results) for industrial energy-efficiency equipment measures in existing and new buildings. The column headings and units are the same as described for the corresponding residential sector tables above.

Table D-11 through Table D-18 list the detailed unit-level data (including economic screen results) for industrial energy-efficiency non-equipment measures in existing and new buildings. The column headings and units are the same as described for the corresponding residential sector tables above.

[2] Measure Description Sources: EnerNOC internal databases.

Table D-1 Industrial Energy Efficiency Equipment Measure Descriptions

End Use	Technology	Measure Description
Cooling	Air-Cooled Chiller	A central chiller plant creates chilled water for distribution throughout the facility. Because of the wide variety of system types and sizes, savings and cost values for efficiency improvements represent an average over screw, reciprocating, and centrifugal technologies. Under this simplified approach, each central system is characterized by an aggregate efficiency value (inclusive of chiller, pumps, and motors), in kW/ton with a further efficiency upgrade through the application of variable refrigerant flow technology.
Cooling	Water-Cooled Chiller	A central chiller plant creates chilled water for distribution throughout the facility. Water source chillers include heat rejection via a condenser loop and cooling tower. Because of the wide variety of system types and sizes, savings and cost values for efficiency improvements represent an average over screw, reciprocating, and centrifugal technologies. Under this simplified approach, each central system is characterized by an aggregate efficiency value (inclusive of chiller, pumps, motors, and condenser loop equipment), in kW/ton with a further efficiency upgrade through the application of variable refrigerant flow technology.
Cooling	Roof Top AC	Packaged cooling systems, such as rooftop units (RTUs), are simple to install and maintain, and are commonly used in small and medium-sized commercial buildings. Applications range from a single supply system with air intake filters, supply fan, and cooling coil, or can become more complex with the addition of a return air duct, return air fan, and various controls to optimize performance. For packaged RTUs, varying Energy Efficiency Ratios (EER) are modeled, as well as a ductless mini-split system.
Cooling / Heating	Air-Source Heat Pump	For heat pumps, units with increasing EER and COP levels are evaluated, as well as a ductless mini-split system.
Cooling / Heating	Geothermal Heat Pump	For heat pumps, units with increasing EER and COP levels are evaluated.
Heating	Electric Furnace	Resistive heating elements are used to convert electricity directly to heat. The heat is then delivered by a supply fan and duct system to the regions that require heating.
Heating	Electric Room Heat	Resistive heating elements are used to convert electricity directly to heat. Conductive fins surrounding the element or another mechanism is used to deliver the heat directly to the surrounding room or area. These are typically either baseboard or wall-mounted units.
Ventilation	Ventilation	A variable air volume ventilation system modulates the air flow rate as needed based on the interior conditions of the building to reduce fan load, improve dehumidification, and reduce energy usage.
Interior Lighting	Screw-in	This measure evaluates higher-efficiency alternatives for screw-in interior lamps including halogen, CFL, and LED.
Interior Lighting	High-Bay Fixtures	With the exception of screw-in lighting, industrial lighting efficiency changes typically require more than the simple purchase and installation of an alternative lamp Restrictions regarding ballasts, fixtures, and circuitry limit the potential for direct substitution of one lamp type for another. Also, during the buildout for a leased office space, management could decide to replace all lamps, ballasts, and fixtures with different configurations. This type of decision-making is modeled on a stock turnover basis because of the time between opportunities for upgrades. For High-Bay fixtures, alternatives include mercury vapor, metal halides, T5 fluorescent high output, and high-pressure sodium.
Interior Lighting	Linear Fluorescent	With the exception of screw-in lighting, industrial lighting efficiency changes typically require more than the simple purchase and installation of an alternative lamp Restrictions regarding ballasts, fixtures, and circuitry limit the potential for direct substitution of one lamp type for another. Also, during the buildout for a leased office space, management could decide to replace all lamps, ballasts, and fixtures with different configurations. This type of decision-

End Use	Technology	Measure Description
		making is modeled on a stock turnover basis because of the time between opportunities for upgrades. For linear fluorescent fixtures, alternatives include T12, T8, Super T8, T5, and LED.
Exterior Lighting	Screw-in	This measure evaluates higher-efficiency alternatives for screw-in interior lamps including halogen, CFL, and LED.
Exterior Lighting	HID	Alternatives modeled include metal halides, T8 and T5 high output, high pressure sodium, and LEDs
Exterior Lighting	Linear Fluorescent	For linear fluorescent fixtures, alternatives include T12, T8, Super T8, T5, and LED.
Process	Process Electrochemical	Electrochemical processes deal with chemical reactions in solution driven by electricity applied at a cathode and anode.
Process	Other Process	This category is a "catch all" for the many unique process applications in the broader industrial sector.
Process	Process Cooling	Industrial process where cooling is applied
Process	Process Refrigeration	Industrial refrigeration process
Process	Process Heating	Industrial process where heating is applied
Process	Other Process	This category is a "catch all" for the many unique process applications in the broader industrial sector.
Motors	Pumps, Fans & Blowers, Compressed Air, Conveyors, Material Handling, Material Processing	Premium efficiency motors reduce the amount of lost energy going into heat rather than power. Since less heat is generated, less energy is needed to cool the motor with a fan. The initial cost of energy efficient motors is generally higher than for standard motors, however their life-cycle costs can make them far more economical because of savings they generate in operating expense. The fact that energy efficient motors run cooler than their standard counterparts also results in an increase in the life of the motor insulation and bearing. High efficiency units use copper instead of aluminum in the windings and increased conductor cross-sectional area to lower a motor's I2R losses.
Miscellaneous	Miscellaneous	Improvement of miscellaneous electric uses.

Table D-2 Industrial Energy Efficiency Non-Equipment Measure Descriptions

End Use	Measure	Description
HVAC (All)	Insulation - Ceiling	Thermal insulation is material or combinations of materials that are used to inhibit the flow of heat energy by conductive, convective, and radiative transfer modes. Thus, thermal insulation can conserve energy by reducing the heat loss or gain of a building. The type of building construction defines insulating possibilities. Typical insulating materials include: loose-fill (blown) cellulose; loose-fill (blown) fiberglass; and rigid polystyrene.
HVAC (All)	Insulation - Ducting	Air distribution ducts can be insulated to reduce heating or cooling losses. Best results can be achieved by covering the entire surface area with insulation. Insulation material inhibits the transfer of heat through the air-supply duct. Several types of ducts and duct insulation are available, including flexible duct, pre-insulated duct, duct board, duct wrap, tacked, or glued rigid insulation, and waterproof hard shell materials for exterior ducts.
HVAC (All)	Insulation - Wall Cavity	Thermal insulation is material or combinations of materials that are used to inhibit the flow of heat energy by conductive, convective, and radiative transfer modes. Thus, thermal insulation can conserve energy by reducing the heat loss or gain of a building. The type of building construction defines insulating possibilities. Typical insulating materials include: loose-fill (blown) cellulose; loose-fill (blown) fiberglass; and rigid polystyrene.
HVAC (All)	HVAC - Duct Repair and Sealing	Leakage in unsealed ducts varies considerably because of the differences in fabricating machinery used, the methods for assembly, installation workmanship, and age of the ductwork. Air leaks from the system to the outdoors result in a direct loss proportional to the amount of leakage and the difference in enthalpy between the outdoor air and the conditioned air. To seal ducts, a wide variety of sealing methods and products exist. Each has a relatively short shelf life, and no documented research has identified the aging characteristics of sealant applications.
Air-Cooled Chiller	Air-Cooled Chiller - Economizer	Economizers allow outside air (when it is cool and dry enough) to be brought into the building space to meet cooling loads instead of using mechanically cooled interior air. A dual enthalpy economizer consists of indoor and outdoor temperature and humidity sensors, dampers, motors, and motor controls. Economizers are most applicable to temperate climates and savings will be smaller in extremely hot or humid areas.
Air-Cooled Chiller	Air-Cooled Chiller - Efficient Mechanical Layout	Improvements to layout and placement of chiller equipment, for example to enable unobstructed access to cooling tower airflow or minimize the length of refrigerant run between cooling tower and chiller head unit.
Air-Cooled Chiller	Air-Cooled Chiller - Maintenance	Filters, coils, and fins require regular cleaning and maintenance for the heat pump or roof top unit to function effectively and efficiently throughout its years of service. Neglecting necessary maintenance leads to a steady decline in performance while energy use increases.
Air-Cooled Chiller	Air-Cooled Chiller - Chilled Water Reset	Chilled water reset controls save energy by improving chiller performance through increasing the supply chilled water temperature, which allows increased suction pressure during low load periods. Raising the chilled water temperature also reduces chilled water piping losses. However, the primary savings from the chilled water reset measure results from chiller efficiency improvement. This is due partly to the smaller temperature difference between chilled water and ambient air, and partly due to the sensitivity of chiller performance to suction temperature.
Air-Cooled Chiller	Air-Cooled Chiller - Chilled Water Variable-Flow System	The part-load efficiency of chilled water loops can be improved substantially by varying the flow speed of the delivered water with the building demand for cooling.
Air-Cooled Chiller	Air-Cooled Chiller - Condenser Water Temperature Reset	Resetting the condenser water temperature to the lowest possible setting allows the cooling tower to generate cooler water whenever possible and decreases the temperature lift between the condenser and the evaporator. This will generally increase chiller part-load efficiency, though it may require

End Use	Measure	Description
		increased tower fan energy use.
Air-Cooled Chiller	Air-Cooled Chiller - High Efficiency Cooling Tower Fans	High-efficiency cooling fans utilize efficient components and variable frequency drives that improve fan performance by adjusting fan speed and rotation as conditions change.
Air-Cooled Chiller	Air-Cooled Chiller - VSD on Fans	Variable speed drives, which reduce chiller energy use under part load, are modeled for both air-cooled and water-cooled chillers.
Water-Cooled Chiller	Water-Cooled Chiller Economizer	Economizers allow outside air (when it is cool and dry enough) to be brought into the building space to meet cooling loads instead of using mechanically cooled interior air. A dual enthalpy economizer consists of indoor and outdoor temperature and humidity sensors, dampers, motors, and motor controls. Economizers are most applicable to temperate climates and savings will be smaller in extremely hot or humid areas.
Water-Cooled Chiller	Water Cooled Chiller-Efficient Mechanical Layout	Improvements to layout and placement of chiller equipment, for example to enable unobstructed access to cooling tower airflow or minimize the length of refrigerant run between cooling tower and chiller head unit.
Water-Cooled Chiller	Water Cooled Chiller Maintenance	Filters, coils, and fins require regular cleaning and maintenance for the heat pump or roof top unit to function effectively and efficiently throughout its years of service. Neglecting necessary maintenance leads to a steady decline in performance while energy use increases.
Water-Cooled Chiller	Water Cooled Chiller-Chilled Water Reset	Chilled water reset controls save energy by improving chiller performance through increasing the supply chilled water temperature, which allows increased suction pressure during low load periods. Raising the chilled water temperature also reduces chilled water piping losses. However, the primary savings from the chilled water reset measure results from chiller efficiency improvement. This is due partly to the smaller temperature difference between chilled water and ambient air, and partly due to the sensitivity of chiller performance to suction temperature.
Water-Cooled Chiller	Water Cooled Chiller-Variable Flow System	The part-load efficiency of chilled water loops can be improved substantially by varying the flow speed of the delivered water with the building demand for cooling.
Water-Cooled Chiller	Water Cooled Chiller Condenser Water Temperature Reset	Resetting the condenser water temperature to the lowest possible setting allows the cooling tower to generate cooler water whenever possible and decreases the temperature lift between the condenser and the evaporator. This will generally increase chiller part-load efficiency, though it may require increased tower fan energy use.
Water-Cooled Chiller	Water Cooled Chiller High Efficiency Cooling Tower Fans	High-efficiency cooling fans utilize efficient components and variable frequency drives that improve fan performance by adjusting fan speed and rotation as conditions change.
Water-Cooled Chiller	Water Cooled Chiller VSD on Fans	Variable speed drives, which reduce chiller energy use under part load, are modeled for both air-cooled and water-cooled chillers.
Roof Top AC	RTU - Maintenance	Regular cleaning and maintenance enables a roof top unit to function effectively and efficiently throughout its years of service. Neglecting necessary maintenance leads to a steady decline in performance while energy use increases. Maintenance can increase the efficiency of poorly performing equipment by as much as 10%.
Cooling / Heating	Heat Pump - Maintenance	Regular cleaning and maintenance enables a heat pump to function effectively and efficiently throughout its years of service. Neglecting necessary maintenance leads to a steady decline in performance while energy use increases. Maintenance can increase the efficiency of poorly performing equipment by as much as 10%.
HVAC (All)	Roofs - High Reflectivity	The color and material of a building structure surface will determine the amount of solar radiation absorbed by that surface and subsequently transferred into a building. This is called solar absorptance. By using a living roof or a roofing material with a light color (and a lower solar absorptance), the roof will absorb less solar radiation and consequently reduce the cooling load.

End Use	Measure	Description
		Living roofs also reduce stormwater runoff.
HVAC (All)	Energy Management System	An energy management system (EMS) allows managers/owners to monitor and control the major energy-consuming systems within a commercial building. At the minimum, the EMS can be used to monitor and record energy consumption of the different end-uses in a building, and can control operation schedules of the HVAC and lighting systems. The monitoring function helps building managers/owners to identify systems that are operating inefficiently so that actions can be taken to correct the problem. The EMS can also provide preventive maintenance scheduling that will reduce the cost of operations and maintenance in the long run. The control functionality of the EMS allows the building manager/owner to operate building systems from one central location. The operation schedules set via the EMS help to prevent building systems from operating during unwanted or unoccupied periods. This analysis assumes that this measure is limited to buildings with a central HVAC system.
HVAC (All)	Thermostat - Clock/Programmable	A programmable thermostat can be added to most heating/cooling systems. They are typically used during winter to lower temperatures at night and in summer to increase temperatures during the afternoon. There are two-setting models, and well as models that allow separate programming for each day of the week. The energy savings from this type of thermostat are identical to those of a "setback" strategy with standard thermostats, but the convenience of a programmable thermostat makes it a much more attractive option. In this analysis, the baseline is assumed to have no thermostat setback.
Interior Lighting	Interior Lighting - Occupancy Sensors	The installation of occupancy sensors allows lights to be turned off during periods when a space is unoccupied, virtually eliminating the wasted energy due to lights being left on. There are several types of occupancy sensors in the market.
Interior Lighting	Interior Lighting - Skylights	Addition of transparent windows/fixtures in the roof to allow daylight to enter and reduce the need for powered lighting.
Interior Lighting	Interior Lighting - Time Clocks and Timers	In many cases lighting remains on at night and during weekends. A simple timer can set a schedule for turning lights off to reduce operating hours.
Interior Lighting	Interior Lighting - LED Exit Lighting	The lamps inside exit signs represent a significant energy end-use, since they usually operate 24 hours per day. Many old exit signs use incandescent lamps, which consume approximately 40 watts per sign. The incandescent lamps can be replaced with LED lamps that are specially designed for this specific purpose. In comparison, the LED lamps consume approximately 2-5 watts.
Interior Lighting	Interior Lighting - Daylighting Controls	Daylighting controls use a photosensor to detect ambient light and adjust or turn off electric lights accordingly.
Interior Lighting	Interior Screw-in - Task Lighting	Individual work areas can use task lighting instead of brightly lighting the entire area. Significant energy savings can be realized by focusing light directly where it is needed and lowering the general lighting level. An example of task lighting is the common desk lamp. A 25W desk lamp can be installed in place of a typical lamp in a fixture.
Interior Lighting	Interior Fluorescent - Bi-Level Fixture	Bi-level fixtures have the ability to reduce light output to a lower level, given a control strategy that is based on a timer, occupancy sensor, motion sensor, or manual switch.
Interior Lighting	Interior Fluorescent - Delamp and Install Reflectors	While sometimes included in lighting retrofit projects, delamping is often performed as a separate energy efficiency measure in which a lighting engineer analyzes the lighting provided by current systems compared to the requirements of building occupants. This often leads to the removal of unnecessary lamps corresponding to an overall reduction in energy usage. In addition, installing a reflector in each fixture can improve light distribution from the remaining lamps.
Exterior Lighting	Exterior Lighting - Bi-Level Fixture	Bi-level fixtures have the ability to reduce light output to a lower level, given a control strategy that is based on a timer, occupancy sensor, motion sensor, or manual switch.

End Use	Measure	Description
Exterior Lighting	Exterior Lighting - Daylighting Controls	Daylighting controls use a photosensor to detect ambient light and adjust or turn off electric lights accordingly.
Exterior Lighting	Exterior Lighting - Photovoltaic Installation	Solar photovoltaic generation may be used to power exterior lighting and thus eliminate all or part of the electrical energy use.
Process	Process - Conductivity Controls	Automated control of conductivity levels in a process solution, for example by variably injecting CO2 into a stream of rinse water, can maintain an optimal solution that increases process effectiveness, decreases impurities, reduces scaling or corrosion, and minimizes required rinse time.
Process	Process - Controls on Fume Hoods	Improved fume hoods involve installing sensors and variable-speed controls to provide ventilation based on actual demand. When the relevant equipment or process is not active, the controls automatically decrease the fan speed accordingly.
Process	Process - Timers and Controls	Significant energy savings can frequently be attained from processes by adding a timer or altering their control algorithms.
Process	Injection Molding Barrel Insulation	Specific to the plastics industry, insulated blankets wrapped around the cylindrical barrels of an injection molder or extruder can minimize the use of resistance heating without affecting temperature control of the molder or extruded resin.
Process Refrigeration	Refrigeration - Floating Head Pressure	Floating head pressure control allows the pressure in the condenser to "float" with ambient temperatures. This method reduces refrigeration compression ratios, improves system efficiency and extends the compressor life. The greatest savings with a floating head pressure approach occurs when the ambient temperatures are low, such as in the winter season. Floating head pressure control is most practical for new installations. However, retrofits installation can be completed with some existing refrigeration systems. Installing floating head pressure control increases the capacity of the compressor when temperatures are low, which may lead to short cycling.
Process Refrigeration	Refrigeration - System Controls	Refrigeration System Controls would include measures such as temperature sensors, flow/float controls, and pressure controls. These work to improve the refrigeration system by limiting demand and improving overall system efficiency.
Process Refrigeration	Refrigeration - System Maintenance	This measure includes repairing and recharging refrigerant lines, cleaning condenser coils, and replacing the oil. This reduces energy consumption by improving the rate at which the system can compress and cool refrigerant as it moves through the system.
Process Refrigeration	Refrigeration - System Optimization	Refrigeration system optimization is a thorough overhaul of the refrigeration system which involves the resizing, sequencing, and controlling of compressors in order to optimize load.
Compressed Air	Compressed Air - Air Usage Reduction	This measure involves a process audit of the facility to determine if the actual application of compressed air can be reduced, reconfigured, consolidated, or otherwise optimized.
Compressed Air	Compressed Air - Compressor Replacement	This measure is the replacement of existing air compressor equipment with more efficient compressors and motors in order to improve energy efficiency.
Compressed Air	Compressed Air - System Controls	Compressed Air System Controls would include measures such as VSDs, centralized controls, and system performance monitoring. These measures work in tandem to reduce energy usage by lowering system demand.
Compressed Air	Compressed Air - System Maintenance	This measure includes repairing holes in air lines, replacing failed nozzles, and lubricating the compressors. This reduces energy consumption by improving compressor efficiency and reducing line loss as gas moves through the system.
Compressed Air	Compressed Air - System Optimization and Improvements	System optimization is a thorough overhaul of the compressed air system which involves the resizing, sequencing, and improving control over all compressors in a system in order to reduce energy consumption to a minimum. This measure may include those from Controls and Maintenance.

End Use	Measure	Description
Pumps	Pumping System - Controls	Significant energy savings can frequently be attained from processes by adding a timer or altering their control algorithms.
Pumps	Pumping System - Maintenance	This measure includes clearing traps, repairing impellers, and repairing broken seals or valves. This reduces energy consumption by reducing losses incurred by moving fluids through the system.
Pumps	Pumping System - Optimization	Optimization integrates best practices of system analysis, equipment improvements, and operational improvements into a sustaining energy program. A facility that implements such a practice treats its energy program in a similar manner to safety or quality control programs: an individual or team is tasked with developing and enforcing standards, goals are set, regular reports are generated and reported to management, and all plant employees are engaged and held accountable.
Pumps	Pumps - Variable Speed Control	The part-load efficiency of drive systems can be improved by varying the speed of the motor drive. An additional benefit of variable-speed controls is the ability to start and stop the motor and process gradually, thus extending the life of the motor and associated machinery.
Pumps	Pump Equipment Upgrade	Improved design of flow, housing, control valves, impeller trimming, proper sizing, etc to increase productive output per energy input. Moreover, these improved systems could be assessed and managed in accordance with recognized standards such as ASME EA-2-2008.
Fans & Blowers	Fan Equipment Upgrade	Improved design of airflow, blades, housing, sizing, etc to increase productive output per energy input. Fans are widely used in industry for conveyance, drying and ventilation. For example, relatively inefficient centrifugal-radial fans, with efficiency as low as 22%, are commonly used in industry. These fans could be replaced with more efficient centrifugal backwardly inclined fans that increase overall fan efficiency by 20% to 30%. The savings potential for premium-efficiency fans is high, and the costs are relatively low. However, premium-efficiency fans are sometimes not chosen for industrial applications because of concerns about reliable operation in dirty environments.
Fans & Blowers	Fan System - Controls	Significant energy savings can frequently be attained from processes by adding a timer or altering their control algorithms.
Fans & Blowers	Fan System - Maintenance	This measure includes repairing holes in ducts, replacing clogged filters, and lubricating the motors. This reduces energy consumption by improving fan efficiency and reducing system loss as gas moves through the ductwork.
Fans & Blowers	Fan System - Optimization	Optimization integrates best practices of system analysis, equipment improvements, and operational improvements into a sustaining energy program. A facility that implements such a practice treats its energy program in a similar manner to safety or quality control programs: an individual or team is tasked with developing and enforcing standards, goals are set, regular reports are generated and reported to management, and all plant employees are engaged and held accountable.
Fans & Blowers	Fans - Variable Speed Control	The part-load efficiency of drive systems can be improved by varying the speed of the motor drive. An additional benefit of variable-speed controls is the ability to start and stop the motor and process gradually, thus extending the life of the motor and associated machinery.
Motors	Motors - Magnetic Adjustable Speed Drives	To allow for adjustable speed operation, this technology uses magnetic induction to couple a drive to its load. Varying the magnetic slip within the coupling controls the speed of the output shaft. Magnetic drives perform best at the upper end of the speed range due to the energy consumed by the slip. Unlike traditional ASDs, magnetically coupled ASDs create no power distortion on the electrical system. However, magnetically coupled ASD efficiency is best when power needs are greatest. VFDs may show greater efficiency when the average load speed is below 90% of the motor speed, however this occurs when power demands are reduced.
Motors	Motors - Efficient Rewind	When a motor burns out or is in need of repair, the owner may elect to either replace the motor or have it rewound. A typical motor rewind costs less than a

End Use	Measure	Description
		replacement motor, but at the cost of efficiency. An efficient rewind, however, attempts to improve the efficiency of the motor by reducing stator losses. If the manufacturer has left stator slots open, or not entirely filled, additional copper wire can be included to reduce resistance and increase efficiency.
Motors	Motors - Synchronous Belts	Synchronous belts offer higher efficiency compared with standard belts due to reduced slipping, as well as less maintenance and retensioning.
Motors	Motors - Variable Frequency Drive	The part-load efficiency of drive systems can be improved by varying the speed of the motor drive. An additional benefit of variable-speed controls is the ability to start and stop the motor and process gradually, thus extending the life of the motor and associated machinery.
HVAC, Lighting	Commissioning - HVAC, Lighting	For new construction and major renovations, commissioning ensures that building systems are properly designed, specified, and installed to meet the design intent and provide high-efficiency performance. Commissioning begins during the design process.
HVAC, Lighting	Retrocommissioning - HVAC, Lighting	In existing buildings, the retrocommissioning process identifies low-cost or no cost measures, including controls adjustments, to improve building performance and reduce operating costs. Retrocommissioning addresses HVAC, lighting, DHW, and other major building systems.
Ventilation	Ventilation - CO2 Controlled	Also known as Demand Controlled Ventilation, this measure uses carbon dioxide (CO2) levels to indicate the level of occupancy in a space. Sensors monitor CO2 levels so that air handling controls can adjust the amount of outside air the system needs to intake. Ventilation rates are thereby controlled based on occupancy, rather than a fixed rate, thus saving HVAC energy use.
All	Transformer - High Efficiency	All electric power passes through one or more transformers on its way to service equipment, lighting, and other loads. Currently available materials and designs can considerably reduce both load and no-load losses. The new NEMA TP-1 standard is used as the reference definition for energy -efficient products. Tier-1 represents TP-1 dry-type transformers while Tier-2 reflects a switch to liquid immersed TP-1 products. More efficient transformers with attractive payback periods are estimated to save 40 to 50 percent of the energy lost by a "typical" transformer, which translates into a one to three percent reduction in electric bills for commercial and industrial customers.
All	Custom Measures	Custom measures may be included in the analysis to serve as a “catch all” for measures for which costs and savings are not easily quantified and that could be part of a custom program. Typical costs and energy savings are assumed such that the measures pass the economic screen.

Table D-3 Energy Efficiency Equipment Data, Electric—Chemicals, Existing Vintage

End Use	Technology	Efficiency Definition	Savings (kWh/Emp)	Incremental Cost ($/Emp)	Lifetime (Years)	BC Ratio	Levelized Cost ($/kWh)
Cooling	Air-Cooled Chiller	1.5 kw/ton, COP 2.3	-	$0.00	20	1.00	$0.000
Cooling	Air-Cooled Chiller	1.3 kw/ton, COP 2.7	2,240.99	$819.14	20	1.14	$0.028
Cooling	Air-Cooled Chiller	1.26 kw/ton, COP 2.8	2,689.16	$1,064.89	20	1.17	$0.031
Cooling	Air-Cooled Chiller	1.0 kw/ton, COP 3.5	5,602.40	$1,310.63	20	1.46	$0.018
Cooling	Air-Cooled Chiller	0.97 kw/ton, COP 3.6	5,938.60	$1,556.37	20	1.50	$0.020
Cooling	Water-Cooled Chiller	0.75 kw/ton, COP 4.7	-	$0.00	20	1.00	$0.000
Cooling	Water-Cooled Chiller	0.60 kw/ton, COP 5.9	4,121.83	$399.12	20	1.24	$0.007
Cooling	Water-Cooled Chiller	0.58 kw/ton, COP 6.1	4,672.78	$798.24	20	1.27	$0.013
Cooling	Water-Cooled Chiller	0.55 kw/Ton, COP 6.4	5,499.90	$957.89	20	1.34	$0.013
Cooling	Water-Cooled Chiller	0.51 kw/ton, COP 6.9	6,600.93	$1,490.05	20	1.43	$0.017
Cooling	Water-Cooled Chiller	0.50 kw/Ton, COP 7.0	6,876.93	$1,649.70	20	1.45	$0.018
Cooling	Water-Cooled Chiller	0.48 kw/ton, COP 7.3	7,429.62	$1,809.34	20	1.51	$0.019
Cooling	Roof top AC	EER 9.2	-	$0.00	16	-	$0.000
Cooling	Roof top AC	EER 10.1	2,673.17	$1,382.44	16	-	$0.046
Cooling	Roof top AC	EER 11.2	5,356.72	$2,658.53	16	1.00	$0.044
Cooling	Roof top AC	EER 12.0	6,999.57	$5,104.38	16	1.06	$0.065

End Use	Technology	Efficiency Definition	Savings (kWh/Emp)	Incremental Cost ($/Emp)	Lifetime (Years)	BC Ratio	Levelized Cost ($/kWh)
Cooling	Roof top AC	Ductless Minisplit	8,768.80	$16,748.76	16	1.06	$0.169
Cooling	Air-Source Heat Pump	EER 9.3, COP 3.1	-	$0.00	16	-	$0.000
Cooling	Air-Source Heat Pump	EER 10.3, COP 3.2	2,912.86	$1,719.86	16	-	$0.052
Cooling	Air-Source Heat Pump	EER 11.0, COP 3.3	4,636.74	$2,472.30	16	1.00	$0.047
Cooling	Air-Source Heat Pump	EER 11.7, COP 3.4	6,154.23	$6,342.00	16	1.04	$0.091
Cooling	Air-Source Heat Pump	EER 12.0, COP 3.4	6,750.68	$8,276.84	16	1.06	$0.109
Cooling	Air-Source Heat Pump	Ductless Minisplit	8,538.79	$15,854.99	16	1.10	$0.164
Cooling	Geothermal Heat Pump	EER 14.1, COP 3.3	-	$0.00	16	1.00	$0.000
Cooling	Geothermal Heat Pump	EER 16, COP 3.5	1,693.13	$3,874.27	16	1.07	$0.203
Cooling	Geothermal Heat Pump	EER 18, COP 3.8	3,089.22	$7,748.54	16	1.13	$0.222
Cooling	Geothermal Heat Pump	EER 30, COP 5.0	7,556.70	$10,219.57	16	1.52	$0.120
Cooling	Other Cooling	EER 9.8	-	$0.00	14	1.00	$0.000
Cooling	Other Cooling	EER 10.2	323.36	$940.74	14	1.01	$0.282
Cooling	Other Cooling	EER 10.8	633.61	$10,700.93	14	0.95	$1.635
Cooling	Other Cooling	EER 11	932.39	$11,325.91	14	0.96	$1.176
Cooling	Other Cooling	EER 11.5	1,219.70	$12,888.37	14	0.96	$1.023
Heating	Air-Source Heat Pump	EER 9.3, COP 3.1	-	$0.00	16	-	$0.000
Heating	Air-Source Heat Pump	EER 10.3, COP 3.2	226.16	$3,653.16	16	-	$1.430
Heating	Air-Source Heat Pump	EER 11.0, COP 3.3	432.21	$5,251.42	16	1.00	$1.075
Heating	Air-Source Heat Pump	EER 11.7, COP 3.4	618.16	$13,471.04	16	0.90	$1.929
Heating	Air-Source Heat Pump	EER 12.0, COP 3.4	618.16	$17,580.85	16	0.85	$2.517
Heating	Air-Source Heat Pump	Ductless Minisplit	788.31	$33,677.60	16	0.71	$3.781
Heating	Geothermal Heat Pump	EER 14.1, COP 3.3	-	$0.00	16	1.00	$0.000
Heating	Geothermal Heat Pump	EER 16, COP 3.5	2,161.72	$7,361.13	16	0.93	$0.301
Heating	Geothermal Heat Pump	EER 18, COP 3.8	4,977.65	$14,722.25	16	0.87	$0.262
Heating	Geothermal Heat Pump	EER 30, COP 5.0	1,095.64	$19,417.23	16	0.81	$1.569
Heating	Electric Room Heat	Standard	-	$0.00	25	1.00	$0.000
Heating	Electric Furnace	Standard	-	$0.00	25	1.00	$0.000
Ventilation	Ventilation	Constant Volume	-	$0.00	10	1.00	$0.000
Ventilation	Ventilation	Variable Air Volume	2,094.74	-$4,266.79	10	1.04	-$0.252
Int. Lighting	Screw-in	Incandescent	-	$0.00	2	1.00	$0.000
Int. Lighting	Screw-in	90W Halogen PAR-38	748.01	$28.24	3	-	$0.013
Int. Lighting	Screw-in	70W HIR PAR-38	1,149.20	$38.84	3	-	$0.012
Int. Lighting	Screw-in	CFL	2,151.36	$22.50	6	3.63	$0.002
Int. Lighting	Screw-in	LED (2010)	2,329.20	$597.47	20	2.50	$0.020
Int. Lighting	Screw-in	LED (2020)	2,675.49	$168.57	20	-	$0.005
Int. Lighting	High-Bay Fixtures	Metal Halides	-	$0.00	3	1.00	$0.000
Int. Lighting	High-Bay Fixtures	LED (2010)	110.84	$168.49	15	0.81	$0.140
Int. Lighting	High-Bay Fixtures	T8	112.83	-$4.48	10	1.78	-$0.005
Int. Lighting	High-Bay Fixtures	High Pressure Sodium	120.06	$0.80	6	1.78	$0.001
Int. Lighting	High-Bay Fixtures	Induction	132.40	$47.53	15	1.38	$0.033
Int. Lighting	High-Bay Fixtures	Light Emitting Plasma	140.50	$2.61	15	1.98	$0.002
Int. Lighting	High-Bay Fixtures	T5	144.01	-$2.69	10	2.20	-$0.002
Int. Lighting	High-Bay Fixtures	LED (2020)	211.79	$43.46	15	-	$0.019
Int. Lighting	Linear Fluorescent	T12	-	$0.00	10	1.00	$0.000
Int. Lighting	Linear Fluorescent	LED (2010)	1,218.07	$4,278.55	15	0.61	$0.324
Int. Lighting	Linear Fluorescent	T8	1,267.32	$1.75	10	1.34	$0.000
Int. Lighting	Linear Fluorescent	Super T8	1,758.16	$28.58	10	1.53	$0.002
Int. Lighting	Linear Fluorescent	T5	2,038.21	$46.08	10	1.66	$0.003
Int. Lighting	Linear Fluorescent	LED (2020)	3,714.16	$1,187.03	15	-	$0.030
Ext. Lighting	Screw-in	Incandescent	-	$0.00	2	1.00	$0.000
Ext. Lighting	Screw-in	90W Halogen PAR-38	1.16	$0.04	3	-	$0.013
Ext. Lighting	Screw-in	70W HIR PAR-38	1.78	$0.06	3	-	$0.012
Ext. Lighting	Screw-in	CFL	3.34	$0.03	6	3.34	$0.002
Ext. Lighting	Screw-in	LED (2010)	3.61	$0.93	20	1.80	$0.020
Ext. Lighting	Screw-in	LED (2020)	4.15	$0.26	20	-	$0.005
Ext. Lighting	HID	Metal Halides	-	$0.00	3	1.00	$0.000
Ext. Lighting	HID	LED (2010)	235.78	$836.22	15	0.45	$0.328
Ext. Lighting	HID	T8	245.49	-$6.32	10	1.27	-$0.003
Ext. Lighting	HID	Light Emitting Plasma	380.25	$28.20	15	1.32	$0.007
Ext. Lighting	HID	High Pressure Sodium	380.38	-$0.34	6	1.58	$0.000
Ext. Lighting	HID	T5	397.35	$2.41	10	1.54	$0.001

End Use	Technology	Efficiency Definition	Savings (kWh/Emp)	Incremental Cost ($/Emp)	Lifetime (Years)	BC Ratio	Levelized Cost ($/kWh)
Ext. Lighting	HID	LED (2020)	727.52	$227.18	15	-	$0.029
Ext. Lighting	Linear Fluorescent	T12	-	$0.00	10	1.00	$0.000
Ext. Lighting	Linear Fluorescent	LED (2010)	0.09	$0.32	15	0.47	$0.324
Ext. Lighting	Linear Fluorescent	T8	0.10	$0.00	10	1.34	$0.000
Ext. Lighting	Linear Fluorescent	Super T8	0.13	$0.00	10	1.51	$0.002
Ext. Lighting	Linear Fluorescent	T5	0.15	$0.00	10	1.63	$0.003
Ext. Lighting	Linear Fluorescent	LED (2020)	0.28	$0.09	15	-	$0.030
Motors	Pumps	Standard	-	$0.00	10	1.00	$0.000
Motors	Pumps	High Efficiency	102.23	$85.43	10	1.00	$0.104
Motors	Fans & Blowers	Standard	-	$0.00	10	1.00	$0.000
Motors	Fans & Blowers	High Efficiency	29.17	$28.15	10	1.00	$0.120
Motors	Compressed Air	Standard	-	$0.00	10	1.00	$0.000
Motors	Compressed Air	High Efficiency	99.70	$61.03	10	1.00	$0.076
Motors	Matl Handling	Standard	-	$0.00	10	1.00	$0.000
Motors	Matl Handling	High Efficiency	28.72	$30.48	10	1.00	$0.132
Motors	Matl Processing	Standard	-	$0.00	10	1.00	$0.000
Motors	Matl Processing	High Efficiency	172.31	$182.88	10	1.00	$0.132
Motors	Other Motors	Standard	-	$0.00	10	1.00	$0.000
Motors	Other Motors	High Efficiency	17.23	$18.29	10	1.00	$0.132
Process	Process Heating	Standard	-	$0.00	15	1.00	$0.000
Process	Process Cool and Refrig	Standard	-	$0.00	15	1.00	$0.000
Process	Electro-Chem Process	Standard	-	$0.00	15	1.00	$0.000
Process	Other Process	Standard	-	$0.00	15	1.00	$0.000
Miscellaneous	Miscellaneous	Standard	-	$0.00	5	1.00	$0.000

Table D-4 Energy Efficiency Equipment Data, Electric—Chemicals, New Vintage

End Use	Technology	Efficiency Definition	Savings (kWh/Emp)	Incremental Cost ($/Emp)	Lifetime (Years)	BC Ratio	Levelized Cost ($/kWh)
Cooling	Air-Cooled Chiller	1.5 kw/ton, COP 2.3	-	$0.00	20	1.00	$0.000
Cooling	Air-Cooled Chiller	1.3 kw/ton, COP 2.7	1,845.30	$886.16	20	1.14	$0.037
Cooling	Air-Cooled Chiller	1.26 kw/ton, COP 2.8	2,214.36	$1,152.01	20	1.17	$0.040
Cooling	Air-Cooled Chiller	1.0 kw/ton, COP 3.5	4,613.26	$1,417.86	20	1.45	$0.024
Cooling	Air-Cooled Chiller	0.97 kw/ton, COP 3.6	4,890.14	$1,683.71	20	1.49	$0.027
Cooling	Water-Cooled Chiller	0.75 kw/ton, COP 4.7	-	$0.00	20	1.00	$0.000
Cooling	Water-Cooled Chiller	0.60 kw/ton, COP 5.9	3,523.65	$458.48	20	1.23	$0.010
Cooling	Water-Cooled Chiller	0.58 kw/ton, COP 6.1	3,994.68	$916.97	20	1.27	$0.018
Cooling	Water-Cooled Chiller	0.55 kw/Ton, COP 6.4	4,701.69	$1,100.36	20	1.33	$0.018
Cooling	Water-Cooled Chiller	0.51 kw/ton, COP 6.9	5,641.71	$1,711.67	20	1.42	$0.023
Cooling	Water-Cooled Chiller	0.50 kw/Ton, COP 7.0	5,877.90	$1,895.07	20	1.44	$0.025
Cooling	Water-Cooled Chiller	0.48 kw/ton, COP 7.3	6,350.30	$2,078.46	20	1.49	$0.025
Cooling	Roof top AC	EER 9.2	-	$0.00	16	-	$0.000
Cooling	Roof top AC	EER 10.1	2,366.36	$1,203.07	16	-	$0.045
Cooling	Roof top AC	EER 11.2	4,744.78	$2,313.59	16	1.00	$0.043
Cooling	Roof top AC	EER 12.0	6,199.67	$4,442.10	16	1.06	$0.063
Cooling	Roof top AC	Ductless Minisplit	7,765.55	$14,575.63	16	1.07	$0.166
Cooling	Air-Source Heat Pump	EER 9.3, COP 3.1	-	$0.00	16	-	$0.000
Cooling	Air-Source Heat Pump	EER 10.3, COP 3.2	2,517.93	$1,461.63	16	-	$0.051
Cooling	Air-Source Heat Pump	EER 11.0, COP 3.3	4,007.92	$2,101.09	16	1.00	$0.046
Cooling	Air-Source Heat Pump	EER 11.7, COP 3.4	5,320.45	$5,389.75	16	1.04	$0.090
Cooling	Air-Source Heat Pump	EER 12.0, COP 3.4	5,836.05	$7,034.08	16	1.06	$0.107
Cooling	Air-Source Heat Pump	Ductless Minisplit	7,383.11	$13,474.36	16	1.10	$0.162
Cooling	Geothermal Heat Pump	EER 14.1, COP 3.3	-	$0.00	16	1.00	$0.000
Cooling	Geothermal Heat Pump	EER 16, COP 3.5	1,489.10	$3,350.05	16	1.07	$0.199
Cooling	Geothermal Heat Pump	EER 18, COP 3.8	2,716.95	$6,700.10	16	1.13	$0.218
Cooling	Geothermal Heat Pump	EER 30, COP 5.0	6,646.08	$8,836.79	16	1.53	$0.118
Cooling	Other Cooling	EER 9.8	-	$0.00	14	1.00	$0.000
Cooling	Other Cooling	EER 10.2	289.69	$839.34	14	1.01	$0.281
Cooling	Other Cooling	EER 10.8	569.63	$9,547.45	14	0.95	$1.623
Cooling	Other Cooling	EER 11	837.78	$10,105.07	14	0.96	$1.168
Cooling	Other Cooling	EER 11.5	1,095.37	$11,499.10	14	0.96	$1.016

End Use	Technology	Efficiency Definition	Savings (kWh/Emp)	Incremental Cost ($/Emp)	Lifetime (Years)	BC Ratio	Levelized Cost ($/kWh)
Heating	Air-Source Heat Pump	EER 9.3, COP 3.1	-	$0.00	16	-	$0.000
Heating	Air-Source Heat Pump	EER 10.3, COP 3.2	642.04	$4,223.26	16	-	$0.582
Heating	Air-Source Heat Pump	EER 11.0, COP 3.3	1,280.94	$6,070.94	16	1.00	$0.420
Heating	Air-Source Heat Pump	EER 11.7, COP 3.4	1,915.14	$15,573.28	16	0.89	$0.720
Heating	Air-Source Heat Pump	EER 12.0, COP 3.4	1,915.14	$20,324.45	16	0.84	$0.939
Heating	Air-Source Heat Pump	Ductless Minisplit	2,544.64	$38,933.19	16	0.69	$1.354
Heating	Geothermal Heat Pump	EER 14.1, COP 3.3	-	$0.00	16	1.00	$0.000
Heating	Geothermal Heat Pump	EER 16, COP 3.5	1,992.22	$8,887.53	16	0.92	$0.395
Heating	Geothermal Heat Pump	EER 18, COP 3.8	4,587.36	$17,775.06	16	0.85	$0.343
Heating	Geothermal Heat Pump	EER 30, COP 5.0	8,922.41	$23,443.59	16	0.83	$0.233
Heating	Electric Room Heat	Standard	-	$0.00	25	1.00	$0.000
Heating	Electric Furnace	Standard	-	$0.00	25	1.00	$0.000
Ventilation	Ventilation	Constant Volume	-	$0.00	10	1.00	$0.000
Ventilation	Ventilation	Variable Air Volume	1,933.92	-$4,661.27	10	1.04	-$0.299
Int. Lighting	Screw-in	Incandescent	-	$0.00	2	1.00	$0.000
Int. Lighting	Screw-in	90W Halogen PAR-38	748.01	$28.24	3	-	$0.013
Int. Lighting	Screw-in	70W HIR PAR-38	1,149.20	$38.84	3	-	$0.012
Int. Lighting	Screw-in	CFL	2,151.36	$22.50	6	3.63	$0.002
Int. Lighting	Screw-in	LED (2010)	2,329.20	$597.47	20	2.50	$0.020
Int. Lighting	Screw-in	LED (2020)	2,675.49	$168.57	20	-	$0.005
Int. Lighting	High-Bay Fixtures	Metal Halides	-	$0.00	3	1.00	$0.000
Int. Lighting	High-Bay Fixtures	LED (2010)	110.84	$168.49	15	0.81	$0.140
Int. Lighting	High-Bay Fixtures	T8	112.83	-$4.48	10	1.78	-$0.005
Int. Lighting	High-Bay Fixtures	High Pressure Sodium	120.06	$0.80	6	1.78	$0.001
Int. Lighting	High-Bay Fixtures	Induction	132.40	$47.53	15	1.38	$0.033
Int. Lighting	High-Bay Fixtures	Light Emitting Plasma	140.50	$2.61	15	1.98	$0.002
Int. Lighting	High-Bay Fixtures	T5	144.01	-$2.69	10	2.20	-$0.002
Int. Lighting	High-Bay Fixtures	LED (2020)	211.79	$43.46	15	-	$0.019
Int. Lighting	Linear Fluorescent	T12	-	$0.00	10	1.00	$0.000
Int. Lighting	Linear Fluorescent	LED (2010)	1,218.07	$4,278.55	15	0.61	$0.324
Int. Lighting	Linear Fluorescent	T8	1,267.32	$1.75	10	1.34	$0.000
Int. Lighting	Linear Fluorescent	Super T8	1,758.16	$28.58	10	1.53	$0.002
Int. Lighting	Linear Fluorescent	T5	2,038.21	$46.08	10	1.66	$0.003
Int. Lighting	Linear Fluorescent	LED (2020)	3,714.16	$1,187.03	15	-	$0.030
Ext. Lighting	Screw-in	Incandescent	-	$0.00	2	1.00	$0.000
Ext. Lighting	Screw-in	90W Halogen PAR-38	1.16	$0.04	3	-	$0.013
Ext. Lighting	Screw-in	70W HIR PAR-38	1.78	$0.06	3	-	$0.012
Ext. Lighting	Screw-in	CFL	3.34	$0.03	6	3.34	$0.002
Ext. Lighting	Screw-in	LED (2010)	3.61	$0.93	20	1.80	$0.020
Ext. Lighting	Screw-in	LED (2020)	4.15	$0.26	20	-	$0.005
Ext. Lighting	HID	Metal Halides	-	$0.00	3	1.00	$0.000
Ext. Lighting	HID	LED (2010)	235.78	$836.22	15	0.45	$0.328
Ext. Lighting	HID	T8	245.49	-$6.32	10	1.27	-$0.003
Ext. Lighting	HID	Light Emitting Plasma	380.25	$28.20	15	1.32	$0.007
Ext. Lighting	HID	High Pressure Sodium	380.38	-$0.34	6	1.58	$0.000
Ext. Lighting	HID	T5	397.35	$2.41	10	1.54	$0.001
Ext. Lighting	HID	LED (2020)	727.52	$227.18	15	-	$0.029
Ext. Lighting	Linear Fluorescent	T12	-	$0.00	10	1.00	$0.000
Ext. Lighting	Linear Fluorescent	LED (2010)	0.09	$0.32	15	0.47	$0.324
Ext. Lighting	Linear Fluorescent	T8	0.10	$0.00	10	1.34	$0.000
Ext. Lighting	Linear Fluorescent	Super T8	0.13	$0.00	10	1.51	$0.002
Ext. Lighting	Linear Fluorescent	T5	0.15	$0.00	10	1.63	$0.003
Ext. Lighting	Linear Fluorescent	LED (2020)	0.28	$0.09	15	-	$0.030
Motors	Pumps	Standard	-	$0.00	10	1.00	$0.000
Motors	Pumps	High Efficiency	102.23	$84.56	10	1.00	$0.102
Motors	Fans & Blowers	Standard	-	$0.00	10	1.00	$0.000
Motors	Fans & Blowers	High Efficiency	29.17	$27.86	10	1.00	$0.118
Motors	Compressed Air	Standard	-	$0.00	10	1.00	$0.000
Motors	Compressed Air	High Efficiency	99.70	$60.41	10	1.00	$0.075
Motors	Matl Handling	Standard	-	$0.00	10	1.00	$0.000
Motors	Matl Handling	High Efficiency	28.72	$30.17	10	1.00	$0.130
Motors	Matl Processing	Standard	-	$0.00	10	1.00	$0.000

End Use	Technology	Efficiency Definition	Savings (kWh/Emp)	Incremental Cost ($/Emp)	Lifetime (Years)	BC Ratio	Levelized Cost ($/kWh)
Motors	Matl Processing	High Efficiency	172.31	$181.01	10	1.00	$0.130
Motors	Other Motors	Standard	-	$0.00	10	1.00	$0.000
Motors	Other Motors	High Efficiency	17.23	$18.10	10	1.00	$0.130
Process	Process Heating	Standard	-	$0.00	15	1.00	$0.000
Process	Process Cool and Refrig	Standard	-	$0.00	15	1.00	$0.000
Process	Electro-Chem Process	Standard	-	$0.00	15	1.00	$0.000
Process	Other Process	Standard	-	$0.00	15	1.00	$0.000
Miscellaneous	Miscellaneous	Standard	-	$0.00	5	1.00	$0.000

Table D-5 Energy Efficiency Equipment Data, Electric—Plastics, Existing Vintage

End Use	Technology	Efficiency Definition	Savings (kWh/Emp)	Incremental Cost ($/Emp)	Lifetime (Years)	BC Ratio	Levelized Cost ($/kWh)
Cooling	Air-Cooled Chiller	1.5 kw/ton, COP 2.3	-	$0.00	20	1.00	$0.000
Cooling	Air-Cooled Chiller	1.3 kw/ton, COP 2.7	2,665.86	$974.44	20	1.14	$0.028
Cooling	Air-Cooled Chiller	1.26 kw/ton, COP 2.8	3,199.00	$1,266.78	20	1.17	$0.031
Cooling	Air-Cooled Chiller	1.0 kw/ton, COP 3.5	6,664.56	$1,559.11	20	1.46	$0.018
Cooling	Air-Cooled Chiller	0.97 kw/ton, COP 3.6	7,064.49	$1,851.44	20	1.50	$0.020
Cooling	Water-Cooled Chiller	0.75 kw/ton, COP 4.7	-	$0.00	20	1.00	$0.000
Cooling	Water-Cooled Chiller	0.60 kw/ton, COP 5.9	4,903.29	$474.79	20	1.24	$0.007
Cooling	Water-Cooled Chiller	0.58 kw/ton, COP 6.1	5,558.70	$949.58	20	1.27	$0.013
Cooling	Water-Cooled Chiller	0.55 kw/Ton, COP 6.4	6,542.63	$1,139.49	20	1.34	$0.013
Cooling	Water-Cooled Chiller	0.51 kw/ton, COP 6.9	7,852.40	$1,772.54	20	1.43	$0.017
Cooling	Water-Cooled Chiller	0.50 kw/Ton, COP 7.0	8,180.72	$1,962.46	20	1.45	$0.018
Cooling	Water-Cooled Chiller	0.48 kw/ton, COP 7.3	8,838.20	$2,152.38	20	1.51	$0.019
Cooling	Roof top AC	EER 9.2	-	$0.00	16	-	$0.000
Cooling	Roof top AC	EER 10.1	3,179.97	$1,644.53	16	-	$0.046
Cooling	Roof top AC	EER 11.2	6,372.30	$3,162.56	16	1.00	$0.044
Cooling	Roof top AC	EER 12.0	8,326.62	$6,072.12	16	1.06	$0.065
Cooling	Roof top AC	Ductless Minisplit	10,431.27	$19,924.16	16	1.06	$0.169
Cooling	Air-Source Heat Pump	EER 9.3, COP 3.1	-	$0.00	16	-	$0.000
Cooling	Air-Source Heat Pump	EER 10.3, COP 3.2	3,465.11	$2,045.93	16	-	$0.052
Cooling	Air-Source Heat Pump	EER 11.0, COP 3.3	5,515.82	$2,941.03	16	1.00	$0.047
Cooling	Air-Source Heat Pump	EER 11.7, COP 3.4	7,321.01	$7,544.38	16	1.04	$0.091
Cooling	Air-Source Heat Pump	EER 12.0, COP 3.4	8,030.53	$9,846.05	16	1.06	$0.109
Cooling	Air-Source Heat Pump	Ductless Minisplit	10,157.66	$18,860.94	16	1.10	$0.164
Cooling	Geothermal Heat Pump	EER 14.1, COP 3.3	-	$0.00	16	1.00	$0.000
Cooling	Geothermal Heat Pump	EER 16, COP 3.5	2,014.13	$4,608.79	16	1.07	$0.203
Cooling	Geothermal Heat Pump	EER 18, COP 3.8	3,674.90	$9,217.58	16	1.13	$0.222
Cooling	Geothermal Heat Pump	EER 30, COP 5.0	8,989.38	$12,157.10	16	1.52	$0.120
Cooling	Other Cooling	EER 9.8	-	$0.00	14	1.00	$0.000
Cooling	Other Cooling	EER 10.2	384.67	$1,119.10	14	1.01	$0.282
Cooling	Other Cooling	EER 10.8	753.74	$12,729.71	14	0.95	$1.635
Cooling	Other Cooling	EER 11	1,109.16	$13,473.19	14	0.96	$1.176
Cooling	Other Cooling	EER 11.5	1,450.94	$15,331.87	14	0.96	$1.023
Heating	Air-Source Heat Pump	EER 9.3, COP 3.1	-	$0.00	16	-	$0.000
Heating	Air-Source Heat Pump	EER 10.3, COP 3.2	269.03	$4,345.77	16	-	$1.430
Heating	Air-Source Heat Pump	EER 11.0, COP 3.3	514.15	$6,247.04	16	1.00	$1.075
Heating	Air-Source Heat Pump	EER 11.7, COP 3.4	735.35	$16,025.01	16	0.90	$1.929
Heating	Air-Source Heat Pump	EER 12.0, COP 3.4	735.35	$20,914.00	16	0.85	$2.517
Heating	Air-Source Heat Pump	Ductless Minisplit	937.77	$40,062.53	16	0.71	$3.781
Heating	Geothermal Heat Pump	EER 14.1, COP 3.3	-	$0.00	16	1.00	$0.000
Heating	Geothermal Heat Pump	EER 16, COP 3.5	2,571.56	$8,756.72	16	0.93	$0.301
Heating	Geothermal Heat Pump	EER 18, COP 3.8	5,921.36	$17,513.44	16	0.87	$0.262
Heating	Geothermal Heat Pump	EER 30, COP 5.0	1,303.37	$23,098.54	16	0.81	$1.569
Heating	Electric Room Heat	Standard	-	$0.00	25	1.00	$0.000
Heating	Electric Furnace	Standard	-	$0.00	25	1.00	$0.000
Ventilation	Ventilation	Constant Volume	-	$0.00	10	1.00	$0.000
Ventilation	Ventilation	Variable Air Volume	2,491.88	-$5,075.74	10	1.04	-$0.252
Int. Lighting	Screw-in	Incandescent	-	$0.00	2	1.00	$0.000
Int. Lighting	Screw-in	90W Halogen PAR-38	1,085.64	$40.99	3	-	$0.013

End Use	Technology	Efficiency Definition	Savings (kWh/Emp)	Incremental Cost ($/Emp)	Lifetime (Years)	BC Ratio	Levelized Cost ($/kWh)
Int. Lighting	Screw-in	70W HIR PAR-38	1,667.92	$56.38	3	-	$0.012
Int. Lighting	Screw-in	CFL	3,122.43	$32.65	6	3.63	$0.002
Int. Lighting	Screw-in	LED (2010)	3,380.54	$867.15	20	2.50	$0.020
Int. Lighting	Screw-in	LED (2020)	3,883.14	$244.65	20	-	$0.005
Int. Lighting	High-Bay Fixtures	Metal Halides	-	$0.00	3	1.00	$0.000
Int. Lighting	High-Bay Fixtures	LED (2010)	160.87	$244.55	15	0.81	$0.140
Int. Lighting	High-Bay Fixtures	T8	163.76	-$6.51	10	1.78	-$0.005
Int. Lighting	High-Bay Fixtures	High Pressure Sodium	174.25	$1.16	6	1.78	$0.001
Int. Lighting	High-Bay Fixtures	Induction	192.16	$68.99	15	1.38	$0.033
Int. Lighting	High-Bay Fixtures	Light Emitting Plasma	203.91	$3.78	15	1.98	$0.002
Int. Lighting	High-Bay Fixtures	T5	209.01	-$3.90	10	2.20	-$0.002
Int. Lighting	High-Bay Fixtures	LED (2020)	307.39	$63.07	15	-	$0.019
Int. Lighting	Linear Fluorescent	T12	-	$0.00	10	1.00	$0.000
Int. Lighting	Linear Fluorescent	LED (2010)	1,767.88	$6,209.77	15	0.61	$0.324
Int. Lighting	Linear Fluorescent	T8	1,839.35	$2.54	10	1.34	$0.000
Int. Lighting	Linear Fluorescent	Super T8	2,551.74	$41.48	10	1.53	$0.002
Int. Lighting	Linear Fluorescent	T5	2,958.20	$66.88	10	1.66	$0.003
Int. Lighting	Linear Fluorescent	LED (2020)	5,390.63	$1,722.82	15	-	$0.030
Ext. Lighting	Screw-in	Incandescent	-	$0.00	2	1.00	$0.000
Ext. Lighting	Screw-in	90W Halogen PAR-38	1.68	$0.06	3	-	$0.013
Ext. Lighting	Screw-in	70W HIR PAR-38	2.59	$0.09	3	-	$0.012
Ext. Lighting	Screw-in	CFL	4.84	$0.05	6	3.34	$0.002
Ext. Lighting	Screw-in	LED (2010)	5.24	$1.34	20	1.80	$0.020
Ext. Lighting	Screw-in	LED (2020)	6.02	$0.38	20	-	$0.005
Ext. Lighting	HID	Metal Halides	-	$0.00	3	1.00	$0.000
Ext. Lighting	HID	LED (2010)	342.21	$1,213.67	15	0.45	$0.328
Ext. Lighting	HID	T8	356.29	-$9.17	10	1.27	-$0.003
Ext. Lighting	HID	Light Emitting Plasma	551.89	$40.93	15	1.32	$0.007
Ext. Lighting	HID	High Pressure Sodium	552.07	-$0.50	6	1.58	$0.000
Ext. Lighting	HID	T5	576.71	$3.50	10	1.54	$0.001
Ext. Lighting	HID	LED (2020)	1,055.90	$329.73	15	-	$0.029
Ext. Lighting	Linear Fluorescent	T12	-	$0.00	10	1.00	$0.000
Ext. Lighting	Linear Fluorescent	LED (2010)	0.13	$0.47	15	0.47	$0.324
Ext. Lighting	Linear Fluorescent	T8	0.14	$0.00	10	1.34	$0.000
Ext. Lighting	Linear Fluorescent	Super T8	0.19	$0.00	10	1.51	$0.002
Ext. Lighting	Linear Fluorescent	T5	0.22	$0.01	10	1.63	$0.003
Ext. Lighting	Linear Fluorescent	LED (2020)	0.41	$0.13	15	-	$0.030
Motors	Pumps	Standard	-	$0.00	10	1.00	$0.000
Motors	Pumps	High Efficiency	66.07	$55.21	10	1.00	$0.104
Motors	Fans & Blowers	Standard	-	$0.00	10	1.00	$0.000
Motors	Fans & Blowers	High Efficiency	15.19	$14.65	10	1.00	$0.120
Motors	Compressed Air	Standard	-	$0.00	10	1.00	$0.000
Motors	Compressed Air	High Efficiency	30.01	$18.37	10	1.00	$0.076
Motors	Matl Handling	Standard	-	$0.00	10	1.00	$0.000
Motors	Matl Handling	High Efficiency	19.91	$21.13	10	1.00	$0.132
Motors	Matl Processing	Standard	-	$0.00	10	1.00	$0.000
Motors	Matl Processing	High Efficiency	119.48	$126.80	10	1.00	$0.132
Motors	Other Motors	Standard	-	$0.00	10	1.00	$0.000
Motors	Other Motors	High Efficiency	9.84	$10.44	10	1.00	$0.132
Process	Process Heating	Standard	-	$0.00	15	1.00	$0.000
Process	Process Cool and Refrig	Standard	-	$0.00	15	1.00	$0.000
Process	Electro-Chem Process	Standard	-	$0.00	15	1.00	$0.000
Process	Other Process	Standard	-	$0.00	15	1.00	$0.000
Miscellaneous	Miscellaneous	Standard	-	$0.00	5	1.00	$0.000

Table D-6 Energy Efficiency Equipment Data, Electric— Plastics, New Vintage

End Use	Technology	Efficiency Definition	Savings (kWh/Emp)	Incremental Cost ($/Emp)	Lifetime (Years)	BC Ratio	Levelized Cost ($/kWh)
Cooling	Air-Cooled Chiller	1.5 kw/ton, COP 2.3	-	$0.00	20	1.00	$0.000
Cooling	Air-Cooled Chiller	1.3 kw/ton, COP 2.7	2,195.15	$1,054.17	20	1.14	$0.037
Cooling	Air-Cooled Chiller	1.26 kw/ton, COP 2.8	2,634.19	$1,370.42	20	1.17	$0.040

End Use	Technology	Efficiency Definition	Savings (kWh/Emp)	Incremental Cost ($/Emp)	Lifetime (Years)	BC Ratio	Levelized Cost ($/kWh)
Cooling	Air-Cooled Chiller	1.0 kw/ton, COP 3.5	5,487.89	$1,686.67	20	1.45	$0.024
Cooling	Air-Cooled Chiller	0.97 kw/ton, COP 3.6	5,817.26	$2,002.92	20	1.49	$0.027
Cooling	Water-Cooled Chiller	0.75 kw/ton, COP 4.7	-	$0.00	20	1.00	$0.000
Cooling	Water-Cooled Chiller	0.60 kw/ton, COP 5.9	4,191.70	$545.41	20	1.23	$0.010
Cooling	Water-Cooled Chiller	0.58 kw/ton, COP 6.1	4,752.04	$1,090.82	20	1.27	$0.018
Cooling	Water-Cooled Chiller	0.55 kw/Ton, COP 6.4	5,593.08	$1,308.98	20	1.33	$0.018
Cooling	Water-Cooled Chiller	0.51 kw/ton, COP 6.9	6,711.32	$2,036.19	20	1.42	$0.023
Cooling	Water-Cooled Chiller	0.50 kw/Ton, COP 7.0	6,992.29	$2,254.35	20	1.44	$0.025
Cooling	Water-Cooled Chiller	0.48 kw/ton, COP 7.3	7,554.25	$2,472.51	20	1.49	$0.025
Cooling	Roof top AC	EER 9.2	-	$0.00	16	-	$0.000
Cooling	Roof top AC	EER 10.1	2,815.00	$1,431.16	16	-	$0.045
Cooling	Roof top AC	EER 11.2	5,644.34	$2,752.23	16	1.00	$0.043
Cooling	Roof top AC	EER 12.0	7,375.07	$5,284.27	16	1.06	$0.063
Cooling	Roof top AC	Ductless Minisplit	9,237.82	$17,339.02	16	1.07	$0.166
Cooling	Air-Source Heat Pump	EER 9.3, COP 3.1	-	$0.00	16	-	$0.000
Cooling	Air-Source Heat Pump	EER 10.3, COP 3.2	2,995.31	$1,738.74	16	-	$0.051
Cooling	Air-Source Heat Pump	EER 11.0, COP 3.3	4,767.78	$2,499.43	16	1.00	$0.046
Cooling	Air-Source Heat Pump	EER 11.7, COP 3.4	6,329.15	$6,411.59	16	1.04	$0.090
Cooling	Air-Source Heat Pump	EER 12.0, COP 3.4	6,942.50	$8,367.66	16	1.06	$0.107
Cooling	Air-Source Heat Pump	Ductless Minisplit	8,782.87	$16,028.97	16	1.10	$0.162
Cooling	Geothermal Heat Pump	EER 14.1, COP 3.3	-	$0.00	16	1.00	$0.000
Cooling	Geothermal Heat Pump	EER 16, COP 3.5	1,771.41	$3,985.19	16	1.07	$0.199
Cooling	Geothermal Heat Pump	EER 18, COP 3.8	3,232.06	$7,970.38	16	1.13	$0.218
Cooling	Geothermal Heat Pump	EER 30, COP 5.0	7,906.10	$10,512.16	16	1.53	$0.118
Cooling	Other Cooling	EER 9.8	-	$0.00	14	1.00	$0.000
Cooling	Other Cooling	EER 10.2	344.61	$998.47	14	1.01	$0.281
Cooling	Other Cooling	EER 10.8	677.62	$11,357.55	14	0.95	$1.623
Cooling	Other Cooling	EER 11	996.62	$12,020.88	14	0.96	$1.168
Cooling	Other Cooling	EER 11.5	1,303.04	$13,679.22	14	0.96	$1.016
Heating	Air-Source Heat Pump	EER 9.3, COP 3.1	-	$0.00	16	-	$0.000
Heating	Air-Source Heat Pump	EER 10.3, COP 3.2	763.76	$5,023.95	16	-	$0.582
Heating	Air-Source Heat Pump	EER 11.0, COP 3.3	1,523.79	$7,221.93	16	1.00	$0.420
Heating	Air-Source Heat Pump	EER 11.7, COP 3.4	2,278.23	$18,525.81	16	0.89	$0.720
Heating	Air-Source Heat Pump	EER 12.0, COP 3.4	2,278.23	$24,177.75	16	0.84	$0.939
Heating	Air-Source Heat Pump	Ductless Minisplit	3,027.07	$46,314.53	16	0.69	$1.354
Heating	Geothermal Heat Pump	EER 14.1, COP 3.3	-	$0.00	16	1.00	$0.000
Heating	Geothermal Heat Pump	EER 16, COP 3.5	2,369.93	$10,572.52	16	0.92	$0.395
Heating	Geothermal Heat Pump	EER 18, COP 3.8	5,457.07	$21,145.03	16	0.85	$0.343
Heating	Geothermal Heat Pump	EER 30, COP 5.0	10,614.01	$27,888.26	16	0.83	$0.233
Heating	Electric Room Heat	Standard	-	$0.00	25	1.00	$0.000
Heating	Electric Furnace	Standard	-	$0.00	25	1.00	$0.000
Ventilation	Ventilation	Constant Volume	-	$0.00	10	1.00	$0.000
Ventilation	Ventilation	Variable Air Volume	2,300.58	-$5,545.00	10	1.04	-$0.299
Int. Lighting	Screw-in	Incandescent	-	$0.00	2	1.00	$0.000
Int. Lighting	Screw-in	90W Halogen PAR-38	1,085.64	$40.99	3	-	$0.013
Int. Lighting	Screw-in	70W HIR PAR-38	1,667.92	$56.38	3	-	$0.012
Int. Lighting	Screw-in	CFL	3,122.43	$32.65	6	3.63	$0.002
Int. Lighting	Screw-in	LED (2010)	3,380.54	$867.15	20	2.50	$0.020
Int. Lighting	Screw-in	LED (2020)	3,883.14	$244.65	20	-	$0.005
Int. Lighting	High-Bay Fixtures	Metal Halides	-	$0.00	3	1.00	$0.000
Int. Lighting	High-Bay Fixtures	LED (2010)	160.87	$244.55	15	0.81	$0.140
Int. Lighting	High-Bay Fixtures	T8	163.76	-$6.51	10	1.78	-$0.005
Int. Lighting	High-Bay Fixtures	High Pressure Sodium	174.25	$1.16	6	1.78	$0.001
Int. Lighting	High-Bay Fixtures	Induction	192.16	$68.99	15	1.38	$0.033
Int. Lighting	High-Bay Fixtures	Light Emitting Plasma	203.91	$3.78	15	1.98	$0.002
Int. Lighting	High-Bay Fixtures	T5	209.01	-$3.90	10	2.20	-$0.002
Int. Lighting	High-Bay Fixtures	LED (2020)	307.39	$63.07	15	-	$0.019
Int. Lighting	Linear Fluorescent	T12	-	$0.00	10	1.00	$0.000
Int. Lighting	Linear Fluorescent	LED (2010)	1,767.88	$6,209.77	15	0.61	$0.324
Int. Lighting	Linear Fluorescent	T8	1,839.35	$2.54	10	1.34	$0.000
Int. Lighting	Linear Fluorescent	Super T8	2,551.74	$41.48	10	1.53	$0.002
Int. Lighting	Linear Fluorescent	T5	2,958.20	$66.88	10	1.66	$0.003

End Use	Technology	Efficiency Definition	Savings (kWh/Emp)	Incremental Cost ($/Emp)	Lifetime (Years)	BC Ratio	Levelized Cost ($/kWh)
Int. Lighting	Linear Fluorescent	LED (2020)	5,390.63	$1,722.82	15	-	$0.030
Ext. Lighting	Screw-in	Incandescent	-	$0.00	2	1.00	$0.000
Ext. Lighting	Screw-in	90W Halogen PAR-38	1.68	$0.06	3	-	$0.013
Ext. Lighting	Screw-in	70W HIR PAR-38	2.59	$0.09	3	-	$0.012
Ext. Lighting	Screw-in	CFL	4.84	$0.05	6	3.34	$0.002
Ext. Lighting	Screw-in	LED (2010)	5.24	$1.34	20	1.80	$0.020
Ext. Lighting	Screw-in	LED (2020)	6.02	$0.38	20	-	$0.005
Ext. Lighting	HID	Metal Halides	-	$0.00	3	1.00	$0.000
Ext. Lighting	HID	LED (2010)	342.21	$1,213.67	15	0.45	$0.328
Ext. Lighting	HID	T8	356.29	-$9.17	10	1.27	-$0.003
Ext. Lighting	HID	Light Emitting Plasma	551.89	$40.93	15	1.32	$0.007
Ext. Lighting	HID	High Pressure Sodium	552.07	-$0.50	6	1.58	$0.000
Ext. Lighting	HID	T5	576.71	$3.50	10	1.54	$0.001
Ext. Lighting	HID	LED (2020)	1,055.90	$329.73	15	-	$0.029
Ext. Lighting	Linear Fluorescent	T12	-	$0.00	10	1.00	$0.000
Ext. Lighting	Linear Fluorescent	LED (2010)	0.13	$0.47	15	0.47	$0.324
Ext. Lighting	Linear Fluorescent	T8	0.14	$0.00	10	1.34	$0.000
Ext. Lighting	Linear Fluorescent	Super T8	0.19	$0.00	10	1.51	$0.002
Ext. Lighting	Linear Fluorescent	T5	0.22	$0.01	10	1.63	$0.003
Ext. Lighting	Linear Fluorescent	LED (2020)	0.41	$0.13	15	-	$0.030
Motors	Pumps	Standard	-	$0.00	10	1.00	$0.000
Motors	Pumps	High Efficiency	66.07	$54.64	10	1.00	$0.102
Motors	Fans & Blowers	Standard	-	$0.00	10	1.00	$0.000
Motors	Fans & Blowers	High Efficiency	15.19	$14.50	10	1.00	$0.118
Motors	Compressed Air	Standard	-	$0.00	10	1.00	$0.000
Motors	Compressed Air	High Efficiency	30.01	$18.18	10	1.00	$0.075
Motors	Matl Handling	Standard	-	$0.00	10	1.00	$0.000
Motors	Matl Handling	High Efficiency	19.91	$20.92	10	1.00	$0.130
Motors	Matl Processing	Standard	-	$0.00	10	1.00	$0.000
Motors	Matl Processing	High Efficiency	119.48	$125.51	10	1.00	$0.130
Motors	Other Motors	Standard	-	$0.00	10	1.00	$0.000
Motors	Other Motors	High Efficiency	9.84	$10.33	10	1.00	$0.130
Process	Process Heating	Standard	-	$0.00	15	1.00	$0.000
Process	Process Cool and Refrig	Standard	-	$0.00	15	1.00	$0.000
Process	Electro-Chem Process	Standard	-	$0.00	15	1.00	$0.000
Process	Other Process	Standard	-	$0.00	15	1.00	$0.000
Miscellaneous	Miscellaneous	Standard	-	$0.00	5	1.00	$0.000

Table D-7 Energy Efficiency Equipment Data, Electric—Transportation, Existing Vintage

End Use	Technology	Efficiency Definition	Savings (kWh/Emp)	Incremental Cost ($/Emp)	Lifetime (Years)	BC Ratio	Levelized Cost ($/kWh)
Cooling	Air-Cooled Chiller	1.5 kw/ton, COP 2.3	-	$0.00	20	1.00	$0.000
Cooling	Air-Cooled Chiller	1.3 kw/ton, COP 2.7	2,168.02	$792.47	20	1.14	$0.028
Cooling	Air-Cooled Chiller	1.26 kw/ton, COP 2.8	2,601.60	$1,030.21	20	1.17	$0.031
Cooling	Air-Cooled Chiller	1.0 kw/ton, COP 3.5	5,420.00	$1,267.96	20	1.46	$0.018
Cooling	Air-Cooled Chiller	0.97 kw/ton, COP 3.6	5,745.24	$1,505.70	20	1.50	$0.020
Cooling	Water-Cooled Chiller	0.75 kw/ton, COP 4.7	-	$0.00	20	1.00	$0.000
Cooling	Water-Cooled Chiller	0.60 kw/ton, COP 5.9	3,987.63	$386.13	20	1.24	$0.007
Cooling	Water-Cooled Chiller	0.58 kw/ton, COP 6.1	4,520.64	$772.25	20	1.27	$0.013
Cooling	Water-Cooled Chiller	0.55 kw/Ton, COP 6.4	5,320.83	$926.70	20	1.34	$0.013
Cooling	Water-Cooled Chiller	0.51 kw/ton, COP 6.9	6,386.01	$1,441.53	20	1.43	$0.017
Cooling	Water-Cooled Chiller	0.50 kw/Ton, COP 7.0	6,653.02	$1,595.98	20	1.45	$0.018
Cooling	Water-Cooled Chiller	0.48 kw/ton, COP 7.3	7,187.72	$1,750.43	20	1.51	$0.019
Cooling	Roof top AC	EER 9.2	-	$0.00	16	-	$0.000
Cooling	Roof top AC	EER 10.1	2,586.13	$1,337.43	16	-	$0.046
Cooling	Roof top AC	EER 11.2	5,182.31	$2,571.98	16	1.00	$0.044
Cooling	Roof top AC	EER 12.0	6,771.68	$4,938.19	16	1.06	$0.065
Cooling	Roof top AC	Ductless Minisplit	8,483.30	$16,203.44	16	1.06	$0.169
Cooling	Air-Source Heat Pump	EER 9.3, COP 3.1	-	$0.00	16	-	$0.000
Cooling	Air-Source Heat Pump	EER 10.3, COP 3.2	2,818.02	$1,663.87	16	-	$0.052

End Use	Technology	Efficiency Definition	Savings (kWh/Emp)	Incremental Cost ($/Emp)	Lifetime (Years)	BC Ratio	Levelized Cost ($/kWh)
Cooling	Air-Source Heat Pump	EER 11.0, COP 3.3	4,485.77	$2,391.81	16	1.00	$0.047
Cooling	Air-Source Heat Pump	EER 11.7, COP 3.4	5,953.86	$6,135.51	16	1.04	$0.091
Cooling	Air-Source Heat Pump	EER 12.0, COP 3.4	6,530.88	$8,007.36	16	1.06	$0.109
Cooling	Air-Source Heat Pump	Ductless Minisplit	8,260.78	$15,338.78	16	1.10	$0.164
Cooling	Geothermal Heat Pump	EER 14.1, COP 3.3	-	$0.00	16	1.00	$0.000
Cooling	Geothermal Heat Pump	EER 16, COP 3.5	1,638.00	$3,748.13	16	1.07	$0.203
Cooling	Geothermal Heat Pump	EER 18, COP 3.8	2,988.64	$7,496.25	16	1.13	$0.222
Cooling	Geothermal Heat Pump	EER 30, COP 5.0	7,310.67	$9,886.84	16	1.52	$0.120
Cooling	Other Cooling	EER 9.8	-	$0.00	14	1.00	$0.000
Cooling	Other Cooling	EER 10.2	312.83	$910.11	14	1.01	$0.282
Cooling	Other Cooling	EER 10.8	612.98	$10,352.52	14	0.95	$1.635
Cooling	Other Cooling	EER 11	902.03	$10,957.15	14	0.96	$1.176
Cooling	Other Cooling	EER 11.5	1,179.99	$12,468.74	14	0.96	$1.023
Heating	Air-Source Heat Pump	EER 9.3, COP 3.1	-	$0.00	16	-	$0.000
Heating	Air-Source Heat Pump	EER 10.3, COP 3.2	218.79	$3,534.22	16	-	$1.430
Heating	Air-Source Heat Pump	EER 11.0, COP 3.3	418.14	$5,080.44	16	1.00	$1.075
Heating	Air-Source Heat Pump	EER 11.7, COP 3.4	598.03	$13,032.44	16	0.90	$1.929
Heating	Air-Source Heat Pump	EER 12.0, COP 3.4	598.03	$17,008.44	16	0.85	$2.517
Heating	Air-Source Heat Pump	Ductless Minisplit	762.65	$32,581.10	16	0.71	$3.781
Heating	Geothermal Heat Pump	EER 14.1, COP 3.3	-	$0.00	16	1.00	$0.000
Heating	Geothermal Heat Pump	EER 16, COP 3.5	2,091.34	$7,121.46	16	0.93	$0.301
Heating	Geothermal Heat Pump	EER 18, COP 3.8	4,815.58	$14,242.92	16	0.87	$0.262
Heating	Geothermal Heat Pump	EER 30, COP 5.0	1,059.97	$18,785.03	16	0.81	$1.569
Heating	Electric Room Heat	Standard	-	$0.00	25	1.00	$0.000
Heating	Electric Furnace	Standard	-	$0.00	25	1.00	$0.000
Ventilation	Ventilation	Constant Volume	-	$0.00	10	1.00	$0.000
Ventilation	Ventilation	Variable Air Volume	2,026.54	-$4,127.87	10	1.04	-$0.252
Int. Lighting	Screw-in	Incandescent	-	$0.00	2	1.00	$0.000
Int. Lighting	Screw-in	90W Halogen PAR-38	828.27	$31.27	3	-	$0.013
Int. Lighting	Screw-in	70W HIR PAR-38	1,272.52	$43.01	3	-	$0.012
Int. Lighting	Screw-in	CFL	2,382.22	$24.91	6	3.63	$0.002
Int. Lighting	Screw-in	LED (2010)	2,579.14	$661.58	20	2.50	$0.020
Int. Lighting	Screw-in	LED (2020)	2,962.59	$186.65	20	-	$0.005
Int. Lighting	High-Bay Fixtures	Metal Halides	-	$0.00	3	1.00	$0.000
Int. Lighting	High-Bay Fixtures	LED (2010)	122.73	$186.57	15	0.81	$0.140
Int. Lighting	High-Bay Fixtures	T8	124.94	-$4.96	10	1.78	-$0.005
Int. Lighting	High-Bay Fixtures	High Pressure Sodium	132.94	$0.89	6	1.78	$0.001
Int. Lighting	High-Bay Fixtures	Induction	146.61	$52.63	15	1.38	$0.033
Int. Lighting	High-Bay Fixtures	Light Emitting Plasma	155.57	$2.88	15	1.98	$0.002
Int. Lighting	High-Bay Fixtures	T5	159.46	-$2.98	10	2.20	-$0.002
Int. Lighting	High-Bay Fixtures	LED (2020)	234.52	$48.12	15	-	$0.019
Int. Lighting	Linear Fluorescent	T12	-	$0.00	10	1.00	$0.000
Int. Lighting	Linear Fluorescent	LED (2010)	1,348.78	$4,737.67	15	0.61	$0.324
Int. Lighting	Linear Fluorescent	T8	1,403.31	$1.94	10	1.34	$0.000
Int. Lighting	Linear Fluorescent	Super T8	1,946.82	$31.65	10	1.53	$0.002
Int. Lighting	Linear Fluorescent	T5	2,256.92	$51.03	10	1.66	$0.003
Int. Lighting	Linear Fluorescent	LED (2020)	4,112.71	$1,314.41	15	-	$0.030
Ext. Lighting	Screw-in	Incandescent	-	$0.00	2	1.00	$0.000
Ext. Lighting	Screw-in	90W Halogen PAR-38	1.28	$0.05	3	-	$0.013
Ext. Lighting	Screw-in	70W HIR PAR-38	1.97	$0.07	3	-	$0.012
Ext. Lighting	Screw-in	CFL	3.69	$0.04	6	3.34	$0.002
Ext. Lighting	Screw-in	LED (2010)	4.00	$1.03	20	1.80	$0.020
Ext. Lighting	Screw-in	LED (2020)	4.59	$0.29	20	-	$0.005
Ext. Lighting	HID	Metal Halides	-	$0.00	3	1.00	$0.000
Ext. Lighting	HID	LED (2010)	261.09	$925.95	15	0.45	$0.328
Ext. Lighting	HID	T8	271.83	-$7.00	10	1.27	-$0.003
Ext. Lighting	HID	Light Emitting Plasma	421.06	$31.23	15	1.32	$0.007
Ext. Lighting	HID	High Pressure Sodium	421.20	-$0.38	6	1.58	$0.000
Ext. Lighting	HID	T5	439.99	$2.67	10	1.54	$0.001
Ext. Lighting	HID	LED (2020)	805.59	$251.56	15	-	$0.029
Ext. Lighting	Linear Fluorescent	T12	-	$0.00	10	1.00	$0.000
Ext. Lighting	Linear Fluorescent	LED (2010)	0.10	$0.36	15	0.47	$0.324

End Use	Technology	Efficiency Definition	Savings (kWh/Emp)	Incremental Cost ($/Emp)	Lifetime (Years)	BC Ratio	Levelized Cost ($/kWh)
Ext. Lighting	Linear Fluorescent	T8	0.11	$0.00	10	1.34	$0.000
Ext. Lighting	Linear Fluorescent	Super T8	0.15	$0.00	10	1.51	$0.002
Ext. Lighting	Linear Fluorescent	T5	0.17	$0.00	10	1.63	$0.003
Ext. Lighting	Linear Fluorescent	LED (2020)	0.31	$0.10	15	-	$0.030
Motors	Pumps	Standard	-	$0.00	10	1.00	$0.000
Motors	Pumps	High Efficiency	-	$0.00	10	1.00	$0.000
Motors	Fans & Blowers	Standard	-	$0.00	10	1.00	$0.000
Motors	Fans & Blowers	High Efficiency	13.77	$13.28	10	1.00	$0.120
Motors	Compressed Air	Standard	-	$0.00	10	1.00	$0.000
Motors	Compressed Air	High Efficiency	4.41	$2.70	10	1.00	$0.076
Motors	Matl Handling	Standard	-	$0.00	10	1.00	$0.000
Motors	Matl Handling	High Efficiency	22.81	$24.21	10	1.00	$0.132
Motors	Matl Processing	Standard	-	$0.00	10	1.00	$0.000
Motors	Matl Processing	High Efficiency	40.65	$43.15	10	1.00	$0.132
Motors	Other Motors	Standard	-	$0.00	10	1.00	$0.000
Motors	Other Motors	High Efficiency	5.08	$5.39	10	1.00	$0.132
Process	Process Heating	Standard	-	$0.00	15	1.00	$0.000
Process	Process Cool and Refrig	Standard	-	$0.00	15	1.00	$0.000
Process	Electro-Chem Process	Standard	-	$0.00	15	1.00	$0.000
Process	Other Process	Standard	-	$0.00	15	1.00	$0.000
Miscellaneous	Miscellaneous	Standard	-	$0.00	5	1.00	$0.000

Table D-8 Energy Efficiency Equipment Data, Electric— Transportation, New Vintage

End Use	Technology	Efficiency Definition	Savings (kWh/Emp)	Incremental Cost ($/Emp)	Lifetime (Years)	BC Ratio	Levelized Cost ($/kWh)
Cooling	Air-Cooled Chiller	1.5 kw/ton, COP 2.3	-	$0.00	20	1.00	$0.000
Cooling	Air-Cooled Chiller	1.3 kw/ton, COP 2.7	1,785.22	$857.31	20	1.14	$0.037
Cooling	Air-Cooled Chiller	1.26 kw/ton, COP 2.8	2,142.27	$1,114.50	20	1.17	$0.040
Cooling	Air-Cooled Chiller	1.0 kw/ton, COP 3.5	4,463.06	$1,371.70	20	1.45	$0.024
Cooling	Air-Cooled Chiller	0.97 kw/ton, COP 3.6	4,730.92	$1,628.89	20	1.49	$0.027
Cooling	Water-Cooled Chiller	0.75 kw/ton, COP 4.7	-	$0.00	20	1.00	$0.000
Cooling	Water-Cooled Chiller	0.60 kw/ton, COP 5.9	3,408.93	$443.56	20	1.23	$0.010
Cooling	Water-Cooled Chiller	0.58 kw/ton, COP 6.1	3,864.62	$887.11	20	1.27	$0.018
Cooling	Water-Cooled Chiller	0.55 kw/Ton, COP 6.4	4,548.61	$1,064.53	20	1.33	$0.018
Cooling	Water-Cooled Chiller	0.51 kw/ton, COP 6.9	5,458.02	$1,655.94	20	1.42	$0.023
Cooling	Water-Cooled Chiller	0.50 kw/Ton, COP 7.0	5,686.53	$1,833.37	20	1.44	$0.025
Cooling	Water-Cooled Chiller	0.48 kw/ton, COP 7.3	6,143.54	$2,010.79	20	1.49	$0.025
Cooling	Roof top AC	EER 9.2	-	$0.00	16	-	$0.000
Cooling	Roof top AC	EER 10.1	2,289.32	$1,163.90	16	-	$0.045
Cooling	Roof top AC	EER 11.2	4,590.30	$2,238.26	16	1.00	$0.043
Cooling	Roof top AC	EER 12.0	5,997.82	$4,297.47	16	1.06	$0.063
Cooling	Roof top AC	Ductless Minisplit	7,512.72	$14,101.07	16	1.07	$0.166
Cooling	Air-Source Heat Pump	EER 9.3, COP 3.1	-	$0.00	16	-	$0.000
Cooling	Air-Source Heat Pump	EER 10.3, COP 3.2	2,435.95	$1,414.04	16	-	$0.051
Cooling	Air-Source Heat Pump	EER 11.0, COP 3.3	3,877.43	$2,032.68	16	1.00	$0.046
Cooling	Air-Source Heat Pump	EER 11.7, COP 3.4	5,147.22	$5,214.26	16	1.04	$0.090
Cooling	Air-Source Heat Pump	EER 12.0, COP 3.4	5,646.03	$6,805.06	16	1.06	$0.107
Cooling	Air-Source Heat Pump	Ductless Minisplit	7,142.73	$13,035.66	16	1.10	$0.162
Cooling	Geothermal Heat Pump	EER 14.1, COP 3.3	-	$0.00	16	1.00	$0.000
Cooling	Geothermal Heat Pump	EER 16, COP 3.5	1,440.61	$3,240.98	16	1.07	$0.199
Cooling	Geothermal Heat Pump	EER 18, COP 3.8	2,628.49	$6,481.96	16	1.13	$0.218
Cooling	Geothermal Heat Pump	EER 30, COP 5.0	6,429.69	$8,549.08	16	1.53	$0.118
Cooling	Other Cooling	EER 9.8	-	$0.00	14	1.00	$0.000
Cooling	Other Cooling	EER 10.2	280.26	$812.01	14	1.01	$0.281
Cooling	Other Cooling	EER 10.8	551.08	$9,236.60	14	0.95	$1.623
Cooling	Other Cooling	EER 11	810.50	$9,776.06	14	0.96	$1.168
Cooling	Other Cooling	EER 11.5	1,059.71	$11,124.71	14	0.96	$1.016
Heating	Air-Source Heat Pump	EER 9.3, COP 3.1	-	$0.00	16	-	$0.000

End Use	Technology	Efficiency Definition	Savings (kWh/Emp)	Incremental Cost ($/Emp)	Lifetime (Years)	BC Ratio	Levelized Cost ($/kWh)
Heating	Air-Source Heat Pump	EER 10.3, COP 3.2	621.13	$4,085.76	16	-	$0.582
Heating	Air-Source Heat Pump	EER 11.0, COP 3.3	1,239.24	$5,873.28	16	1.00	$0.420
Heating	Air-Source Heat Pump	EER 11.7, COP 3.4	1,852.79	$15,066.23	16	0.89	$0.720
Heating	Air-Source Heat Pump	EER 12.0, COP 3.4	1,852.79	$19,662.71	16	0.84	$0.939
Heating	Air-Source Heat Pump	Ductless Minisplit	2,461.79	$37,665.58	16	0.69	$1.354
Heating	Geothermal Heat Pump	EER 14.1, COP 3.3	-	$0.00	16	1.00	$0.000
Heating	Geothermal Heat Pump	EER 16, COP 3.5	1,927.36	$8,598.16	16	0.92	$0.395
Heating	Geothermal Heat Pump	EER 18, COP 3.8	4,438.00	$17,196.33	16	0.85	$0.343
Heating	Geothermal Heat Pump	EER 30, COP 5.0	8,631.91	$22,680.30	16	0.83	$0.233
Heating	Electric Room Heat	Standard	-	$0.00	25	1.00	$0.000
Heating	Electric Furnace	Standard	-	$0.00	25	1.00	$0.000
Ventilation	Ventilation	Constant Volume	-	$0.00	10	1.00	$0.000
Ventilation	Ventilation	Variable Air Volume	1,870.96	-$4,509.51	10	1.04	-$0.299
Int. Lighting	Screw-in	Incandescent	-	$0.00	2	1.00	$0.000
Int. Lighting	Screw-in	90W Halogen PAR-38	828.27	$31.27	3	-	$0.013
Int. Lighting	Screw-in	70W HIR PAR-38	1,272.52	$43.01	3	-	$0.012
Int. Lighting	Screw-in	CFL	2,382.22	$24.91	6	3.63	$0.002
Int. Lighting	Screw-in	LED (2010)	2,579.14	$661.58	20	2.50	$0.020
Int. Lighting	Screw-in	LED (2020)	2,962.59	$186.65	20	-	$0.005
Int. Lighting	High-Bay Fixtures	Metal Halides	-	$0.00	3	1.00	$0.000
Int. Lighting	High-Bay Fixtures	LED (2010)	122.73	$186.57	15	0.81	$0.140
Int. Lighting	High-Bay Fixtures	T8	124.94	-$4.96	10	1.78	-$0.005
Int. Lighting	High-Bay Fixtures	High Pressure Sodium	132.94	$0.89	6	1.78	$0.001
Int. Lighting	High-Bay Fixtures	Induction	146.61	$52.63	15	1.38	$0.033
Int. Lighting	High-Bay Fixtures	Light Emitting Plasma	155.57	$2.88	15	1.98	$0.002
Int. Lighting	High-Bay Fixtures	T5	159.46	-$2.98	10	2.20	-$0.002
Int. Lighting	High-Bay Fixtures	LED (2020)	234.52	$48.12	15	-	$0.019
Int. Lighting	Linear Fluorescent	T12	-	$0.00	10	1.00	$0.000
Int. Lighting	Linear Fluorescent	LED (2010)	1,348.78	$4,737.67	15	0.61	$0.324
Int. Lighting	Linear Fluorescent	T8	1,403.31	$1.94	10	1.34	$0.000
Int. Lighting	Linear Fluorescent	Super T8	1,946.82	$31.65	10	1.53	$0.002
Int. Lighting	Linear Fluorescent	T5	2,256.92	$51.03	10	1.66	$0.003
Int. Lighting	Linear Fluorescent	LED (2020)	4,112.71	$1,314.41	15	-	$0.030
Ext. Lighting	Screw-in	Incandescent	-	$0.00	2	1.00	$0.000
Ext. Lighting	Screw-in	90W Halogen PAR-38	1.28	$0.05	3	-	$0.013
Ext. Lighting	Screw-in	70W HIR PAR-38	1.97	$0.07	3	-	$0.012
Ext. Lighting	Screw-in	CFL	3.69	$0.04	6	3.34	$0.002
Ext. Lighting	Screw-in	LED (2010)	4.00	$1.03	20	1.80	$0.020
Ext. Lighting	Screw-in	LED (2020)	4.59	$0.29	20	-	$0.005
Ext. Lighting	HID	Metal Halides	-	$0.00	3	1.00	$0.000
Ext. Lighting	HID	LED (2010)	261.09	$925.95	15	0.45	$0.328
Ext. Lighting	HID	T8	271.83	-$7.00	10	1.27	-$0.003
Ext. Lighting	HID	Light Emitting Plasma	421.06	$31.23	15	1.32	$0.007
Ext. Lighting	HID	High Pressure Sodium	421.20	-$0.38	6	1.58	$0.000
Ext. Lighting	HID	T5	439.99	$2.67	10	1.54	$0.001
Ext. Lighting	HID	LED (2020)	805.59	$251.56	15	-	$0.029
Ext. Lighting	Linear Fluorescent	T12	-	$0.00	10	1.00	$0.000
Ext. Lighting	Linear Fluorescent	LED (2010)	0.10	$0.36	15	0.47	$0.324
Ext. Lighting	Linear Fluorescent	T8	0.11	$0.00	10	1.34	$0.000
Ext. Lighting	Linear Fluorescent	Super T8	0.15	$0.00	10	1.51	$0.002
Ext. Lighting	Linear Fluorescent	T5	0.17	$0.00	10	1.63	$0.003
Ext. Lighting	Linear Fluorescent	LED (2020)	0.31	$0.10	15	-	$0.030
Motors	Pumps	Standard	-	$0.00	10	1.00	$0.000
Motors	Pumps	High Efficiency	-	$0.00	10	1.00	$0.000
Motors	Fans & Blowers	Standard	-	$0.00	10	1.00	$0.000
Motors	Fans & Blowers	High Efficiency	13.77	$13.15	10	1.00	$0.118
Motors	Compressed Air	Standard	-	$0.00	10	1.00	$0.000
Motors	Compressed Air	High Efficiency	4.41	$2.67	10	1.00	$0.075
Motors	Matl Handling	Standard	-	$0.00	10	1.00	$0.000
Motors	Matl Handling	High Efficiency	22.81	$23.97	10	1.00	$0.130
Motors	Matl Processing	Standard	-	$0.00	10	1.00	$0.000
Motors	Matl Processing	High Efficiency	40.65	$42.71	10	1.00	$0.130

End Use	Technology	Efficiency Definition	Savings (kWh/Emp)	Incremental Cost ($/Emp)	Lifetime (Years)	BC Ratio	Levelized Cost ($/kWh)
Motors	Other Motors	Standard	-	$0.00	10	1.00	$0.000
Motors	Other Motors	High Efficiency	5.08	$5.34	10	1.00	$0.130
Process	Process Heating	Standard	-	$0.00	15	1.00	$0.000
Process	Process Cool and Refrig	Standard	-	$0.00	15	1.00	$0.000
Process	Electro-Chem Process	Standard	-	$0.00	15	1.00	$0.000
Process	Other Process	Standard	-	$0.00	15	1.00	$0.000
Miscellaneous	Miscellaneous	Standard	-	$0.00	5	1.00	$0.000

Table D-9 Energy Efficiency Equipment Data, Electric—Other Industrial, Existing Vintage

End Use	Technology	Efficiency Definition	Savings (kWh/Emp)	Incremental Cost ($/Emp)	Lifetime (Years)	BC Ratio	Levelized Cost ($/kWh)
Cooling	Air-Cooled Chiller	1.5 kw/ton, COP 2.3	-	$0.00	20	1.00	$0.000
Cooling	Air-Cooled Chiller	1.3 kw/ton, COP 2.7	2,401.71	$877.89	20	1.14	$0.028
Cooling	Air-Cooled Chiller	1.26 kw/ton, COP 2.8	2,882.03	$1,141.26	20	1.17	$0.031
Cooling	Air-Cooled Chiller	1.0 kw/ton, COP 3.5	6,004.21	$1,404.63	20	1.46	$0.018
Cooling	Air-Cooled Chiller	0.97 kw/ton, COP 3.6	6,364.52	$1,668.00	20	1.50	$0.020
Cooling	Water-Cooled Chiller	0.75 kw/ton, COP 4.7	-	$0.00	20	1.00	$0.000
Cooling	Water-Cooled Chiller	0.60 kw/ton, COP 5.9	4,417.46	$427.75	20	1.24	$0.007
Cooling	Water-Cooled Chiller	0.58 kw/ton, COP 6.1	5,007.92	$855.49	20	1.27	$0.013
Cooling	Water-Cooled Chiller	0.55 kw/Ton, COP 6.4	5,894.36	$1,026.59	20	1.34	$0.013
Cooling	Water-Cooled Chiller	0.51 kw/ton, COP 6.9	7,074.36	$1,596.91	20	1.43	$0.017
Cooling	Water-Cooled Chiller	0.50 kw/Ton, COP 7.0	7,370.15	$1,768.01	20	1.45	$0.018
Cooling	Water-Cooled Chiller	0.48 kw/ton, COP 7.3	7,962.48	$1,939.11	20	1.51	$0.019
Cooling	Roof top AC	EER 9.2	-	$0.00	16	-	$0.000
Cooling	Roof top AC	EER 10.1	2,864.89	$1,481.59	16	-	$0.046
Cooling	Roof top AC	EER 11.2	5,740.91	$2,849.21	16	1.00	$0.044
Cooling	Roof top AC	EER 12.0	7,501.59	$5,470.48	16	1.06	$0.065
Cooling	Roof top AC	Ductless Minisplit	9,397.70	$17,950.00	16	1.06	$0.169
Cooling	Air-Source Heat Pump	EER 9.3, COP 3.1	-	$0.00	16	-	$0.000
Cooling	Air-Source Heat Pump	EER 10.3, COP 3.2	3,121.77	$1,843.21	16	-	$0.052
Cooling	Air-Source Heat Pump	EER 11.0, COP 3.3	4,969.29	$2,649.62	16	1.00	$0.047
Cooling	Air-Source Heat Pump	EER 11.7, COP 3.4	6,595.62	$6,796.85	16	1.04	$0.091
Cooling	Air-Source Heat Pump	EER 12.0, COP 3.4	7,234.84	$8,870.47	16	1.06	$0.109
Cooling	Air-Source Heat Pump	Ductless Minisplit	9,151.20	$16,992.13	16	1.10	$0.164
Cooling	Geothermal Heat Pump	EER 14.1, COP 3.3	-	$0.00	16	1.00	$0.000
Cooling	Geothermal Heat Pump	EER 16, COP 3.5	1,814.56	$4,152.13	16	1.07	$0.203
Cooling	Geothermal Heat Pump	EER 18, COP 3.8	3,310.78	$8,304.27	16	1.13	$0.222
Cooling	Geothermal Heat Pump	EER 30, COP 5.0	8,098.68	$10,952.53	16	1.52	$0.120
Cooling	Other Cooling	EER 9.8	-	$0.00	14	1.00	$0.000
Cooling	Other Cooling	EER 10.2	346.55	$1,008.21	14	1.01	$0.282
Cooling	Other Cooling	EER 10.8	679.05	$11,468.41	14	0.95	$1.635
Cooling	Other Cooling	EER 11	999.26	$12,138.22	14	0.96	$1.176
Cooling	Other Cooling	EER 11.5	1,307.18	$13,812.73	14	0.96	$1.023
Heating	Air-Source Heat Pump	EER 9.3, COP 3.1	-	$0.00	16	-	$0.000
Heating	Air-Source Heat Pump	EER 10.3, COP 3.2	242.38	$3,915.17	16	-	$1.430
Heating	Air-Source Heat Pump	EER 11.0, COP 3.3	463.21	$5,628.06	16	1.00	$1.075
Heating	Air-Source Heat Pump	EER 11.7, COP 3.4	662.49	$14,437.20	16	0.90	$1.929
Heating	Air-Source Heat Pump	EER 12.0, COP 3.4	662.49	$18,841.76	16	0.85	$2.517
Heating	Air-Source Heat Pump	Ductless Minisplit	844.85	$36,092.99	16	0.71	$3.781
Heating	Geothermal Heat Pump	EER 14.1, COP 3.3	-	$0.00	16	1.00	$0.000
Heating	Geothermal Heat Pump	EER 16, COP 3.5	2,316.76	$7,889.07	16	0.93	$0.301
Heating	Geothermal Heat Pump	EER 18, COP 3.8	5,334.65	$15,778.15	16	0.87	$0.262
Heating	Geothermal Heat Pump	EER 30, COP 5.0	1,174.22	$20,809.86	16	0.81	$1.569
Heating	Electric Room Heat	Standard	-	$0.00	25	1.00	$0.000
Heating	Electric Furnace	Standard	-	$0.00	25	1.00	$0.000
Ventilation	Ventilation	Constant Volume	-	$0.00	10	1.00	$0.000
Ventilation	Ventilation	Variable Air Volume	2,244.97	-$4,572.81	10	1.04	-$0.252
Int. Lighting	Screw-in	Incandescent	-	$0.00	2	1.00	$0.000
Int. Lighting	Screw-in	90W Halogen PAR-38	834.11	$31.49	3	-	$0.013
Int. Lighting	Screw-in	70W HIR PAR-38	1,281.48	$43.32	3	-	$0.012

End Use	Technology	Efficiency Definition	Savings (kWh/Emp)	Incremental Cost ($/Emp)	Lifetime (Years)	BC Ratio	Levelized Cost ($/kWh)
Int. Lighting	Screw-in	CFL	2,399.00	$25.09	6	3.63	$0.002
Int. Lighting	Screw-in	LED (2010)	2,597.31	$666.24	20	2.50	$0.020
Int. Lighting	Screw-in	LED (2020)	2,983.46	$187.97	20	-	$0.005
Int. Lighting	High-Bay Fixtures	Metal Halides	-	$0.00	3	1.00	$0.000
Int. Lighting	High-Bay Fixtures	LED (2010)	123.60	$187.89	15	0.81	$0.140
Int. Lighting	High-Bay Fixtures	T8	125.82	-$5.00	10	1.78	-$0.005
Int. Lighting	High-Bay Fixtures	High Pressure Sodium	133.88	$0.89	6	1.78	$0.001
Int. Lighting	High-Bay Fixtures	Induction	147.64	$53.00	15	1.38	$0.033
Int. Lighting	High-Bay Fixtures	Light Emitting Plasma	156.67	$2.90	15	1.98	$0.002
Int. Lighting	High-Bay Fixtures	T5	160.59	-$3.00	10	2.20	-$0.002
Int. Lighting	High-Bay Fixtures	LED (2020)	236.17	$48.46	15	-	$0.019
Int. Lighting	Linear Fluorescent	T12	-	$0.00	10	1.00	$0.000
Int. Lighting	Linear Fluorescent	LED (2010)	1,358.28	$4,771.05	15	0.61	$0.324
Int. Lighting	Linear Fluorescent	T8	1,413.19	$1.95	10	1.34	$0.000
Int. Lighting	Linear Fluorescent	Super T8	1,960.53	$31.87	10	1.53	$0.002
Int. Lighting	Linear Fluorescent	T5	2,272.82	$51.39	10	1.66	$0.003
Int. Lighting	Linear Fluorescent	LED (2020)	4,141.69	$1,323.67	15	-	$0.030
Ext. Lighting	Screw-in	Incandescent	-	$0.00	2	1.00	$0.000
Ext. Lighting	Screw-in	90W Halogen PAR-38	1.29	$0.05	3	-	$0.013
Ext. Lighting	Screw-in	70W HIR PAR-38	1.99	$0.07	3	-	$0.012
Ext. Lighting	Screw-in	CFL	3.72	$0.04	6	3.34	$0.002
Ext. Lighting	Screw-in	LED (2010)	4.03	$1.03	20	1.80	$0.020
Ext. Lighting	Screw-in	LED (2020)	4.63	$0.29	20	-	$0.005
Ext. Lighting	HID	Metal Halides	-	$0.00	3	1.00	$0.000
Ext. Lighting	HID	LED (2010)	262.92	$932.48	15	0.45	$0.328
Ext. Lighting	HID	T8	273.74	-$7.05	10	1.27	-$0.003
Ext. Lighting	HID	Light Emitting Plasma	424.02	$31.45	15	1.32	$0.007
Ext. Lighting	HID	High Pressure Sodium	424.16	-$0.38	6	1.58	$0.000
Ext. Lighting	HID	T5	443.09	$2.69	10	1.54	$0.001
Ext. Lighting	HID	LED (2020)	811.26	$253.33	15	-	$0.029
Ext. Lighting	Linear Fluorescent	T12	-	$0.00	10	1.00	$0.000
Ext. Lighting	Linear Fluorescent	LED (2010)	0.10	$0.36	15	0.47	$0.324
Ext. Lighting	Linear Fluorescent	T8	0.11	$0.00	10	1.34	$0.000
Ext. Lighting	Linear Fluorescent	Super T8	0.15	$0.00	10	1.51	$0.002
Ext. Lighting	Linear Fluorescent	T5	0.17	$0.00	10	1.63	$0.003
Ext. Lighting	Linear Fluorescent	LED (2020)	0.31	$0.10	15	-	$0.030
Motors	Pumps	Standard	-	$0.00	10	1.00	$0.000
Motors	Pumps	High Efficiency	13.41	$11.20	10	1.00	$0.104
Motors	Fans & Blowers	Standard	-	$0.00	10	1.00	$0.000
Motors	Fans & Blowers	High Efficiency	16.54	$15.96	10	1.00	$0.120
Motors	Compressed Air	Standard	-	$0.00	10	1.00	$0.000
Motors	Compressed Air	High Efficiency	11.43	$6.99	10	1.00	$0.076
Motors	Matl Handling	Standard	-	$0.00	10	1.00	$0.000
Motors	Matl Handling	High Efficiency	5.61	$5.95	10	1.00	$0.132
Motors	Matl Processing	Standard	-	$0.00	10	1.00	$0.000
Motors	Matl Processing	High Efficiency	22.24	$23.60	10	1.00	$0.132
Motors	Other Motors	Standard	-	$0.00	10	1.00	$0.000
Motors	Other Motors	High Efficiency	0.47	$0.50	10	1.00	$0.132
Process	Process Heating	Standard	-	$0.00	15	1.00	$0.000
Process	Process Cool and Refrig	Standard	-	$0.00	15	1.00	$0.000
Process	Electro-Chem Process	Standard	-	$0.00	15	1.00	$0.000
Process	Other Process	Standard	-	$0.00	15	1.00	$0.000
Miscellaneous	Miscellaneous	Standard	-	$0.00	5	1.00	$0.000

Table D-10 Energy Efficiency Equipment Data, Electric— Other Industrial, New Vintage

End Use	Technology	Efficiency Definition	Savings (kWh/Emp)	Incremental Cost ($/Emp)	Lifetime (Years)	BC Ratio	Levelized Cost ($/kWh)
Cooling	Air-Cooled Chiller	1.5 kw/ton, COP 2.3	-	$0.00	20	1.00	$0.000
Cooling	Air-Cooled Chiller	1.3 kw/ton, COP 2.7	1,977.65	$949.72	20	1.14	$0.037
Cooling	Air-Cooled Chiller	1.26 kw/ton, COP 2.8	2,373.18	$1,234.64	20	1.17	$0.040

End Use	Technology	Efficiency Definition	Savings (kWh/Emp)	Incremental Cost ($/Emp)	Lifetime (Years)	BC Ratio	Levelized Cost ($/kWh)
Cooling	Air-Cooled Chiller	1.0 kw/ton, COP 3.5	4,944.13	$1,519.55	20	1.45	$0.024
Cooling	Air-Cooled Chiller	0.97 kw/ton, COP 3.6	5,240.86	$1,804.47	20	1.49	$0.027
Cooling	Water-Cooled Chiller	0.75 kw/ton, COP 4.7	-	$0.00	20	1.00	$0.000
Cooling	Water-Cooled Chiller	0.60 kw/ton, COP 5.9	3,776.37	$491.37	20	1.23	$0.010
Cooling	Water-Cooled Chiller	0.58 kw/ton, COP 6.1	4,281.19	$982.73	20	1.27	$0.018
Cooling	Water-Cooled Chiller	0.55 kw/Ton, COP 6.4	5,038.90	$1,179.28	20	1.33	$0.018
Cooling	Water-Cooled Chiller	0.51 kw/ton, COP 6.9	6,046.34	$1,834.44	20	1.42	$0.023
Cooling	Water-Cooled Chiller	0.50 kw/Ton, COP 7.0	6,299.47	$2,030.98	20	1.44	$0.025
Cooling	Water-Cooled Chiller	0.48 kw/ton, COP 7.3	6,805.75	$2,227.53	20	1.49	$0.025
Cooling	Roof top AC	EER 9.2	-	$0.00	16	-	$0.000
Cooling	Roof top AC	EER 10.1	2,536.08	$1,289.35	16	-	$0.045
Cooling	Roof top AC	EER 11.2	5,085.08	$2,479.53	16	1.00	$0.043
Cooling	Roof top AC	EER 12.0	6,644.32	$4,760.69	16	1.06	$0.063
Cooling	Roof top AC	Ductless Minisplit	8,322.51	$15,621.01	16	1.07	$0.166
Cooling	Air-Source Heat Pump	EER 9.3, COP 3.1	-	$0.00	16	-	$0.000
Cooling	Air-Source Heat Pump	EER 10.3, COP 3.2	2,698.52	$1,566.46	16	-	$0.051
Cooling	Air-Source Heat Pump	EER 11.0, COP 3.3	4,295.37	$2,251.78	16	1.00	$0.046
Cooling	Air-Source Heat Pump	EER 11.7, COP 3.4	5,702.04	$5,776.30	16	1.04	$0.090
Cooling	Air-Source Heat Pump	EER 12.0, COP 3.4	6,254.61	$7,538.57	16	1.06	$0.107
Cooling	Air-Source Heat Pump	Ductless Minisplit	7,912.63	$14,440.76	16	1.10	$0.162
Cooling	Geothermal Heat Pump	EER 14.1, COP 3.3	-	$0.00	16	1.00	$0.000
Cooling	Geothermal Heat Pump	EER 16, COP 3.5	1,595.90	$3,590.32	16	1.07	$0.199
Cooling	Geothermal Heat Pump	EER 18, COP 3.8	2,911.81	$7,180.64	16	1.13	$0.218
Cooling	Geothermal Heat Pump	EER 30, COP 5.0	7,122.74	$9,470.58	16	1.53	$0.118
Cooling	Other Cooling	EER 9.8	-	$0.00	14	1.00	$0.000
Cooling	Other Cooling	EER 10.2	310.47	$899.53	14	1.01	$0.281
Cooling	Other Cooling	EER 10.8	610.48	$10,232.20	14	0.95	$1.623
Cooling	Other Cooling	EER 11	897.87	$10,829.81	14	0.96	$1.168
Cooling	Other Cooling	EER 11.5	1,173.93	$12,323.83	14	0.96	$1.016
Heating	Air-Source Heat Pump	EER 9.3, COP 3.1	-	$0.00	16	-	$0.000
Heating	Air-Source Heat Pump	EER 10.3, COP 3.2	688.09	$4,526.16	16	-	$0.582
Heating	Air-Source Heat Pump	EER 11.0, COP 3.3	1,372.81	$6,506.35	16	1.00	$0.420
Heating	Air-Source Heat Pump	EER 11.7, COP 3.4	2,052.50	$16,690.21	16	0.89	$0.720
Heating	Air-Source Heat Pump	EER 12.0, COP 3.4	2,052.50	$21,782.14	16	0.84	$0.939
Heating	Air-Source Heat Pump	Ductless Minisplit	2,727.14	$41,725.52	16	0.69	$1.354
Heating	Geothermal Heat Pump	EER 14.1, COP 3.3	-	$0.00	16	1.00	$0.000
Heating	Geothermal Heat Pump	EER 16, COP 3.5	2,135.11	$9,524.95	16	0.92	$0.395
Heating	Geothermal Heat Pump	EER 18, COP 3.8	4,916.37	$19,049.91	16	0.85	$0.343
Heating	Geothermal Heat Pump	EER 30, COP 5.0	9,562.34	$25,124.99	16	0.83	$0.233
Heating	Electric Room Heat	Standard	-	$0.00	25	1.00	$0.000
Heating	Electric Furnace	Standard	-	$0.00	25	1.00	$0.000
Ventilation	Ventilation	Constant Volume	-	$0.00	10	1.00	$0.000
Ventilation	Ventilation	Variable Air Volume	2,072.63	-$4,995.58	10	1.04	-$0.299
Int. Lighting	Screw-in	Incandescent	-	$0.00	2	1.00	$0.000
Int. Lighting	Screw-in	90W Halogen PAR-38	834.11	$31.49	3	-	$0.013
Int. Lighting	Screw-in	70W HIR PAR-38	1,281.48	$43.32	3	-	$0.012
Int. Lighting	Screw-in	CFL	2,399.00	$25.09	6	3.63	$0.002
Int. Lighting	Screw-in	LED (2010)	2,597.31	$666.24	20	2.50	$0.020
Int. Lighting	Screw-in	LED (2020)	2,983.46	$187.97	20	-	$0.005
Int. Lighting	High-Bay Fixtures	Metal Halides	-	$0.00	3	1.00	$0.000
Int. Lighting	High-Bay Fixtures	LED (2010)	123.60	$187.89	15	0.81	$0.140
Int. Lighting	High-Bay Fixtures	T8	125.82	-$5.00	10	1.78	-$0.005
Int. Lighting	High-Bay Fixtures	High Pressure Sodium	133.88	$0.89	6	1.78	$0.001
Int. Lighting	High-Bay Fixtures	Induction	147.64	$53.00	15	1.38	$0.033
Int. Lighting	High-Bay Fixtures	Light Emitting Plasma	156.67	$2.90	15	1.98	$0.002
Int. Lighting	High-Bay Fixtures	T5	160.59	-$3.00	10	2.20	-$0.002
Int. Lighting	High-Bay Fixtures	LED (2020)	236.17	$48.46	15	-	$0.019
Int. Lighting	Linear Fluorescent	T12	-	$0.00	10	1.00	$0.000
Int. Lighting	Linear Fluorescent	LED (2010)	1,358.28	$4,771.05	15	0.61	$0.324
Int. Lighting	Linear Fluorescent	T8	1,413.19	$1.95	10	1.34	$0.000
Int. Lighting	Linear Fluorescent	Super T8	1,960.53	$31.87	10	1.53	$0.002
Int. Lighting	Linear Fluorescent	T5	2,272.82	$51.39	10	1.66	$0.003

End Use	Technology	Efficiency Definition	Savings (kWh/Emp)	Incremental Cost ($/Emp)	Lifetime (Years)	BC Ratio	Levelized Cost ($/kWh)
Int. Lighting	Linear Fluorescent	LED (2020)	4,141.69	$1,323.67	15	-	$0.030
Ext. Lighting	Screw-in	Incandescent	-	$0.00	2	1.00	$0.000
Ext. Lighting	Screw-in	90W Halogen PAR-38	1.29	$0.05	3	-	$0.013
Ext. Lighting	Screw-in	70W HIR PAR-38	1.99	$0.07	3	-	$0.012
Ext. Lighting	Screw-in	CFL	3.72	$0.04	6	3.34	$0.002
Ext. Lighting	Screw-in	LED (2010)	4.03	$1.03	20	1.80	$0.020
Ext. Lighting	Screw-in	LED (2020)	4.63	$0.29	20	-	$0.005
Ext. Lighting	HID	Metal Halides	-	$0.00	3	1.00	$0.000
Ext. Lighting	HID	LED (2010)	262.92	$932.48	15	0.45	$0.328
Ext. Lighting	HID	T8	273.74	-$7.05	10	1.27	-$0.003
Ext. Lighting	HID	Light Emitting Plasma	424.02	$31.45	15	1.32	$0.007
Ext. Lighting	HID	High Pressure Sodium	424.16	-$0.38	6	1.58	$0.000
Ext. Lighting	HID	T5	443.09	$2.69	10	1.54	$0.001
Ext. Lighting	HID	LED (2020)	811.26	$253.33	15	-	$0.029
Ext. Lighting	Linear Fluorescent	T12	-	$0.00	10	1.00	$0.000
Ext. Lighting	Linear Fluorescent	LED (2010)	0.10	$0.36	15	0.47	$0.324
Ext. Lighting	Linear Fluorescent	T8	0.11	$0.00	10	1.34	$0.000
Ext. Lighting	Linear Fluorescent	Super T8	0.15	$0.00	10	1.51	$0.002
Ext. Lighting	Linear Fluorescent	T5	0.17	$0.00	10	1.63	$0.003
Ext. Lighting	Linear Fluorescent	LED (2020)	0.31	$0.10	15	-	$0.030
Motors	Pumps	Standard	-	$0.00	10	1.00	$0.000
Motors	Pumps	High Efficiency	13.41	$11.09	10	1.00	$0.102
Motors	Fans & Blowers	Standard	-	$0.00	10	1.00	$0.000
Motors	Fans & Blowers	High Efficiency	16.54	$15.80	10	1.00	$0.118
Motors	Compressed Air	Standard	-	$0.00	10	1.00	$0.000
Motors	Compressed Air	High Efficiency	11.43	$6.92	10	1.00	$0.075
Motors	Matl Handling	Standard	-	$0.00	10	1.00	$0.000
Motors	Matl Handling	High Efficiency	5.61	$5.89	10	1.00	$0.130
Motors	Matl Processing	Standard	-	$0.00	10	1.00	$0.000
Motors	Matl Processing	High Efficiency	22.24	$23.36	10	1.00	$0.130
Motors	Other Motors	Standard	-	$0.00	10	1.00	$0.000
Motors	Other Motors	High Efficiency	0.47	$0.49	10	1.00	$0.130
Process	Process Heating	Standard	-	$0.00	15	1.00	$0.000
Process	Process Cool and Refrig	Standard	-	$0.00	15	1.00	$0.000
Process	Electro-Chem Process	Standard	-	$0.00	15	1.00	$0.000
Process	Other Process	Standard	-	$0.00	15	1.00	$0.000
Miscellaneous	Miscellaneous	Standard	-	$0.00	5	1.00	$0.000

Table D-11 Energy Efficiency Non-Equipment Data— Chemicals, Existing Vintage

Measure	Base Saturation	Applicability	Lifetime (Years)	Incremental Cost ($/Emp)	Savings (kWh/Emp)	BC Ratio	Levelized Cost of Energy ($/kWh)
Insulation - Ceiling	3.6%	12.5%	20	$0.52	3.558	8.75	$0.011
Insulation - Ducting	7.0%	12.5%	20	$0.77	0.439	0.92	$0.135
Insulation - Wall Cavity	3.6%	12.5%	20	$0.49	2.546	6.47	$0.015
HVAC - Duct Repair and Sealing	5.0%	25.0%	15	$0.50	1.020	1.96	$0.045
Air-Cooled Chiller - Economizer	26.8%	48.8%	15	$0.00	0.571	1,302.79	$0.000
Air-Cooled Chiller - Efficient Mechanical Layout	62.2%	90.0%	4	$0.06	0.496	6.86	$0.033
Air-Cooled Chiller - Maintenance	46.4%	90.0%	4	$0.04	0.334	10.06	$0.031
Air-Cooled Chiller - Chilled Water Reset	5.0%	75.0%	10	$0.06	0.375	18.16	$0.020
Air-Cooled Chiller - Chilled Water Variable-Flow System	30.0%	75.0%	10	$0.01	0.070	14.29	$0.025
Air-Cooled Chiller - Condenser Water Temperature Reset	30.0%	75.0%	4	$0.18	0.207	1.32	$0.234
Air-Cooled Chiller - High Efficiency Cooling Tower Fans	15.0%	41.3%	10	$0.10	0.680	19.05	$0.019
Air-Cooled Chiller - VSD on Fans	15.0%	66.2%	20	$1.17	0.808	3.92	$0.112
Water-Cooled Chiller - Economizer	26.8%	48.8%	15	$0.00	0.565	1,275.99	$0.000

Measure	Base Saturation	Applicability	Lifetime (Years)	Incremental Cost ($/Emp)	Savings (kWh/Emp)	BC Ratio	Levelized Cost of Energy ($/kWh)
Water-Cooled Chiller - Efficient Mechanical Layout	62.2%	90.0%	4	$0.06	0.481	6.65	$0.034
Water-Cooled Chiller - Maintenance	46.4%	90.0%	4	$0.04	0.321	9.75	$0.032
Water-Cooled Chiller - Chilled Water Reset	5.0%	75.0%	10	$0.06	0.467	22.57	$0.016
Water-Cooled Chiller - Chilled Water Variable-Flow System	30.0%	75.0%	10	$0.01	0.080	16.41	$0.022
Water-Cooled Chiller - Condenser Water Temperature Reset	30.0%	75.0%	4	$0.18	0.043	0.27	$1.136
Water-Cooled Chiller - High Efficiency Cooling Tower Fans	15.0%	41.3%	10	$0.10	0.001	0.04	$8.874
Water-Cooled Chiller - VSD on Fans	15.0%	66.2%	20	$1.17	0.193	0.92	$0.466
RTU - Maintenance	46.4%	90.0%	4	$0.08	0.514	5.29	$0.039
Heat Pump - Maintenance	46.4%	95.0%	4	$0.06	0.257	3.19	$0.063
Roof - High Reflectivity	35.9%	75.0%	15	$0.32	0.351	3.14	$0.084
Energy Management System	33.0%	75.0%	14	$0.35	2.380	8.89	$0.014
Thermostat - Clock/Programmable	40.8%	50.0%	11	$0.13	0.214	0.98	$0.070
Interior Lighting - Occupancy Sensors	6.9%	56.3%	8	$0.01	0.305	29.68	$0.003
Interior Lighting - Skylights	15.3%	20.3%	8	$0.29	0.976	1.44	$0.043
Interior Lighting - Timeclocks and Timers	27.6%	56.3%	8	$0.01	0.038	3.29	$0.029
Interior Lighting - LED Exit Lighting	50.0%	85.5%	10	$0.00	0.002	0.90	$0.114
Interior Lighting - Daylighting Controls	4.3%	20.3%	8	$0.00	0.228	1.00	$0.000
Interior Lighting - Task Lighting	0.6%	75.0%	5	$0.24	0.079	0.09	$0.670
Interior Fluorescent - Bi-Level Fixture	10.0%	22.5%	8	$0.20	0.222	0.56	$0.133
Interior Fluorescent - Delamp and Install Reflectors	0.6%	56.3%	11	$0.50	0.188	0.28	$0.306
Exterior Lighting - Bi-Level Fixture	10.0%	30.0%	8	$0.20	0.000	0.00	$207.804
Exterior Lighting - Daylighting Controls	18.0%	37.5%	8	$0.02	0.001	0.25	$4.156
Exterior Lighting - Photovoltaic Installation	0.0%	12.5%	5	$0.92	0.000	0.00	$474.955
Process - Conductivity Controls	20.0%	100.0%	5	$0.53	1.000	0.44	$0.117
Process - Controls on Fume Hoods	30.0%	100.0%	10	$0.13	1.000	4.15	$0.016
Process - Timers and Controls	40.0%	100.0%	5	$0.42	2.000	1.12	$0.046
Refrigeration - Floating Head Pressure	30.0%	90.0%	18	$0.57	1.000	1.99	$0.047
Refrigeration - System Controls	40.0%	56.0%	18	$1.33	1.000	0.85	$0.109
Refrigeration - System Maintenance	30.0%	72.0%	3	$0.24	1.000	0.56	$0.085
Refrigeration - System Optimization	40.0%	56.0%	15	$0.15	1.000	5.99	$0.014
Compressed Air - Air Usage Reduction	20.2%	25.9%	10	$0.08	1.000	7.16	$0.010
Compressed Air - Compressor Replacement	14.6%	17.1%	10	$0.06	1.000	9.67	$0.008
Compressed Air - System Controls	5.0%	33.8%	15	$0.01	1.000	84.74	$0.001
Compressed Air - System Maintenance	5.0%	33.8%	3	$0.03	1.000	4.09	$0.012
Compressed Air - System Optimization and Improvements	24.8%	35.6%	10	$0.20	1.000	3.29	$0.025
Pumping System - Controls	22.8%	31.0%	10	$0.01	1.000	48.63	$0.001
Pumping System - Maintenance	5.0%	33.8%	3	$0.02	1.000	6.08	$0.008
Pumping System - Optimization	22.4%	30.0%	10	$0.28	1.000	2.40	$0.034
Pumps - Variable Speed Control	5.0%	33.8%	15	$0.02	1.000	46.38	$0.002
Pump Equipment Upgrade	24.0%	33.6%	10	$0.13	1.000	4.50	$0.016
Fan Equipment Upgrade	18.6%	23.2%	10	$0.09	1.000	7.03	$0.011
Fan System - Controls	20.9%	27.2%	10	$0.01	1.000	49.28	$0.001
Fan System - Maintenance	10.0%	37.5%	3	$0.01	1.000	12.79	$0.004

Measure	Base Saturation	Applicability	Lifetime (Years)	Incremental Cost ($/Emp)	Savings (kWh/Emp)	BC Ratio	Levelized Cost of Energy ($/kWh)
Fan System - Optimization	22.2%	29.6%	10	$0.13	1.000	5.00	$0.016
Fans - Variable Speed Control	10.0%	37.5%	15	$0.01	1.000	73.58	$0.001
Motors - Magnetic Adjustable Speed Drives	5.0%	15.0%	20	$0.19	1.000	7.85	$0.014
Motors - Efficient Rewind	14.9%	17.4%	10	$0.35	1.000	1.49	$0.043
Motors - Variable Frequency Drive	5.0%	33.8%	15	$0.02	1.000	46.38	$0.002
Motors - Synchronous Belts	17.3%	21.0%	10	$0.22	1.000	2.43	$0.027
Commissioning - HVAC	75.0%	75.0%	25	$0.00	-	3.00	$0.000
Commissioning - Lighting	60.0%	75.0%	25	$0.00	-	2.00	$0.000
Retrocommissioning - HVAC	0.6%	24.0%	4	$0.75	1.356	0.61	$0.149
Retrocommissioning - Lighting	0.6%	30.6%	5	$0.05	0.076	0.60	$0.145
Ventilation - CO2 Controlled	1.0%	7.5%	10	$0.65	0.045	0.06	$1.772
Transformer - High Efficiency	8.6%	9.4%	10	$0.11	0.930	5.23	$0.015
Custom Measures	10.0%	45.0%	15	$0.67	-	-	$0.000

Table D-12 Energy Efficiency Non-Equipment Data— Chemicals, New Vintage

Measure	Base Saturation	Applicability	Lifetime (Years)	Incremental Cost ($/Emp)	Savings (kWh/Emp)	BC Ratio	Levelized Cost of Energy ($/kWh)
Insulation - Ceiling	3.6%	12.5%	20	$0.68	1.322	3.01	$0.040
Insulation - Ducting	7.0%	12.5%	20	$0.77	0.461	0.92	$0.129
Insulation - Wall Cavity	3.6%	12.5%	20	$0.32	0.552	2.38	$0.045
HVAC - Duct Repair and Sealing	25.0%	25.0%	15	$0.50	0.426	0.91	$0.108
Air-Cooled Chiller - Economizer	26.8%	48.8%	15	$0.00	0.355	972.93	$0.001
Air-Cooled Chiller - Efficient Mechanical Layout	62.8%	90.0%	4	$0.06	0.316	5.45	$0.051
Air-Cooled Chiller - Maintenance	46.4%	90.0%	4	$0.04	0.210	8.52	$0.046
Air-Cooled Chiller - Chilled Water Reset	25.0%	75.0%	10	$0.06	0.248	14.38	$0.032
Air-Cooled Chiller - Chilled Water Variable-Flow System	30.0%	75.0%	10	$0.01	0.079	22.10	$0.021
Air-Cooled Chiller - Condenser Water Temperature Reset	60.0%	75.0%	4	$0.18	0.147	1.20	$0.329
Air-Cooled Chiller - High Efficiency Cooling Tower Fans	15.0%	41.3%	10	$0.11	0.520	17.47	$0.026
Air-Cooled Chiller - VSD on Fans	15.0%	66.2%	20	$1.17	0.598	3.74	$0.151
Water-Cooled Chiller - Economizer	26.8%	48.8%	15	$0.00	0.244	627.62	$0.001
Water-Cooled Chiller - Efficient Mechanical Layout	62.8%	90.0%	4	$0.06	0.338	5.45	$0.048
Water-Cooled Chiller - Maintenance	46.4%	90.0%	4	$0.04	0.222	8.49	$0.044
Water-Cooled Chiller - Chilled Water Reset	25.0%	75.0%	10	$0.06	0.288	15.68	$0.027
Water-Cooled Chiller - Chilled Water Variable-Flow System	30.0%	75.0%	10	$0.01	0.107	27.87	$0.015
Water-Cooled Chiller - Condenser Water Temperature Reset	60.0%	75.0%	4	$0.18	0.011	0.08	$4.460
Water-Cooled Chiller - High Efficiency Cooling Tower Fans	15.0%	41.3%	10	$0.11	0.002	0.07	$6.032
Water-Cooled Chiller - VSD on Fans	15.0%	66.2%	20	$1.17	0.086	0.50	$1.052
RTU - Maintenance	46.4%	90.0%	4	$0.08	0.328	4.34	$0.062
Heat Pump - Maintenance	46.4%	95.0%	4	$0.06	0.207	3.22	$0.078
Roof - High Reflectivity	35.9%	95.0%	15	$0.32	0.234	2.77	$0.127
Energy Management System	33.0%	75.0%	14	$0.35	1.827	7.97	$0.019
Thermostat - Clock/Programmable	40.8%	86.3%	11	$0.13	1.091	9.69	$0.014
Interior Lighting - Occupancy	6.9%	56.3%	8	$0.01	0.210	25.68	$0.005

Measure	Base Saturation	Applicability	Lifetime (Years)	Incremental Cost ($/Emp)	Savings (kWh/Emp)	BC Ratio	Levelized Cost of Energy ($/kWh)
Sensors							
Interior Lighting - Skylights	42.2%	42.2%	8	$0.19	0.614	1.67	$0.046
Interior Lighting - Timeclocks and Timers	27.6%	56.3%	8	$0.01	0.026	2.85	$0.045
Interior Lighting - LED Exit Lighting	85.5%	85.5%	10	$0.00	0.001	0.77	$0.177
Interior Lighting - Daylighting Controls	4.3%	42.2%	8	$0.00	0.157	1.00	$0.000
Interior Lighting - Task Lighting	0.6%	75.0%	5	$0.24	0.054	0.12	$0.972
Interior Fluorescent - Bi-Level Fixture	10.0%	22.5%	8	$0.20	0.208	0.54	$0.142
Interior Fluorescent - Delamp and Install Reflectors	0.6%	56.3%	11	$0.50	-	-	$0.000
Exterior Lighting - Bi-Level Fixture	10.0%	30.0%	8	$0.20	0.000	0.01	$363.410
Exterior Lighting - Daylighting Controls	18.0%	37.5%	8	$0.02	0.000	0.34	$7.268
Exterior Lighting - Photovoltaic Installation	0.0%	12.5%	5	$0.92	0.000	0.00	$830.607
Process - Conductivity Controls	20.0%	100.0%	5	$0.53	1.000	0.44	$0.117
Process - Controls on Fume Hoods	30.0%	100.0%	10	$0.13	1.000	4.15	$0.016
Process - Timers and Controls	40.0%	100.0%	5	$0.42	2.000	1.13	$0.046
Refrigeration - Floating Head Pressure	30.0%	90.0%	18	$0.57	1.000	1.99	$0.047
Refrigeration - System Controls	40.0%	56.0%	18	$1.33	1.000	0.85	$0.109
Refrigeration - System Maintenance	30.0%	72.0%	3	$0.24	1.000	0.56	$0.085
Refrigeration - System Optimization	40.0%	56.0%	15	$0.15	1.000	5.99	$0.014
Compressed Air - Air Usage Reduction	20.2%	25.9%	10	$0.08	1.000	7.21	$0.010
Compressed Air - Compressor Replacement	14.6%	17.1%	10	$0.06	1.000	9.75	$0.008
Compressed Air - System Controls	5.0%	33.8%	15	$0.01	1.000	85.48	$0.001
Compressed Air - System Maintenance	5.0%	33.8%	3	$0.03	1.000	4.11	$0.012
Compressed Air - System Optimization and Improvements	24.8%	35.6%	10	$0.20	1.000	3.32	$0.025
Pumping System - Controls	22.8%	31.0%	10	$0.01	1.000	49.02	$0.001
Pumping System - Maintenance	5.0%	33.8%	3	$0.02	1.000	6.11	$0.008
Pumping System - Optimization	22.4%	30.0%	10	$0.28	1.000	2.42	$0.034
Pumps - Variable Speed Control	5.0%	33.8%	15	$0.02	1.000	46.79	$0.002
Pump Equipment Upgrade	24.0%	33.6%	10	$0.13	1.000	4.54	$0.016
Fan Equipment Upgrade	18.6%	23.2%	10	$0.09	1.000	7.09	$0.011
Fan System - Controls	20.9%	27.2%	10	$0.01	1.000	49.67	$0.001
Fan System - Maintenance	10.0%	37.5%	3	$0.01	1.000	12.86	$0.004
Fan System - Optimization	22.2%	29.6%	10	$0.13	1.000	5.04	$0.016
Fans - Variable Speed Control	10.0%	37.5%	15	$0.01	1.000	74.23	$0.001
Motors - Magnetic Adjustable Speed Drives	5.0%	15.0%	20	$0.19	1.000	7.92	$0.014
Motors - Efficient Rewind	14.9%	17.4%	10	$0.35	1.000	1.50	$0.043
Motors - Variable Frequency Drive	5.0%	33.8%	15	$0.02	1.000	46.79	$0.002
Motors - Synchronous Belts	17.3%	21.0%	10	$0.22	1.000	2.45	$0.027
Commissioning - HVAC	75.0%	75.0%	25	$1.00	1.203	3.31	$0.057
Commissioning - Lighting	60.0%	75.0%	25	$0.15	0.053	1.05	$0.195
Retrocommissioning - HVAC	0.6%	24.0%	4	$0.75	-	-	$0.000
Retrocommissioning - Lighting	0.6%	30.6%	5	$0.00	-	2.00	$0.000
Ventilation - CO2 Controlled	5.9%	7.5%	10	$0.65	0.036	0.06	$2.216
Transformer - High Efficiency	8.6%	9.4%	10	$0.11	0.930	5.37	$0.015
Custom Measures	10.0%	45.0%	15	$0.67	-	-	$0.000

Table D-13 Energy Efficiency Non-Equipment Data— Plastics, Existing Vintage

Measure	Base Saturation	Applicability	Lifetime (Years)	Incremental Cost ($/Emp)	Savings (kWh/Emp)	BC Ratio	Levelized Cost of Energy ($/kWh)
Insulation - Ceiling	3.6%	12.5%	20	$0.52	3.558	8.75	$0.011
Insulation - Ducting	7.0%	12.5%	20	$0.77	0.439	0.92	$0.135
Insulation - Wall Cavity	3.6%	12.5%	20	$0.49	2.546	6.47	$0.015
HVAC - Duct Repair and Sealing	5.0%	25.0%	15	$0.50	1.020	1.96	$0.045
Air-Cooled Chiller - Economizer	26.8%	48.8%	15	$0.00	0.571	1,302.79	$0.000
Air-Cooled Chiller - Efficient Mechanical Layout	62.2%	90.0%	4	$0.06	0.496	6.86	$0.033
Air-Cooled Chiller - Maintenance	46.4%	90.0%	4	$0.04	0.334	10.06	$0.031
Air-Cooled Chiller - Chilled Water Reset	5.0%	75.0%	10	$0.06	0.375	18.16	$0.020
Air-Cooled Chiller - Chilled Water Variable-Flow System	30.0%	75.0%	10	$0.01	0.070	14.29	$0.025
Air-Cooled Chiller - Condenser Water Temperature Reset	30.0%	75.0%	4	$0.18	0.207	1.32	$0.234
Air-Cooled Chiller - High Efficiency Cooling Tower Fans	15.0%	41.3%	10	$0.10	0.680	19.05	$0.019
Air-Cooled Chiller - VSD on Fans	15.0%	66.2%	20	$1.17	0.808	3.92	$0.112
Water-Cooled Chiller - Economizer	26.8%	48.8%	15	$0.00	0.565	1,275.99	$0.000
Water-Cooled Chiller - Efficient Mechanical Layout	62.2%	90.0%	4	$0.06	0.481	6.65	$0.034
Water-Cooled Chiller - Maintenance	46.4%	90.0%	4	$0.04	0.321	9.75	$0.032
Water-Cooled Chiller - Chilled Water Reset	5.0%	75.0%	10	$0.06	0.467	22.57	$0.016
Water-Cooled Chiller - Chilled Water Variable-Flow System	30.0%	75.0%	10	$0.01	0.080	16.41	$0.022
Water-Cooled Chiller - Condenser Water Temperature Reset	30.0%	75.0%	4	$0.18	0.043	0.27	$1.136
Water-Cooled Chiller - High Efficiency Cooling Tower Fans	15.0%	41.3%	10	$0.10	0.001	0.04	$8.874
Water-Cooled Chiller - VSD on Fans	15.0%	66.2%	20	$1.17	0.193	0.92	$0.466
RTU - Maintenance	46.4%	90.0%	4	$0.08	0.514	5.29	$0.039
Heat Pump - Maintenance	46.4%	95.0%	4	$0.06	0.257	3.19	$0.063
Roof - High Reflectivity	35.9%	75.0%	15	$0.32	0.351	3.14	$0.084
Energy Management System	33.0%	75.0%	14	$0.35	2.380	8.89	$0.014
Thermostat - Clock/Programmable	40.8%	50.0%	11	$0.13	0.214	0.98	$0.070
Interior Lighting - Occupancy Sensors	6.9%	56.3%	8	$0.01	0.305	29.68	$0.003
Interior Lighting - Skylights	15.3%	20.3%	8	$0.29	0.976	1.44	$0.043
Interior Lighting - Timeclocks and Timers	27.6%	56.3%	8	$0.01	0.038	3.29	$0.029
Interior Lighting - LED Exit Lighting	50.0%	85.5%	10	$0.00	0.002	0.90	$0.114
Interior Lighting - Daylighting Controls	4.3%	20.3%	8	$0.00	0.228	1.00	$0.000
Interior Lighting - Task Lighting	0.6%	75.0%	5	$0.24	0.079	0.09	$0.670
Interior Fluorescent - Bi-Level Fixture	10.0%	22.5%	8	$0.20	0.222	0.56	$0.133
Interior Fluorescent - Delamp and Install Reflectors	0.6%	56.3%	11	$0.50	0.188	0.28	$0.306
Exterior Lighting - Bi-Level Fixture	10.0%	30.0%	8	$0.20	0.000	0.00	$207.804
Exterior Lighting - Daylighting Controls	18.0%	37.5%	8	$0.02	0.001	0.25	$4.156
Exterior Lighting - Photovoltaic Installation	0.0%	12.5%	5	$0.92	0.000	0.00	$474.955
Process - Conductivity Controls	20.0%	100.0%	5	$0.53	1.000	0.44	$0.117
Process - Controls on Fume Hoods	30.0%	100.0%	10	$0.13	1.000	4.15	$0.016
Process - Timers and Controls	40.0%	100.0%	5	$0.42	2.000	1.12	$0.046
Refrigeration - Floating Head Pressure	30.0%	90.0%	18	$0.57	1.000	1.99	$0.047
Refrigeration - System Controls	40.0%	56.0%	18	$1.33	1.000	0.85	$0.109

Measure	Base Saturation	Applicability	Lifetime (Years)	Incremental Cost ($/Emp)	Savings (kWh/Emp)	BC Ratio	Levelized Cost of Energy ($/kWh)
Refrigeration - System Maintenance	30.0%	72.0%	3	$0.24	1.000	0.56	$0.085
Refrigeration - System Optimization	40.0%	56.0%	15	$0.15	1.000	5.99	$0.014
Compressed Air - Air Usage Reduction	20.2%	25.9%	10	$0.08	1.000	7.16	$0.010
Compressed Air - Compressor Replacement	14.6%	17.1%	10	$0.06	1.000	9.67	$0.008
Compressed Air - System Controls	5.0%	33.8%	15	$0.01	1.000	84.74	$0.001
Compressed Air - System Maintenance	5.0%	33.8%	3	$0.03	1.000	4.09	$0.012
Compressed Air - System Optimization and Improvements	24.8%	35.6%	10	$0.20	1.000	3.29	$0.025
Pumping System - Controls	22.8%	31.0%	10	$0.01	1.000	48.63	$0.001
Pumping System - Maintenance	5.0%	33.8%	3	$0.02	1.000	6.08	$0.008
Pumping System - Optimization	22.4%	30.0%	10	$0.28	1.000	2.40	$0.034
Pumps - Variable Speed Control	5.0%	33.8%	15	$0.02	1.000	46.38	$0.002
Pump Equipment Upgrade	24.0%	33.6%	10	$0.13	1.000	4.50	$0.016
Fan Equipment Upgrade	18.6%	23.2%	10	$0.09	1.000	7.03	$0.011
Fan System - Controls	20.9%	27.2%	10	$0.01	1.000	49.28	$0.001
Fan System - Maintenance	10.0%	37.5%	3	$0.01	1.000	12.79	$0.004
Fan System - Optimization	22.2%	29.6%	10	$0.13	1.000	5.00	$0.016
Fans - Variable Speed Control	10.0%	37.5%	15	$0.01	1.000	73.58	$0.001
Motors - Magnetic Adjustable Speed Drives	5.0%	15.0%	20	$0.19	1.000	7.85	$0.014
Motors - Efficient Rewind	10.9%	12.1%	10	$0.35	1.000	1.49	$0.043
Motors - Variable Frequency Drive	5.0%	33.8%	15	$0.02	1.000	46.38	$0.002
Motors - Synchronous Belts	17.3%	21.0%	10	$0.22	1.000	2.33	$0.028
Commissioning - HVAC	75.0%	75.0%	25	$0.00	-	3.00	$0.000
Commissioning - Lighting	60.0%	75.0%	25	$0.00	-	2.00	$0.000
Retrocommissioning - HVAC	0.6%	24.0%	4	$0.75	1.356	0.61	$0.149
Retrocommissioning - Lighting	0.6%	30.6%	5	$0.05	0.076	0.60	$0.145
Ventilation - CO2 Controlled	1.0%	7.5%	10	$0.65	0.045	0.06	$1.772
Transformer - High Efficiency	8.6%	9.4%	10	$0.13	0.903	4.22	$0.018
Custom Measures	10.0%	45.0%	15	$0.67	-	-	$0.000
Injection Molding Barrel Insulation	25.0%	25.0%	5	$490.00	10,000.000	6.33	$0.011

Table D-14 Energy Efficiency Non-Equipment Data— Plastics, New Vintage

Measure	Base Saturation	Applicability	Lifetime (Years)	Incremental Cost ($/Emp)	Savings (kWh/Emp)	BC Ratio	Levelized Cost of Energy ($/kWh)
Insulation - Ceiling	3.6%	12.5%	20	$0.68	1.322	3.01	$0.040
Insulation - Ducting	7.0%	12.5%	20	$0.77	0.461	0.92	$0.129
Insulation - Wall Cavity	3.6%	12.5%	20	$0.32	0.552	2.38	$0.045
HVAC - Duct Repair and Sealing	25.0%	25.0%	15	$0.50	0.426	0.91	$0.108
Air-Cooled Chiller - Economizer	26.8%	48.8%	15	$0.00	0.355	972.93	$0.001
Air-Cooled Chiller - Efficient Mechanical Layout	62.8%	90.0%	4	$0.06	0.316	5.45	$0.051
Air-Cooled Chiller - Maintenance	46.4%	90.0%	4	$0.04	0.210	8.52	$0.046
Air-Cooled Chiller - Chilled Water Reset	25.0%	75.0%	10	$0.06	0.248	14.38	$0.032
Air-Cooled Chiller - Chilled Water Variable-Flow System	30.0%	75.0%	10	$0.01	0.079	22.10	$0.021
Air-Cooled Chiller - Condenser Water Temperature Reset	60.0%	75.0%	4	$0.18	0.147	1.20	$0.329
Air-Cooled Chiller - High Efficiency Cooling Tower Fans	15.0%	41.3%	10	$0.11	0.520	17.47	$0.026
Air-Cooled Chiller - VSD on Fans	15.0%	66.2%	20	$1.17	0.598	3.74	$0.151
Water-Cooled Chiller - Economizer	26.8%	48.8%	15	$0.00	0.244	627.62	$0.001

Measure	Base Saturation	Applicability	Lifetime (Years)	Incremental Cost ($/Emp)	Savings (kWh/Emp)	BC Ratio	Levelized Cost of Energy ($/kWh)
Water-Cooled Chiller - Efficient Mechanical Layout	62.8%	90.0%	4	$0.06	0.338	5.45	$0.048
Water-Cooled Chiller - Maintenance	46.4%	90.0%	4	$0.04	0.222	8.49	$0.044
Water-Cooled Chiller - Chilled Water Reset	25.0%	75.0%	10	$0.06	0.288	15.68	$0.027
Water-Cooled Chiller - Chilled Water Variable-Flow System	30.0%	75.0%	10	$0.01	0.107	27.87	$0.015
Water-Cooled Chiller - Condenser Water Temperature Reset	60.0%	75.0%	4	$0.18	0.011	0.08	$4.460
Water-Cooled Chiller - High Efficiency Cooling Tower Fans	15.0%	41.3%	10	$0.11	0.002	0.07	$6.032
Water-Cooled Chiller - VSD on Fans	15.0%	66.2%	20	$1.17	0.086	0.50	$1.052
RTU - Maintenance	46.4%	90.0%	4	$0.08	0.328	4.34	$0.062
Heat Pump - Maintenance	46.4%	95.0%	4	$0.06	0.207	3.22	$0.078
Roof - High Reflectivity	35.9%	95.0%	15	$0.32	0.234	2.77	$0.127
Energy Management System	33.0%	75.0%	14	$0.35	1.827	7.97	$0.019
Thermostat - Clock/Programmable	40.8%	86.3%	11	$0.13	1.091	9.69	$0.014
Interior Lighting - Occupancy Sensors	6.9%	56.3%	8	$0.01	0.210	25.68	$0.005
Interior Lighting - Skylights	42.2%	42.2%	8	$0.19	0.614	1.67	$0.046
Interior Lighting - Timeclocks and Timers	27.6%	56.3%	8	$0.01	0.026	2.85	$0.045
Interior Lighting - LED Exit Lighting	85.5%	85.5%	10	$0.00	0.001	0.77	$0.177
Interior Lighting - Daylighting Controls	4.3%	42.2%	8	$0.00	0.157	1.00	$0.000
Interior Lighting - Task Lighting	0.6%	75.0%	5	$0.24	0.054	0.12	$0.972
Interior Fluorescent - Bi-Level Fixture	10.0%	22.5%	8	$0.20	0.208	0.54	$0.142
Interior Fluorescent - Delamp and Install Reflectors	0.6%	56.3%	11	$0.50	-	-	$0.000
Exterior Lighting - Bi-Level Fixture	10.0%	30.0%	8	$0.20	0.000	0.01	$363.410
Exterior Lighting - Daylighting Controls	18.0%	37.5%	8	$0.02	0.000	0.34	$7.268
Exterior Lighting - Photovoltaic Installation	0.0%	12.5%	5	$0.92	0.000	0.00	$830.607
Process - Conductivity Controls	20.0%	100.0%	5	$0.53	1.000	0.44	$0.117
Process - Controls on Fume Hoods	30.0%	100.0%	10	$0.13	1.000	4.15	$0.016
Process - Timers and Controls	40.0%	100.0%	5	$0.42	2.000	1.13	$0.046
Refrigeration - Floating Head Pressure	30.0%	90.0%	18	$0.57	1.000	1.99	$0.047
Refrigeration - System Controls	40.0%	56.0%	18	$1.33	1.000	0.85	$0.109
Refrigeration - System Maintenance	30.0%	72.0%	3	$0.24	1.000	0.56	$0.085
Refrigeration - System Optimization	40.0%	56.0%	15	$0.15	1.000	5.99	$0.014
Compressed Air - Air Usage Reduction	20.2%	25.9%	10	$0.08	1.000	7.21	$0.010
Compressed Air - Compressor Replacement	14.6%	17.1%	10	$0.06	1.000	9.75	$0.008
Compressed Air - System Controls	5.0%	33.8%	15	$0.01	1.000	85.48	$0.001
Compressed Air - System Maintenance	5.0%	33.8%	3	$0.03	1.000	4.11	$0.012
Compressed Air - System Optimization and Improvements	24.8%	35.6%	10	$0.20	1.000	3.32	$0.025
Pumping System - Controls	22.8%	31.0%	10	$0.01	1.000	49.02	$0.001
Pumping System - Maintenance	5.0%	33.8%	3	$0.02	1.000	6.11	$0.008
Pumping System - Optimization	22.4%	30.0%	10	$0.28	1.000	2.42	$0.034
Pumps - Variable Speed Control	5.0%	33.8%	15	$0.02	1.000	46.79	$0.002
Pump Equipment Upgrade	24.0%	33.6%	10	$0.13	1.000	4.54	$0.016
Fan Equipment Upgrade	18.6%	23.2%	10	$0.09	1.000	7.09	$0.011
Fan System - Controls	20.9%	27.2%	10	$0.01	1.000	49.67	$0.001
Fan System - Maintenance	10.0%	37.5%	3	$0.01	1.000	12.86	$0.004
Fan System - Optimization	22.2%	29.6%	10	$0.13	1.000	5.04	$0.016
Fans - Variable Speed Control	10.0%	37.5%	15	$0.01	1.000	74.23	$0.001
Motors - Magnetic Adjustable Speed Drives	5.0%	15.0%	20	$0.19	1.000	7.92	$0.014

Measure	Base Saturation	Applicability	Lifetime (Years)	Incremental Cost ($/Emp)	Savings (kWh/Emp)	BC Ratio	Levelized Cost of Energy ($/kWh)
Motors - Efficient Rewind	10.9%	12.1%	10	$0.35	1.000	1.50	$0.043
Motors - Variable Frequency Drive	5.0%	33.8%	15	$0.02	1.000	46.79	$0.002
Motors - Synchronous Belts	17.3%	21.0%	10	$0.22	1.000	2.35	$0.028
Commissioning - HVAC	75.0%	75.0%	25	$1.00	1.203	3.31	$0.057
Commissioning - Lighting	60.0%	75.0%	25	$0.15	0.053	1.05	$0.195
Retrocommissioning - HVAC	0.6%	24.0%	4	$0.75	-	-	$0.000
Retrocommissioning - Lighting	0.6%	30.6%	5	$0.00	-	2.00	$0.000
Ventilation - CO2 Controlled	5.9%	7.5%	10	$0.65	0.036	0.06	$2.216
Transformer - High Efficiency	8.6%	9.4%	10	$0.13	0.903	4.35	$0.018
Custom Measures	10.0%	45.0%	15	$0.67	-	-	$0.000
Injection Molding Barrel Insulation	25.0%	25.0%	5	$490.00	10,000.000	6.33	$0.011

Table D-15 Energy Efficiency Non-Equipment Data— Transportation, Existing Vintage

Measure	Base Saturation	Applicability	Lifetime (Years)	Incremental Cost ($/Emp)	Savings (kWh/Emp)	BC Ratio	Levelized Cost of Energy ($/kWh)
Insulation - Ceiling	3.6%	12.5%	20	$0.52	3.558	8.75	$0.011
Insulation - Ducting	7.0%	12.5%	20	$0.77	0.439	0.92	$0.135
Insulation - Wall Cavity	3.6%	12.5%	20	$0.49	2.546	6.47	$0.015
HVAC - Duct Repair and Sealing	5.0%	25.0%	15	$0.50	1.020	1.96	$0.045
Air-Cooled Chiller - Economizer	26.8%	48.8%	15	$0.00	0.571	1,302.79	$0.000
Air-Cooled Chiller - Efficient Mechanical Layout	62.2%	90.0%	4	$0.06	0.496	6.86	$0.033
Air-Cooled Chiller - Maintenance	46.4%	90.0%	4	$0.04	0.334	10.06	$0.031
Air-Cooled Chiller - Chilled Water Reset	5.0%	75.0%	10	$0.06	0.375	18.16	$0.020
Air-Cooled Chiller - Chilled Water Variable-Flow System	30.0%	75.0%	10	$0.01	0.070	14.29	$0.025
Air-Cooled Chiller - Condenser Water Temperature Reset	30.0%	75.0%	4	$0.18	0.207	1.32	$0.234
Air-Cooled Chiller - High Efficiency Cooling Tower Fans	15.0%	41.3%	10	$0.10	0.680	19.05	$0.019
Air-Cooled Chiller - VSD on Fans	15.0%	66.2%	20	$1.17	0.808	3.92	$0.112
Water-Cooled Chiller - Economizer	26.8%	48.8%	15	$0.00	0.565	1,275.99	$0.000
Water-Cooled Chiller - Efficient Mechanical Layout	62.2%	90.0%	4	$0.06	0.481	6.65	$0.034
Water-Cooled Chiller - Maintenance	46.4%	90.0%	4	$0.04	0.321	9.75	$0.032
Water-Cooled Chiller - Chilled Water Reset	5.0%	75.0%	10	$0.06	0.467	22.57	$0.016
Water-Cooled Chiller - Chilled Water Variable-Flow System	30.0%	75.0%	10	$0.01	0.080	16.41	$0.022
Water-Cooled Chiller - Condenser Water Temperature Reset	30.0%	75.0%	4	$0.18	0.043	0.27	$1.136
Water-Cooled Chiller - High Efficiency Cooling Tower Fans	15.0%	41.3%	10	$0.10	0.001	0.04	$8.874
Water-Cooled Chiller - VSD on Fans	15.0%	66.2%	20	$1.17	0.193	0.92	$0.466
RTU - Maintenance	46.4%	90.0%	4	$0.08	0.514	5.29	$0.039
Heat Pump - Maintenance	46.4%	95.0%	4	$0.06	0.257	3.19	$0.063
Roof - High Reflectivity	35.9%	75.0%	15	$0.32	0.351	3.14	$0.084
Energy Management System	33.0%	75.0%	14	$0.35	2.380	8.89	$0.014
Thermostat - Clock/Programmable	40.8%	50.0%	11	$0.13	0.214	0.98	$0.070
Interior Lighting - Occupancy Sensors	6.9%	56.3%	8	$0.01	0.305	29.68	$0.003
Interior Lighting - Skylights	15.3%	20.3%	8	$0.29	0.976	1.44	$0.043
Interior Lighting - Timeclocks and Timers	27.6%	56.3%	8	$0.01	0.038	3.29	$0.029
Interior Lighting - LED Exit Lighting	50.0%	85.5%	10	$0.00	0.002	0.90	$0.114
Interior Lighting - Daylighting	4.3%	20.3%	8	$0.00	0.228	1.00	$0.000

Measure	Base Saturation	Applicability	Lifetime (Years)	Incremental Cost ($/Emp)	Savings (kWh/Emp)	BC Ratio	Levelized Cost of Energy ($/kWh)
Controls							
Interior Lighting - Task Lighting	0.6%	75.0%	5	$0.24	0.079	0.09	$0.670
Interior Fluorescent - Bi-Level Fixture	10.0%	22.5%	8	$0.20	0.222	0.56	$0.133
Interior Fluorescent - Delamp and Install Reflectors	0.6%	56.3%	11	$0.50	0.188	0.28	$0.306
Exterior Lighting - Bi-Level Fixture	10.0%	30.0%	8	$0.20	0.000	0.00	$207.804
Exterior Lighting - Daylighting Controls	18.0%	37.5%	8	$0.02	0.001	0.25	$4.156
Exterior Lighting - Photovoltaic Installation	0.0%	12.5%	5	$0.92	0.000	0.00	$474.955
Process - Conductivity Controls	20.0%	100.0%	5	$0.53	1.000	0.44	$0.117
Process - Controls on Fume Hoods	30.0%	100.0%	10	$0.13	1.000	4.15	$0.016
Process - Timers and Controls	40.0%	100.0%	5	$0.42	2.000	1.12	$0.046
Refrigeration - Floating Head Pressure	30.0%	90.0%	18	$0.57	1.000	1.99	$0.047
Refrigeration - System Controls	40.0%	56.0%	18	$1.33	1.000	0.85	$0.109
Refrigeration - System Maintenance	30.0%	72.0%	3	$0.24	1.000	0.56	$0.085
Refrigeration - System Optimization	40.0%	56.0%	15	$0.15	1.000	5.99	$0.014
Compressed Air - Air Usage Reduction	20.2%	25.9%	10	$0.08	1.000	7.16	$0.010
Compressed Air - Compressor Replacement	14.6%	17.1%	10	$0.06	1.000	9.67	$0.008
Compressed Air - System Controls	5.0%	33.8%	15	$0.01	1.000	84.74	$0.001
Compressed Air - System Maintenance	5.0%	33.8%	3	$0.03	1.000	4.09	$0.012
Compressed Air - System Optimization and Improvements	24.8%	35.6%	10	$0.20	1.000	3.29	$0.025
Pumping System - Controls	22.8%	31.0%	10	$0.01	1.000	49.02	$0.001
Pumping System - Maintenance	5.0%	33.8%	3	$0.02	1.000	6.11	$0.008
Pumping System - Optimization	22.4%	30.0%	10	$0.28	1.000	2.42	$0.034
Pumps - Variable Speed Control	5.0%	33.8%	15	$0.02	1.000	46.79	$0.002
Pump Equipment Upgrade	24.0%	33.6%	10	$0.13	1.000	4.54	$0.016
Fan Equipment Upgrade	18.6%	23.2%	10	$0.09	1.000	7.03	$0.011
Fan System - Controls	20.9%	27.2%	10	$0.01	1.000	49.28	$0.001
Fan System - Maintenance	10.0%	37.5%	3	$0.01	1.000	12.79	$0.004
Fan System - Optimization	22.2%	29.6%	10	$0.13	1.000	5.00	$0.016
Fans - Variable Speed Control	10.0%	37.5%	15	$0.01	1.000	73.58	$0.001
Motors - Magnetic Adjustable Speed Drives	5.0%	15.0%	20	$0.19	1.000	7.85	$0.014
Motors - Efficient Rewind	14.9%	17.4%	10	$0.35	1.000	1.49	$0.043
Motors - Variable Frequency Drive	5.0%	33.8%	15	$0.02	1.000	46.38	$0.002
Motors - Synchronous Belts	17.3%	21.0%	10	$0.22	1.000	2.43	$0.027
Commissioning - HVAC	75.0%	75.0%	25	$0.00	-	3.00	$0.000
Commissioning - Lighting	60.0%	75.0%	25	$0.00	-	2.00	$0.000
Retrocommissioning - HVAC	0.6%	24.0%	4	$0.75	1.356	0.61	$0.149
Retrocommissioning - Lighting	0.6%	30.6%	5	$0.05	0.076	0.60	$0.145
Ventilation - CO2 Controlled	1.0%	7.5%	10	$0.65	0.045	0.06	$1.772
Transformer - High Efficiency	8.6%	9.4%	10	$0.11	0.802	4.50	$0.017
Custom Measures	10.0%	45.0%	15	$0.67	-	-	$0.000

Table D-16 Energy Efficiency Non-Equipment Data— Transportation, New Vintage

Measure	Base Saturation	Applicability	Lifetime (Years)	Incremental Cost ($/Emp)	Savings (kWh/Emp)	BC Ratio	Levelized Cost of Energy ($/kWh)
Insulation - Ceiling	3.6%	12.5%	20	$0.68	1.322	3.01	$0.040
Insulation - Ducting	7.0%	12.5%	20	$0.77	0.461	0.92	$0.129

Measure	Base Saturation	Applicability	Lifetime (Years)	Incremental Cost ($/Emp)	Savings (kWh/Emp)	BC Ratio	Levelized Cost of Energy ($/kWh)
Insulation - Wall Cavity	3.6%	12.5%	20	$0.32	0.552	2.38	$0.045
HVAC - Duct Repair and Sealing	25.0%	25.0%	15	$0.50	0.426	0.91	$0.108
Air-Cooled Chiller - Economizer	26.8%	48.8%	15	$0.00	0.355	972.93	$0.001
Air-Cooled Chiller - Efficient Mechanical Layout	62.8%	90.0%	4	$0.06	0.316	5.45	$0.051
Air-Cooled Chiller - Maintenance	46.4%	90.0%	4	$0.04	0.210	8.52	$0.046
Air-Cooled Chiller - Chilled Water Reset	25.0%	75.0%	10	$0.06	0.248	14.38	$0.032
Air-Cooled Chiller - Chilled Water Variable-Flow System	30.0%	75.0%	10	$0.01	0.079	22.10	$0.021
Air-Cooled Chiller - Condenser Water Temperature Reset	60.0%	75.0%	4	$0.18	0.147	1.20	$0.329
Air-Cooled Chiller - High Efficiency Cooling Tower Fans	15.0%	41.3%	10	$0.11	0.520	17.47	$0.026
Air-Cooled Chiller - VSD on Fans	15.0%	66.2%	20	$1.17	0.598	3.74	$0.151
Water-Cooled Chiller - Economizer	26.8%	48.8%	15	$0.00	0.244	627.62	$0.001
Water-Cooled Chiller - Efficient Mechanical Layout	62.8%	90.0%	4	$0.06	0.338	5.45	$0.048
Water-Cooled Chiller - Maintenance	46.4%	90.0%	4	$0.04	0.222	8.49	$0.044
Water-Cooled Chiller - Chilled Water Reset	25.0%	75.0%	10	$0.06	0.288	15.68	$0.027
Water-Cooled Chiller - Chilled Water Variable-Flow System	30.0%	75.0%	10	$0.01	0.107	27.87	$0.015
Water-Cooled Chiller - Condenser Water Temperature Reset	60.0%	75.0%	4	$0.18	0.011	0.08	$4.460
Water-Cooled Chiller - High Efficiency Cooling Tower Fans	15.0%	41.3%	10	$0.11	0.002	0.07	$6.032
Water-Cooled Chiller - VSD on Fans	15.0%	66.2%	20	$1.17	0.086	0.50	$1.052
RTU - Maintenance	46.4%	90.0%	4	$0.08	0.328	4.34	$0.062
Heat Pump - Maintenance	46.4%	95.0%	4	$0.06	0.207	3.22	$0.078
Roof - High Reflectivity	35.9%	95.0%	15	$0.32	0.234	2.77	$0.127
Energy Management System	33.0%	75.0%	14	$0.35	1.827	7.97	$0.019
Thermostat - Clock/Programmable	40.8%	86.3%	11	$0.13	1.091	9.69	$0.014
Interior Lighting - Occupancy Sensors	6.9%	56.3%	8	$0.01	0.210	25.68	$0.005
Interior Lighting - Skylights	42.2%	42.2%	8	$0.19	0.614	1.67	$0.046
Interior Lighting - Timeclocks and Timers	27.6%	56.3%	8	$0.01	0.026	2.85	$0.045
Interior Lighting - LED Exit Lighting	85.5%	85.5%	10	$0.00	0.001	0.77	$0.177
Interior Lighting - Daylighting Controls	4.3%	42.2%	8	$0.00	0.157	1.00	$0.000
Interior Lighting - Task Lighting	0.6%	75.0%	5	$0.24	0.054	0.12	$0.972
Interior Fluorescent - Bi-Level Fixture	10.0%	22.5%	8	$0.20	0.208	0.54	$0.142
Interior Fluorescent - Delamp and Install Reflectors	0.6%	56.3%	11	$0.50	-	-	$0.000
Exterior Lighting - Bi-Level Fixture	10.0%	30.0%	8	$0.20	0.000	0.01	$363.410
Exterior Lighting - Daylighting Controls	18.0%	37.5%	8	$0.02	0.000	0.34	$7.268
Exterior Lighting - Photovoltaic Installation	0.0%	12.5%	5	$0.92	0.000	0.00	$830.607
Process - Conductivity Controls	20.0%	100.0%	5	$0.53	1.000	0.44	$0.117
Process - Controls on Fume Hoods	30.0%	100.0%	10	$0.13	1.000	4.15	$0.016
Process - Timers and Controls	40.0%	100.0%	5	$0.42	2.000	1.13	$0.046
Refrigeration - Floating Head Pressure	30.0%	90.0%	18	$0.57	1.000	1.99	$0.047
Refrigeration - System Controls	40.0%	56.0%	18	$1.33	1.000	0.85	$0.109
Refrigeration - System Maintenance	30.0%	72.0%	3	$0.24	1.000	0.56	$0.085
Refrigeration - System Optimization	40.0%	56.0%	15	$0.15	1.000	5.99	$0.014
Compressed Air - Air Usage	20.2%	25.9%	10	$0.08	1.000	7.21	$0.010

Measure	Base Saturation	Applicability	Lifetime (Years)	Incremental Cost ($/Emp)	Savings (kWh/Emp)	BC Ratio	Levelized Cost of Energy ($/kWh)
Reduction							
Compressed Air - Compressor Replacement	14.6%	17.1%	10	$0.06	1.000	9.75	$0.008
Compressed Air - System Controls	5.0%	33.8%	15	$0.01	1.000	85.48	$0.001
Compressed Air - System Maintenance	5.0%	33.8%	3	$0.03	1.000	4.11	$0.012
Compressed Air - System Optimization and Improvements	24.8%	35.6%	10	$0.20	1.000	3.32	$0.025
Pumping System - Controls	22.8%	31.0%	10	$0.01	1.000	49.02	$0.001
Pumping System - Maintenance	5.0%	33.8%	3	$0.02	1.000	6.11	$0.008
Pumping System - Optimization	22.4%	30.0%	10	$0.28	1.000	2.42	$0.034
Pumps - Variable Speed Control	5.0%	33.8%	15	$0.02	1.000	46.79	$0.002
Pump Equipment Upgrade	24.0%	33.6%	10	$0.13	1.000	4.54	$0.016
Fan Equipment Upgrade	18.6%	23.2%	10	$0.09	1.000	7.09	$0.011
Fan System - Controls	20.9%	27.2%	10	$0.01	1.000	49.67	$0.001
Fan System - Maintenance	10.0%	37.5%	3	$0.01	1.000	12.86	$0.004
Fan System - Optimization	22.2%	29.6%	10	$0.13	1.000	5.04	$0.016
Fans - Variable Speed Control	10.0%	37.5%	15	$0.01	1.000	74.23	$0.001
Motors - Magnetic Adjustable Speed Drives	5.0%	15.0%	20	$0.19	1.000	7.92	$0.014
Motors - Efficient Rewind	14.9%	17.4%	10	$0.35	1.000	1.50	$0.043
Motors - Variable Frequency Drive	5.0%	33.8%	15	$0.02	1.000	46.79	$0.002
Motors - Synchronous Belts	17.3%	21.0%	10	$0.22	1.000	2.45	$0.027
Commissioning - HVAC	75.0%	75.0%	25	$1.00	1.203	3.31	$0.057
Commissioning - Lighting	60.0%	75.0%	25	$0.15	0.053	1.05	$0.195
Retrocommissioning - HVAC	0.6%	24.0%	4	$0.75	-	-	$0.000
Retrocommissioning - Lighting	0.6%	30.6%	5	$0.00	-	2.00	$0.000
Ventilation - CO2 Controlled	5.9%	7.5%	10	$0.65	0.036	0.06	$2.216
Transformer - High Efficiency	8.6%	9.4%	10	$0.11	0.802	4.74	$0.017
Custom Measures	10.0%	45.0%	15	$0.67	-	-	$0.000

Table D-17 Energy Efficiency Non-Equipment Data— Other Industrial, Existing Vintage

Measure	Base Saturation	Applicability	Lifetime (Years)	Incremental Cost ($/Emp)	Savings (kWh/Emp)	BC Ratio	Levelized Cost of Energy ($/kWh)
Insulation - Ceiling	3.6%	12.5%	20	$0.52	3.558	8.75	$0.011
Insulation - Ducting	7.0%	12.5%	20	$0.77	0.439	0.92	$0.135
Insulation - Wall Cavity	3.6%	12.5%	20	$0.49	2.546	6.47	$0.015
HVAC - Duct Repair and Sealing	5.0%	25.0%	15	$0.50	1.020	1.96	$0.045
Air-Cooled Chiller - Economizer	26.8%	48.8%	15	$0.00	0.571	1,302.79	$0.000
Air-Cooled Chiller - Efficient Mechanical Layout	62.2%	90.0%	4	$0.06	0.496	6.86	$0.033
Air-Cooled Chiller - Maintenance	46.4%	90.0%	4	$0.04	0.334	10.06	$0.031
Air-Cooled Chiller - Chilled Water Reset	5.0%	75.0%	10	$0.06	0.375	18.16	$0.020
Air-Cooled Chiller - Chilled Water Variable-Flow System	30.0%	75.0%	10	$0.01	0.070	14.29	$0.025
Air-Cooled Chiller - Condenser Water Temperature Reset	30.0%	75.0%	4	$0.18	0.207	1.32	$0.234
Air-Cooled Chiller - High Efficiency Cooling Tower Fans	15.0%	41.3%	10	$0.10	0.680	19.05	$0.019
Air-Cooled Chiller - VSD on Fans	15.0%	66.2%	20	$1.17	0.808	3.92	$0.112
Water-Cooled Chiller - Economizer	26.8%	48.8%	15	$0.00	0.565	1,275.99	$0.000
Water-Cooled Chiller - Efficient Mechanical Layout	62.2%	90.0%	4	$0.06	0.481	6.65	$0.034
Water-Cooled Chiller - Maintenance	46.4%	90.0%	4	$0.04	0.321	9.75	$0.032
Water-Cooled Chiller - Chilled Water Reset	5.0%	75.0%	10	$0.06	0.467	22.57	$0.016

Measure	Base Saturation	Applicability	Lifetime (Years)	Incremental Cost ($/Emp)	Savings (kWh/Emp)	BC Ratio	Levelized Cost of Energy ($/kWh)
Water-Cooled Chiller - Chilled Water Variable-Flow System	30.0%	75.0%	10	$0.01	0.080	16.41	$0.022
Water-Cooled Chiller - Condenser Water Temperature Reset	30.0%	75.0%	4	$0.18	0.043	0.27	$1.136
Water-Cooled Chiller - High Efficiency Cooling Tower Fans	15.0%	41.3%	10	$0.10	0.001	0.04	$8.874
Water-Cooled Chiller - VSD on Fans	15.0%	66.2%	20	$1.17	0.193	0.92	$0.466
RTU - Maintenance	46.4%	90.0%	4	$0.08	0.514	5.29	$0.039
Heat Pump - Maintenance	46.4%	95.0%	4	$0.06	0.257	3.19	$0.063
Roof - High Reflectivity	35.9%	75.0%	15	$0.32	0.351	3.14	$0.084
Energy Management System	33.0%	75.0%	14	$0.35	2.380	8.89	$0.014
Thermostat - Clock/Programmable	40.8%	50.0%	11	$0.13	0.214	0.98	$0.070
Interior Lighting - Occupancy Sensors	6.9%	56.3%	8	$0.01	0.305	29.68	$0.003
Interior Lighting - Skylights	15.3%	20.3%	8	$0.29	0.976	1.44	$0.043
Interior Lighting - Timeclocks and Timers	27.6%	56.3%	8	$0.01	0.038	3.29	$0.029
Interior Lighting - LED Exit Lighting	50.0%	85.5%	10	$0.00	0.002	0.90	$0.114
Interior Lighting - Daylighting Controls	4.3%	20.3%	8	$0.00	0.228	1.00	$0.000
Interior Lighting - Task Lighting	0.6%	75.0%	5	$0.24	0.079	0.09	$0.670
Interior Fluorescent - Bi-Level Fixture	10.0%	22.5%	8	$0.20	0.222	0.56	$0.133
Interior Fluorescent - Delamp and Install Reflectors	0.6%	56.3%	11	$0.50	0.188	0.28	$0.306
Exterior Lighting - Bi-Level Fixture	10.0%	30.0%	8	$0.20	0.000	0.00	$207.804
Exterior Lighting - Daylighting Controls	18.0%	37.5%	8	$0.02	0.001	0.25	$4.156
Exterior Lighting - Photovoltaic Installation	0.0%	12.5%	5	$0.92	0.000	0.00	$474.955
Process - Conductivity Controls	20.0%	100.0%	5	$0.53	1.000	0.44	$0.117
Process - Controls on Fume Hoods	30.0%	100.0%	10	$0.13	1.000	4.15	$0.016
Process - Timers and Controls	40.0%	100.0%	5	$0.42	2.000	1.12	$0.046
Refrigeration - Floating Head Pressure	30.0%	90.0%	18	$0.57	1.000	1.99	$0.047
Refrigeration - System Controls	40.0%	56.0%	18	$1.33	1.000	0.85	$0.109
Refrigeration - System Maintenance	30.0%	72.0%	3	$0.24	1.000	0.56	$0.085
Refrigeration - System Optimization	40.0%	56.0%	15	$0.15	1.000	5.99	$0.014
Compressed Air - Air Usage Reduction	20.2%	25.9%	10	$0.08	1.000	7.16	$0.010
Compressed Air - Compressor Replacement	14.6%	17.1%	10	$0.06	1.000	9.67	$0.008
Compressed Air - System Controls	5.0%	33.8%	15	$0.01	1.000	84.74	$0.001
Compressed Air - System Maintenance	5.0%	33.8%	3	$0.03	1.000	4.09	$0.012
Compressed Air - System Optimization and Improvements	24.8%	35.6%	10	$0.20	1.000	3.29	$0.025
Pumping System - Controls	22.8%	31.0%	10	$0.01	1.000	48.63	$0.001
Pumping System - Maintenance	5.0%	33.8%	3	$0.02	1.000	6.08	$0.008
Pumping System - Optimization	22.4%	30.0%	10	$0.28	1.000	2.40	$0.034
Pumps - Variable Speed Control	5.0%	33.8%	15	$0.02	1.000	46.38	$0.002
Pump Equipment Upgrade	24.0%	33.6%	10	$0.13	1.000	4.50	$0.016
Fan Equipment Upgrade	18.6%	23.2%	10	$0.09	1.000	7.03	$0.011
Fan System - Controls	20.9%	27.2%	10	$0.01	1.000	49.28	$0.001
Fan System - Maintenance	10.0%	37.5%	3	$0.01	1.000	12.79	$0.004
Fan System - Optimization	22.2%	29.6%	10	$0.13	1.000	5.00	$0.016
Fans - Variable Speed Control	10.0%	37.5%	15	$0.01	1.000	73.58	$0.001
Motors - Magnetic Adjustable Speed Drives	5.0%	15.0%	20	$0.19	1.000	7.85	$0.014
Motors - Efficient Rewind	14.9%	17.4%	10	$0.35	1.000	1.49	$0.043

Measure	Base Saturation	Applicability	Lifetime (Years)	Incremental Cost ($/Emp)	Savings (kWh/Emp)	BC Ratio	Levelized Cost of Energy ($/kWh)
Motors - Variable Frequency Drive	5.0%	33.8%	15	$0.02	1.000	46.38	$0.002
Motors - Synchronous Belts	17.3%	21.0%	10	$0.22	1.000	2.43	$0.027
Commissioning - HVAC	75.0%	75.0%	25	$0.00	-	3.00	$0.000
Commissioning - Lighting	60.0%	75.0%	25	$0.00	-	2.00	$0.000
Retrocommissioning - HVAC	0.6%	24.0%	4	$0.75	1.356	0.61	$0.149
Retrocommissioning - Lighting	0.6%	30.6%	5	$0.05	0.076	0.60	$0.145
Ventilation - CO2 Controlled	1.0%	7.5%	10	$0.65	0.045	0.06	$1.772
Transformer - High Efficiency	8.6%	9.4%	10	$0.11	0.802	4.50	$0.017
Custom Measures	10.0%	45.0%	15	$0.67	-	-	$0.000

Table D-18 Energy Efficiency Non-Equipment Data— Other Industrial, New Vintage

Measure	Base Saturation	Applicability	Lifetime (Years)	Incremental Cost ($/Emp)	Savings (kWh/Emp)	BC Ratio	Levelized Cost of Energy ($/kWh)
Insulation - Ceiling	3.6%	12.5%	20	$0.68	1.322	3.01	$0.040
Insulation - Ducting	7.0%	12.5%	20	$0.77	0.461	0.92	$0.129
Insulation - Wall Cavity	3.6%	12.5%	20	$0.32	0.552	2.38	$0.045
HVAC - Duct Repair and Sealing	25.0%	25.0%	15	$0.50	0.426	0.91	$0.108
Air-Cooled Chiller - Economizer	26.8%	48.8%	15	$0.00	0.355	972.93	$0.001
Air-Cooled Chiller - Efficient Mechanical Layout	62.8%	90.0%	4	$0.06	0.316	5.45	$0.051
Air-Cooled Chiller - Maintenance	46.4%	90.0%	4	$0.04	0.210	8.52	$0.046
Air-Cooled Chiller - Chilled Water Reset	25.0%	75.0%	10	$0.06	0.248	14.38	$0.032
Air-Cooled Chiller - Chilled Water Variable-Flow System	30.0%	75.0%	10	$0.01	0.079	22.10	$0.021
Air-Cooled Chiller - Condenser Water Temperature Reset	60.0%	75.0%	4	$0.18	0.147	1.20	$0.329
Air-Cooled Chiller - High Efficiency Cooling Tower Fans	15.0%	41.3%	10	$0.11	0.520	17.47	$0.026
Air-Cooled Chiller - VSD on Fans	15.0%	66.2%	20	$1.17	0.598	3.74	$0.151
Water-Cooled Chiller - Economizer	26.8%	48.8%	15	$0.00	0.244	627.62	$0.001
Water-Cooled Chiller - Efficient Mechanical Layout	62.8%	90.0%	4	$0.06	0.338	5.45	$0.048
Water-Cooled Chiller - Maintenance	46.4%	90.0%	4	$0.04	0.222	8.49	$0.044
Water-Cooled Chiller - Chilled Water Reset	25.0%	75.0%	10	$0.06	0.288	15.68	$0.027
Water-Cooled Chiller - Chilled Water Variable-Flow System	30.0%	75.0%	10	$0.01	0.107	27.87	$0.015
Water-Cooled Chiller - Condenser Water Temperature Reset	60.0%	75.0%	4	$0.18	0.011	0.08	$4.460
Water-Cooled Chiller - High Efficiency Cooling Tower Fans	15.0%	41.3%	10	$0.11	0.002	0.07	$6.032
Water-Cooled Chiller - VSD on Fans	15.0%	66.2%	20	$1.17	0.086	0.50	$1.052
RTU - Maintenance	46.4%	90.0%	4	$0.08	0.328	4.34	$0.062
Heat Pump - Maintenance	46.4%	95.0%	4	$0.06	0.207	3.22	$0.078
Roof - High Reflectivity	35.9%	95.0%	15	$0.32	0.234	2.77	$0.127
Energy Management System	33.0%	75.0%	14	$0.35	1.827	7.97	$0.019
Thermostat - Clock/Programmable	40.8%	86.3%	11	$0.13	1.091	9.69	$0.014
Interior Lighting - Occupancy Sensors	6.9%	56.3%	8	$0.01	0.210	25.68	$0.005
Interior Lighting - Skylights	42.2%	42.2%	8	$0.19	0.614	1.67	$0.046
Interior Lighting - Timeclocks and Timers	27.6%	56.3%	8	$0.01	0.026	2.85	$0.045
Interior Lighting - LED Exit Lighting	85.5%	85.5%	10	$0.00	0.001	0.77	$0.177
Interior Lighting - Daylighting Controls	4.3%	42.2%	8	$0.00	0.157	1.00	$0.000
Interior Lighting - Task Lighting	0.6%	75.0%	5	$0.24	0.054	0.12	$0.972

Measure	Base Saturation	Applicability	Lifetime (Years)	Incremental Cost ($/Emp)	Savings (kWh/Emp)	BC Ratio	Levelized Cost of Energy ($/kWh)
Interior Fluorescent - Bi-Level Fixture	10.0%	22.5%	8	$0.20	0.208	0.54	$0.142
Interior Fluorescent - Delamp and Install Reflectors	0.6%	56.3%	11	$0.50	-	-	$0.000
Exterior Lighting - Bi-Level Fixture	10.0%	30.0%	8	$0.20	0.000	0.01	$363.410
Exterior Lighting - Daylighting Controls	18.0%	37.5%	8	$0.02	0.000	0.34	$7.268
Exterior Lighting - Photovoltaic Installation	0.0%	12.5%	5	$0.92	0.000	0.00	$830.607
Process - Conductivity Controls	20.0%	100.0%	5	$0.53	1.000	0.44	$0.117
Process - Controls on Fume Hoods	30.0%	100.0%	10	$0.13	1.000	4.15	$0.016
Process - Timers and Controls	40.0%	100.0%	5	$0.42	2.000	1.13	$0.046
Refrigeration - Floating Head Pressure	30.0%	90.0%	18	$0.57	1.000	1.99	$0.047
Refrigeration - System Controls	40.0%	56.0%	18	$1.33	1.000	0.85	$0.109
Refrigeration - System Maintenance	30.0%	72.0%	3	$0.24	1.000	0.56	$0.085
Refrigeration - System Optimization	40.0%	56.0%	15	$0.15	1.000	5.99	$0.014
Compressed Air - Air Usage Reduction	20.2%	25.9%	10	$0.08	1.000	7.21	$0.010
Compressed Air - Compressor Replacement	14.6%	17.1%	10	$0.06	1.000	9.75	$0.008
Compressed Air - System Controls	5.0%	33.8%	15	$0.01	1.000	85.48	$0.001
Compressed Air - System Maintenance	5.0%	33.8%	3	$0.03	1.000	4.11	$0.012
Compressed Air - System Optimization and Improvements	24.8%	35.6%	10	$0.20	1.000	3.32	$0.025
Pumping System - Controls	22.8%	31.0%	10	$0.01	1.000	49.02	$0.001
Pumping System - Maintenance	5.0%	33.8%	3	$0.02	1.000	6.11	$0.008
Pumping System - Optimization	22.4%	30.0%	10	$0.28	1.000	2.42	$0.034
Pumps - Variable Speed Control	5.0%	33.8%	15	$0.02	1.000	46.79	$0.002
Pump Equipment Upgrade	24.0%	33.6%	10	$0.13	1.000	4.54	$0.016
Fan Equipment Upgrade	18.6%	23.2%	10	$0.09	1.000	7.09	$0.011
Fan System - Controls	20.9%	27.2%	10	$0.01	1.000	49.67	$0.001
Fan System - Maintenance	10.0%	37.5%	3	$0.01	1.000	12.86	$0.004
Fan System - Optimization	22.2%	29.6%	10	$0.13	1.000	5.04	$0.016
Fans - Variable Speed Control	10.0%	37.5%	15	$0.01	1.000	74.23	$0.001
Motors - Magnetic Adjustable Speed Drives	5.0%	15.0%	20	$0.19	1.000	7.92	$0.014
Motors - Efficient Rewind	14.9%	17.4%	10	$0.35	1.000	1.50	$0.043
Motors - Variable Frequency Drive	5.0%	33.8%	15	$0.02	1.000	46.79	$0.002
Motors - Synchronous Belts	17.3%	21.0%	10	$0.22	1.000	2.45	$0.027
Commissioning - HVAC	75.0%	75.0%	25	$1.00	1.203	3.31	$0.057
Commissioning - Lighting	60.0%	75.0%	25	$0.15	0.053	1.05	$0.195
Retrocommissioning - HVAC	0.6%	24.0%	4	$0.75	-	-	$0.000
Retrocommissioning - Lighting	0.6%	30.6%	5	$0.00	-	2.00	$0.000
Ventilation - CO2 Controlled	5.9%	7.5%	10	$0.65	0.036	0.06	$2.216
Transformer - High Efficiency	8.6%	9.4%	10	$0.11	0.802	4.74	$0.017
Custom Measures	10.0%	45.0%	15	$0.67	-	-	$0.000

MARKET ADOPTION FACTORS

To calculate achievable potential, we apply a set of market adoption factors to economic potential. These parameters are described below, along with a discussion of how they are applied to calculate achievable potential. Finally, we present the various sets of factors at the end of this section.

Achievable High adoption rates

These factors are applied to Economic potential to estimate the upper bound: Achievable High potential. These estimate customer adoption of economic measures when delivered through efficiency programs under ideal market, implementation, and customer preference conditions. Information channels are assumed to be established and efficient for marketing, educating consumers, and coordinating with trade allies and delivery partners. The Achievable High adoption rates are based on the ramp rates from the Northwest Power & Conservation Council's Sixth Plan as a starting point. The NWPCC has been running programs in the Pacific Northwest for many years, so the portfolio of programs reflects a more mature profile of market maturity. Because of this, the ramp rates are adjusted downward by 10%, and then further adjusted with actual Vectren program history and information from program evaluations. Achievable High potential establishes a maximum target for the EE savings that an administrator can hope to achieve through its EE programs and involves incentives that represent a substantial portion of the incremental cost combined with high administrative and marketing costs. These adoption rates increase over time, reflecting an increasing awareness and willingness to adopt energy-efficient measures.

Again, the Achievable High adoption rates are applied directly to economic potential to calculate the Achievable High potential estimates.

Achievable Low adoption rates

These factors are applied to Achievable High potential to calculate Achievable Low potential, decrementing them by a range of 40% to 75% based on where measures lie in the time horizon of the study or whether they are already familiar inclusions in existing programs. They reflect expected program participation given significant barriers to customer acceptance, non-ideal implementation conditions, and limited program budgets. This represents a lower bound on achievable potential. Like the Achievable High rates, these rates increase over time.

To review, the Achievable Low adoption rates are applied directly to the Achievable High potential to calculate the Achievable Low potential estimates. Stated differently, both Low and High adoption rates are applied to Economic potential to calculate the Achievable Low estimates.

Tabulated adoption rates

Table E-1 through Table E-4 present the Achievable High factors (High) that represent how Economic potential is changed to reach Achievable High potential for residential equipment and non-equipment measures.

Table E-5 through Table E-8 present the product of Achievable High factors and Achievable Low factors (High x Low) to show how Economic potential is changed to reach Achievable Low potential for residential equipment and non-equipment measures.

Table E-9 through Table E-12 present the (High) and (High x Low) factors for commercial equipment and measures.

Table E-13 through Table E-16 presents the same data for industrial equipment and measures.

Table E-1 Single Family Equipment Measures—(Achievable High factor)

End Use	Fuel	Technology	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Cooling	Electric	Central AC	0%	9%	18%	27%	36%	45%	54%	59%	59%	59%	59%	59%	59%
Cooling	Electric	Room AC	0%	6%	12%	18%	24%	30%	36%	42%	48%	54%	59%	59%	59%
Cooling	Electric	Air-Source Heat Pump	0%	6%	12%	18%	24%	30%	36%	42%	48%	54%	59%	59%	59%
Cooling	Electric	Geothermal Heat Pump	0%	5%	9%	14%	18%	23%	27%	32%	36%	41%	45%	50%	54%
Heating	Electric	Electric Resistance	0%	6%	12%	18%	24%	30%	36%	42%	48%	54%	59%	59%	59%
Heating	Electric	Furnace	0%	6%	12%	18%	24%	30%	36%	42%	48%	54%	59%	59%	59%
Heating	Electric	Air-Source Heat Pump	0%	6%	12%	18%	24%	30%	36%	42%	48%	54%	59%	59%	59%
Heating	Electric	Geothermal Heat Pump	0%	5%	9%	14%	18%	23%	27%	32%	36%	41%	45%	50%	54%
Water Heating	Electric	Water Heater <= 55 gal	0%	9%	18%	27%	36%	45%	54%	59%	59%	59%	59%	59%	59%
Water Heating	Electric	Water Heater > 55 gal	0%	9%	18%	27%	36%	45%	54%	59%	59%	59%	59%	59%	59%
Interior Lighting	Electric	Screw-in	0%	18%	36%	54%	72%	77%	77%	77%	77%	77%	77%	77%	77%
Interior Lighting	Electric	Linear Fluorescent	0%	9%	18%	27%	36%	45%	54%	63%	72%	77%	77%	77%	77%
Interior Lighting	Electric	Specialty	0%	9%	18%	27%	36%	45%	54%	63%	72%	77%	77%	77%	77%
Exterior Lighting	Electric	Exterior Lighting	0%	18%	36%	54%	72%	77%	77%	77%	77%	77%	77%	77%	77%
Appliances	Electric	Clothes Washer	0%	9%	18%	27%	36%	45%	54%	63%	72%	77%	77%	77%	77%
Appliances	Electric	Clothes Dryer	0%	9%	18%	27%	36%	45%	54%	63%	72%	77%	77%	77%	77%
Appliances	Electric	Dishwasher	0%	9%	18%	27%	36%	45%	54%	63%	72%	77%	77%	77%	77%
Appliances	Electric	Refrigerator	0%	9%	18%	27%	36%	45%	54%	63%	72%	77%	77%	77%	77%
Appliances	Electric	Freezer	0%	9%	18%	27%	36%	45%	54%	59%	59%	59%	59%	59%	59%
Appliances	Electric	Second Refrigerator	0%	9%	18%	27%	36%	45%	54%	63%	72%	77%	77%	77%	77%
Appliances	Electric	Stove	0%	9%	18%	27%	36%	45%	54%	59%	59%	59%	59%	59%	59%
Appliances	Electric	Microwave	0%	9%	18%	27%	36%	45%	54%	59%	59%	59%	59%	59%	59%
Electronics	Electric	Personal Computers	0%	9%	18%	27%	36%	45%	54%	59%	59%	59%	59%	59%	59%
Electronics	Electric	Monitor	0%	9%	18%	27%	36%	45%	54%	59%	59%	59%	59%	59%	59%
Electronics	Electric	Laptops	0%	9%	18%	27%	36%	45%	54%	59%	59%	59%	59%	59%	59%
Electronics	Electric	TVs	0%	9%	18%	27%	36%	45%	54%	59%	59%	59%	59%	59%	59%
Electronics	Electric	Printer/Fax/Copier	0%	9%	18%	27%	36%	45%	54%	59%	59%	59%	59%	59%	59%
Electronics	Electric	Set-top Boxes/DVR	0%	9%	18%	27%	36%	45%	54%	59%	59%	59%	59%	59%	59%
Electronics	Electric	Devices and Gadgets	0%	9%	18%	27%	36%	45%	54%	59%	59%	59%	59%	59%	59%
Miscellaneous	Electric	Pool Pump	0%	6%	12%	18%	24%	30%	36%	42%	48%	54%	59%	59%	59%
Miscellaneous	Electric	Pool Heater	0%	6%	12%	18%	24%	30%	36%	42%	48%	54%	59%	59%	59%
Miscellaneous	Electric	Hot Tub / Spa	0%	6%	12%	18%	24%	30%	36%	42%	48%	54%	59%	59%	59%
Miscellaneous	Electric	Well Pump	0%	6%	12%	18%	24%	30%	36%	42%	48%	54%	59%	59%	59%
Miscellaneous	Electric	Furnace Fan	0%	6%	12%	18%	24%	30%	36%	42%	48%	54%	59%	59%	59%
Miscellaneous	Electric	Miscellaneous	0%	9%	18%	27%	36%	45%	54%	59%	59%	59%	59%	59%	59%

Table E-2 Single Family Non-Equipment Measures—(Achievable High factor)

Measures	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Insulation - Ceiling	0%	5%	9%	14%	18%	23%	27%	32%	36%	41%	45%	50%	54%
Insulation - Ducting	0%	5%	9%	14%	18%	23%	27%	32%	36%	41%	45%	50%	54%
Insulation - Foundation	0%	5%	9%	14%	18%	23%	27%	32%	36%	41%	45%	50%	54%
Insulation - Infiltration Control	0%	6%	12%	18%	24%	30%	36%	42%	48%	54%	59%	59%	59%
Insulation - Radiant Barrier	0%	5%	9%	14%	18%	23%	27%	32%	36%	41%	45%	50%	54%
Insulation - Wall Cavity	0%	5%	9%	14%	18%	23%	27%	32%	36%	41%	45%	50%	54%
Insulation - Wall Sheathing	0%	5%	9%	14%	18%	23%	27%	32%	36%	41%	45%	50%	54%
Ducting - Repair and Sealing	0%	6%	12%	18%	24%	30%	36%	42%	48%	54%	59%	59%	59%
Windows - High Efficiency/ENERGY STAR	0%	6%	12%	18%	24%	30%	36%	42%	48%	54%	59%	59%	59%
Windows - Install Reflective Film	0%	6%	12%	18%	24%	30%	36%	42%	48%	54%	59%	59%	59%
Doors - Storm and Thermal	0%	6%	12%	18%	24%	30%	36%	42%	48%	54%	59%	59%	59%
Roofs - High Reflectivity	0%	5%	9%	14%	18%	23%	27%	32%	36%	41%	45%	50%	54%
Attic Fan - Installation	0%	5%	9%	14%	18%	23%	27%	32%	36%	41%	45%	50%	54%
Attic Fan - Photovoltaic - Installation	0%	5%	9%	14%	18%	23%	27%	32%	36%	41%	45%	50%	54%
Whole-House Fan - Installation	0%	5%	9%	14%	18%	23%	27%	32%	36%	41%	45%	50%	54%
Ceiling Fan - Installation	0%	6%	12%	18%	24%	30%	36%	42%	48%	54%	59%	59%	59%
Thermostat - Clock/Programmable	0%	9%	18%	27%	36%	45%	54%	63%	72%	77%	77%	77%	77%
Home Energy Management System	0%	9%	18%	27%	36%	45%	54%	59%	59%	59%	59%	59%	59%
Central AC - Early Replacement	0%	6%	12%	18%	24%	30%	36%	42%	48%	54%	59%	59%	59%
Central AC - Maintenance and Tune-Up	0%	9%	18%	27%	36%	45%	54%	59%	59%	59%	59%	59%	59%
Central Heat Pump - Maintenance	0%	9%	18%	27%	36%	45%	54%	59%	59%	59%	59%	59%	59%
Room AC - Removal of Second Unit	0%	18%	36%	54%	59%	59%	59%	59%	59%	59%	59%	59%	59%
Water Heater - Drainwater Heat Recovery	0%	5%	9%	14%	18%	23%	27%	32%	36%	41%	45%	50%	54%
Water Heater - Faucet Aerators	0%	18%	36%	54%	72%	77%	77%	77%	77%	77%	77%	77%	77%
Water Heater - Low-Flow Showerheads	0%	18%	36%	54%	72%	77%	77%	77%	77%	77%	77%	77%	77%
Water Heater - Pipe Insulation	0%	18%	36%	54%	59%	59%	59%	59%	59%	59%	59%	59%	59%
Water Heater - Timer	0%	18%	36%	54%	59%	59%	59%	59%	59%	59%	59%	59%	59%
Water Heater - Desuperheater	0%	5%	9%	14%	18%	23%	27%	32%	36%	41%	45%	50%	54%
Water Heater - Solar System	0%	5%	9%	14%	18%	23%	27%	32%	36%	41%	45%	50%	54%
Interior Lighting - Occupancy Sensors	0%	18%	36%	54%	59%	59%	59%	59%	59%	59%	59%	59%	59%
Exterior Lighting - Photosensor Control	0%	18%	36%	54%	72%	77%	77%	77%	77%	77%	77%	77%	77%
Exterior Lighting - Photovoltaic Installation	0%	18%	36%	54%	59%	59%	59%	59%	59%	59%	59%	59%	59%
Exterior Lighting - Timeclock Installation	0%	18%	36%	54%	59%	59%	59%	59%	59%	59%	59%	59%	59%
Refrigerator - Early Replacement	0%	9%	18%	27%	36%	45%	54%	63%	72%	77%	77%	77%	77%
Refrigerator - Maintenance	0%	18%	36%	54%	59%	59%	59%	59%	59%	59%	59%	59%	59%
Refrigerator - Remove Second Unit	0%	18%	36%	54%	59%	59%	59%	59%	59%	59%	59%	59%	59%
Freezer - Remove Second Unit	0%	18%	36%	54%	59%	59%	59%	59%	59%	59%	59%	59%	59%
Freezer - Early Replacement	0%	9%	18%	27%	36%	45%	54%	59%	59%	59%	59%	59%	59%
Freezer - Maintenance	0%	18%	36%	54%	59%	59%	59%	59%	59%	59%	59%	59%	59%
Electronics - Smart Power Strips	0%	18%	36%	54%	59%	59%	59%	59%	59%	59%	59%	59%	59%

Measures	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Pool Pump - Timer	0%	9%	18%	27%	36%	45%	54%	59%	59%	59%	59%	59%	59%
Pool Heater - Solar System	0%	9%	18%	27%	36%	45%	54%	59%	59%	59%	59%	59%	59%
ENERGY STAR Home Design	0%	5%	9%	14%	18%	23%	27%	32%	36%	41%	45%	50%	54%
Dehumidifier	0%	6%	12%	18%	24%	30%	36%	42%	48%	54%	59%	59%	59%
PC Power Management Software	0%	18%	36%	54%	59%	59%	59%	59%	59%	59%	59%	59%	59%

Table E-3 Multi Family Equipment Measures—(Achievable High factor)

End Use	Fuel	Technology	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Cooling	Electric	Central AC	0%	9%	18%	27%	36%	45%	54%	59%	59%	59%	59%	59%	59%
Cooling	Electric	Room AC	0%	6%	12%	18%	24%	30%	36%	42%	48%	54%	59%	59%	59%
Cooling	Electric	Air-Source Heat Pump	0%	6%	12%	18%	24%	30%	36%	42%	48%	54%	59%	59%	59%
Cooling	Electric	Geothermal Heat Pump	0%	5%	9%	14%	18%	23%	27%	32%	36%	41%	45%	50%	54%
Heating	Electric	Electric Resistance	0%	6%	12%	18%	24%	30%	36%	42%	48%	54%	59%	59%	59%
Heating	Electric	Furnace	0%	6%	12%	18%	24%	30%	36%	42%	48%	54%	59%	59%	59%
Heating	Electric	Air-Source Heat Pump	0%	6%	12%	18%	24%	30%	36%	42%	48%	54%	59%	59%	59%
Heating	Electric	Geothermal Heat Pump	0%	5%	9%	14%	18%	23%	27%	32%	36%	41%	45%	50%	54%
Water Heating	Electric	Water Heater <= 55 gal	0%	9%	18%	27%	36%	45%	54%	59%	59%	59%	59%	59%	59%
Water Heating	Electric	Water Heater > 55 gal	0%	9%	18%	27%	36%	45%	54%	59%	59%	59%	59%	59%	59%
Interior Lighting	Electric	Screw-in	0%	18%	36%	54%	72%	77%	77%	77%	77%	77%	77%	77%	77%
Interior Lighting	Electric	Linear Fluorescent	0%	9%	18%	27%	36%	45%	54%	63%	72%	77%	77%	77%	77%
Interior Lighting	Electric	Specialty	0%	9%	18%	27%	36%	45%	54%	63%	72%	77%	77%	77%	77%
Exterior Lighting	Electric	Exterior Lighting	0%	18%	36%	54%	72%	77%	77%	77%	77%	77%	77%	77%	77%
Appliances	Electric	Clothes Washer	0%	9%	18%	27%	36%	45%	54%	63%	72%	77%	77%	77%	77%
Appliances	Electric	Clothes Dryer	0%	9%	18%	27%	36%	45%	54%	63%	72%	77%	77%	77%	77%
Appliances	Electric	Dishwasher	0%	9%	18%	27%	36%	45%	54%	63%	72%	77%	77%	77%	77%
Appliances	Electric	Refrigerator	0%	9%	18%	27%	36%	45%	54%	63%	72%	77%	77%	77%	77%
Appliances	Electric	Freezer	0%	9%	18%	27%	36%	45%	54%	59%	59%	59%	59%	59%	59%
Appliances	Electric	Second Refrigerator	0%	9%	18%	27%	36%	45%	54%	63%	72%	77%	77%	77%	77%
Appliances	Electric	Stove	0%	9%	18%	27%	36%	45%	54%	59%	59%	59%	59%	59%	59%
Appliances	Electric	Microwave	0%	9%	18%	27%	36%	45%	54%	59%	59%	59%	59%	59%	59%
Electronics	Electric	Personal Computers	0%	9%	18%	27%	36%	45%	54%	59%	59%	59%	59%	59%	59%
Electronics	Electric	Monitor	0%	9%	18%	27%	36%	45%	54%	59%	59%	59%	59%	59%	59%
Electronics	Electric	Laptops	0%	9%	18%	27%	36%	45%	54%	59%	59%	59%	59%	59%	59%
Electronics	Electric	TVs	0%	9%	18%	27%	36%	45%	54%	59%	59%	59%	59%	59%	59%
Electronics	Electric	Printer/Fax/Copier	0%	9%	18%	27%	36%	45%	54%	59%	59%	59%	59%	59%	59%
Electronics	Electric	Set-top Boxes/DVR	0%	9%	18%	27%	36%	45%	54%	59%	59%	59%	59%	59%	59%
Electronics	Electric	Devices and Gadgets	0%	9%	18%	27%	36%	45%	54%	59%	59%	59%	59%	59%	59%
Miscellaneous	Electric	Pool Pump	0%	6%	12%	18%	24%	30%	36%	42%	48%	54%	59%	59%	59%
Miscellaneous	Electric	Pool Heater	0%	6%	12%	18%	24%	30%	36%	42%	48%	54%	59%	59%	59%
Miscellaneous	Electric	Hot Tub / Spa	0%	6%	12%	18%	24%	30%	36%	42%	48%	54%	59%	59%	59%
Miscellaneous	Electric	Well Pump	0%	6%	12%	18%	24%	30%	36%	42%	48%	54%	59%	59%	59%
Miscellaneous	Electric	Furnace Fan	0%	6%	12%	18%	24%	30%	36%	42%	48%	54%	59%	59%	59%
Miscellaneous	Electric	Miscellaneous	0%	9%	18%	27%	36%	45%	54%	59%	59%	59%	59%	59%	59%

Table E-4 Multi Family Non-Equipment Measures—(Achievable High factor)

Measures	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Insulation - Ceiling	0%	5%	9%	14%	18%	23%	27%	32%	36%	41%	45%	50%	54%
Insulation - Ducting	0%	5%	9%	14%	18%	23%	27%	32%	36%	41%	45%	50%	54%
Insulation - Foundation	0%	5%	9%	14%	18%	23%	27%	32%	36%	41%	45%	50%	54%
Insulation - Infiltration Control	0%	6%	12%	18%	24%	30%	36%	42%	48%	54%	59%	59%	59%
Insulation - Radiant Barrier	0%	5%	9%	14%	18%	23%	27%	32%	36%	41%	45%	50%	54%
Insulation - Wall Cavity	0%	5%	9%	14%	18%	23%	27%	32%	36%	41%	45%	50%	54%
Insulation - Wall Sheathing	0%	5%	9%	14%	18%	23%	27%	32%	36%	41%	45%	50%	54%
Ducting - Repair and Sealing	0%	6%	12%	18%	24%	30%	36%	42%	48%	54%	59%	59%	59%
Windows - High Efficiency/ENERGY STAR	0%	6%	12%	18%	24%	30%	36%	42%	48%	54%	59%	59%	59%
Windows - Install Reflective Film	0%	6%	12%	18%	24%	30%	36%	42%	48%	54%	59%	59%	59%
Doors - Storm and Thermal	0%	6%	12%	18%	24%	30%	36%	42%	48%	54%	59%	59%	59%
Roofs - High Reflectivity	0%	5%	9%	14%	18%	23%	27%	32%	36%	41%	45%	50%	54%
Attic Fan - Installation	0%	5%	9%	14%	18%	23%	27%	32%	36%	41%	45%	50%	54%
Attic Fan - Photovoltaic - Installation	0%	5%	9%	14%	18%	23%	27%	32%	36%	41%	45%	50%	54%
Whole-House Fan - Installation	0%	5%	9%	14%	18%	23%	27%	32%	36%	41%	45%	50%	54%
Ceiling Fan - Installation	0%	6%	12%	18%	24%	30%	36%	42%	48%	54%	59%	59%	59%
Thermostat - Clock/Programmable	0%	9%	18%	27%	36%	45%	54%	63%	72%	77%	77%	77%	77%
Home Energy Management System	0%	9%	18%	27%	36%	45%	54%	59%	59%	59%	59%	59%	59%
Central AC - Early Replacement	0%	6%	12%	18%	24%	30%	36%	42%	48%	54%	59%	59%	59%
Central AC - Maintenance and Tune-Up	0%	9%	18%	27%	36%	45%	54%	59%	59%	59%	59%	59%	59%
Central Heat Pump - Maintenance	0%	9%	18%	27%	36%	45%	54%	59%	59%	59%	59%	59%	59%
Room AC - Removal of Second Unit	0%	18%	36%	54%	59%	59%	59%	59%	59%	59%	59%	59%	59%
Water Heater - Drainwater Heat Recovery	0%	5%	9%	14%	18%	23%	27%	32%	36%	41%	45%	50%	54%
Water Heater - Faucet Aerators	0%	18%	36%	54%	72%	77%	77%	77%	77%	77%	77%	77%	77%
Water Heater - Low-Flow Showerheads	0%	18%	36%	54%	72%	77%	77%	77%	77%	77%	77%	77%	77%
Water Heater - Pipe Insulation	0%	18%	36%	54%	59%	59%	59%	59%	59%	59%	59%	59%	59%
Water Heater - Timer	0%	18%	36%	54%	59%	59%	59%	59%	59%	59%	59%	59%	59%
Water Heater - Desuperheater	0%	5%	9%	14%	18%	23%	27%	32%	36%	41%	45%	50%	54%
Water Heater - Solar System	0%	5%	9%	14%	18%	23%	27%	32%	36%	41%	45%	50%	54%
Interior Lighting - Occupancy Sensors	0%	18%	36%	54%	59%	59%	59%	59%	59%	59%	59%	59%	59%
Exterior Lighting - Photosensor Control	0%	18%	36%	54%	72%	77%	77%	77%	77%	77%	77%	77%	77%
Exterior Lighting - Photovoltaic Installation	0%	18%	36%	54%	59%	59%	59%	59%	59%	59%	59%	59%	59%
Exterior Lighting - Timeclock Installation	0%	18%	36%	54%	59%	59%	59%	59%	59%	59%	59%	59%	59%
Refrigerator - Early Replacement	0%	9%	18%	27%	36%	45%	54%	63%	72%	77%	77%	77%	77%
Refrigerator - Maintenance	0%	18%	36%	54%	59%	59%	59%	59%	59%	59%	59%	59%	59%
Refrigerator - Remove Second Unit	0%	18%	36%	54%	59%	59%	59%	59%	59%	59%	59%	59%	59%
Freezer - Remove Second Unit	0%	18%	36%	54%	59%	59%	59%	59%	59%	59%	59%	59%	59%
Freezer - Early Replacement	0%	9%	18%	27%	36%	45%	54%	59%	59%	59%	59%	59%	59%
Freezer - Maintenance	0%	18%	36%	54%	59%	59%	59%	59%	59%	59%	59%	59%	59%
Electronics - Smart Power Strips	0%	18%	36%	54%	59%	59%	59%	59%	59%	59%	59%	59%	59%

Measures	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Pool Pump - Timer	0%	9%	18%	27%	36%	45%	54%	59%	59%	59%	59%	59%	59%
Pool Heater - Solar System	0%	9%	18%	27%	36%	45%	54%	59%	59%	59%	59%	59%	59%
ENERGY STAR Home Design	0%	5%	9%	14%	18%	23%	27%	32%	36%	41%	45%	50%	54%
Dehumidifier	0%	6%	12%	18%	24%	30%	36%	42%	48%	54%	59%	59%	59%
PC Power Management Software	0%	18%	36%	54%	59%	59%	59%	59%	59%	59%	59%	59%	59%

Table E-5 Single Family Equipment Measures—(Achievable High factor x Achievable Low factor)

End Use	Fuel	Technology	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Cooling	Electric	Central AC	0%	0%	1%	7%	11%	16%	21%	26%	29%	30%	32%	33%	34%
Cooling	Electric	Room AC	0%	0%	0%	5%	8%	11%	14%	17%	21%	25%	29%	33%	34%
Cooling	Electric	Air-Source Heat Pump	0%	0%	0%	5%	8%	11%	14%	17%	21%	25%	29%	33%	34%
Cooling	Electric	Geothermal Heat Pump	0%	0%	0%	4%	6%	8%	10%	13%	16%	19%	22%	25%	29%
Heating	Electric	Electric Resistance	0%	0%	0%	5%	8%	11%	14%	17%	21%	25%	29%	33%	34%
Heating	Electric	Furnace	0%	0%	0%	5%	8%	11%	14%	17%	21%	25%	29%	33%	34%
Heating	Electric	Air-Source Heat Pump	0%	0%	0%	5%	8%	11%	14%	17%	21%	25%	29%	33%	34%
Heating	Electric	Geothermal Heat Pump	0%	0%	0%	4%	6%	8%	10%	13%	16%	19%	22%	25%	29%
Water Heating	Electric	Water Heater <= 55 gal	0%	0%	1%	7%	11%	16%	21%	26%	29%	30%	32%	33%	34%
Water Heating	Electric	Water Heater > 55 gal	0%	0%	1%	7%	11%	16%	21%	26%	29%	30%	32%	33%	34%
Interior Lighting	Electric	Screw-in	0%	0%	3%	14%	23%	32%	35%	37%	38%	40%	41%	43%	44%
Interior Lighting	Electric	Linear Fluorescent	0%	0%	1%	7%	11%	16%	21%	26%	32%	37%	41%	43%	44%
Interior Lighting	Electric	Specialty	0%	0%	1%	7%	11%	16%	21%	26%	32%	37%	41%	43%	44%
Exterior Lighting	Electric	Exterior Lighting	0%	0%	3%	14%	23%	32%	35%	37%	38%	40%	41%	43%	44%
Appliances	Electric	Clothes Washer	0%	0%	1%	7%	11%	16%	21%	26%	32%	37%	41%	43%	44%
Appliances	Electric	Clothes Dryer	0%	0%	1%	7%	11%	16%	21%	26%	32%	37%	41%	43%	44%
Appliances	Electric	Dishwasher	0%	0%	1%	7%	11%	16%	21%	26%	32%	37%	41%	43%	44%
Appliances	Electric	Refrigerator	0%	0%	1%	7%	11%	16%	21%	26%	32%	37%	41%	43%	44%
Appliances	Electric	Freezer	0%	0%	1%	7%	11%	16%	21%	26%	29%	30%	32%	33%	34%
Appliances	Electric	Second Refrigerator	0%	0%	1%	7%	11%	16%	21%	26%	32%	37%	41%	43%	44%
Appliances	Electric	Stove	0%	0%	1%	7%	11%	16%	21%	26%	29%	30%	32%	33%	34%
Appliances	Electric	Microwave	0%	0%	1%	7%	11%	16%	21%	26%	29%	30%	32%	33%	34%
Electronics	Electric	Personal Computers	0%	0%	1%	7%	11%	16%	21%	26%	29%	30%	32%	33%	34%
Electronics	Electric	Monitor	0%	0%	1%	7%	11%	16%	21%	26%	29%	30%	32%	33%	34%
Electronics	Electric	Laptops	0%	0%	1%	7%	11%	16%	21%	26%	29%	30%	32%	33%	34%
Electronics	Electric	TVs	0%	0%	1%	7%	11%	16%	21%	26%	29%	30%	32%	33%	34%
Electronics	Electric	Printer/Fax/Copier	0%	0%	1%	7%	11%	16%	21%	26%	29%	30%	32%	33%	34%
Electronics	Electric	Set-top Boxes/DVR	0%	0%	1%	7%	11%	16%	21%	26%	29%	30%	32%	33%	34%
Electronics	Electric	Devices and Gadgets	0%	0%	1%	7%	11%	16%	21%	26%	29%	30%	32%	33%	34%
Miscellaneous	Electric	Pool Pump	0%	0%	0%	5%	8%	11%	14%	17%	21%	25%	29%	33%	34%
Miscellaneous	Electric	Pool Heater	0%	0%	0%	5%	8%	11%	14%	17%	21%	25%	29%	33%	34%
Miscellaneous	Electric	Hot Tub / Spa	0%	0%	0%	5%	8%	11%	14%	17%	21%	25%	29%	33%	34%
Miscellaneous	Electric	Well Pump	0%	0%	0%	5%	8%	11%	14%	17%	21%	25%	29%	33%	34%
Miscellaneous	Electric	Furnace Fan	0%	0%	0%	5%	8%	11%	14%	17%	21%	25%	29%	33%	34%

End Use	Fuel	Technology	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Miscellaneous	Electric	Miscellaneous	0%	0%	1%	7%	11%	16%	21%	26%	29%	30%	32%	33%	34%

Table E-6 Single Family Non-Equipment Measures—(Achievable High factor x Achievable Low factor)

Measures	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Insulation - Ceiling	0%	0%	4%	6%	8%	10%	13%	16%	19%	22%	25%	29%	32%
Insulation - Ducting	0%	0%	4%	6%	8%	10%	13%	16%	19%	22%	25%	29%	32%
Insulation - Foundation	0%	0%	4%	6%	8%	10%	13%	16%	19%	22%	25%	29%	32%
Insulation - Infiltration Control	0%	0%	5%	8%	11%	14%	17%	21%	25%	29%	33%	34%	35%
Insulation - Radiant Barrier	0%	0%	4%	6%	8%	10%	13%	16%	19%	22%	25%	29%	32%
Insulation - Wall Cavity	0%	0%	4%	6%	8%	10%	13%	16%	19%	22%	25%	29%	32%
Insulation - Wall Sheathing	0%	0%	4%	6%	8%	10%	13%	16%	19%	22%	25%	29%	32%
Ducting - Repair and Sealing	0%	0%	5%	8%	11%	14%	17%	21%	25%	29%	33%	34%	35%
Windows - High Efficiency/ENERGY STAR	0%	0%	5%	8%	11%	14%	17%	21%	25%	29%	33%	34%	35%
Windows - Install Reflective Film	0%	0%	5%	8%	11%	14%	17%	21%	25%	29%	33%	34%	35%
Doors - Storm and Thermal	0%	0%	5%	8%	11%	14%	17%	21%	25%	29%	33%	34%	35%
Roofs - High Reflectivity	0%	0%	4%	6%	8%	10%	13%	16%	19%	22%	25%	29%	32%
Attic Fan - Installation	0%	0%	4%	6%	8%	10%	13%	16%	19%	22%	25%	29%	32%
Attic Fan - Photovoltaic - Installation	0%	0%	4%	6%	8%	10%	13%	16%	19%	22%	25%	29%	32%
Whole-House Fan - Installation	0%	0%	4%	6%	8%	10%	13%	16%	19%	22%	25%	29%	32%
Ceiling Fan - Installation	0%	0%	5%	8%	11%	14%	17%	21%	25%	29%	33%	34%	35%
Thermostat - Clock/Programmable	0%	1%	7%	11%	16%	21%	26%	32%	37%	41%	43%	44%	46%
Home Energy Management System	0%	1%	7%	11%	16%	21%	26%	29%	30%	32%	33%	34%	35%
Central AC - Early Replacement	0%	0%	5%	8%	11%	14%	17%	21%	25%	29%	33%	34%	35%
Central AC - Maintenance and Tune-Up	0%	1%	7%	11%	16%	21%	26%	29%	30%	32%	33%	34%	35%
Central Heat Pump - Maintenance	0%	1%	7%	11%	16%	21%	26%	29%	30%	32%	33%	34%	35%
Room AC - Removal of Second Unit	0%	3%	14%	23%	26%	27%	28%	29%	30%	32%	33%	34%	35%
Water Heater - Drainwater Heat Recovery	0%	0%	4%	6%	8%	10%	13%	16%	19%	22%	25%	29%	32%
Water Heater - Faucet Aerators	0%	3%	14%	23%	32%	35%	37%	38%	40%	41%	43%	44%	46%
Water Heater - Low-Flow Showerheads	0%	3%	14%	23%	32%	35%	37%	38%	40%	41%	43%	44%	46%
Water Heater - Pipe Insulation	0%	3%	14%	23%	26%	27%	28%	29%	30%	32%	33%	34%	35%
Water Heater - Timer	0%	3%	14%	23%	26%	27%	28%	29%	30%	32%	33%	34%	35%
Water Heater - Desuperheater	0%	0%	4%	6%	8%	10%	13%	16%	19%	22%	25%	29%	32%
Water Heater - Solar System	0%	0%	4%	6%	8%	10%	13%	16%	19%	22%	25%	29%	32%
Interior Lighting - Occupancy Sensors	0%	3%	14%	23%	26%	27%	28%	29%	30%	32%	33%	34%	35%
Exterior Lighting - Photosensor Control	0%	3%	14%	23%	32%	35%	37%	38%	40%	41%	43%	44%	46%
Exterior Lighting - Photovoltaic Installation	0%	3%	14%	23%	26%	27%	28%	29%	30%	32%	33%	34%	35%
Exterior Lighting - Timeclock Installation	0%	3%	14%	23%	26%	27%	28%	29%	30%	32%	33%	34%	35%
Refrigerator - Early Replacement	0%	1%	7%	11%	16%	21%	26%	32%	37%	41%	43%	44%	46%

Measures	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Refrigerator - Maintenance	0%	3%	14%	23%	26%	27%	28%	29%	30%	32%	33%	34%	35%
Refrigerator - Remove Second Unit	0%	3%	14%	23%	26%	27%	28%	29%	30%	32%	33%	34%	35%
Freezer - Remove Second Unit	0%	3%	14%	23%	26%	27%	28%	29%	30%	32%	33%	34%	35%
Freezer - Early Replacement	0%	1%	7%	11%	16%	21%	26%	29%	30%	32%	33%	34%	35%
Freezer - Maintenance	0%	3%	14%	23%	26%	27%	28%	29%	30%	32%	33%	34%	35%
Electronics - Smart Power Strips	0%	3%	14%	23%	26%	27%	28%	29%	30%	32%	33%	34%	35%
Pool Pump - Timer	0%	1%	7%	11%	16%	21%	26%	29%	30%	32%	33%	34%	35%
Pool Heater - Solar System	0%	1%	7%	11%	16%	21%	26%	29%	30%	32%	33%	34%	35%
ENERGY STAR Home Design	0%	0%	4%	6%	8%	10%	13%	16%	19%	22%	25%	29%	32%
Dehumidifier	0%	0%	5%	8%	11%	14%	17%	21%	25%	29%	33%	34%	35%
PC Power Management Software	0%	3%	14%	23%	26%	27%	28%	29%	30%	32%	33%	34%	35%

Table E-7 Multi Family Equipment Measures—(Achievable High factor x Achievable Low factor)

End Use	Fuel	Technology	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Cooling	Electric	Central AC	0%	1%	7%	11%	16%	21%	26%	29%	30%	32%	33%	34%	35%
Cooling	Electric	Room AC	0%	0%	5%	8%	11%	14%	17%	21%	25%	29%	33%	34%	35%
Cooling	Electric	Air-Source Heat Pump	0%	0%	5%	8%	11%	14%	17%	21%	25%	29%	33%	34%	35%
Cooling	Electric	Geothermal Heat Pump	0%	0%	4%	6%	8%	10%	13%	16%	19%	22%	25%	29%	32%
Heating	Electric	Electric Resistance	0%	0%	5%	8%	11%	14%	17%	21%	25%	29%	33%	34%	35%
Heating	Electric	Furnace	0%	0%	5%	8%	11%	14%	17%	21%	25%	29%	33%	34%	35%
Heating	Electric	Air-Source Heat Pump	0%	0%	5%	8%	11%	14%	17%	21%	25%	29%	33%	34%	35%
Heating	Electric	Geothermal Heat Pump	0%	0%	4%	6%	8%	10%	13%	16%	19%	22%	25%	29%	32%
Water Heating	Electric	Water Heater <= 55 gal	0%	1%	7%	11%	16%	21%	26%	29%	30%	32%	33%	34%	35%
Water Heating	Electric	Water Heater > 55 gal	0%	1%	7%	11%	16%	21%	26%	29%	30%	32%	33%	34%	35%
Interior Lighting	Electric	Screw-in	0%	3%	14%	23%	32%	35%	37%	38%	40%	41%	43%	44%	46%
Interior Lighting	Electric	Linear Fluorescent	0%	1%	7%	11%	16%	21%	26%	32%	37%	41%	43%	44%	46%
Interior Lighting	Electric	Specialty	0%	1%	7%	11%	16%	21%	26%	32%	37%	41%	43%	44%	46%
Exterior Lighting	Electric	Exterior Lighting	0%	3%	14%	23%	32%	35%	37%	38%	40%	41%	43%	44%	46%
Appliances	Electric	Clothes Washer	0%	1%	7%	11%	16%	21%	26%	32%	37%	41%	43%	44%	46%
Appliances	Electric	Clothes Dryer	0%	1%	7%	11%	16%	21%	26%	32%	37%	41%	43%	44%	46%
Appliances	Electric	Dishwasher	0%	1%	7%	11%	16%	21%	26%	32%	37%	41%	43%	44%	46%
Appliances	Electric	Refrigerator	0%	1%	7%	11%	16%	21%	26%	32%	37%	41%	43%	44%	46%
Appliances	Electric	Freezer	0%	1%	7%	11%	16%	21%	26%	29%	30%	32%	33%	34%	35%
Appliances	Electric	Second Refrigerator	0%	1%	7%	11%	16%	21%	26%	32%	37%	41%	43%	44%	46%
Appliances	Electric	Stove	0%	1%	7%	11%	16%	21%	26%	29%	30%	32%	33%	34%	35%
Appliances	Electric	Microwave	0%	1%	7%	11%	16%	21%	26%	29%	30%	32%	33%	34%	35%
Electronics	Electric	Personal Computers	0%	1%	7%	11%	16%	21%	26%	29%	30%	32%	33%	34%	35%
Electronics	Electric	Monitor	0%	1%	7%	11%	16%	21%	26%	29%	30%	32%	33%	34%	35%
Electronics	Electric	Laptops	0%	1%	7%	11%	16%	21%	26%	29%	30%	32%	33%	34%	35%
Electronics	Electric	TVs	0%	1%	7%	11%	16%	21%	26%	29%	30%	32%	33%	34%	35%
Electronics	Electric	Printer/Fax/Copier	0%	1%	7%	11%	16%	21%	26%	29%	30%	32%	33%	34%	35%
Electronics	Electric	Set-top Boxes/DVR	0%	1%	7%	11%	16%	21%	26%	29%	30%	32%	33%	34%	35%
Electronics	Electric	Devices and Gadgets	0%	1%	7%	11%	16%	21%	26%	29%	30%	32%	33%	34%	35%
Miscellaneous	Electric	Pool Pump	0%	0%	5%	8%	11%	14%	17%	21%	25%	29%	33%	34%	35%
Miscellaneous	Electric	Pool Heater	0%	0%	5%	8%	11%	14%	17%	21%	25%	29%	33%	34%	35%
Miscellaneous	Electric	Hot Tub / Spa	0%	0%	5%	8%	11%	14%	17%	21%	25%	29%	33%	34%	35%
Miscellaneous	Electric	Well Pump	0%	0%	5%	8%	11%	14%	17%	21%	25%	29%	33%	34%	35%
Miscellaneous	Electric	Furnace Fan	0%	0%	5%	8%	11%	14%	17%	21%	25%	29%	33%	34%	35%
Miscellaneous	Electric	Miscellaneous	0%	1%	7%	11%	16%	21%	26%	29%	30%	32%	33%	34%	35%

Table E-8 Multi Family Non-Equipment Measures—(Achievable High factor x Achievable Low factor)

Measures	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Insulation - Ceiling	0%	0%	4%	6%	8%	10%	13%	16%	19%	22%	25%	29%	32%
Insulation - Ducting	0%	0%	4%	6%	8%	10%	13%	16%	19%	22%	25%	29%	32%
Insulation - Foundation	0%	0%	4%	6%	8%	10%	13%	16%	19%	22%	25%	29%	32%
Insulation - Infiltration Control	0%	0%	5%	8%	11%	14%	17%	21%	25%	29%	33%	34%	35%
Insulation - Radiant Barrier	0%	0%	4%	6%	8%	10%	13%	16%	19%	22%	25%	29%	32%
Insulation - Wall Cavity	0%	0%	4%	6%	8%	10%	13%	16%	19%	22%	25%	29%	32%
Insulation - Wall Sheathing	0%	0%	4%	6%	8%	10%	13%	16%	19%	22%	25%	29%	32%
Ducting - Repair and Sealing	0%	0%	5%	8%	11%	14%	17%	21%	25%	29%	33%	34%	35%
Windows - High Efficiency/ENERGY STAR	0%	0%	5%	8%	11%	14%	17%	21%	25%	29%	33%	34%	35%
Windows - Install Reflective Film	0%	0%	5%	8%	11%	14%	17%	21%	25%	29%	33%	34%	35%
Doors - Storm and Thermal	0%	0%	5%	8%	11%	14%	17%	21%	25%	29%	33%	34%	35%
Roofs - High Reflectivity	0%	0%	4%	6%	8%	10%	13%	16%	19%	22%	25%	29%	32%
Attic Fan - Installation	0%	0%	4%	6%	8%	10%	13%	16%	19%	22%	25%	29%	32%
Attic Fan - Photovoltaic - Installation	0%	0%	4%	6%	8%	10%	13%	16%	19%	22%	25%	29%	32%
Whole-House Fan - Installation	0%	0%	4%	6%	8%	10%	13%	16%	19%	22%	25%	29%	32%
Ceiling Fan - Installation	0%	0%	5%	8%	11%	14%	17%	21%	25%	29%	33%	34%	35%
Thermostat - Clock/Programmable	0%	1%	7%	11%	16%	21%	26%	32%	37%	41%	43%	44%	46%
Home Energy Management System	0%	1%	7%	11%	16%	21%	26%	29%	30%	32%	33%	34%	35%
Central AC - Early Replacement	0%	0%	5%	8%	11%	14%	17%	21%	25%	29%	33%	34%	35%
Central AC - Maintenance and Tune-Up	0%	1%	7%	11%	16%	21%	26%	29%	30%	32%	33%	34%	35%
Central Heat Pump - Maintenance	0%	1%	7%	11%	16%	21%	26%	29%	30%	32%	33%	34%	35%
Room AC - Removal of Second Unit	0%	3%	14%	23%	26%	27%	28%	29%	30%	32%	33%	34%	35%
Water Heater - Drainwater Heat Recovery	0%	0%	4%	6%	8%	10%	13%	16%	19%	22%	25%	29%	32%
Water Heater - Faucet Aerators	0%	3%	14%	23%	32%	35%	37%	38%	40%	41%	43%	44%	46%
Water Heater - Low-Flow Showerheads	0%	3%	14%	23%	32%	35%	37%	38%	40%	41%	43%	44%	46%
Water Heater - Pipe Insulation	0%	3%	14%	23%	26%	27%	28%	29%	30%	32%	33%	34%	35%
Water Heater - Timer	0%	3%	14%	23%	26%	27%	28%	29%	30%	32%	33%	34%	35%
Water Heater - Desuperheater	0%	0%	4%	6%	8%	10%	13%	16%	19%	22%	25%	29%	32%
Water Heater - Solar System	0%	0%	4%	6%	8%	10%	13%	16%	19%	22%	25%	29%	32%
Interior Lighting - Occupancy Sensors	0%	3%	14%	23%	26%	27%	28%	29%	30%	32%	33%	34%	35%
Exterior Lighting - Photosensor Control	0%	3%	14%	23%	32%	35%	37%	38%	40%	41%	43%	44%	46%
Exterior Lighting - Photovoltaic Installation	0%	3%	14%	23%	26%	27%	28%	29%	30%	32%	33%	34%	35%
Exterior Lighting - Timeclock Installation	0%	3%	14%	23%	26%	27%	28%	29%	30%	32%	33%	34%	35%
Refrigerator - Early Replacement	0%	1%	7%	11%	16%	21%	26%	32%	37%	41%	43%	44%	46%

Measures	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Refrigerator - Maintenance	0%	3%	14%	23%	26%	27%	28%	29%	30%	32%	33%	34%	35%
Refrigerator - Remove Second Unit	0%	3%	14%	23%	26%	27%	28%	29%	30%	32%	33%	34%	35%
Freezer - Remove Second Unit	0%	3%	14%	23%	26%	27%	28%	29%	30%	32%	33%	34%	35%
Freezer - Early Replacement	0%	1%	7%	11%	16%	21%	26%	29%	30%	32%	33%	34%	35%
Freezer - Maintenance	0%	3%	14%	23%	26%	27%	28%	29%	30%	32%	33%	34%	35%
Electronics - Smart Power Strips	0%	3%	14%	23%	26%	27%	28%	29%	30%	32%	33%	34%	35%
Pool Pump - Timer	0%	1%	7%	11%	16%	21%	26%	29%	30%	32%	33%	34%	35%
Pool Heater - Solar System	0%	1%	7%	11%	16%	21%	26%	29%	30%	32%	33%	34%	35%
ENERGY STAR Home Design	0%	0%	4%	6%	8%	10%	13%	16%	19%	22%	25%	29%	32%
Dehumidifier	0%	0%	5%	8%	11%	14%	17%	21%	25%	29%	33%	34%	35%
PC Power Management Software	0%	3%	14%	23%	26%	27%	28%	29%	30%	32%	33%	34%	35%

Table E-9 Commercial Equipment Measures (Achievable High factor)

End Use	Fuel	Technology	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Cooling	Electric	Air-Cooled Chiller	0%	9%	18%	27%	36%	45%	54%	59%	59%	59%	59%	59%	59%
Cooling	Electric	Water-Cooled Chiller	0%	9%	18%	27%	36%	45%	54%	59%	59%	59%	59%	59%	59%
Cooling	Electric	Roof top AC	0%	9%	18%	27%	36%	45%	54%	59%	59%	59%	59%	59%	59%
Cooling	Electric	Air Source Heat Pump	0%	6%	12%	18%	24%	30%	36%	42%	48%	54%	59%	59%	59%
Cooling	Electric	Geothermal Heat Pump	0%	5%	9%	14%	18%	23%	27%	32%	36%	41%	45%	50%	50%
Cooling	Electric	Other Cooling	0%	6%	12%	18%	24%	30%	36%	42%	48%	54%	59%	59%	59%
Heating	Electric	Air Source Heat Pump	0%	6%	12%	18%	24%	30%	36%	42%	48%	54%	59%	59%	59%
Heating	Electric	Geothermal Heat Pump	0%	5%	9%	14%	18%	23%	27%	32%	36%	41%	45%	50%	50%
Heating	Electric	Electric Room Heat	0%	6%	12%	18%	24%	30%	36%	42%	48%	54%	59%	59%	59%
Heating	Electric	Electric Furnace	0%	6%	12%	18%	24%	30%	36%	42%	48%	54%	59%	59%	59%
Ventilation	Electric	Ventilation	0%	5%	9%	14%	18%	23%	27%	32%	36%	41%	45%	50%	50%
Water Heating	Electric	Water Heating	0%	9%	18%	27%	36%	45%	54%	59%	59%	59%	59%	59%	59%
Interior Lighting	Electric	Screw-in	0%	18%	36%	54%	72%	77%	77%	77%	77%	77%	77%	77%	77%
Interior Lighting	Electric	High-Bay Fixtures	0%	9%	18%	27%	36%	45%	54%	63%	72%	77%	77%	77%	77%
Interior Lighting	Electric	Linear Fluorescent	0%	9%	18%	27%	36%	45%	54%	63%	72%	77%	77%	77%	77%
Exterior Lighting	Electric	Screw-in	0%	18%	36%	54%	72%	77%	77%	77%	77%	77%	77%	77%	77%
Exterior Lighting	Electric	HID	0%	18%	36%	54%	72%	77%	77%	77%	77%	77%	77%	77%	77%
Exterior Lighting	Electric	Linear Fluorescent	0%	9%	18%	27%	36%	45%	54%	63%	72%	77%	77%	77%	77%
Refrigeration	Electric	Walk-in Refrigerator	0%	18%	36%	54%	59%	59%	59%	59%	59%	59%	59%	59%	59%
Refrigeration	Electric	Reach-in Refrigerator	0%	18%	36%	54%	59%	59%	59%	59%	59%	59%	59%	59%	59%
Refrigeration	Electric	Glass Door Display	0%	18%	36%	54%	59%	59%	59%	59%	59%	59%	59%	59%	59%
Refrigeration	Electric	Open Display Case	0%	18%	36%	54%	59%	59%	59%	59%	59%	59%	59%	59%	59%
Refrigeration	Electric	Icemaker	0%	18%	36%	54%	59%	59%	59%	59%	59%	59%	59%	59%	59%
Refrigeration	Electric	Vending Machine	0%	18%	36%	54%	59%	59%	59%	59%	59%	59%	59%	59%	59%
Food Preparation	Electric	Oven	0%	9%	18%	27%	36%	45%	54%	59%	59%	59%	59%	59%	59%
Food Preparation	Electric	Fryer	0%	9%	18%	27%	36%	45%	54%	59%	59%	59%	59%	59%	59%
Food Preparation	Electric	Dishwasher	0%	9%	18%	27%	36%	45%	54%	63%	72%	77%	77%	77%	77%
Food Preparation	Electric	Hot Food Container	0%	18%	36%	54%	59%	59%	59%	59%	59%	59%	59%	59%	59%
Office Equipment	Electric	Desktop Computer	0%	18%	36%	54%	59%	59%	59%	59%	59%	59%	59%	59%	59%
Office Equipment	Electric	Laptop	0%	18%	36%	54%	59%	59%	59%	59%	59%	59%	59%	59%	59%
Office Equipment	Electric	Server	0%	18%	36%	54%	59%	59%	59%	59%	59%	59%	59%	59%	59%
Office Equipment	Electric	Monitor	0%	18%	36%	54%	59%	59%	59%	59%	59%	59%	59%	59%	59%
Office Equipment	Electric	Printer/Copier/Fax	0%	18%	36%	54%	59%	59%	59%	59%	59%	59%	59%	59%	59%
Office Equipment	Electric	POS Terminal	0%	9%	18%	27%	36%	45%	54%	59%	59%	59%	59%	59%	59%
Miscellaneous	Electric	Non-HVAC Motors	0%	6%	12%	18%	24%	30%	36%	42%	48%	54%	59%	59%	59%
Miscellaneous	Electric	Pool Pump	0%	6%	12%	18%	24%	30%	36%	42%	48%	54%	59%	59%	59%
Miscellaneous	Electric	Pool Heater	0%	6%	12%	18%	24%	30%	36%	42%	48%	54%	59%	59%	59%
Miscellaneous	Electric	Miscellaneous	0%	9%	18%	27%	36%	45%	54%	59%	59%	59%	59%	59%	59%

Table E-10 Commercial Non-Equipment Measures (Achievable High factor)

Technology	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Insulation - Ceiling	0%	5%	9%	14%	18%	23%	27%	32%	36%	41%	45%	50%	50%
Insulation - Ducting	0%	5%	9%	14%	18%	23%	27%	32%	36%	41%	45%	50%	50%
Insulation - Radiant Barrier	0%	5%	9%	14%	18%	23%	27%	32%	36%	41%	45%	50%	50%
Insulation - Wall Cavity	0%	5%	9%	14%	18%	23%	27%	32%	36%	41%	45%	50%	50%
HVAC - Duct Repair and Sealing	0%	6%	12%	18%	24%	30%	36%	42%	48%	54%	59%	59%	59%
Doors - High Efficiency	0%	6%	12%	18%	24%	30%	36%	42%	48%	54%	59%	59%	59%
Windows - High Efficiency	0%	6%	12%	18%	24%	30%	36%	42%	48%	54%	59%	59%	59%
Roof - High Reflectivity	0%	5%	9%	14%	18%	23%	27%	32%	36%	41%	45%	50%	50%
Air-Cooled Chiller - Condenser Water Temperature Reset	0%	9%	18%	27%	36%	45%	54%	59%	59%	59%	59%	59%	59%
Air-Cooled Chiller - Economizer	0%	9%	18%	27%	36%	45%	54%	59%	59%	59%	59%	59%	59%
Air-Cooled Chiller - Thermal Energy Storage	0%	5%	9%	14%	18%	23%	27%	32%	36%	41%	45%	50%	50%
Air-Cooled Chiller - VSD on Fans	0%	18%	36%	54%	59%	59%	59%	59%	59%	59%	59%	59%	59%
Air-Cooled Chiller - Chilled Water Reset	0%	9%	18%	27%	36%	45%	54%	59%	59%	59%	59%	59%	59%
Air-Cooled Chiller - Chilled Water Variable-Flow System	0%	9%	18%	27%	36%	45%	54%	59%	59%	59%	59%	59%	59%
Air-Cooled Chiller - High Efficiency Cooling Tower Fans	0%	9%	18%	27%	36%	45%	54%	59%	59%	59%	59%	59%	59%
Air-Cooled Chiller - Maintenance	0%	9%	18%	27%	36%	45%	54%	59%	59%	59%	59%	59%	59%
Air-Cooled Chiller - Chiller Heat Recovery	0%	9%	18%	27%	36%	45%	54%	59%	59%	59%	59%	59%	59%
Water-Cooled Chiller - Condenser Water Temperature Reset	0%	9%	18%	27%	36%	45%	54%	59%	59%	59%	59%	59%	59%
Water-Cooled Chiller - Economizer	0%	9%	18%	27%	36%	45%	54%	59%	59%	59%	59%	59%	59%
Water-Cooled Chiller - Thermal Energy Storage	0%	5%	9%	14%	18%	23%	27%	32%	36%	41%	45%	50%	50%
Water-Cooled Chiller - VSD on Fans	0%	18%	36%	54%	59%	59%	59%	59%	59%	59%	59%	59%	59%
Water-Cooled Chiller - Chilled Water Reset	0%	9%	18%	27%	36%	45%	54%	59%	59%	59%	59%	59%	59%
Water-Cooled Chiller - Chilled Water Variable-Flow System	0%	9%	18%	27%	36%	45%	54%	59%	59%	59%	59%	59%	59%
Water-Cooled Chiller - High Efficiency Cooling Tower Fans	0%	9%	18%	27%	36%	45%	54%	59%	59%	59%	59%	59%	59%
Water-Cooled Chiller - Maintenance	0%	9%	18%	27%	36%	45%	54%	59%	59%	59%	59%	59%	59%
Water-Cooled Chiller - Chiller Heat Recovery	0%	9%	18%	27%	36%	45%	54%	59%	59%	59%	59%	59%	59%
RTU - Evaporative Precooler	0%	9%	18%	27%	36%	45%	54%	59%	59%	59%	59%	59%	59%
RTU - Maintenance	0%	9%	18%	27%	36%	45%	54%	59%	59%	59%	59%	59%	59%
Space Heating - Heat Recovery Ventilator	0%	5%	9%	14%	18%	23%	27%	32%	36%	41%	45%	50%	50%
Heat Pump - Maintenance	0%	9%	18%	27%	36%	45%	54%	59%	59%	59%	59%	59%	59%
Ventilation - ECM on VAV Boxes	0%	9%	18%	27%	36%	45%	54%	59%	59%	59%	59%	59%	59%
Ventilation - Variable Speed Control	0%	9%	18%	27%	36%	45%	54%	59%	59%	59%	59%	59%	59%
Water Heater - Drainwater Heat Recovery	0%	5%	9%	14%	18%	23%	27%	32%	36%	41%	45%	50%	50%
Water Heater - Faucet Aerators/Low Flow Nozzles	0%	18%	36%	54%	72%	77%	77%	77%	77%	77%	77%	77%	77%

Technology	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Water Heater - High Efficiency Circulation Pump	0%	9%	18%	27%	36%	45%	54%	59%	59%	59%	59%	59%	59%
Water Heater - Desuperheater	0%	5%	9%	14%	18%	23%	27%	32%	36%	41%	45%	50%	50%
Water Heater - Solar System	0%	5%	9%	14%	18%	23%	27%	32%	36%	41%	45%	50%	50%
Water Heater - Install Timer	0%	18%	36%	54%	59%	59%	59%	59%	59%	59%	59%	59%	59%
Water Heater - Pipe Insulation	0%	18%	36%	54%	59%	59%	59%	59%	59%	59%	59%	59%	59%
Water Heater - Tank Blanket/Insulation	0%	18%	36%	54%	59%	59%	59%	59%	59%	59%	59%	59%	59%
Interior Lighting - Daylighting Controls	0%	18%	36%	54%	59%	59%	59%	59%	59%	59%	59%	59%	59%
Interior Lighting - LED Exit Lighting	0%	18%	36%	54%	72%	77%	77%	77%	77%	77%	77%	77%	77%
Interior Lighting - Occupancy Sensors	0%	9%	18%	27%	36%	45%	54%	63%	72%	77%	77%	77%	77%
Interior Lighting - Timeclocks and Timers	0%	9%	18%	27%	36%	45%	54%	63%	72%	77%	77%	77%	77%
Interior Lighting - Task Lighting	0%	9%	18%	27%	36%	45%	54%	59%	59%	59%	59%	59%	59%
Interior Fluorescent - Bi-Level Fixture	0%	9%	18%	27%	36%	45%	54%	59%	59%	59%	59%	59%	59%
Interior Fluorescent - Delamp and Install Reflectors	0%	9%	18%	27%	36%	45%	54%	59%	59%	59%	59%	59%	59%
Exterior Lighting - Bi-Level Fixture	0%	18%	36%	54%	59%	59%	59%	59%	59%	59%	59%	59%	59%
Exterior Lighting - Daylighting Controls	0%	18%	36%	54%	72%	77%	77%	77%	77%	77%	77%	77%	77%
Exterior Lighting - Photovoltaic Installation	0%	6%	12%	18%	24%	30%	36%	42%	48%	54%	59%	59%	59%
Refrigerator - Anti-Sweat Heater	0%	18%	36%	54%	59%	59%	59%	59%	59%	59%	59%	59%	59%
Refrigerator - Decommissioning	0%	9%	18%	27%	36%	45%	54%	59%	59%	59%	59%	59%	59%
Refrigerator - Demand Defrost	0%	18%	36%	54%	59%	59%	59%	59%	59%	59%	59%	59%	59%
Refrigerator - Door Gasket Replacement	0%	18%	36%	54%	59%	59%	59%	59%	59%	59%	59%	59%	59%
Refrigerator - Evaporator Fan Controls	0%	9%	18%	27%	36%	45%	54%	59%	59%	59%	59%	59%	59%
Refrigerator - Floating Head Pressure	0%	9%	18%	27%	36%	45%	54%	59%	59%	59%	59%	59%	59%
Refrigerator - Strip Curtain	0%	18%	36%	54%	59%	59%	59%	59%	59%	59%	59%	59%	59%
Refrigerator - High Efficiency Compressor	0%	9%	18%	27%	36%	45%	54%	59%	59%	59%	59%	59%	59%
Refrigerator - Variable Speed Compressor	0%	9%	18%	27%	36%	45%	54%	59%	59%	59%	59%	59%	59%
Refrigerator - eCube	0%	9%	18%	27%	36%	45%	54%	59%	59%	59%	59%	59%	59%
Vending Machine - Controller	0%	18%	36%	54%	72%	77%	77%	77%	77%	77%	77%	77%	77%
Grocery - Display Case - LED Lighting	0%	18%	36%	54%	59%	59%	59%	59%	59%	59%	59%	59%	59%
Grocery - Display Case Motion Sensors	0%	18%	36%	54%	59%	59%	59%	59%	59%	59%	59%	59%	59%
Grocery - ECMs for Display Cases	0%	6%	12%	18%	24%	30%	36%	42%	48%	54%	59%	59%	59%
Grocery - Open Display Case - Night Covers	0%	9%	18%	27%	36%	45%	54%	59%	59%	59%	59%	59%	59%
Office Equipment - ENERGY STAR Power Supplies	0%	5%	9%	14%	18%	23%	27%	32%	36%	41%	45%	50%	50%
Office Equipment - Plug Load Occupancy Sensors	0%	9%	18%	27%	36%	45%	54%	59%	59%	59%	59%	59%	59%
Pool Heater - Solar	0%	9%	18%	27%	36%	45%	54%	59%	59%	59%	59%	59%	59%
Pool Pump - Timer	0%	9%	18%	27%	36%	45%	54%	63%	72%	77%	77%	77%	77%
Ventilation - CO2 Controlled	0%	9%	18%	27%	36%	45%	54%	59%	59%	59%	59%	59%	59%

Technology	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Non-HVAC Motors - Variable Speed Control	0%	9%	18%	27%	36%	45%	54%	59%	59%	59%	59%	59%	59%
Energy Management System	0%	9%	18%	27%	36%	45%	54%	59%	59%	59%	59%	59%	59%
Thermostat - Clock/Programmable	0%	9%	18%	27%	36%	45%	54%	59%	59%	59%	59%	59%	59%
HVAC - Occupancy Sensors	0%	9%	18%	27%	36%	45%	54%	59%	59%	59%	59%	59%	59%
Commissioning - HVAC	0%	5%	9%	14%	18%	23%	27%	32%	36%	41%	45%	50%	50%
Commissioning - Lighting	0%	9%	18%	27%	36%	45%	54%	59%	59%	59%	59%	59%	59%
Retrocommissioning - HVAC	0%	18%	36%	54%	59%	59%	59%	59%	59%	59%	59%	59%	59%
Retrocommissioning - Lighting	0%	18%	36%	54%	72%	77%	77%	77%	77%	77%	77%	77%	77%
Advanced New Construction Designs	0%	5%	9%	14%	18%	23%	27%	32%	36%	41%	45%	50%	50%
Custom Measures	0%	5%	9%	14%	18%	23%	27%	32%	36%	41%	45%	50%	50%
PC Power Management Software	0%	5%	9%	14%	18%	23%	27%	32%	36%	41%	45%	50%	50%
Pre-rinse Sprayer	0%	5%	9%	14%	18%	23%	27%	32%	36%	41%	45%	50%	50%

Table E-11 Commercial Equipment Measures (Achievable High factor x Achievable Low factor)

End Use	Fuel	Technology	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Cooling	Electric	Air-Cooled Chiller	0%	1%	7%	11%	16%	21%	26%	29%	30%	32%	33%	34%	35%
Cooling	Electric	Water-Cooled Chiller	0%	1%	7%	11%	16%	21%	26%	29%	30%	32%	33%	34%	35%
Cooling	Electric	Roof top AC	0%	1%	7%	11%	16%	21%	26%	29%	30%	32%	33%	34%	35%
Cooling	Electric	Air Source Heat Pump	0%	0%	5%	8%	11%	14%	17%	21%	25%	29%	33%	34%	35%
Cooling	Electric	Geothermal Heat Pump	0%	0%	4%	6%	8%	10%	13%	16%	19%	22%	25%	29%	32%
Cooling	Electric	Other Cooling	0%	0%	5%	8%	11%	14%	17%	21%	25%	29%	33%	34%	35%
Heating	Electric	Air Source Heat Pump	0%	0%	5%	8%	11%	14%	17%	21%	25%	29%	33%	34%	35%
Heating	Electric	Geothermal Heat Pump	0%	0%	4%	6%	8%	10%	13%	16%	19%	22%	25%	29%	32%
Heating	Electric	Electric Room Heat	0%	0%	5%	8%	11%	14%	17%	21%	25%	29%	33%	34%	35%
Heating	Electric	Electric Furnace	0%	0%	5%	8%	11%	14%	17%	21%	25%	29%	33%	34%	35%
Ventilation	Electric	Ventilation	0%	0%	4%	6%	8%	10%	13%	16%	19%	22%	25%	29%	32%
Water Heating	Electric	Water Heating	0%	1%	7%	11%	16%	21%	26%	29%	30%	32%	33%	34%	35%
Interior Lighting	Electric	Screw-in	0%	3%	14%	23%	32%	35%	37%	38%	40%	41%	43%	44%	46%
Interior Lighting	Electric	High-Bay Fixtures	0%	1%	7%	11%	16%	21%	26%	32%	37%	41%	43%	44%	46%
Interior Lighting	Electric	Linear Fluorescent	0%	1%	7%	11%	16%	21%	26%	32%	37%	41%	43%	44%	46%
Exterior Lighting	Electric	Screw-in	0%	3%	14%	23%	32%	35%	37%	38%	40%	41%	43%	44%	46%
Exterior Lighting	Electric	HID	0%	3%	14%	23%	32%	35%	37%	38%	40%	41%	43%	44%	46%
Exterior Lighting	Electric	Linear Fluorescent	0%	1%	7%	11%	16%	21%	26%	32%	37%	41%	43%	44%	46%
Refrigeration	Electric	Walk-in Refrigerator	0%	3%	14%	23%	26%	27%	28%	29%	30%	32%	33%	34%	35%
Refrigeration	Electric	Reach-in Refrigerator	0%	3%	14%	23%	26%	27%	28%	29%	30%	32%	33%	34%	35%
Refrigeration	Electric	Glass Door Display	0%	3%	14%	23%	26%	27%	28%	29%	30%	32%	33%	34%	35%
Refrigeration	Electric	Open Display Case	0%	3%	14%	23%	26%	27%	28%	29%	30%	32%	33%	34%	35%
Refrigeration	Electric	Icemaker	0%	3%	14%	23%	26%	27%	28%	29%	30%	32%	33%	34%	35%
Refrigeration	Electric	Vending Machine	0%	3%	14%	23%	26%	27%	28%	29%	30%	32%	33%	34%	35%
Food Preparation	Electric	Oven	0%	1%	7%	11%	16%	21%	26%	29%	30%	32%	33%	34%	35%
Food Preparation	Electric	Fryer	0%	1%	7%	11%	16%	21%	26%	29%	30%	32%	33%	34%	35%
Food Preparation	Electric	Dishwasher	0%	1%	7%	11%	16%	21%	26%	32%	37%	41%	43%	44%	46%
Food Preparation	Electric	Hot Food Container	0%	3%	14%	23%	26%	27%	28%	29%	30%	32%	33%	34%	35%
Office Equipment	Electric	Desktop Computer	0%	3%	14%	23%	26%	27%	28%	29%	30%	32%	33%	34%	35%
Office Equipment	Electric	Laptop	0%	3%	14%	23%	26%	27%	28%	29%	30%	32%	33%	34%	35%
Office Equipment	Electric	Server	0%	3%	14%	23%	26%	27%	28%	29%	30%	32%	33%	34%	35%
Office Equipment	Electric	Monitor	0%	3%	14%	23%	26%	27%	28%	29%	30%	32%	33%	34%	35%
Office Equipment	Electric	Printer/Copier/Fax	0%	3%	14%	23%	26%	27%	28%	29%	30%	32%	33%	34%	35%
Office Equipment	Electric	POS Terminal	0%	1%	7%	11%	16%	21%	26%	29%	30%	32%	33%	34%	35%
Miscellaneous	Electric	Non-HVAC Motors	0%	0%	5%	8%	11%	14%	17%	21%	25%	29%	33%	34%	35%
Miscellaneous	Electric	Pool Pump	0%	0%	5%	8%	11%	14%	17%	21%	25%	29%	33%	34%	35%
Miscellaneous	Electric	Pool Heater	0%	0%	5%	8%	11%	14%	17%	21%	25%	29%	33%	34%	35%
Miscellaneous	Electric	Miscellaneous	0%	1%	7%	11%	16%	21%	26%	29%	30%	32%	33%	34%	35%

Table E-12 Commercial Non-Equipment Measures (Achievable High factor x Achievable Low factor)

Technology	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Insulation - Ceiling	0%	2%	4%	6%	8%	11%	14%	16%	19%	23%	26%	30%	30%
Insulation - Ducting	0%	2%	4%	6%	8%	11%	14%	16%	19%	23%	26%	30%	30%
Insulation - Radiant Barrier	0%	2%	4%	6%	8%	11%	14%	16%	19%	23%	26%	30%	30%
Insulation - Wall Cavity	0%	2%	4%	6%	8%	11%	14%	16%	19%	23%	26%	30%	30%
HVAC - Duct Repair and Sealing	0%	2%	5%	8%	11%	14%	18%	22%	26%	30%	34%	35%	35%
Doors - High Efficiency	0%	2%	5%	8%	11%	14%	18%	22%	26%	30%	34%	35%	35%
Windows - High Efficiency	0%	2%	5%	8%	11%	14%	18%	22%	26%	30%	34%	35%	35%
Roof - High Reflectivity	0%	2%	4%	6%	8%	11%	14%	16%	19%	23%	26%	30%	30%
Air-Cooled Chiller - Condenser Water Temperature Reset	0%	4%	8%	12%	17%	22%	27%	30%	32%	33%	34%	35%	35%
Air-Cooled Chiller - Economizer	0%	4%	8%	12%	17%	22%	27%	30%	32%	33%	34%	35%	35%
Air-Cooled Chiller - Thermal Energy Storage	0%	2%	4%	6%	8%	11%	14%	16%	19%	23%	26%	30%	30%
Air-Cooled Chiller - VSD on Fans	0%	7%	15%	24%	27%	28%	29%	30%	32%	33%	34%	35%	35%
Air-Cooled Chiller - Chilled Water Reset	0%	4%	8%	12%	17%	22%	27%	30%	32%	33%	34%	35%	35%
Air-Cooled Chiller - Chilled Water Variable-Flow System	0%	4%	8%	12%	17%	22%	27%	30%	32%	33%	34%	35%	35%
Air-Cooled Chiller - High Efficiency Cooling Tower Fans	0%	4%	8%	12%	17%	22%	27%	30%	32%	33%	34%	35%	35%
Air-Cooled Chiller - Maintenance	0%	4%	8%	12%	17%	22%	27%	30%	32%	33%	34%	35%	35%
Air-Cooled Chiller - Chiller Heat Recovery	0%	4%	8%	12%	17%	22%	27%	30%	32%	33%	34%	35%	35%
Water-Cooled Chiller - Condenser Water Temperature Reset	0%	4%	8%	12%	17%	22%	27%	30%	32%	33%	34%	35%	35%
Water-Cooled Chiller - Economizer	0%	4%	8%	12%	17%	22%	27%	30%	32%	33%	34%	35%	35%
Water-Cooled Chiller - Thermal Energy Storage	0%	2%	4%	6%	8%	11%	14%	16%	19%	23%	26%	30%	30%
Water-Cooled Chiller - VSD on Fans	0%	7%	15%	24%	27%	28%	29%	30%	32%	33%	34%	35%	35%
Water-Cooled Chiller - Chilled Water Reset	0%	4%	8%	12%	17%	22%	27%	30%	32%	33%	34%	35%	35%
Water-Cooled Chiller - Chilled Water Variable-Flow System	0%	4%	8%	12%	17%	22%	27%	30%	32%	33%	34%	35%	35%
Water-Cooled Chiller - High Efficiency Cooling Tower Fans	0%	4%	8%	12%	17%	22%	27%	30%	32%	33%	34%	35%	35%
Water-Cooled Chiller - Maintenance	0%	4%	8%	12%	17%	22%	27%	30%	32%	33%	34%	35%	35%
Water-Cooled Chiller - Chiller Heat Recovery	0%	4%	8%	12%	17%	22%	27%	30%	32%	33%	34%	35%	35%
RTU - Evaporative Precooler	0%	4%	8%	12%	17%	22%	27%	30%	32%	33%	34%	35%	35%
RTU - Maintenance	0%	4%	8%	12%	17%	22%	27%	30%	32%	33%	34%	35%	35%
Space Heating - Heat Recovery Ventilator	0%	2%	4%	6%	8%	11%	14%	16%	19%	23%	26%	30%	30%
Heat Pump - Maintenance	0%	4%	8%	12%	17%	22%	27%	30%	32%	33%	34%	35%	35%
Ventilation - ECM on VAV Boxes	0%	4%	8%	12%	17%	22%	27%	30%	32%	33%	34%	35%	35%
Ventilation - Variable Speed Control	0%	4%	8%	12%	17%	22%	27%	30%	32%	33%	34%	35%	35%
Water Heater - Drainwater Heat Recovery	0%	2%	4%	6%	8%	11%	14%	16%	19%	23%	26%	30%	30%
Water Heater - Faucet Aerators/Low Flow Nozzles	0%	7%	15%	24%	33%	37%	38%	40%	41%	43%	44%	46%	46%

Technology	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Water Heater - High Efficiency Circulation Pump	0%	4%	8%	12%	17%	22%	27%	30%	32%	33%	34%	35%	35%
Water Heater - Desuperheater	0%	2%	4%	6%	8%	11%	14%	16%	19%	23%	26%	30%	30%
Water Heater - Solar System	0%	2%	4%	6%	8%	11%	14%	16%	19%	23%	26%	30%	30%
Water Heater - Install Timer	0%	7%	15%	24%	27%	28%	29%	30%	32%	33%	34%	35%	35%
Water Heater - Pipe Insulation	0%	7%	15%	24%	27%	28%	29%	30%	32%	33%	34%	35%	35%
Water Heater - Tank Blanket/Insulation	0%	7%	15%	24%	27%	28%	29%	30%	32%	33%	34%	35%	35%
Interior Lighting - Daylighting Controls	0%	7%	15%	24%	27%	28%	29%	30%	32%	33%	34%	35%	35%
Interior Lighting - LED Exit Lighting	0%	7%	15%	24%	33%	37%	38%	40%	41%	43%	44%	46%	46%
Interior Lighting - Occupancy Sensors	0%	4%	8%	12%	17%	22%	27%	33%	39%	43%	44%	46%	46%
Interior Lighting - Timeclocks and Timers	0%	4%	8%	12%	17%	22%	27%	33%	39%	43%	44%	46%	46%
Interior Lighting - Task Lighting	0%	4%	8%	12%	17%	22%	27%	30%	32%	33%	34%	35%	35%
Interior Fluorescent - Bi-Level Fixture	0%	4%	8%	12%	17%	22%	27%	30%	32%	33%	34%	35%	35%
Interior Fluorescent - Delamp and Install Reflectors	0%	4%	8%	12%	17%	22%	27%	30%	32%	33%	34%	35%	35%
Exterior Lighting - Bi-Level Fixture	0%	7%	15%	24%	27%	28%	29%	30%	32%	33%	34%	35%	35%
Exterior Lighting - Daylighting Controls	0%	7%	15%	24%	33%	37%	38%	40%	41%	43%	44%	46%	46%
Exterior Lighting - Photovoltaic Installation	0%	2%	5%	8%	11%	14%	18%	22%	26%	30%	34%	35%	35%
Refrigerator - Anti-Sweat Heater	0%	7%	15%	24%	27%	28%	29%	30%	32%	33%	34%	35%	35%
Refrigerator - Decommissioning	0%	4%	8%	12%	17%	22%	27%	30%	32%	33%	34%	35%	35%
Refrigerator - Demand Defrost	0%	7%	15%	24%	27%	28%	29%	30%	32%	33%	34%	35%	35%
Refrigerator - Door Gasket Replacement	0%	7%	15%	24%	27%	28%	29%	30%	32%	33%	34%	35%	35%
Refrigerator - Evaporator Fan Controls	0%	4%	8%	12%	17%	22%	27%	30%	32%	33%	34%	35%	35%
Refrigerator - Floating Head Pressure	0%	4%	8%	12%	17%	22%	27%	30%	32%	33%	34%	35%	35%
Refrigerator - Strip Curtain	0%	7%	15%	24%	27%	28%	29%	30%	32%	33%	34%	35%	35%
Refrigerator - High Efficiency Compressor	0%	4%	8%	12%	17%	22%	27%	30%	32%	33%	34%	35%	35%
Refrigerator - Variable Speed Compressor	0%	4%	8%	12%	17%	22%	27%	30%	32%	33%	34%	35%	35%
Refrigerator - eCube	0%	4%	8%	12%	17%	22%	27%	30%	32%	33%	34%	35%	35%
Vending Machine - Controller	0%	7%	15%	24%	33%	37%	38%	40%	41%	43%	44%	46%	46%
Grocery - Display Case - LED Lighting	0%	7%	15%	24%	27%	28%	29%	30%	32%	33%	34%	35%	35%
Grocery - Display Case Motion Sensors	0%	7%	15%	24%	27%	28%	29%	30%	32%	33%	34%	35%	35%
Grocery - ECMs for Display Cases	0%	2%	5%	8%	11%	14%	18%	22%	26%	30%	34%	35%	35%
Grocery - Open Display Case - Night Covers	0%	4%	8%	12%	17%	22%	27%	30%	32%	33%	34%	35%	35%
Office Equipment - ENERGY STAR Power Supplies	0%	2%	4%	6%	8%	11%	14%	16%	19%	23%	26%	30%	30%
Office Equipment - Plug Load Occupancy Sensors	0%	4%	8%	12%	17%	22%	27%	30%	32%	33%	34%	35%	35%
Pool Heater - Solar	0%	4%	8%	12%	17%	22%	27%	30%	32%	33%	34%	35%	35%
Pool Pump - Timer	0%	4%	8%	12%	17%	22%	27%	33%	39%	43%	44%	46%	46%
Ventilation - CO2 Controlled	0%	4%	8%	12%	17%	22%	27%	30%	32%	33%	34%	35%	35%

Technology	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Non-HVAC Motors - Variable Speed Control	0%	4%	8%	12%	17%	22%	27%	30%	32%	33%	34%	35%	35%
Energy Management System	0%	4%	8%	12%	17%	22%	27%	30%	32%	33%	34%	35%	35%
Thermostat - Clock/Programmable	0%	4%	8%	12%	17%	22%	27%	30%	32%	33%	34%	35%	35%
HVAC - Occupancy Sensors	0%	4%	8%	12%	17%	22%	27%	30%	32%	33%	34%	35%	35%
Commissioning - HVAC	0%	2%	4%	6%	8%	11%	14%	16%	19%	23%	26%	30%	30%
Commissioning - Lighting	0%	4%	8%	12%	17%	22%	27%	30%	32%	33%	34%	35%	35%
Retrocommissioning - HVAC	0%	7%	15%	24%	27%	28%	29%	30%	32%	33%	34%	35%	35%
Retrocommissioning - Lighting	0%	7%	15%	24%	33%	37%	38%	40%	41%	43%	44%	46%	46%
Advanced New Construction Designs	0%	2%	4%	6%	8%	11%	14%	16%	19%	23%	26%	30%	30%
Custom Measures	0%	2%	4%	6%	8%	11%	14%	16%	19%	23%	26%	30%	30%
PC Power Management Software	0%	2%	4%	6%	8%	11%	14%	16%	19%	23%	26%	30%	30%
Pre-rinse Sprayer	0%	2%	4%	6%	8%	11%	14%	16%	19%	23%	26%	30%	30%

Table E-13 Industrial Equipment Measures (Achievable High factor)

End Use	Fuel	Technology	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Cooling	Electric	Air-Cooled Chiller	0%	9%	18%	27%	36%	45%	54%	59%	59%	59%	59%	59%	59%
Cooling	Electric	Water-Cooled Chiller	0%	9%	18%	27%	36%	45%	54%	59%	59%	59%	59%	59%	59%
Cooling	Electric	Roof top AC	0%	9%	18%	27%	36%	45%	54%	59%	59%	59%	59%	59%	59%
Cooling	Electric	Air-Source Heat Pump	0%	6%	12%	18%	24%	30%	36%	42%	48%	54%	59%	59%	59%
Cooling	Electric	Geothermal Heat Pump	0%	5%	9%	14%	18%	23%	27%	32%	36%	41%	45%	50%	54%
Cooling	Electric	Other Cooling	0%	6%	12%	18%	24%	30%	36%	42%	48%	54%	59%	59%	59%
Heating	Electric	Air-Source Heat Pump	0%	6%	12%	18%	24%	30%	36%	42%	48%	54%	59%	59%	59%
Heating	Electric	Geothermal Heat Pump	0%	5%	9%	14%	18%	23%	27%	32%	36%	41%	45%	50%	54%
Heating	Electric	Electric Room Heat	0%	6%	12%	18%	24%	30%	36%	42%	48%	54%	59%	59%	59%
Heating	Electric	Electric Furnace	0%	6%	12%	18%	24%	30%	36%	42%	48%	54%	59%	59%	59%
Ventilation	Electric	Ventilation	0%	5%	9%	14%	18%	23%	27%	32%	36%	41%	45%	50%	54%
Interior Lighting	Electric	Screw-in	0%	18%	36%	54%	72%	77%	77%	77%	77%	77%	77%	77%	77%
Interior Lighting	Electric	High-Bay Fixtures	0%	9%	18%	27%	36%	45%	54%	63%	72%	77%	77%	77%	77%
Interior Lighting	Electric	Linear Fluorescent	0%	9%	18%	27%	36%	45%	54%	63%	72%	77%	77%	77%	77%
Exterior Lighting	Electric	Screw-in	0%	18%	36%	54%	72%	77%	77%	77%	77%	77%	77%	77%	77%
Exterior Lighting	Electric	HID	0%	18%	36%	54%	72%	77%	77%	77%	77%	77%	77%	77%	77%
Exterior Lighting	Electric	Linear Fluorescent	0%	9%	18%	27%	36%	45%	54%	63%	72%	77%	77%	77%	77%
Motors	Electric	Pumps	0%	6%	12%	18%	24%	30%	36%	42%	48%	54%	59%	59%	59%
Motors	Electric	Fans & Blowers	0%	6%	12%	18%	24%	30%	36%	42%	48%	54%	59%	59%	59%
Motors	Electric	Compressed Air	0%	6%	12%	18%	24%	30%	36%	42%	48%	54%	59%	59%	59%
Motors	Electric	Matl Handling	0%	6%	12%	18%	24%	30%	36%	42%	48%	54%	59%	59%	59%
Motors	Electric	Matl Processing	0%	6%	12%	18%	24%	30%	36%	42%	48%	54%	59%	59%	59%
Motors	Electric	Other Motors	0%	6%	12%	18%	24%	30%	36%	42%	48%	54%	59%	59%	59%
Process	Electric	Process Heating	0%	6%	12%	18%	24%	30%	36%	42%	48%	54%	59%	59%	59%
Process	Electric	Process Cooling and Refrigeration	0%	6%	12%	18%	24%	30%	36%	42%	48%	54%	59%	59%	59%
Process	Electric	Electro-Chemical Processes	0%	6%	12%	18%	24%	30%	36%	42%	48%	54%	59%	59%	59%
Process	Electric	Other Process	0%	6%	12%	18%	24%	30%	36%	42%	48%	54%	59%	59%	59%
Miscellaneous	Electric	Miscellaneous	0%	9%	18%	27%	36%	45%	54%	59%	59%	59%	59%	59%	59%

Table E-14 Industrial Non-Equipment Measures (Achievable High factor)

Technology	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Insulation - Ceiling	0%	5%	9%	14%	18%	23%	27%	32%	36%	41%	45%	50%	50%
Insulation - Ducting	0%	5%	9%	14%	18%	23%	27%	32%	36%	41%	45%	50%	50%
Insulation - Wall Cavity	0%	5%	9%	14%	18%	23%	27%	32%	36%	41%	45%	50%	50%
HVAC - Duct Repair and Sealing	0%	6%	12%	18%	24%	30%	36%	42%	48%	54%	59%	59%	59%
Air-Cooled Chiller - Economizer	0%	9%	18%	27%	36%	45%	54%	59%	59%	59%	59%	59%	59%
Air-Cooled Chiller - Efficient Mechanical Layout	0%	5%	9%	14%	18%	23%	27%	32%	36%	41%	45%	50%	50%
Air-Cooled Chiller - Maintenance	0%	9%	18%	27%	36%	45%	54%	59%	59%	59%	59%	59%	59%
Air-Cooled Chiller - Chilled Water Reset	0%	9%	18%	27%	36%	45%	54%	59%	59%	59%	59%	59%	59%
Air-Cooled Chiller - Chilled Water Variable-Flow System	0%	9%	18%	27%	36%	45%	54%	59%	59%	59%	59%	59%	59%
Air-Cooled Chiller - Condenser Water Temperature Reset	0%	9%	18%	27%	36%	45%	54%	59%	59%	59%	59%	59%	59%
Air-Cooled Chiller - High Efficiency Cooling Tower Fans	0%	9%	18%	27%	36%	45%	54%	59%	59%	59%	59%	59%	59%
Air-Cooled Chiller - VSD on Fans	0%	18%	36%	54%	59%	59%	59%	59%	59%	59%	59%	59%	59%
Water-Cooled Chiller - Economizer	0%	9%	18%	27%	36%	45%	54%	59%	59%	59%	59%	59%	59%
Water-Cooled Chiller - Efficient Mechanical Layout	0%	5%	9%	14%	18%	23%	27%	32%	36%	41%	45%	50%	50%
Water-Cooled Chiller - Maintenance	0%	9%	18%	27%	36%	45%	54%	59%	59%	59%	59%	59%	59%
Water-Cooled Chiller - Chilled Water Reset	0%	9%	18%	27%	36%	45%	54%	59%	59%	59%	59%	59%	59%
Water-Cooled Chiller - Chilled Water Variable-Flow System	0%	9%	18%	27%	36%	45%	54%	59%	59%	59%	59%	59%	59%
Water-Cooled Chiller - Condenser Water Temperature Reset	0%	9%	18%	27%	36%	45%	54%	59%	59%	59%	59%	59%	59%
Water-Cooled Chiller - High Efficiency Cooling Tower Fans	0%	9%	18%	27%	36%	45%	54%	59%	59%	59%	59%	59%	59%
Water-Cooled Chiller - VSD on Fans	0%	18%	36%	54%	59%	59%	59%	59%	59%	59%	59%	59%	59%
RTU - Maintenance	0%	9%	18%	27%	36%	45%	54%	59%	59%	59%	59%	59%	59%
Heat Pump - Maintenance	0%	9%	18%	27%	36%	45%	54%	59%	59%	59%	59%	59%	59%
Roof - High Reflectivity	0%	5%	9%	14%	18%	23%	27%	32%	36%	41%	45%	50%	50%
Energy Management System	0%	9%	18%	27%	36%	45%	54%	59%	59%	59%	59%	59%	59%
Thermostat - Clock/Programmable	0%	9%	18%	27%	36%	45%	54%	63%	72%	77%	77%	77%	77%
Interior Lighting - Occupancy Sensors	0%	9%	18%	27%	36%	45%	54%	63%	72%	77%	77%	77%	77%
Interior Lighting - Skylights	0%	6%	12%	18%	24%	30%	36%	42%	48%	54%	59%	59%	59%
Interior Lighting - Timeclocks and Timers	0%	9%	18%	27%	36%	45%	54%	63%	72%	77%	77%	77%	77%
Interior Lighting - LED Exit Lighting	0%	18%	36%	54%	72%	77%	77%	77%	77%	77%	77%	77%	77%
Interior Lighting - Daylighting Controls	0%	18%	36%	54%	59%	59%	59%	59%	59%	59%	59%	59%	59%
Interior Lighting - Task Lighting	0%	9%	18%	27%	36%	45%	54%	59%	59%	59%	59%	59%	59%
Interior Fluorescent - Bi-Level Fixture	0%	9%	18%	27%	36%	45%	54%	59%	59%	59%	59%	59%	59%
Interior Fluorescent - Delamp and Install Reflectors	0%	9%	18%	27%	36%	45%	54%	59%	59%	59%	59%	59%	59%
Exterior Lighting - Bi-Level Fixture	0%	18%	36%	54%	59%	59%	59%	59%	59%	59%	59%	59%	59%
Exterior Lighting - Daylighting Controls	0%	18%	36%	54%	72%	77%	77%	77%	77%	77%	77%	77%	77%
Exterior Lighting - Photovoltaic Installation	0%	6%	12%	18%	24%	30%	36%	42%	48%	54%	59%	59%	59%
Process - Conductivity Controls	0%	9%	18%	27%	36%	45%	54%	59%	59%	59%	59%	59%	59%
Process - Controls on Fume Hoods	0%	9%	18%	27%	36%	45%	54%	59%	59%	59%	59%	59%	59%
Process - Timers and Controls	0%	9%	18%	27%	36%	45%	54%	59%	59%	59%	59%	59%	59%
Refrigeration - Floating Head Pressure	0%	9%	18%	27%	36%	45%	54%	59%	59%	59%	59%	59%	59%

Technology	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Refrigeration - System Controls	0%	9%	18%	27%	36%	45%	54%	59%	59%	59%	59%	59%	59%
Refrigeration - System Maintenance	0%	9%	18%	27%	36%	45%	54%	59%	59%	59%	59%	59%	59%
Refrigeration - System Optimization	0%	9%	18%	27%	36%	45%	54%	59%	59%	59%	59%	59%	59%
Compressed Air - Air Usage Reduction	0%	9%	18%	27%	36%	45%	54%	59%	59%	59%	59%	59%	59%
Compressed Air - Compressor Replacement	0%	9%	18%	27%	36%	45%	54%	59%	59%	59%	59%	59%	59%
Compressed Air - System Controls	0%	9%	18%	27%	36%	45%	54%	59%	59%	59%	59%	59%	59%
Compressed Air - System Maintenance	0%	9%	18%	27%	36%	45%	54%	59%	59%	59%	59%	59%	59%
Compressed Air - System Optimization and Improvements	0%	9%	18%	27%	36%	45%	54%	59%	59%	59%	59%	59%	59%
Pumping System - Controls	0%	9%	18%	27%	36%	45%	54%	59%	59%	59%	59%	59%	59%
Pumping System - Maintenance	0%	9%	18%	27%	36%	45%	54%	59%	59%	59%	59%	59%	59%
Pumping System - Optimization	0%	9%	18%	27%	36%	45%	54%	59%	59%	59%	59%	59%	59%
Pumps - Variable Speed Control	0%	18%	36%	54%	59%	59%	59%	59%	59%	59%	59%	59%	59%
Pump Equipment Upgrade	0%	6%	12%	18%	24%	30%	36%	42%	48%	54%	59%	59%	59%
Fan Equipment Upgrade	0%	6%	12%	18%	24%	30%	36%	42%	48%	54%	59%	59%	59%
Fan System - Controls	0%	9%	18%	27%	36%	45%	54%	59%	59%	59%	59%	59%	59%
Fan System - Maintenance	0%	9%	18%	27%	36%	45%	54%	59%	59%	59%	59%	59%	59%
Fan System - Optimization	0%	9%	18%	27%	36%	45%	54%	59%	59%	59%	59%	59%	59%
Fans - Variable Speed Control	0%	18%	36%	54%	59%	59%	59%	59%	59%	59%	59%	59%	59%
Motors - Magnetic Adjustable Speed Drives	0%	18%	36%	54%	59%	59%	59%	59%	59%	59%	59%	59%	59%
Motors - Efficient Rewind	0%	9%	18%	27%	36%	45%	54%	59%	59%	59%	59%	59%	59%
Motors - Variable Frequency Drive	0%	9%	18%	27%	36%	45%	54%	59%	59%	59%	59%	59%	59%
Motors - Synchronous Belts	0%	9%	18%	27%	36%	45%	54%	59%	59%	59%	59%	59%	59%
Commissioning - HVAC	0%	9%	18%	27%	36%	45%	54%	59%	59%	59%	59%	59%	59%
Commissioning - Lighting	0%	9%	18%	27%	36%	45%	54%	59%	59%	59%	59%	59%	59%
Retrocommissioning - HVAC	0%	9%	18%	27%	36%	45%	54%	59%	59%	59%	59%	59%	59%
Retrocommissioning - Lighting	0%	9%	18%	27%	36%	45%	54%	59%	59%	59%	59%	59%	59%
Ventilation - CO2 Controlled	0%	5%	9%	14%	18%	23%	27%	32%	36%	41%	45%	50%	50%
Transformer - High Efficiency	0%	5%	9%	14%	18%	23%	27%	32%	36%	41%	45%	50%	50%
Custom Measures	0%	9%	18%	27%	36%	45%	54%	59%	59%	59%	59%	59%	59%
Injection Molding Barrel Insulation	0%	18%	36%	54%	59%	59%	59%	59%	59%	59%	59%	59%	59%

Table E-15 Industrial Equipment Measures (Achievable High factor x Achievable Low factor)

End Use	Fuel	Technology	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Cooling	Electric	Air-Cooled Chiller	0%	1%	7%	11%	16%	21%	26%	29%	30%	32%	33%	34%	35%
Cooling	Electric	Water-Cooled Chiller	0%	1%	7%	11%	16%	21%	26%	29%	30%	32%	33%	34%	35%
Cooling	Electric	Roof top AC	0%	1%	7%	11%	16%	21%	26%	29%	30%	32%	33%	34%	35%
Cooling	Electric	Air-Source Heat Pump	0%	0%	5%	8%	11%	14%	17%	21%	25%	29%	33%	34%	35%
Cooling	Electric	Geothermal Heat Pump	0%	0%	4%	6%	8%	10%	13%	16%	19%	22%	25%	29%	32%
Cooling	Electric	Other Cooling	0%	0%	5%	8%	11%	14%	17%	21%	25%	29%	33%	34%	35%
Heating	Electric	Air-Source Heat Pump	0%	0%	5%	8%	11%	14%	17%	21%	25%	29%	33%	34%	35%
Heating	Electric	Geothermal Heat Pump	0%	0%	4%	6%	8%	10%	13%	16%	19%	22%	25%	29%	32%
Heating	Electric	Electric Room Heat	0%	0%	5%	8%	11%	14%	17%	21%	25%	29%	33%	34%	35%
Heating	Electric	Electric Furnace	0%	0%	5%	8%	11%	14%	17%	21%	25%	29%	33%	34%	35%
Ventilation	Electric	Ventilation	0%	0%	4%	6%	8%	10%	13%	16%	19%	22%	25%	29%	32%
Interior Lighting	Electric	Screw-in	0%	3%	14%	23%	32%	35%	37%	38%	40%	41%	43%	44%	46%
Interior Lighting	Electric	High-Bay Fixtures	0%	1%	7%	11%	16%	21%	26%	32%	37%	41%	43%	44%	46%
Interior Lighting	Electric	Linear Fluorescent	0%	1%	7%	11%	16%	21%	26%	32%	37%	41%	43%	44%	46%
Exterior Lighting	Electric	Screw-in	0%	3%	14%	23%	32%	35%	37%	38%	40%	41%	43%	44%	46%
Exterior Lighting	Electric	HID	0%	3%	14%	23%	32%	35%	37%	38%	40%	41%	43%	44%	46%
Exterior Lighting	Electric	Linear Fluorescent	0%	1%	7%	11%	16%	21%	26%	32%	37%	41%	43%	44%	46%
Motors	Electric	Pumps	0%	0%	5%	8%	11%	14%	17%	21%	25%	29%	33%	34%	35%
Motors	Electric	Fans & Blowers	0%	0%	5%	8%	11%	14%	17%	21%	25%	29%	33%	34%	35%
Motors	Electric	Compressed Air	0%	0%	5%	8%	11%	14%	17%	21%	25%	29%	33%	34%	35%
Motors	Electric	Matl Handling	0%	0%	5%	8%	11%	14%	17%	21%	25%	29%	33%	34%	35%
Motors	Electric	Matl Processing	0%	0%	5%	8%	11%	14%	17%	21%	25%	29%	33%	34%	35%
Motors	Electric	Other Motors	0%	0%	5%	8%	11%	14%	17%	21%	25%	29%	33%	34%	35%
Process	Electric	Process Heating	0%	0%	5%	8%	11%	14%	17%	21%	25%	29%	33%	34%	35%
Process	Electric	Process Cooling and Refrigeration	0%	0%	5%	8%	11%	14%	17%	21%	25%	29%	33%	34%	35%
Process	Electric	Electro-Chemical Processes	0%	0%	5%	8%	11%	14%	17%	21%	25%	29%	33%	34%	35%
Process	Electric	Other Process	0%	0%	5%	8%	11%	14%	17%	21%	25%	29%	33%	34%	35%
Miscellaneous	Electric	Miscellaneous	0%	1%	7%	11%	16%	21%	26%	29%	30%	32%	33%	34%	35%

Table E-16 Industrial Non-Equipment Measures (Achievable High factor x Achievable Low factor)

Technology	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Insulation - Ceiling	0%	2%	4%	6%	8%	11%	14%	16%	19%	23%	26%	30%	30%
Insulation - Ducting	0%	2%	4%	6%	8%	11%	14%	16%	19%	23%	26%	30%	30%
Insulation - Wall Cavity	0%	2%	4%	6%	8%	11%	14%	16%	19%	23%	26%	30%	30%
HVAC - Duct Repair and Sealing	0%	2%	5%	8%	11%	14%	18%	22%	26%	30%	34%	35%	35%
Air-Cooled Chiller - Economizer	0%	4%	8%	12%	17%	22%	27%	30%	32%	33%	34%	35%	35%
Air-Cooled Chiller - Efficient Mechanical Layout	0%	2%	4%	6%	8%	11%	14%	16%	19%	23%	26%	30%	30%
Air-Cooled Chiller - Maintenance	0%	4%	8%	12%	17%	22%	27%	30%	32%	33%	34%	35%	35%
Air-Cooled Chiller - Chilled Water Reset	0%	4%	8%	12%	17%	22%	27%	30%	32%	33%	34%	35%	35%
Air-Cooled Chiller - Chilled Water Variable-Flow System	0%	4%	8%	12%	17%	22%	27%	30%	32%	33%	34%	35%	35%
Air-Cooled Chiller - Condenser Water Temperature Reset	0%	4%	8%	12%	17%	22%	27%	30%	32%	33%	34%	35%	35%
Air-Cooled Chiller - High Efficiency Cooling Tower Fans	0%	4%	8%	12%	17%	22%	27%	30%	32%	33%	34%	35%	35%
Air-Cooled Chiller - VSD on Fans	0%	7%	15%	24%	27%	28%	29%	30%	32%	33%	34%	35%	35%
Water-Cooled Chiller - Economizer	0%	4%	8%	12%	17%	22%	27%	30%	32%	33%	34%	35%	35%
Water-Cooled Chiller - Efficient Mechanical Layout	0%	2%	4%	6%	8%	11%	14%	16%	19%	23%	26%	30%	30%
Water-Cooled Chiller - Maintenance	0%	4%	8%	12%	17%	22%	27%	30%	32%	33%	34%	35%	35%
Water-Cooled Chiller - Chilled Water Reset	0%	4%	8%	12%	17%	22%	27%	30%	32%	33%	34%	35%	35%
Water-Cooled Chiller - Chilled Water Variable-Flow System	0%	4%	8%	12%	17%	22%	27%	30%	32%	33%	34%	35%	35%
Water-Cooled Chiller - Condenser Water Temperature Reset	0%	4%	8%	12%	17%	22%	27%	30%	32%	33%	34%	35%	35%
Water-Cooled Chiller - High Efficiency Cooling Tower Fans	0%	4%	8%	12%	17%	22%	27%	30%	32%	33%	34%	35%	35%
Water-Cooled Chiller - VSD on Fans	0%	7%	15%	24%	27%	28%	29%	30%	32%	33%	34%	35%	35%
RTU - Maintenance	0%	4%	8%	12%	17%	22%	27%	30%	32%	33%	34%	35%	35%
Heat Pump - Maintenance	0%	4%	8%	12%	17%	22%	27%	30%	32%	33%	34%	35%	35%
Roof - High Reflectivity	0%	2%	4%	6%	8%	11%	14%	16%	19%	23%	26%	30%	30%
Energy Management System	0%	4%	8%	12%	17%	22%	27%	30%	32%	33%	34%	35%	35%
Thermostat - Clock/Programmable	0%	4%	8%	12%	17%	22%	27%	33%	39%	43%	44%	46%	46%
Interior Lighting - Occupancy Sensors	0%	4%	8%	12%	17%	22%	27%	33%	39%	43%	44%	46%	46%
Interior Lighting - Skylights	0%	2%	5%	8%	11%	14%	18%	22%	26%	30%	34%	35%	35%
Interior Lighting - Timeclocks and Timers	0%	4%	8%	12%	17%	22%	27%	33%	39%	43%	44%	46%	46%
Interior Lighting - LED Exit Lighting	0%	7%	15%	24%	33%	37%	38%	40%	41%	43%	44%	46%	46%
Interior Lighting - Daylighting Controls	0%	7%	15%	24%	27%	28%	29%	30%	32%	33%	34%	35%	35%
Interior Lighting - Task Lighting	0%	4%	8%	12%	17%	22%	27%	30%	32%	33%	34%	35%	35%
Interior Fluorescent - Bi-Level Fixture	0%	4%	8%	12%	17%	22%	27%	30%	32%	33%	34%	35%	35%
Interior Fluorescent - Delamp and Install Reflectors	0%	4%	8%	12%	17%	22%	27%	30%	32%	33%	34%	35%	35%
Exterior Lighting - Bi-Level Fixture	0%	7%	15%	24%	27%	28%	29%	30%	32%	33%	34%	35%	35%
Exterior Lighting - Daylighting Controls	0%	7%	15%	24%	33%	37%	38%	40%	41%	43%	44%	46%	46%
Exterior Lighting - Photovoltaic Installation	0%	2%	5%	8%	11%	14%	18%	22%	26%	30%	34%	35%	35%
Process - Conductivity Controls	0%	4%	8%	12%	17%	22%	27%	30%	32%	33%	34%	35%	35%
Process - Controls on Fume Hoods	0%	4%	8%	12%	17%	22%	27%	30%	32%	33%	34%	35%	35%
Process - Timers and Controls	0%	4%	8%	12%	17%	22%	27%	30%	32%	33%	34%	35%	35%
Refrigeration - Floating Head Pressure	0%	4%	8%	12%	17%	22%	27%	30%	32%	33%	34%	35%	35%

Technology	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Refrigeration - System Controls	0%	4%	8%	12%	17%	22%	27%	30%	32%	33%	34%	35%	35%
Refrigeration - System Maintenance	0%	4%	8%	12%	17%	22%	27%	30%	32%	33%	34%	35%	35%
Refrigeration - System Optimization	0%	4%	8%	12%	17%	22%	27%	30%	32%	33%	34%	35%	35%
Compressed Air - Air Usage Reduction	0%	4%	8%	12%	17%	22%	27%	30%	32%	33%	34%	35%	35%
Compressed Air - Compressor Replacement	0%	4%	8%	12%	17%	22%	27%	30%	32%	33%	34%	35%	35%
Compressed Air - System Controls	0%	4%	8%	12%	17%	22%	27%	30%	32%	33%	34%	35%	35%
Compressed Air - System Maintenance	0%	4%	8%	12%	17%	22%	27%	30%	32%	33%	34%	35%	35%
Compressed Air - System Optimization and Improvements	0%	4%	8%	12%	17%	22%	27%	30%	32%	33%	34%	35%	35%
Pumping System - Controls	0%	4%	8%	12%	17%	22%	27%	30%	32%	33%	34%	35%	35%
Pumping System - Maintenance	0%	4%	8%	12%	17%	22%	27%	30%	32%	33%	34%	35%	35%
Pumping System - Optimization	0%	4%	8%	12%	17%	22%	27%	30%	32%	33%	34%	35%	35%
Pumps - Variable Speed Control	0%	7%	15%	24%	27%	28%	29%	30%	32%	33%	34%	35%	35%
Pump Equipment Upgrade	0%	2%	5%	8%	11%	14%	18%	22%	26%	30%	34%	35%	35%
Fan Equipment Upgrade	0%	2%	5%	8%	11%	14%	18%	22%	26%	30%	34%	35%	35%
Fan System - Controls	0%	4%	8%	12%	17%	22%	27%	30%	32%	33%	34%	35%	35%
Fan System - Maintenance	0%	4%	8%	12%	17%	22%	27%	30%	32%	33%	34%	35%	35%
Fan System - Optimization	0%	4%	8%	12%	17%	22%	27%	30%	32%	33%	34%	35%	35%
Fans - Variable Speed Control	0%	7%	15%	24%	27%	28%	29%	30%	32%	33%	34%	35%	35%
Motors - Magnetic Adjustable Speed Drives	0%	7%	15%	24%	27%	28%	29%	30%	32%	33%	34%	35%	35%
Motors - Efficient Rewind	0%	4%	8%	12%	17%	22%	27%	30%	32%	33%	34%	35%	35%
Motors - Variable Frequency Drive	0%	4%	8%	12%	17%	22%	27%	30%	32%	33%	34%	35%	35%
Motors - Synchronous Belts	0%	4%	8%	12%	17%	22%	27%	30%	32%	33%	34%	35%	35%
Commissioning - HVAC	0%	4%	8%	12%	17%	22%	27%	30%	32%	33%	34%	35%	35%
Commissioning - Lighting	0%	4%	8%	12%	17%	22%	27%	30%	32%	33%	34%	35%	35%
Retrocommissioning - HVAC	0%	4%	8%	12%	17%	22%	27%	30%	32%	33%	34%	35%	35%
Retrocommissioning - Lighting	0%	4%	8%	12%	17%	22%	27%	30%	32%	33%	34%	35%	35%
Ventilation - CO2 Controlled	0%	2%	4%	6%	8%	11%	14%	16%	19%	23%	26%	30%	30%
Transformer - High Efficiency	0%	2%	4%	6%	8%	11%	14%	16%	19%	23%	26%	30%	30%
Custom Measures	0%	4%	8%	12%	17%	22%	27%	30%	32%	33%	34%	35%	35%
Injection Molding Barrel Insulation	0%	7%	15%	24%	27%	28%	29%	30%	32%	33%	34%	35%	35%

APPENDIX | F

MEASURE-LEVEL POTENTIAL SAVINGS

This section presents the estimates of annual savings at the measure level. Selected years are shown in Chapter 6 and 7 of the report. Table F-1 and Table F-2 show the overall annual savings for electric energy and peak demand, respectively. Table F-3 through Table F-8 show the annual savings for each sector. Note that the downstream steps of measure bundling, program design, and program delivery produce different results that are presented in the next section at the program-level.

Table F-1 Measure-Level Annual Electric Energy Savings, All Sectors

	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Baseline Forecast	5,646	5,605	5,627	5,630	5,608	5,626	5,673	5,738	5,799	5,861	5,923	5,977	6,033
Cumulative Savings (GWh)													
Achievable Potential Low	-	-	-	-	32	63	100	151	203	270	338	405	456
Achievable Potential High	-	-	-	-	67	125	192	277	357	455	548	637	711
Economic Potential	-	-	-	-	112	191	274	377	478	602	725	846	947
Technical Potential	-	-	-	-	142	251	366	504	640	791	935	1,075	1,192
Cumulative Savings % of Baseline													
Achievable Potential Low	0.0%	0.0%	0.0%	0.0%	0.6%	1.1%	1.8%	2.6%	3.5%	4.6%	5.7%	6.8%	7.5%
Achievable Potential High	0.0%	0.0%	0.0%	0.0%	1.2%	2.2%	3.4%	4.8%	6.2%	7.8%	9.3%	10.7%	11.8%
Economic Potential	0.0%	0.0%	0.0%	0.0%	2.0%	3.4%	4.8%	6.6%	8.2%	10.3%	12.2%	14.2%	15.7%
Technical Potential	0.0%	0.0%	0.0%	0.0%	2.5%	4.5%	6.5%	8.8%	11.0%	13.5%	15.8%	18.0%	19.8%
Incremental Savings (GWh)													
Achievable Potential Low	-	-	-	-	32	31	38	51	52	67	68	67	51
Achievable Potential High	-	-	-	-	67	58	68	85	79	99	93	88	74
Economic Potential	-	-	-	-	112	79	83	103	101	124	122	122	101
Technical Potential	-	-	-	-	142	109	115	138	136	151	144	140	117
Incremental Savings % of Baseline													
Achievable Potential Low	0.0%	0.0%	0.0%	0.0%	0.6%	0.5%	0.7%	0.9%	0.9%	1.1%	1.2%	1.1%	0.8%
Achievable Potential High	0.0%	0.0%	0.0%	0.0%	1.2%	1.0%	1.2%	1.5%	1.4%	1.7%	1.6%	1.5%	1.2%
Economic Potential	0.0%	0.0%	0.0%	0.0%	2.0%	1.4%	1.5%	1.8%	1.7%	2.1%	2.1%	2.0%	1.7%
Technical Potential	0.0%	0.0%	0.0%	0.0%	2.5%	1.9%	2.0%	2.4%	2.3%	2.6%	2.4%	2.3%	1.9%

Table F-2 Measure-Level Annual Electric Peak Demand Savings, All Sectors

	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Baseline Forecast	4,752	4,706	4,718	4,667	4,635	4,621	4,641	4,686	4,725	4,768	4,806	4,836	4,873
Peak Demand Savings (GWh)													
Achievable Potential Low	-	-	-	-	23	47	80	123	165	218	271	325	366
Achievable Potential High	-	-	-	-	45	87	144	218	283	362	436	506	566
Economic Potential	-	-	-	-	63	111	180	277	368	474	575	671	755
Technical Potential	-	-	-	-	87	159	254	376	494	626	749	867	969
Peak Demand Savings % of Baseline													
Achievable Potential Low	0.0%	0.0%	0.0%	0.0%	0.5%	1.0%	1.7%	2.6%	3.5%	4.6%	5.6%	6.7%	7.5%
Achievable Potential High	0.0%	0.0%	0.0%	0.0%	1.0%	1.9%	3.1%	4.7%	6.0%	7.6%	9.1%	10.5%	11.6%
Economic Potential	0.0%	0.0%	0.0%	0.0%	1.4%	2.4%	3.9%	5.9%	7.8%	9.9%	12.0%	13.9%	15.5%
Technical Potential	0.0%	0.0%	0.0%	0.0%	1.9%	3.4%	5.5%	8.0%	10.5%	13.1%	15.6%	17.9%	19.9%
Peak Demand Incremental Savings (GWh)													
Achievable Potential Low	-	-	-	-	23	24	32	44	42	53	53	54	40
Achievable Potential High	-	-	-	-	45	42	57	74	65	78	74	71	60
Economic Potential	-	-	-	-	63	48	69	96	91	107	100	97	83
Technical Potential	-	-	-	-	87	73	95	122	118	132	124	117	102
Peak Demand Incremental Savings % o f Baseline													
Achievable Potential Low	0.0%	0.0%	0.0%	0.0%	0.5%	0.5%	0.7%	0.9%	0.9%	1.1%	1.1%	1.1%	0.8%
Achievable Potential High	0.0%	0.0%	0.0%	0.0%	1.0%	0.9%	1.2%	1.6%	1.4%	1.6%	1.5%	1.5%	1.2%
Economic Potential	0.0%	0.0%	0.0%	0.0%	1.4%	1.0%	1.5%	2.1%	1.9%	2.2%	2.1%	2.0%	1.7%
Technical Potential	0.0%	0.0%	0.0%	0.0%	1.9%	1.6%	2.0%	2.6%	2.5%	2.8%	2.6%	2.4%	2.1%

Table F-3 Measure-Level Annual Electric Energy Savings, Residential

	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Baseline Forecast	1,483	1,482	1,485	1,482	1,459	1,453	1,463	1,476	1,488	1,497	1,514	1,529	1,541
Cumulative Savings (GWh)													
Achievable Potential Low	-	-	-	-	9	16	22	32	43	55	70	83	94
Achievable Potential High	-	-	-	-	20	32	44	61	77	94	118	135	148
Economic Potential	-	-	-	-	37	52	66	81	98	119	151	177	198
Technical Potential	-	-	-	-	57	92	125	163	203	242	288	326	359
Cumulative Savings % of Baseline													
Achievable Potential Low	0.0%	0.0%	0.0%	0.0%	0.6%	1.1%	1.5%	2.2%	2.9%	3.7%	4.7%	5.4%	6.1%
Achievable Potential High	0.0%	0.0%	0.0%	0.0%	1.4%	2.2%	3.0%	4.1%	5.2%	6.3%	7.8%	8.8%	9.6%
Economic Potential	0.0%	0.0%	0.0%	0.0%	2.5%	3.6%	4.5%	5.5%	6.6%	8.0%	10.0%	11.6%	12.9%
Technical Potential	0.0%	0.0%	0.0%	0.0%	3.9%	6.3%	8.5%	11.0%	13.6%	16.2%	19.0%	21.3%	23.3%
Incremental Savings (GWh)													
Achievable Potential Low	-	-	-	-	9	6	6	10	11	12	15	13	11
Achievable Potential High	-	-	-	-	20	12	12	17	16	18	24	17	13
Economic Potential	-	-	-	-	37	16	14	16	16	21	32	26	21
Technical Potential	-	-	-	-	57	34	33	38	40	39	46	38	33
Incremental Savings % of Baseline													
Achievable Potential Low	0.0%	0.0%	0.0%	0.0%	0.6%	0.4%	0.4%	0.7%	0.7%	0.8%	1.0%	0.8%	0.7%
Achievable Potential High	0.0%	0.0%	0.0%	0.0%	1.4%	0.8%	0.8%	1.2%	1.1%	1.2%	1.6%	1.1%	0.9%
Economic Potential	0.0%	0.0%	0.0%	0.0%	2.5%	1.1%	0.9%	1.1%	1.1%	1.4%	2.1%	1.7%	1.4%
Technical Potential	0.0%	0.0%	0.0%	0.0%	3.9%	2.4%	2.3%	2.6%	2.7%	2.6%	3.0%	2.5%	2.1%

Table F-4 Measure-Level Annual Electric Peak Demand Savings, Residential

	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Baseline Forecast	739	739	741	740	734	733	738	744	750	756	764	773	781
Peak Demand Savings (GWh)													
Achievable Potential Low	-	-	-	-	2	4	6	10	14	19	26	33	40
Achievable Potential High	-	-	-	-	5	8	12	18	25	33	45	54	64
Economic Potential	-	-	-	-	9	14	20	27	36	48	63	78	93
Technical Potential	-	-	-	-	26	47	69	94	121	150	182	212	241
Peak Demand Savings % of Baseline													
Achievable Potential Low	0.0%	0.0%	0.0%	0.0%	0.3%	0.6%	0.8%	1.3%	1.9%	2.5%	3.4%	4.3%	5.1%
Achievable Potential High	0.0%	0.0%	0.0%	0.0%	0.7%	1.1%	1.7%	2.4%	3.3%	4.4%	5.8%	7.0%	8.2%
Economic Potential	0.0%	0.0%	0.0%	0.0%	1.3%	2.0%	2.7%	3.7%	4.8%	6.3%	8.2%	10.1%	12.0%
Technical Potential	0.0%	0.0%	0.0%	0.0%	3.5%	6.4%	9.3%	12.6%	16.1%	19.8%	23.8%	27.4%	30.9%
Peak Demand Incremental Savings (GWh)													
Achievable Potential Low	-	-	-	-	2	2	2	3	4	5	7	7	7
Achievable Potential High	-	-	-	-	5	3	4	6	7	9	11	10	10
Economic Potential	-	-	-	-	9	5	6	7	9	11	15	15	15
Technical Potential	-	-	-	-	26	21	22	25	27	29	32	30	29
Peak Demand Incremental Savings % of Baseline													
Achievable Potential Low	0.0%	0.0%	0.0%	0.0%	0.3%	0.2%	0.3%	0.5%	0.6%	0.7%	0.9%	0.9%	0.9%
Achievable Potential High	0.0%	0.0%	0.0%	0.0%	0.7%	0.5%	0.5%	0.8%	0.9%	1.1%	1.5%	1.2%	1.2%
Economic Potential	0.0%	0.0%	0.0%	0.0%	1.3%	0.7%	0.8%	1.0%	1.2%	1.5%	2.0%	2.0%	1.9%
Technical Potential	0.0%	0.0%	0.0%	0.0%	3.5%	2.9%	3.0%	3.3%	3.6%	3.8%	4.2%	3.9%	3.7%

Table F-5 Measure-Level Annual Electric Energy Savings, Commercial

	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Baseline Forecast (GWh)	1,318	1,299	1,293	1,288	1,286	1,296	1,313	1,339	1,368	1,399	1,429	1,457	1,486
Cumulative Savings (GWh)													
Achievable Potential Low	-	-	-	-	12	23	36	53	72	100	128	152	170
Achievable Potential High	-	-	-	-	25	46	69	98	127	169	204	235	262
Economic Potential	-	-	-	-	42	70	99	136	173	221	263	302	337
Technical Potential	-	-	-	-	49	86	125	170	216	271	318	362	400
Energy Savings (% of Baseline)													
Achievable Potential Low	0.0%	0.0%	0.0%	0.0%	0.9%	1.8%	2.7%	4.0%	5.3%	7.2%	9.0%	10.4%	11.5%
Achievable Potential High	0.0%	0.0%	0.0%	0.0%	2.0%	3.5%	5.3%	7.3%	9.3%	12.0%	14.3%	16.1%	17.6%
Economic Potential	0.0%	0.0%	0.0%	0.0%	3.2%	5.4%	7.6%	10.2%	12.7%	15.8%	18.4%	20.7%	22.7%
Technical Potential	0.0%	0.0%	0.0%	0.0%	3.8%	6.6%	9.5%	12.7%	15.8%	19.3%	22.3%	24.8%	27.0%
Incremental Savings (GWh)													
Achievable Potential Low	-	-	-	-	12	11	13	17	19	29	28	24	19
Achievable Potential High	-	-	-	-	25	20	24	29	29	41	36	31	27
Economic Potential	-	-	-	-	42	28	30	37	37	48	42	39	34
Technical Potential	-	-	-	-	49	37	39	46	45	55	47	44	39
Incremental Savings (% of Baseline)													
Achievable Potential Low	0.0%	0.0%	0.0%	0.0%	0.9%	0.8%	1.0%	1.3%	1.4%	2.0%	1.9%	1.6%	1.2%
Achievable Potential High	0.0%	0.0%	0.0%	0.0%	2.0%	1.6%	1.8%	2.1%	2.1%	3.0%	2.5%	2.1%	1.8%
Economic Potential	0.0%	0.0%	0.0%	0.0%	3.2%	2.2%	2.3%	2.8%	2.7%	3.4%	2.9%	2.7%	2.3%
Technical Potential	0.0%	0.0%	0.0%	0.0%	3.8%	2.9%	3.0%	3.4%	3.3%	3.9%	3.3%	3.0%	2.6%

Table F-6 Measure-Level Annual Electric Peak Demand Savings, Commercial

	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Baseline Forecast (GWh)	783	772	771	725	711	696	703	725	746	772	795	811	828
Cumulative Savings (GWh)													
Achievable Potential Low	-	-	-	-	5	8	13	22	31	45	58	69	77
Achievable Potential High	-	-	-	-	10	11	18	34	48	69	87	100	110
Economic Potential	-	-	-	-	5	(4)	4	26	45	71	94	108	122
Technical Potential	-	-	-	-	9	6	19	47	72	103	129	147	165
Energy Savings (% of Baseline)													
Achievable Potential Low	0.0%	0.0%	0.0%	0.0%	0.8%	1.2%	1.8%	3.1%	4.2%	5.8%	7.3%	8.5%	9.3%
Achievable Potential High	0.0%	0.0%	0.0%	0.0%	1.4%	1.6%	2.5%	4.7%	6.5%	8.9%	11.0%	12.3%	13.3%
Economic Potential	0.0%	0.0%	0.0%	0.0%	0.7%	-0.6%	0.5%	3.5%	6.1%	9.3%	11.8%	13.4%	14.7%
Technical Potential	0.0%	0.0%	0.0%	0.0%	1.3%	0.9%	2.7%	6.5%	9.7%	13.4%	16.3%	18.2%	19.9%
Incremental Savings (GWh)													
Achievable Potential Low	-	-	-	-	5	3	5	10	9	14	13	11	8
Achievable Potential High	-	-	-	-	10	1	7	17	14	21	18	12	11
Economic Potential	-	-	-	-	5	(9)	8	22	20	26	22	15	14
Technical Potential	-	-	-	-	9	(3)	13	28	25	31	26	18	17
Incremental Savings (% of Baseline)													
Achievable Potential Low	0.0%	0.0%	0.0%	0.0%	0.8%	0.4%	0.6%	1.4%	1.2%	1.8%	1.7%	1.3%	1.0%
Achievable Potential High	0.0%	0.0%	0.0%	0.0%	1.4%	0.2%	0.9%	2.3%	1.9%	2.7%	2.3%	1.5%	1.3%
Economic Potential	0.0%	0.0%	0.0%	0.0%	0.7%	-1.3%	1.1%	3.1%	2.6%	3.4%	2.8%	1.8%	1.7%
Technical Potential	0.0%	0.0%	0.0%	0.0%	1.3%	-0.5%	1.9%	3.8%	3.3%	4.0%	3.3%	2.2%	2.1%

Table F-7 Measure-Level Annual Electric Energy Savings, Industrial

	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Baseline Forecast (GWh)	2,845	2,824	2,848	2,861	2,863	2,877	2,896	2,922	2,943	2,964	2,979	2,991	3,007
Cumulative Savings (GWh)													
Achievable Potential Low	-	-	-	-	11	24	42	65	87	114	139	170	191
Achievable Potential High	-	-	-	-	22	47	79	119	153	192	226	267	300
Economic Potential	-	-	-	-	34	69	109	160	207	262	310	367	412
Technical Potential	-	-	-	-	36	74	117	171	221	278	329	387	433
Cumulative Savings (% of Baseline)													
Achievable Potential Low	0.0%	0.0%	0.0%	0.0%	0.4%	0.8%	1.5%	2.2%	3.0%	3.8%	4.7%	5.7%	6.4%
Achievable Potential High	0.0%	0.0%	0.0%	0.0%	0.8%	1.6%	2.7%	4.1%	5.2%	6.5%	7.6%	8.9%	10.0%
Economic Potential	0.0%	0.0%	0.0%	0.0%	1.2%	2.4%	3.8%	5.5%	7.0%	8.8%	10.4%	12.3%	13.7%
Technical Potential	0.0%	0.0%	0.0%	0.0%	1.3%	2.6%	4.0%	5.8%	7.5%	9.4%	11.0%	12.9%	14.4%
Incremental Savings (GWh)													
Achievable Potential Low	-	-	-	-	11	14	18	23	22	27	25	30	21
Achievable Potential High	-	-	-	-	22	26	32	39	34	40	34	40	33
Economic Potential	-	-	-	-	34	35	40	51	47	55	48	56	45
Technical Potential	-	-	-	-	36	38	43	54	51	57	51	58	46
Incremental Savings													
Achievable Potential Low	0.0%	0.0%	0.0%	0.0%	0.4%	0.5%	0.6%	0.8%	0.7%	0.9%	0.8%	1.0%	0.7%
Achievable Potential High	0.0%	0.0%	0.0%	0.0%	0.8%	0.9%	1.1%	1.3%	1.2%	1.3%	1.1%	1.4%	1.1%
Economic Potential	0.0%	0.0%	0.0%	0.0%	1.2%	1.2%	1.4%	1.7%	1.6%	1.9%	1.6%	1.9%	1.5%
Technical Potential	0.0%	0.0%	0.0%	0.0%	1.3%	1.3%	1.5%	1.8%	1.7%	1.9%	1.7%	1.9%	1.5%

Table F-8 Measure-Level Annual Electric Peak Demand Savings, Industrial

	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Baseline Forecast (GWh)	3,229	3,195	3,206	3,202	3,190	3,191	3,200	3,216	3,228	3,240	3,247	3,253	3,264
Cumulative Savings (GWh)													
Achievable Potential Low	-	-	-	-	15	35	61	91	120	153	186	223	249
Achievable Potential High	-	-	-	-	31	68	114	166	210	259	304	353	392
Economic Potential	-	-	-	-	49	101	157	224	286	355	418	485	539
Technical Potential	-	-	-	-	52	106	166	235	301	373	438	507	563
Cumulative Savings (% of Baseline)													
Achievable Potential Low	0.0%	0.0%	0.0%	0.0%	0.5%	1.1%	1.9%	2.8%	3.7%	4.7%	5.7%	6.9%	7.6%
Achievable Potential High	0.0%	0.0%	0.0%	0.0%	1.0%	2.1%	3.6%	5.2%	6.5%	8.0%	9.4%	10.8%	12.0%
Economic Potential	0.0%	0.0%	0.0%	0.0%	1.5%	3.1%	4.9%	7.0%	8.9%	11.0%	12.9%	14.9%	16.5%
Technical Potential	0.0%	0.0%	0.0%	0.0%	1.6%	3.3%	5.2%	7.3%	9.3%	11.5%	13.5%	15.6%	17.3%
Incremental Savings (GWh)													
Achievable Potential Low	-	-	-	-	15	20	26	31	29	34	33	37	25
Achievable Potential High	-	-	-	-	31	37	46	52	44	49	45	49	39
Economic Potential	-	-	-	-	49	52	56	67	62	69	63	67	55
Technical Potential	-	-	-	-	52	55	60	69	66	72	66	69	56
Incremental Savings													
Achievable Potential Low	0.0%	0.0%	0.0%	0.0%	0.5%	0.6%	0.8%	1.0%	0.9%	1.0%	1.0%	1.1%	0.8%
Achievable Potential High	0.0%	0.0%	0.0%	0.0%	1.0%	1.2%	1.4%	1.6%	1.4%	1.5%	1.4%	1.5%	1.2%
Economic Potential	0.0%	0.0%	0.0%	0.0%	1.5%	1.6%	1.8%	2.1%	1.9%	2.1%	1.9%	2.1%	1.7%
Technical Potential	0.0%	0.0%	0.0%	0.0%	1.6%	1.7%	1.9%	2.1%	2.0%	2.2%	2.0%	2.1%	1.7%

APPENDIX | G

PROGRAM POTENTIAL SAVINGS AND BUDGETS

Table G-1 shows the detailed budgets and net savings (on an annual or incremental basis) for the Recommended Portfolio. Table G-2 and Table G-3 show the Achievable Low and Achievable High portfolios.

Table G-1 Vectren Recommended Electric Energy Efficiency Portfolio Summary

Program	Total Utility Costs (000$)					Total Net Incremental Energy Savings (MWh)					Total Net Incremental Demand Savings (kW)				
	2015	2016	2017	2018	2019	2015	2016	2017	2018	2019	2015	2016	2017	2018	2019
Res Lighting	891	924	1,648	1,737	1,619	8,738	8,642	8,696	8,621	8,590	525	520	523	518	516
Res Efficient Products	309	349	406	455	496	2,425	2,957	3,773	4,061	4,096	259	310	385	420	438
Res IQW	491	491	728	712	680	1,876	1,799	1,527	1,517	1,518	116	112	95	94	94
Res IQW Plus	282	282	291	291	291	142	141	144	143	142	88	87	87	86	86
Res NC	57	64	107	116	119	193	193	220	236	248	24	26	29	32	35
Res MF Direct Install	146	115	-	-	-	610	448	-	-	-	44	32	-	-	-
Res HEA	434	452	861	872	855	2,846	2,911	3,092	3,218	3,354	138	140	149	155	161
Res School Kit	252	252	252	252	252	741	726	721	715	711	132	131	130	130	130
Res Whole House Plus	966	1,037	1,105	1,163	1,213	1,343	1,426	1,507	1,579	1,646	936	994	1,049	1,100	1,146
Res Appliance Recycling	174	174	174	165	155	561	561	561	528	495	143	143	143	135	126
Res Behavioral Feedback Tools	300	300	300	300	300	4,659	5,177	5,177	5,177	5,177	1,299	1,443	1,443	1,443	1,443
Bus Prescriptive	2,120	2,660	3,119	3,527	3,510	12,310	13,774	15,438	16,535	17,112	8,088	9,683	11,231	14,842	13,627
Bus Custom Incentives	2,725	3,157	3,578	4,025	4,426	12,906	14,891	16,801	18,698	20,595	8,027	9,329	10,587	11,946	13,206
Bus Schools Program	268	324	372	422	454	719	839	919	938	1,027	110	135	155	174	192
Bus SEM	150	225	298	373	373	832	1,663	2,757	3,589	3,589	141	281	495	635	635
Bus & MF NC	298	364	395	479	493	1,109	1,386	1,530	1,902	2,009	587	725	749	960	939
Bus Direct Install	737	826	908	1,025	1,056	1,977	2,134	2,278	2,399	2,526	648	720	797	925	982
Residential Total:	4,301	4,440	5,872	6,062	5,979	24,134	24,981	25,418	25,795	25,977	3,704	3,938	4,034	4,113	4,175
Business Total:	6,298	7,557	8,669	9,851	10,311	29,851	34,686	39,723	44,060	46,857	17,602	20,873	24,013	29,482	29,581
Portfolio Total:	**10,599**	**11,996**	**14,542**	**15,913**	**16,290**	**53,986**	**59,667**	**65,140**	**69,855**	**72,834**	**21,306**	**24,811**	**28,047**	**33,596**	**33,757**

Table G-2 Vectren Avhievable Low Electric Energy Efficiency Portfolio Summary

Program	Total Utility Costs (000$)					Total Incremental Energy Savings (MWh)					Total Incremental Demand Savings (kW)				
	2015	2016	2017	2018	2019	2015	2016	2017	2018	2019	2015	2016	2017	2018	2019
Res Lighting	446	469	1,290	1,394	1,329	4,823	4,885	5,556	5,847	6,021	290	294	334	352	362
Res Efficient Products	182	204	236	264	288	1,444	1,815	2,380	2,671	2,794	158	194	245	277	297
Res IQW	137	137	206	202	194	373	362	365	362	357	24	23	23	23	23
Res IQW Plus	349	349	360	360	360	114	113	115	114	114	71	70	70	69	69
Res NC	113	126	209	228	233	565	564	656	708	737	69	75	87	96	103
Res MF Direct Install	122	89	-	-	-	571	374	-	-	-	41	27	-	-	-
Res HEA	274	274	533	518	488	2,091	2,035	2,045	2,029	2,000	133	129	130	129	127
Res School Kit	176	176	176	176	176	494	484	481	477	473	88	87	87	87	86
Res Whole House Plus	389	443	501	558	613	428	480	540	601	658	333	370	408	445	482
Res Appliance Recycling	228	228	228	216	204	951	951	951	895	839	148	148	148	139	130
Res Behavioral Feedback Tools	300	300	300	300	300	5,695	6,212	6,730	7,248	7,766	1,588	1,732	1,876	2,021	2,165
Bus Prescriptive	1,224	1,503	1,711	1,879	1,961	7,572	8,277	9,014	9,562	10,460	5,850	6,679	7,534	9,521	9,170
Bus Custom Incentives	2,719	3,138	3,565	3,983	4,387	12,889	14,816	16,787	18,574	20,562	8,398	9,691	11,017	12,351	13,682
Bus Schools Program	190	216	242	266	288	543	604	658	665	739	91	105	119	132	148
Bus SEM	281	349	393	462	462	2,495	3,326	4,158	4,989	4,989	422	563	703	844	844
Bus & MF NC	187	217	229	272	269	700	838	939	1,125	1,201	481	573	585	738	701
Bus Direct Install	244	275	305	333	369	506	569	629	672	747	224	255	287	321	357
Residential Total:	2,715	2,795	4,040	4,216	4,186	17,548	18,275	19,817	20,950	21,758	2,942	3,148	3,407	3,636	3,844
Business Total:	4,934	5,800	6,570	7,336	7,890	24,804	28,547	32,335	35,762	38,895	15,539	17,950	20,347	24,023	25,030
Portfolio Total:	**7,650**	**8,594**	**10,610**	**11,552**	**12,076**	**42,352**	**46,822**	**52,152**	**56,712**	**60,653**	**18,481**	**21,098**	**23,754**	**27,658**	**28,873**

Table G-3 Vectren Achievable High Electric Energy Efficiency Portfolio Summary

Program	Total Utility Costs (000$)					Total Incremental Energy Savings (MWh)					Total Incremental Demand Savings (kW)				
	2015	2016	2017	2018	2019	2015	2016	2017	2018	2019	2015	2016	2017	2018	2019
Res Lighting	945	999	2,633	2,788	2,674	9,198	9,292	9,995	10,386	10,874	553	559	601	624	654
Res Efficient Products	378	428	500	563	615	3,023	3,687	4,691	5,044	5,083	324	388	481	525	548
Res IQW	152	152	239	234	224	467	453	456	452	450	29	29	29	29	28
Res IQW Plus	433	433	447	447	447	142	141	144	143	142	88	87	87	86	86
Res NC	234	264	451	491	505	1,072	1,072	1,222	1,310	1,375	132	143	164	180	196
Res MF Direct Install	135	108	-	-	-	610	448	-	-	-	44	32	-	-	-
Res HEA	50	75	178	222	256	209	407	613	811	1,008	13	26	39	51	64
Res School Kit	290	290	290	290	290	865	847	841	834	829	153	152	152	151	151
Res Whole House Plus	786	921	1,067	1,209	1,348	652	761	883	1,007	1,124	460	540	622	702	782
Res Appliance Recycling	415	415	415	393	370	1,828	1,828	1,828	1,720	1,613	284	284	284	268	251
Res Behavioral Feedback Tools	850	850	850	850	850	10,553	11,513	12,472	13,432	14,391	2,942	3,210	3,477	3,745	4,012
Bus Prescriptive	3,141	3,833	4,297	4,636	4,752	14,841	15,785	16,798	17,298	18,620	11,047	12,779	14,140	17,424	16,720
Bus Custom Incentives	6,532	7,532	8,548	9,546	10,508	23,947	27,326	30,770	33,823	37,271	15,240	17,541	19,893	22,245	24,591
Bus Schools Program	460	524	588	647	700	1,057	1,153	1,233	1,217	1,333	174	199	223	244	270
Bus SEM	349	418	462	530	599	3,326	4,158	4,989	5,821	6,652	563	703	844	985	1,125
Bus & MF NC	458	530	549	649	629	1,358	1,605	1,764	2,083	2,182	980	1,134	1,121	1,381	1,275
Bus Direct Install	431	490	545	597	662	974	1,077	1,175	1,237	1,361	420	474	530	590	651
Residential Total:	4,668	4,935	7,071	7,487	7,578	28,619	30,449	33,144	35,139	36,889	5,024	5,450	5,935	6,362	6,772
Business Total:	11,550	13,529	15,249	16,901	18,176	45,682	51,309	56,993	61,785	67,762	28,552	32,979	36,930	43,070	44,857
Portfolio Total:	**16,218**	**18,465**	**22,320**	**24,388**	**25,754**	**74,301**	**81,758**	**90,137**	**96,924**	**104,651**	**33,576**	**38,429**	**42,866**	**49,432**	**51,629**

About EnerNOC

EnerNOC's Utility Solutions Consulting team is part of EnerNOC's Utility Solutions, which provides a comprehensive suite of demand-side management (DSM) services to utilities and grid operators worldwide. Hundreds of utilities have leveraged our technology, our people, and our proven processes to make their energy efficiency (EE) and demand response (DR) initiatives a success. Utilities trust EnerNOC to work with them at every stage of the DSM program lifecycle – assessing market potential, designing effective programs, implementing those programs, and measuring program results.

EnerNOC's Utility Solutions deliver value to our utility clients through two separate practice areas – Implementation and Consulting.

- Our Implementation team leverages EnerNOC's deep "behind-the-meter expertise" and world-class technology platform to help utilities create and manage DR and EE programs that deliver reliable and cost-effective energy savings. We focus exclusively on the commercial and industrial (C&I) customer segments, with a track record of successful partnerships that spans more than a decade. Through a focus on high quality, measurable savings, EnerNOC has successfully delivered hundreds of thousands of MWh of energy efficiency for our utility clients, and we have thousands of MW of demand response capacity under management.
- The Consulting team provides expertise and analysis to support a broad range of utility DSM activities, including: potential assessments; end-use forecasts; integrated resource planning; EE, DR, and smart grid pilot and program design and administration; load research; technology assessments and demonstrations; evaluation, measurement and verification; and regulatory support.

The team has decades of combined experience in the utility DSM industry. The staff is comprised of professional electrical, mechanical, chemical, civil, industrial, and environmental engineers as well as economists, business planners, project managers, market researchers, load research professionals, and statisticians. Utilities view EnerNOC's experts as trusted advisors, and we work together collaboratively to make any DSM initiative a success.

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ELECTRIC DEMAND SIDE MANAGEMENT: MARKET POTENTIAL STUDY AND ACTION PLAN

Volume 4: Detailed Appendices: Action Plan & Program Write-ups

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RESIDENTIAL LIGHTING PROGRAM

Program Description	The Residential Lighting program is a retrofit and renovation program in which Vectren will encourage and assist residential customers in improving the energy efficiency of their homes through high efficiency lighting. The promotion and incentive of high-efficiency lighting measures is a core program required by the state of Indiana. To adapt to the incoming EISA efficiency standards, the program will gradually shift focus from general purpose CFL lighting to specialty CFLs and will begin incorporating LEDs starting in 2017. The program will promote and provide incentives to help defray the cost of high-efficiency lighting by engaging in upstream "buydowns" of lamps so that customers pay a lower price at the point of purchase without needing to apply or mail-in for a rebate. The upstream buydown activity is a component of the program's focus on market transformation that will increase the demand for high efficiency lighting, and eventually decrease the availability of lower-efficiency lighting in the marketplace.
Objectives	The purpose of the Residential Lighting program is to increase the penetration of high-efficiency lighting in the homes of Vectren's residential customers. The program has several objectives: • Increase consumers' awareness of the breadth of energy efficiency lighting opportunities in their homes. • Make significant contribution to Vectren's energy savings goals. • Strengthen customer trust in Vectren as their partner in saving energy. The Residential Lighting program is well-suited for accomplishing these objectives because the incentive-eligible lighting measures are proven technologies about which customers can readily find supporting information; and the program affords Vectren the opportunity to strengthen relationships with upstream suppliers and influence stocking decisions.
Target Market	The target market for the Residential Lighting program is all residential customers in Vectren's service territory. The target market includes customers in existing single-family homes or multifamily dwellings. Both owners and renters are eligible to participate in the program.
Implementation Strategy	<u>Overview of Activities</u> The program will be administered through a third-party implementation contractor. During the implementation of this program, Vectren and the program implementation contractor will be involved in several activity areas: • Development of upstream supplier network to stock and promote program, and to participate in upstream buydown activities • Program marketing and education: including development and distribution of program materials in collaboration with upstream allies; and promotional campaigns in coordination with other Vectren

	programs • Incentive processing: including receipt, review and verification of incentive applications from participating vendors and retailers; and paying of incentives • Program performance tracking and improvement: including tracking availability of qualifying lighting, incentive submittals and payments, opportunities to improve the program • Reporting: including reporting of program activities to meet regulatory and internal requirements, in particular progress toward program goals. The program is designed so that participating retailers can easily submit incentive applications and information to the program administrator. In the next step, the appropriate party submits incentive form(s) to the program administrator with information that documents the qualifying sales. Finally, the program administrator mails incentive checks to retailers. Lighting suppliers and contractors can be very instrumental in achieving program success. Using the incentives and ENERGY STAR quality assurance as selling points, these allies can increase sales of qualifying equipment. All of the rebate processing activities will be done by the retailers and distributors behind the scenes, so that the process is seamless and effortless to the end consumer. <u>Education Overview</u> Under the program, Vectren will educate local dealers and contractors about program procedures and benefits. It may be possible to organize standing annual meetings with local trade ally associations, where Vectren staff describes the program and makes them aware of any changes that may have taken place. To further promote good communication, Vectren may conduct seminars to familiarize participating dealers and contractors with the structure and procedures of the program. Handouts will likely include specific information about incentive schedules. Consumer education will be combined with program awareness activities. Through the use of bill inserts, newsletters, on-line information, and direct mail, customers will receive educational information regarding the benefits of and opportunities to save money on energy efficient lighting. In addition, point of purchase displays may be useful in educating both retail sales associates who may work part time and customers who haven't done a lot of research prior to their visit to the store.
Issues, Risks, and Risk Management Strategies	The use of prescriptive incentives, that is, fixed per-unit incentives for specific types of lighting, is perhaps the approach with the most history among utility-sponsored energy efficiency programs. Because the qualifying lighting is well defined and the per-unit incentives are fixed, it is easily understood by customers and easy to administer. An issue of potential concern is the relatively high cost of processing applications for small incentives. If this is a major concern, minimum purchase conditions for a retailer could be imposed on eligibility. However, this could impose a barrier to participation. All consideration should be given to making the program as accessible and appealing as possible so as to ensure that the potential program savings are achieved..

Marketing and Outreach	The Residential Lighting program will be marketed mainly by working with upstream suppliers, retailers, and trade allies, as well as by direct contact with Vectren customers. • Vectren develops awareness through direct marketing—e.g., bill inserts, newsletters, website, broadcast and print media, point of purchase (POP) displays, and direct mail. • Coordinated advertising with selected retail outlets may be an effective strategy; it will be possible for the program to capitalize on big-box retail store initiatives as additional, collaborative support. Retailers and lighting contractors/installers may be engaged to promote awareness of and use rebate offers to help sell qualifying equipment. Program implementation contractors can also provide assistance with Vectren's direct marketing, and work with upstream suppliers to stock qualifying lighting measures, promote the program, and track and report program activities and achievements toward goals.
Evaluation, Measurement and Verification Requirements	The evaluation methodology and data collection proposed for the Residential Lighting program are guidelines that reflect current measurement and verification (M&V) practices. The ultimate M&V requirements for this program should conform to state protocols. <u>Metrics for Gauging Program Success</u> Primary: • Net number of lighting measures purchased/installed • Energy savings associated with purchased/installed lighting • Customer satisfaction with the program and the products • Program implementation costs incurred Secondary: • Distribution of lighting popularity and cost-effectiveness of the program • Increase in number and variety of suppliers who stock qualified lighting • Market share of high efficiency stock or sales versus standard equipment stock or sales. <u>Data Collection Approaches</u> Program staff will collect data on program marketing, outreach, and service activities. The program will utilize a data tracking system to record and report program activities and achievements. The data required for evaluating the program will depend on the methodology chosen. <u>Impact Evaluation Methodology</u> The program will record energy savings and peak load reductions from the program data tracking systems, using the per-unit savings values. Because lighting is an established technology and data are available demonstrating the reliability of savings, it will not be necessary to conduct customer-level billing analyses or metering studies. However, some projects will be inspected for independent verification of installation and operation as reported. Ex Post Surveys with participating customers will be used to estimate the net-to-gross ratio accounting for free-riders and free-drivers. Customers will be asked to provide information regarding whether they would have purchased the

incentivized items without the Vectren program, whether they installed the items, and whether they subsequently purchased additional incentive-eligible items at full cost. This outline of the self-report methodology for the assessment of net impacts describes only the basic approach. The selected M&V contractor will develop the complete plan that ensures the appropriate measurement of savings in compliance with industry and state protocols.

Process Evaluation Methodology

Program process evaluation is important to ensure that the program is operating as intended and to provide information that can enable improvements in both the program design and implementation. Process evaluation will be undertaken and conducted throughout the program. Often issues uncovered by process evaluation early in the program year can be addressed immediately, helping to ensure program success.

Process evaluation will assess customer understanding, attitudes about, and satisfaction with the program and with Vectren's other educational activities. The evaluations will make use of survey data collected by Vectren, implementation contractors, and M&V contractors. These surveys will include both customers known to have participated in the program and eligible nonparticipants.

Interviews with Vectren program staff and/or implementation contractors will be conducted to assess satisfaction with the program and to identify problems and possible program services/implementation improvements.

The M&V contractor will also help Vectren assess the performance of the program design and program delivery, including effectiveness of the marketing and educational materials, effectiveness of advertising and promotional campaigns and messages, effectiveness of the trade ally involvement, and whether implementation milestones are met adequately and on schedule. These evaluations will use sales and promotion data maintained by Vectren, the implementation contractor, and customer survey data.

Program Schedule

The Residential Lighting program is already part of the current Vectren portfolio and will continue to operate through PY 2019. The following table provides a schedule of key milestones:

Key Milestones	Timing
Assign internal program manager and staff	Anticipated in late 2013 or early 2014.
Select and contract with program implementation contractor(s)	2014, in concert with statewide Core program implementation contractor process
Finalize program design	2014, Q2
Pre-rollout program development: Develop upstream network Develop in-store, on-line information Prepare marketing materials and incentive forms Develop activity and incentive processing protocols	2014, Q3 and Q4
Program re-launch: Launch consumer education, marketing,	2015, Q1

and outreach All program services	
Prepare reports: Documentation of program activities and progress toward goals Reports to Commission	Monthly throughout program implementation period Quarterly, and annually
Conclude program operation for this planning cycle	2019

Estimated Participation

Participation and measure adoption estimates were developed based on the number of residential customers in the service territory and an assessment of the attainable market potential in the area, as well as past program performance and the experience of other organizations that have offered this type of program.

Total Estimated Participation (# of Households)

Measure	Option	No. of Gross Installations*	NTG Ratio	No. of Net Installations*
Screw-in	CFL	54,899	0.85	46,664
Specialty	CFL	59,897	0.85	50,912
Screw-in	LED	27,545	0.85	23,413

Projected Energy Savings

The estimated energy savings are given in terms of annual kWh by measure. The savings noted in each year are incremental, that is reflective of new measures installed by customers through the program in that year. This does *not* include the cumulative impact of measures still in operation from previous years.

Total Net Incremental Electricity Savings (kWh)

		Total Net Incremental Energy Savings (kWh)				
Measure	Option	2015	2016	2017	2018	2019
Screw-in	CFL	5,327,261	5,083,005	3,453,261	3,212,983	3,223,886
Specialty	CFL	3,410,785	3,558,788	3,542,170	3,581,672	3,603,519
Screw-in	LED	-	-	1,700,423	1,826,000	1,763,082
TOTAL		**8,738,046**	**8,641,792**	**8,695,854**	**8,620,656**	**8,590,487**

Customer Incentives

Incentives will be paid in the form of cash-back rebates primarily to upstream suppliers and retailers – which in turn result in a buydown of the cost seen by customers. Incentives for the individual measures account for 50% of the incremental measure cost. Incremental cost is the additional cost of a high-efficiency measure beyond a standard-efficiency alternative.

Administrative Requirements

Vectren will administer the Residential Lighting program through an implementation contractor. Vectren's role will be to ensure that:

- the implementation contractor performs all the activities associated with delivery of all components of the program, and
- Vectren's educational and program messages are delivered accurately and clearly to ensure the effectiveness of program delivery and maximize customer satisfaction with the program.

The program is expected to operate according to the following administrative and total utility budget:

Total Program Budget

Total Program Budget					
	2015	2016	2017	2018	2019
Program Staff Labor Cost	$75,000	$75,000	$75,000	$75,000	$75,000
Education & Marketing Cost	$75,096	$78,109	$144,776	$152,966	$142,049
Evaluation Cost	$40,051	$41,658	$77,214	$81,582	$75,760
Implementation Cost	$200,256	$208,291	$386,070	$407,909	$378,798
Incentive Costs	$500,640	$520,728	$965,175	$1,019,772	$946,996
Total Budget	**$891,044**	**$923,787**	**$1,648,235**	**$1,737,228**	**$1,618,603**

Cost-Effectiveness

The cost-effectiveness metrics of the Residential Lighting program are as follows:

Cost Effectiveness Tests						
	TRC Ratio	TRC Benefits	TRC Costs	UCT Ratio	PCT Ratio	RIM Ratio
Res Lighting	**1.47**	**$12,729,504**	**$8,638,583**	**2.33**	**7.39**	**0.44**

RESIDENTIAL EFFICIENT PRODUCTS PROGRAM

Program Description	The Residential Efficient Products program is a retrofit and renovation program in which Vectren will encourage and assist residential customers in improving the energy efficiency of their homes through a broad range of energy efficient products that are commonly purchased in retail settings. The program will begin in 2015 and primarily focus on ENERGY STAR appliances, pool equipment, TVs, computers, set-top boxes, ceiling fans, dehumidifiers, etc. The program will promote and provide cash rebates to help defray the cost of high-efficiency models of common home equipment. In additional to prescriptive rebates for customers, the program will engage in upstream "buydowns" of certain products so that customers pay a lower price at the point of purchase without needing to apply for a rebate. The upstream buydown activity is a component of the program's focus on market transformation that will increase the demand for high efficiency products, and eventually decrease the availability of lower-efficiency products in the marketplace. Measures will be assigned on a case-by-case basis to an upstream buydown approach or a downstream, direct rebate approach, based on the most suitable approach.
Objectives	The purpose of the Residential Efficient Products program is to increase the penetration of high-efficiency measures in the homes of Vectren's residential customers. The program has several objectives: • Increase consumers' awareness of the breadth of energy efficiency opportunities in their homes. • Make significant contribution to Vectren's energy savings goals. • Strengthen customer trust in Vectren as their partner in saving energy. The Residential Efficient Products program is well-suited for accomplishing these objectives because the rebate-eligible measures are proven technologies about which customers can readily find supporting information; customers are familiar with cash-back rebates from other types of purchases they make, and the list of included measures affords Vectren the opportunity to strengthen relationships with upstream suppliers and influence stocking decisions.
Target Market	The target market for the Residential Efficient Products program is all residential customers in Vectren's service territory and, in particular, those customers with existing equipment that needs replacing or who can be persuaded to replace early. The target market includes customers in existing single-family homes or multifamily dwellings who are either replacing existing equipment or are purchasing equipment for the first time. Both owners and renters are eligible to participate in the program.
Implementation Strategy	<u>Overview of Activities</u> The program will be administered through a third-party implementation contractor. During the implementation of this program, Vectren and the program implementation contractor will be involved in several activity areas: • Development of upstream supplier network to stock and promote program, and to participate in upstream buydown activities • Program marketing and education: including development and distribution of

	program materials in collaboration with upstream allies; and promotional campaigns in coordination with other Vectren programs • Rebate processing: including receive, review and verify applications; and pay rebates • Program performance tracking and improvement: including tracking availability of qualifying products, rebate submittals and payments, opportunities to improve the program • Reporting: including reporting of program activities to meet regulatory and internal requirements, in particular progress toward program goals. The program is designed so that either customers or participating retailers can easily submit rebate applications and information to the program administrator. In the next step, the appropriate party submits rebate form(s) to the program administrator with information that documents the qualifying sale/installation. The forms allow customers to see the exact rebate they can receive. Finally, the program administrator mails rebate checks to customers or retailers. Retailers can be very instrumental in achieving program success. Using the rebates and ENERGY STAR quality assurance as selling points, these allies can increase sales of qualifying equipment. They can further assist by aiding in the submittal of the rebate application. Across the country, many retailers will print out an extra receipt, suitable for submittal with the application; provide the customer with the appropriate rebate application; some may even help fill out and submit it. For upstream buydowns, all of the above rebate processing activities will be done by the retailers and distributors behind the scenes, so that the process is seamless and effortless to the end consumer. <u>Education Overview</u> Under the program, Vectren will educate retailers about program procedures and benefits. It may be possible to organize standing annual meetings with local retailers, where Vectren staff describes the program and make them aware of any changes that may have taken place. Handouts will likely include specific information about rebate schedules and lists of qualifying high-efficiency models. Consumer education will be combined with program awareness activities. Through the use of bill inserts, newsletters, on-line information, and direct mail, customers will receive educational information regarding the benefits of and opportunities to save money on energy efficiency upgrades. In addition, point of purchase displays may be useful in educating both retail sales associates who may work part time and customers who haven't done a lot of research prior to their visit to the store.
Issues, Risks, and Risk Management Strategies	The use of prescriptive rebates, that is, fixed per-unit incentives for a specific list of measures, is perhaps the approach with the most history among utility-sponsored energy efficiency programs. Because the measures on the list are well defined and the per-unit rebates are fixed, it is easily understood by customers and easy to administer. Targeting of the fixed per-unit incentives at the manufacturer or retailer level to create upstream buydowns should be utilized as frequently as possible, to simplify the process for the end customer.

Marketing and Outreach	The Residential Efficient Products program will be marketed through direct contact between Vectren and its customers, as well as with trade allies and other upstream suppliers. • Vectren develops awareness through direct marketing—e.g., bill inserts, newsletters, website, broadcast and print media, point of purchase (POP) displays, direct mail; and pays the participant rebates. • The Residential Home Energy Assessment program is a natural channel for this program. The walk-through audit recommendations will include resource information for the recommended measures, including rebates available under the Residential Efficient Products program. • The Residential New Construction program is also a natural channel for this program. That program will offer rebates for the installation of packages of measures, rather than individual measures. Owners or builders who participate in the new construction program will be made aware of additional measures that can be installed after construction to further improve the home performance, including installation of ENERGY STAR appliances. • Coordinated advertising with selected retail outlets may be an effective strategy. It will be possible for the program to capitalize on big-box retail store initiatives as additional, collaborative support. Retailers may be engaged to promote awareness of and use rebate offers to help sell qualifying equipment. Program implementation contractors can also provide assistance with Vectren's direct marketing, and work with upstream suppliers to stock qualifying measures, promote the program, assist with rebate applications and rebate fulfillment services, and track and report program activities and achievements toward goals.
Evaluation, Measurement and Verification Requirements	The evaluation methodology and data collection proposed for the Residential Efficient Products program are guidelines that reflect current measurement and verification (M&V) practices. The ultimate M&V requirements for this program should conform to state protocols. <u>Metrics for Gauging Program Success</u> Primary: • Net number of measures purchased/installed • Energy savings associated with purchased/installed measures • Customer satisfaction with the program and the products • Program implementation costs incurred Secondary: • Distribution of measure popularity and cost-effectiveness of the program • Increase in number and variety of suppliers who stock qualified products • Market share of high efficiency stock or sales versus standard equipment stock or sales. <u>Data Collection Approaches</u> Program staff will collect data on program marketing, outreach, and service activities. The program will utilize a data tracking system to record and report program activities and achievements. The data required for evaluating the program will depend on the methodology chosen. <u>Impact Evaluation Methodology</u> The program will record energy savings and peak load reductions from the rebate

applications processed, using the per-unit deemed savings values. Because measures are established technologies and data are available demonstrating the reliability of savings, it will not be necessary to conduct customer-level billing analyses or metering studies. However, some projects will be inspected for independent verification of installation and operation as reported.

Ex Post Surveys with participating customers will be used to estimate the net-to-gross ratio accounting for free-riders and free-drivers. Customers will be asked to provide information regarding whether they would have purchased the rebated items without the Vectren program, whether they installed the items, and whether they subsequently purchased additional rebate-eligible items at full cost. This outline of the self-report methodology for the assessment of net impacts describes only the basic approach. The selected M&V contractor will develop the complete plan that ensures the appropriate measurement of savings in compliance with industry and state protocols.

Process Evaluation Methodology

Program process evaluation is important to ensure that the program is operating as intended and to provide information that can enable improvements in both the program design and implementation. Process evaluation will be undertaken and conducted throughout the program. Often issues uncovered by process evaluation early in the program year can be addressed immediately, helping to ensure program success.

Process evaluation will assess customer understanding, attitudes about, and satisfaction with the program and with Vectren's other educational activities. The evaluations will make use of survey data collected by Vectren, implementation contractors, and M&V contractors. These surveys will include both customers known to have participated in the program and eligible nonparticipants.

Interviews with Vectren program staff and/or implementation contractors will be conducted to assess satisfaction with the program and to identify problems and possible program services/implementation improvements.

The M&V contractor will also help Vectren assess the performance of the program design and delivery of the products and services featured in the program, including effectiveness of the marketing and educational materials, effectiveness of advertising and promotional campaigns and messages, effectiveness of the trade ally involvement, and whether implementation milestones are met adequately and on schedule. These evaluations will use sales and promotion data maintained by Vectren, the implementation contractor, and customer survey data.

Program Schedule

The Residential Efficient Products program is a newly recommended Core Plus program that would begin in PY 2015 and operate through PY 2019. The following table provides a schedule of key milestones:

Key Milestones	Timing
Assign internal program manager and staff	Anticipated in late 2013 or early 2014.
Select and contract with program implementation contractor(s)	2014, Q2 or immediately upon program approval
Finalize program design	2014, Q2
Pre-rollout program development: Develop upstream network Develop in-store, on-line information Prepare marketing materials and rebate forms	2014, Q3 and Q4

Develop activity and rebate processing protocols	
Program rollout: Launch consumer education, marketing, and outreach All program services	2015, Q1
Prepare reports: Documentation of program activities and progress toward goals Reports to Commission	Monthly throughout program implementation period Quarterly, and annually
Conclude program operation for this planning cycle	2019

Estimated Participation

Participation and measure adoption estimates were developed based on the number of residential customers in the service territory and an assessment of the attainable market potential in the area, as well as the experience of other organizations that have offered this type of program.

Total Estimated Participation (# of Households)

Measure	Option	No. of Gross Installations*	NTG Ratio	No. of Net Installations*
Room AC	EER 11.5	888	0.80	710
Air-Source Heat Pump	SEER 15, HSPF 8.2	411	0.80	329
Water Heater <= 55 gal	EF 0.95	1,009	0.80	808
Personal Computers	Energy Star	11,797	0.80	9,438
Monitor	Energy Star	9,547	0.80	7,638
Laptops	Energy Star	10,202	0.80	8,162
TVs	Energy Star (5.1)	51,003	0.80	40,802
Printer/Fax/Copier	Energy Star	3,951	0.80	3,161
Set-top Boxes/DVR	Energy Star (2011)	94,891	0.80	75,912
Pool Pump	High Efficiency	1,337	0.80	1,070
Pool Heater	Heat Pump (COP = 5.0)	136	0.80	109
Well Pump	High Efficiency (60% EF)	380	0.80	304
Ceiling Fan - Installation		1,303	0.80	1,042
Electronics - Smart Power Strips		3,492	0.80	2,793
Dehumidifier		1,780	0.80	1,424
PC Power Management Software		68,019	0.80	54,415

Projected Energy Savings

The estimated energy savings are given in terms of annual kWh by measure. The savings noted in each year are incremental, that is reflective of new measures installed by customers through the program in that year. This does *not* include the cumulative impact of measures still in operation from previous years.

Total Net Incremental Electricity Savings (kWh)

Total Net Incremental Energy Savings (kWh)						
Measure	**Option**	**2015**	**2016**	**2017**	**2018**	**2019**
Room AC	EER 11.5	15,673	18,511	24,734	29,000	33,231
Air-Source Heat Pump	SEER 15, HSPF 8.2	14,432	16,469	38,261	50,160	58,786
Water Heater <= 55 gal	EF 0.95	10,020	11,767	17,028	19,667	20,509
Personal Computers	Energy Star	148,082	258,367	180,048	178,365	178,037
Monitor	Energy Star	16,740	20,828	15,295	22,987	19,128
Laptops	Energy Star	80,431	76,768	76,555	71,813	70,411
TVs	Energy Star (5.1)	692,329	873,603	1,055,655	1,314,198	1,355,062
Printer/Fax/Copier	Energy Star	4,874	5,394	13,606	9,216	6,722
Set-top Boxes/DVR	Energy Star (2011)	669,903	793,656	1,350,263	1,237,416	1,115,171
Pool Pump	High Efficiency	22,817	25,952	34,520	38,631	42,718
Pool Heater	Heat Pump (COP = 5.0)	83,173	92,839	91,827	86,041	88,743
Well Pump	High Efficiency (60% EF)	-	-	2,446	28,708	31,499
Ceiling Fan - Installation		41,110	47,465	53,900	60,281	66,642
Electronics - Smart Power Strips		-	-	7,844	8,918	9,997
Dehumidifier		28,403	32,775	37,210	41,605	45,984
PC Power Management Software		597,103	683,006	773,864	863,967	953,686
TOTAL		**2,425,091**	**2,957,401**	**3,773,057**	**4,060,973**	**4,096,327**

Customer Incentives

Incentives will be paid in the form of cash-back rebates to customers or to retailers – which in turn result in a buydown of the cost seen by customers. Incentives for the individual measures account for 50% of the incremental measure cost. Incremental cost is the additional cost of a high-efficiency measure beyond a standard-efficiency alternative. When the program design is finalized, the rebate application form can allow for incentives that vary by measure or even within a measure.

The program upstream buydowns of certain products will enable customers to purchase the products at a lower cost without the need to apply for a rebate.

Administrative Requirements

Vectren will administer the Residential Efficient Products program through an implementation contractor. Vectren's role will be to ensure that

- the implementation contractor performs all the activities associated with delivery of all components of the program, and
- Vectren's educational and program messages are delivered accurately and clearly to ensure the effectiveness of program delivery and maximize customer satisfaction with the program.

The program is expected to operate according to the following administrative and total utility budget:

Total Program Budget

Total Program Budget					
	2015	2016	2017	2018	2019
Program Staff Labor Cost	$50,000	$50,000	$50,000	$50,000	$50,000
Education & Marketing Cost	$23,826	$27,509	$32,748	$37,287	$41,064
Evaluation Cost	$12,707	$14,672	$17,466	$19,887	$21,901
Implementation Cost	$63,535	$73,358	$87,329	$99,433	$109,505
Incentive Costs	$158,837	$183,394	$218,322	$248,582	$273,761
Total Budget	**$308,904**	**$348,932**	**$405,864**	**$455,188**	**$496,231**

Cost-Effectiveness

The cost-effectiveness metrics of the Residential Efficient Products program are as follows:

Cost Effectiveness Tests						
	TRC Ratio	TRC Benefits	TRC Costs	UCT Ratio	PCT Ratio	RIM Ratio
Res Efficient Products	**2.31**	**$5,767,547**	**$2,494,058**	**3.55**	**11.18**	**0.51**

RESIDENTIAL INCOME QUALIFIED WEATHERIZATION PROGRAM

Program Description	The Residential Income Qualified Weatherization program is a Core program that will provide energy efficiency services and energy education to Vectren's low-income customers; helping them to reduce their energy usage and increase the affordability of their energy bills. This program will focus on education and the installation of measures in homes that meet the low income criteria. Participating households will receive the following types of assistance: • In-Home Audits and Education—these are on-site inspections used to identify the applicability of energy-savings measures the program offers and to educate residents about ways to reduce their energy usage. • Direct Installation of Measures—Install measures to reduce energy use in the home at no charge to residents.
Objectives	The purpose of the Residential Income Qualified Weatherization program is to educate and assist eligible residential customers with making their homes more energy efficient. Unlike other programs, a core objective is to provide repairs necessary to install energy savings improvements in a part of the housing stock that is often old and substandard in comparison to middle and upper income housing.
Target Market	The eligible customer population for the Residential Income Qualified Weatherization program is low-income residents in residential units that are provided with electricity by Vectren and who are financially responsible for the utility bill payment. Customers must meet the following usage and income eligibility criteria for program participation: • Income qualified participants are all those with an average household income at or below 200% of the federal poverty level.
Implementation Strategy	During the implementation of this program, the implementation staff will be involved in several activity areas: <u>In-Home Audits and Education</u> • Trained auditors perform on-site audits and assess the energy performance of the house; i.e., identify where energy is used and where there are inefficiencies and determine which measures are appropriate to install. This includes an optional blower door test to check for air infiltration and building envelope tightness. • The auditors discuss the opportunities to reduce energy use and bills with residents. • Follow-up contacts with the participants reinforce the message of the benefits of energy-saving behaviors (e.g., turning off lights in unoccupied rooms) and adoption of energy-savings measures offered by the auditors. <u>Direct Installation Components</u> Applicable measures will be installed, at no cost to residents. Measures for the program include: • Compact fluorescent lamps

	• Low flow showerheads • Low flow faucet aerators <u>Education Overview</u> Customers will be provided with energy education materials to enhance their understanding of energy-saving behaviors and measures and to make them aware of other Vectren energy efficiency and demand response programs, as well as other State and local resources available to assist them. <u>Applicable Collaborative Resources</u> There are several programs in place at the State level that provide qualified residents with loans and/or rebates to enable action on commonly recommended measures. Vectren can leverage these resources to expand or supplement benefits to income qualified customers.
Issues, Risks, and Risk Management Strategies	The Residential Income Qualified Weatherization program focuses on providing energy efficiency services to low-income residents to ensure reduced consumption. There is little risk associated with this program. Attention will be given to ensuring that the implementation contractor supplies the services that funding from this program will enable, as well as the documentation of activities that will meet the tracking and reporting requirements of this program.
Marketing and Outreach	The Residential Income Qualified Weatherization program will reach the target low income households by using the following channels: • Recruitment by the program implementation contractor • Use of utility bill stuffers for customer awareness and education • Weatherization contractors and other appropriate community groups to refer eligible participants • Since this program defines eligibility by income, canvassing neighborhoods with low income census tracking data is a marketing approach that has been used successfully by other low-income program implementers around the nation, such as Focus on Energy. The approach consists of sending a postcard to all households in a specific area, detailing plans to be in the neighborhood during a certain number of days. It then asks the customer to call to set up an appointment for free energy efficiency products. This approach can ensure that contractor teams are efficiently scheduled, decreasing administrative costs and improving cost effectiveness. • In addition, Vectren will encourage in the RFP process that bidding program implementation contractors investigate opportunities to hire low income, unemployed workers through various programs throughout the State.
Evaluation, Measurement and Verification Requirements	The evaluation methodology and data collection proposed for the program are guidelines that reflect current measurement and verification (M&V) practices. The ultimate M&V requirements for this program will conform with the state protocols. <u>Metrics for Gauging Program Success</u> • Number of measures installed in participating households • Customer satisfaction with the program and the products • Energy usage reduction and bill savings among participating households • Program implementation costs incurred • Weatherization program provider satisfaction with partnership <u>Data Collection Approaches</u>

Program staff will collect data on program marketing, outreach, and service activities. The program will utilize a data tracking system to record and report program activities and achievements. The data required for evaluating the program will depend on the methodology chosen.

Impact Evaluation Methodology

The energy savings and demand reduction resulting from measures installed by the program implementation contractor can be evaluated through records of installations performed and follow-up surveys with recipient households to assess retention of the installations. Deemed per-unit savings can be applied to the retained installations to obtain final savings estimates.

It is assumed that participants in this program would not have been able to afford these services without the program, and so there is no free-ridership and a net-to-gross ratio of 100%.

Process Evaluation Methodology

Program process evaluation is important to ensure that the program is operating as intended and to provide information that can enable improvements in both the program design and implementation. Process evaluations will be undertaken and conducted throughout the program by the implementation and M&V contractor selected by Vectren.

Process evaluation will assess eligible customers' understanding, attitudes about, and satisfaction with the program. They will make use of survey data collected by the implementation and M&V contractors. These surveys will include both customers known to have participated in the program and eligible nonparticipants.

Interviews with program service providers will be conducted to assess satisfaction with the program and to identify problems and possible program services/implementation improvements. The data from the interviews will be used to identify problems/concerns with the partnerships and/or procedures. These reviews will be conducted throughout the program operation period so that improvements can be incorporated into the implementation.

Program Schedule

This program is a Core program and is already part of the current Vectren portfolio and will continue to operate through PY 2019. The following table provides a schedule of key milestones:

Key Milestones	Timing
Assign internal program manager and staff	Anticipated in late 2013 or early 2014.
Select and contract with program implementation contractor(s)	2014, in concert with statewide Core program implementation contractor process
Finalize program design	2014, Q2
Pre-rollout program development: Develop procedures and protocols for delivery of services and activity tracking	2014, Q3 and Q4
Program rollout: Re-Launch program services	2015, Q1
Prepare reports: Documentation of program activities	Monthly throughout program

and progress toward goals Reports to Commission	implementation period Quarterly, and annually
Conclude program operation for this planning cycle	2019

Estimated Participation

Participation and measure adoption estimates were developed based on the number of residential customers in the service territory and an assessment of the attainable market potential in the area, as well as past program performance and the experience of other organizations that have offered this type of program.

Total Estimated Participation (# of Units, Bulbs, or Fixtures)

Measure	Option	No. of Gross Installations*	NTG Ratio	No. of Net Installations*
Screw-in	CFL	34,000	1.00	34,000
Specialty	CFL	10,000	1.00	10,000
Screw-in	LED	6,000	1.00	6,000
Water Heater - Tank Insulation		625	1.00	625
Water Heater - Pipe Wrap		625	1.00	625
Water Heater - Faucet Aerators		5,000	1.00	5,000
Water Heater - Low-Flow Showerheads		2,500	1.00	2,500

Total Estimated Participation (# of Households)

Number of Households Participating					
	2015	2016	2017	2018	2019
Gross HH's	1000	1000	1000	1000	1000
Net HH's	1000	1000	1000	1000	1000

Projected Energy Savings

The estimated energy savings are given in terms of annual kWh by measure. The savings noted in each year are incremental, that is reflective of new measures installed by customers through the program in that year. This does *not* include the cumulative impact of measures still in operation from previous years.

Total Net Incremental Electricity Savings (kWh)

Total Net Incremental Energy Savings (kWh)						
Measure	Option	2015	2016	2017	2018	2019
Screw-in	CFL	1,421,140	1,343,717	908,505	898,576	898,576
Specialty	CFL	139,902	139,906	140,190	140,426	140,703
Screw-in	LED	-	-	162,643	162,871	163,206
Water Heater - Tank Insulation		9,875	9,875	9,875	9,875	9,875
Water Heater - Pipe Wrap		6,375	6,375	6,375	6,375	6,375
Water Heater - Faucet Aerators		158,000	158,000	158,000	158,000	158,000

Water Heater - Low-Flow Showerheads		141,000	141,000	141,000	141,000	141,000
TOTAL		**1,876,292**	**1,798,874**	**1,526,587**	**1,517,123**	**1,517,735**

Customer Incentives

The energy efficiency measures are installed at no charge to low income residents. Since the cost of the measures is fully covered by the program, there are no direct financial incentives provided to the customers.

Administrative Requirements

Vectren will mainly administer the Residential Income Qualified Weatherization program with a program implementation contractor and through partnerships with weatherization program providers. The program is expected to operate according to the following administrative and total utility budget:

Total Program Budget

Total Program Budget					
	2015	2016	2017	2018	2019
Program Staff Labor Cost	$75,000	$75,000	$75,000	$75,000	$75,000
Education & Marketing Cost	$51,318	$51,318	$80,659	$78,678	$74,714
Evaluation Cost	$25,659	$25,659	$40,330	$39,339	$37,357
Implementation Cost	$236,063	$236,063	$371,034	$361,917	$343,683
Incentive Costs	$102,636	$102,636	$161,319	$157,355	$149,427
Total Budget	**$490,676**	**$490,676**	**$728,342**	**$712,288**	**$680,181**

Cost-Effectiveness

The cost-effectiveness metrics of the Residential Income Qualified Weatherization program are as follows:

Cost Effectiveness Tests						
	TRC Ratio	TRC Benefits	TRC Costs	UCT Ratio	PCT Ratio	RIM Ratio
Res IQW	**0.99**	**$2,475,435**	**$2,503,149**	**0.99**	**-**	**0.35**

RESIDENTIAL IQW PLUS PROGRAM

Program Description	The Residential Income Qualified Weatherization (IQW) Plus program will provide additional energy efficiency services and follow-on measures to Vectren's low-income customers; helping them to reduce their energy usage and increase the affordability of their energy bills. This Core Plus program will focus on expanding the types of measures installed in homes that meet the low income criteria beyond what is offered in the Core IQW program in order to pursue deeper savings. The full measure and installation cost will be covered by program rebates so that household income constraints do not preclude the attainment of these savings.
Objectives	The purpose of the Residential IQW Plus program is to educate and assist eligible, income-limited residential customers with making their homes more energy efficient.
Target Market	The eligible customer population for the Residential IQW Core Plus program is all customers that have participated in the IQW Core program.
Implementation Strategy	The implementation of this program will involve careful tracking and follow-up with the participants of the IQW Core program. After they have received a walk-thru audit and direct-install measures, this program will reach out to them and provide the opportunity to follow up on any non-standard measures or recommendations uncovered in the IQW Core activities. Applicable measures would be installed at no cost to residents. These measures include: • Weather stripping and other infiltration reduction • Duct repair and sealing • Ceiling Insulation • Whole-House Fan • Programmable Thermostats • Possible measures from other programs like the Efficient Products program or the Whole House Plus program. <u>Education Overview</u> Customers will be provided with energy education materials to enhance their understanding of energy-saving behaviors and measures and to make them aware of other Vectren energy efficiency and demand response programs, as well as other State and local resources available to assist them. <u>Applicable Collaborative Resources</u> There are several programs in place at the State level that provide qualified residents with loans and/or rebates to enable action on commonly recommended measures. Vectren can leverage these resources to expand or supplement benefits to income qualified customers.
Issues, Risks, and Risk Management	The Residential IQW Plus program focuses on providing energy efficiency services to low-income residents to ensure reduced consumption. There is little risk associated with this program. Attention will be given to ensuring that the implementation contractor and

Strategies	weatherization providers supply the services that funding from this program will enable, as well as the documentation of activities that will meet the tracking and reporting requirements of this program.
Marketing and Outreach	The Residential IQW Core Plus program will primarily target past and current participants in the Residential IQW Core program, reaching out to them via direct mail, email, and phone recruitment.
Evaluation, Measurement and Verification Requirements	The evaluation methodology and data collection proposed for the program are guidelines that reflect current measurement and verification (M&V) practices. The ultimate M&V requirements for this program will conform with the state protocols. <u>Metrics for Gauging Program Success</u> • Number of measures installed in participating households • Customer satisfaction with the program and the products • Energy usage reduction and bill savings among participating households • Program implementation costs incurred • Weatherization program provider satisfaction with partnership <u>Data Collection Approaches</u> Program staff will collect data on program marketing, outreach, and service activities. Customer billing data prior to and following program participation will be required to assess energy use and improvement opportunities, and assess and/or verify savings for the payment of customer incentives. The program will utilize a data tracking system to record and report program activities and achievements. The data required for evaluating the program will depend on the methodology chosen. <u>Impact Evaluation Methodology</u> The first step is to establish a pre-participation energy use “baseline” based on customer bills, followed by post-participation tracking of energy use through bills. This, together with information on exact measures installed during the audit and additional weatherization measures installed as provided by the installation contractors, would allow assessment of customer energy savings. It is assumed that participants in this program would not have been able to afford these services without the program, and so there is no free-ridership and a net-to-gross ratio of 100%. <u>Process Evaluation Methodology</u> Program process evaluation is important to ensure that the program is operating as intended and to provide information that can enable improvements in both the program design and implementation. Process evaluations will be undertaken and conducted throughout the program by the implementation and M&V contractor selected by Vectren. Process evaluation will assess eligible customers’ understanding, attitudes about, and satisfaction with the program. They will make use of survey data collected by the implementation and M&V contractors. These surveys will include both customers known to have participated in the program and eligible nonparticipants. Interviews with program service providers will be conducted to assess satisfaction with the program and to identify problems and possible program services/implementation improvements. The data from the interviews will be used to identify problems/concerns with the partnerships and/or procedures. These reviews will be conducted throughout the program operation period so that improvements can be incorporated into the

	implementation.
Program Schedule	This program is a newly recommended Core Plus program that would begin in PY 2015 and operate through PY 2019. The following table provides a schedule of key milestones:

Key Milestones	Timing
Assign internal program manager and staff	Anticipated in late 2013 or early 2014.
Select and contract with program implementation contractor(s)	2014, Q2 or immediately upon program approval
Finalize program design	2014, Q2
Pre-rollout program development: Develop procedures and protocols for delivery of services and activity tracking	2014, Q3 and Q4
Program rollout: Launch program services	2015, Q1
Prepare reports: Documentation of program activities and progress toward goals Reports to Commission	 Monthly throughout program implementation period Quarterly, and annually
Conclude program operation for this planning cycle	2019

Estimated Participation

Participation and measure adoption estimates were developed based on the number of residential customers in the service territory and an assessment of the attainable market potential in the area, as well as the experience of other organizations that have offered this type of program.

Total Estimated Participation (# of Households)

Measure	No. of Gross Installations*	NTG Ratio	No. of Net Installations*
Total Res IQW Plus	354	1	354

Projected Energy Savings

The estimated energy savings are given in terms of annual kWh by measure. The savings noted in each year are incremental, that is reflective of new measures installed by customers through the program in that year. This does *not* include the cumulative impact of measures still in operation from previous years.

Total Net Incremental Electricity Savings (kWh)

Total Net Incremental Energy Savings (kWh)					
Measure	**2015**	**2016**	**2017**	**2018**	**2019**
Total Res IQW Plus	141,998	140,662	143,545	142,725	141,991
TOTAL	**141,998**	**140,662**	**143,545**	**142,725**	**141,991**

These savings will be attributable to house-as-a-system type measures such as:

- Insulation - Ceiling
- Insulation - Ducting
- Insulation - Foundation
- Insulation - Infiltration Control
- Insulation - Radiant Barrier
- Ducting - Repair and Sealing
- Windows - Install Reflective Film
- Doors - Storm and Thermal
- Roofs - High Reflectivity
- Whole-House Fan - Installation
- Thermostat - Clock/Programmable
- Electronics - Smart Power Strips

Customer Incentives

The energy efficiency measures are installed at no charge to low income residents. Since the cost of the measures is fully covered by the program, there are no direct financial incentives provided to the customers.

Administrative Requirements

Vectren will mainly administer the Residential IQW Plus program with a program implementation contractor and through partnerships with weatherization program providers. The program is expected to operate according to the following administrative and total utility budget:

Total Program Budget

Total Program Budget					
	2015	2016	2017	2018	2019
Program Staff Labor Cost	$10,000	$10,000	$10,000	$10,000	$10,000
Education & Marketing Cost	$19,687	$19,687	$20,337	$20,337	$20,337
Evaluation Cost	$15,750	$15,750	$16,270	$16,270	$16,270
Implementation Cost	$39,374	$39,374	$40,674	$40,674	$40,674
Incentive Costs	$196,869	$196,869	$203,369	$203,369	$203,369
Total Budget	**$281,679**	**$281,679**	**$290,649**	**$290,649**	**$290,649**

Cost-Effectiveness

The cost-effectiveness metrics of the Residential IQW Plus program are as follows:

Cost Effectiveness Tests						
	TRC Ratio	TRC Benefits	TRC Costs	UCT Ratio	PCT Ratio	RIM Ratio
Res IQW Plus	**0.56**	**$650,864**	**$1,166,742**	**0.56**	**-**	**0.35**

RESIDENTIAL NEW CONSTRUCTION PROGRAM

Program Description	The Residential New Construction program is designed to accelerate the incorporation of energy efficiency in the design, construction, and operation of single-family homes and renovated or reconstructed homes. The program works with builders and qualified Home Energy Raters to build homes that are, more comfortable, more durable, and more energy efficient than homes built to conventional practices. All home certifications go through a third party verification process, ensuring the construction meets the high standard of the programs. Upstream designers/builders and owner-builders will be offered education on and rebates for the installation of high efficiency end-use equipment and building envelope measures in new residential dwellings. This program takes a "whole home" approach, encouraging designers, builders, and home buyers to think of home performance in total, rather than in terms of the efficiency of individual components. It focuses on raising the standards of all components, from building shell through appliances and fixtures. The program has the following components: • Education – teach the new home market stakeholders, and renovation contractors and developers, about the benefits of energy-efficient home design and inform them of incentives available for the installation of energy-efficiency shell and equipment. • Rebates – offer rebates to builders or homeowners for the incorporation of high efficiency end-use equipment and building envelope measures in new residential dwellings; higher rebates are offered to homes that meet higher efficiency standards. <u>Education</u> • Develop seminars and materials to address the factors that generally prevent homebuilders' from incorporating energy efficiency into homes; e.g., reliability, cost-effectiveness. • Offer this training to builders, developers, contractors and others, including builders of tract homes, renovation contractors and developers, real estate agents, and lenders. • Set up demonstration homes to familiarize the community, from builders to homeowners, with the high-efficiency measures. <u>Rebates</u> The program will offer rebates that encourage the installation of measures that improve home energy performance as a whole, using ENERGY STAR recommended design practices, materials, and appliances. The packages include progressively more and higher efficiency measures, providing opportunities for builders of homes in many price categories to participate. The packages combine a number of measures offered for retrofits under other residential programs into new housing design; many are more cost-effective to install as part of new construction. The rebate-eligible measure packages are:

	• Bronze Package— high efficiency HVAC equipment, ENERGY STAR lighting fixtures, high-efficiency water heater, programmable thermostat • Silver Package—Bronze Package measures plus: Attic / roof insulation, wall insulation, floor/foundation insulation, ENERGY STAR refrigerator • Gold Package—Silver Package measures plus: ENERGY STAR windows, ENERGY STAR clothes washer, ENERGY STAR dishwasher; one or more of the following measures: exhaust ventilation strategy, drainwater heat recovery, high reflectivity roof. The program will be most effective if the rebates are directed to new home builders rather than to the eventual new homeowners, though owner-builders are eligible to receive them.
Objectives	The purpose of the Residential New Construction program is to greatly improve the energy efficiency of all newly constructed and reconstructed facilities in the Vectren service territory. The goals of the program are to meet the demands of Indiana's climate, push the levels of energy efficiency of Indiana's residential building standards, and facilitate builder participation by adding value to their business. The program provides financial incentives for builders as a means to not only promote energy efficient new construction, but also accelerate the adoption of new technologies. The program has the following objectives: • Make valuable contributions toward achievement of reduction goals. • Produce a permanent improvement in "standard" design practices among building designers and owners that will continue without the need for short-term incentives.
Target Market	The eligible market for this program is all new single-family homes constructed in the applicable service territory, as well as buildings that are completely renovated or reconstructed. The target market for participation in the program is residential designers, builders, developers, and owner-builders. While the energy savings resulting from this program will be accrued by the homeowners of units that include measures installed under the program, and all residential customers who are building new homes are eligible to participate, the key target market of the program are the trades people most responsible for the design and equipment decisions—builders, developers, and contractors. Homes expected to be targeted for participation will include those with water heat and/or space conditioning systems which have the potential to save the most energy.
Implementation Strategy	<u>Overview of Activities</u> The program will be administered through third-party implementation contractors. The implementation contractor will be responsible for providing technical assistance and develop training for builders, building trades, and realtors to raise awareness about the benefits of energy efficient new home construction. During implementation, program staff will be involved in several activity areas: • Identification and recruitment of upstream market stakeholders for program participation and delivery channel activities • Education: including development and operation of training seminars for designers, builders, developers, and homeowners; development and operation of demonstration homes; and development and distribution of educational publications • Marketing: including development and distribution of program materials in

collaboration with upstream trades people who will be both program participants and promoters

- Rebate Processing: including receipt, review and verification of applications; and either pay or submit rebates for payment
- Program Performance Tracking and Improvement: including rebate submittals and payments, opportunities to improve the program
- Reporting: including reporting of program activities to meet regulatory and internal requirements, in particular progress toward program goals

The program will be marketed to builders primarily through the Indiana Builders Association as well as direct business-to-business contacts. The implementation contractor will work with program staff Business Managers to identify key builders and conduct in-person meetings to recruit the builders into the program. The contractor will work on developing opportunities to present the program at builder and other trade association meetings, and to place information in association newsletters. A dedicated program webpage will serve as a source for program information and application forms for rebates. Participating builders will be supplied with collateral materials to aid them in communicating the benefits of energy efficient homes to their customers.

The upstream market stakeholders, including the designers, builders, developers, real estate agents, and mortgage lenders will receive extensive education about energy-efficient home construction and benefits. They will also have the following roles as delivery channels:

- Designers, builders, and developers who participate in training seminars can distinguish themselves to prospective homebuyers as qualified or certified energy-efficient providers. Ones who also receive rebates for installing rebate-eligible measures can pass some or all of these incentives along to buyers.
- Builders and real estate agents educated about the features and advantages of energy-efficient homes will, in-turn, serve as ambassadors for the program and can use the advantages as a selling point.
- Lenders can offer homebuyers larger loan amounts and/or lower interest rates than they would have otherwise qualified for, towards the purchase of certified energy-efficient homes. These are referred to as “energy efficient mortgages.”

<u>Education Overview</u>

Education is a key component of the Residential New Construction program. The market will change through training, education and demonstration. The program will increase confidence in the performance and benefits of increased energy efficiency (better performance, lower fuel bills, reduced maintenance, etc.). Designers and builders will be encouraged to implement more energy-efficient strategies to increase energy efficiency through the program. Emphasis on the additional benefits of comprehensive energy efficiency improvements and continual maintenance to retain savings will demonstrate an overall cost-effectiveness that can be achieved without the need for financial incentives over the longer term. Ongoing deployment of these strategies will become “standard” practice by these same designers and builders in additional projects, affecting long-term market transformation.

To accomplish this, the program will offer several forms of education:

- Training seminars will be taught by experts in specific aspects of high-efficiency home design and construction. Many utilities offer these no-fee sessions on an ongoing basis. In addition to teaching key principles and an understanding of the program, they provide Vectren with an excellent opportunity to develop strong

	relationships and build trust with this influential group. • Publications with technical information, practical advice, and persuasive messages will be developed. These can be included in newsletters directed to the design/build/sales community, published in trade journals, sent in direct mail, distributed at seminars, and made available on a website page designed for this audience. • Demonstration homes are effective in encouraging the community's involvement. Vectren will work with communities to set total savings goals. This demonstration program will work to incorporate the use of the existing Home Energy Rating System (HERS). Program staff will work with HERS raters to establish a workable data tracking system. Vectren may also be able to leverage the support of HERS raters in recruiting and training builders. Demonstration homes will also promote and educate home builders, sellers, and buyers in regards to energy efficiency measures that can be incorporated into their homes, allowing them to see different types of upgrades such as lighting, window and water heaters in operation. One of the goals will be to increase the education of builders of tract homes, real estate agents and lenders about the value of a home rating system. The program will also promote energy efficiency mortgages through the local lending community.
Issues, Risks, and Risk Management Strategies	Currently, several market barriers inhibit the participation in new construction programs. All of the implementation activities—the educational component, together with outreach and marketing of the program, will address the following barriers to achieve the educational and energy savings goals of the program: • Perception of Higher Cost: Many designers and builders feel that increased building performance costs more, and that it is not cost-effective. Higher efficiency measures have higher first cost, but are likely to have a lower cost on a lifecycle basis due to energy savings over the life of the measure. • Risk Aversion: The building industry is particularly slow to adopt new technologies or solutions. Designers prefer to install systems and build buildings using familiar technologies. Liability issues are also a concern. • First Cost vs. Lifecycle Cost Considerations: Building developers are only concerned with first cost considerations as they must build the house within a pre-determined budget. As such, they are reluctant to consider the higher cost high-efficiency equipment that would have to be passed onto the homeowner through a higher cost of the home. • Limited Technical Information: Designers and owners have limited familiarity with new products, technologies and their applications, and their associated benefits that extend beyond energy savings (comfort, durability, health, productivity and maintenance). • Inadequate Operational Procedures: Building systems are usually not tested to ensure that they perform as designed and owners fail to implement an ongoing maintenance and quality assurance procedure to properly operate the equipment. Vectren should take additional steps to encourage participation and satisfaction with the program. Some of these might include: • Recognition of builders who meet or exceed the program requirements through press releases and other advertisements • Offering an annual award for the most energy-efficient residential design

	• Offering information to designers and builders on the cost-effectiveness of higher performance measures • Organizing training sessions and workshops for providing designers and builders with technical information related to the higher efficiency products and their associated benefits. • Providing an incentive bonus for builders to install a "whole home" package of measures • Working with communities to site a demonstration home and set community savings goals
Marketing and Outreach	Because they are the key decision makers in new home design, it will be advantageous for the program to work "upstream"— mainly with designers, builders and developers, but also with real estate agents and mortgage lenders. By doing so, the program can teach these trade allies about the benefits of energy-efficient home design and inform them of the financial incentives for the installation of energy-efficiency equipment. • Vectren develops awareness through direct marketing—e.g., bill inserts, newsletters, website, broadcast and print media, real estate guide ads, and direct mail. A focus of marketing activities should be targeted to homeowners through advertisements in home sales magazines, home shows, parade of homes, and seminars. Informed and educated homeowners are likely to create a market pull and bring up higher efficiency options with their designers/builders. • Designers, Builders, and Developers—Trades people are key decision makers for building shell and systems, and determining the appliances installed in new homes. In order for the program to be effective, the program must educate them on how and why to upgrade their building practices through training sessions and ongoing technical assistance. Once convinced, these construction influencers can promote the program and the efficiency benefits to new homebuyers as well as to their suppliers and subcontractors. Some utility programs are designed to encourage builders to pass the incentives they receive for installing high-efficiency measures on to homebuyers. These trades people are both participants and delivery channels for the program. • Mortgage Lenders—In addition to the participation of local builders, it will be important for the program to enlist the help of mortgage lenders in promoting the sale of energy-efficient homes. Other utilities with similar new construction programs have obtained the cooperation of lenders who have agreed to offer favorable financing terms for energy-efficient homes. • Real Estate Agents—To encourage Realtors to promote energy-efficient homes, it would be extremely beneficial if Vectren were to clearly identify qualifying homes, and perhaps offer cooperative advertising dollars to realtors selling such homes.
Evaluation, Measurement and Verification Requirements	The evaluation methodology and data collection proposed for the Residential New Construction program are guidelines that reflect current measurement and verification (M&V) practices. The ultimate M&V requirements for this program will conform with the state and local protocols. Two key issues for evaluation of new construction programs are: • Determination of whether the program attracts builders who were already building homes that meet the program requirements.

- An assessment of whether promotional and marketing efforts are in fact effective.

Metrics for Gauging Program Success

- Number of projects completed
- Number of participating builders
- Number of in-person visits to key builders
- Energy savings associated with homes built through participation in the program
- Number of seminar attendees and/or trades people certified in energy-efficient building principles
- Increase in receptivity/adoption of energy-efficient building practices by designers, builders, and developers to measure the effectiveness of the marketing and education activities and progress towards market transformation.
- Delivery at or below budgeted costs
- Achieving estimated benefit-cost ratios

Data Collection Approaches

The data required for evaluating the program will depend on the methodology chosen. They will likely include the following sources and information:

- Billing and/or metered use data
- Engineering estimates of measure savings
- Local weather data
- Program tracking system for measures installed, rebates paid, and home characteristics
- Upstream and homeowner surveys regarding program awareness, satisfaction with the program, understanding and perceived savings from measures, program influence on design and construction decisions
- Program staff surveys

Impact Evaluation Methodology

The impact evaluation will conform with the state protocols. Some possible approaches are described below.

The impact evaluation will use a variety of techniques to obtain data on energy consumption in new residential buildings, but will focus on the effect of the program on building practices. The program will compare a sample of homes completed under the program with a control sample of non-program homes, preferably built by the same builders either before they entered the program (a before-after analysis) or at the same time but not as part of the program (a side-by-side analysis). The before-after analysis will be preferable, but it may be difficult to locate the necessary homes. Therefore, a side-by-side analysis will probably be the more viable option

The analysis techniques will include performing engineering analyses on a sample of program and non-program homes “as built”, metering these same program and non-program homes to calibrate the engineering estimates, and conducting a billing analysis of weather-adjusted energy consumption for a larger sample of program and a comparable group of non-program homes. To complete the engineering analysis and metering study for the program, detailed data on each home, including occupant characteristics, appliance stock, and structural features, will be required. Similar, but less detailed, information will be gathered using an occupant survey for the homes included in the statistical billing analysis.

A similar approach to sampling program and non-program buildings will be used to evaluate impacts for multifamily units. Metering may be conducted at the whole building level and a sample of units will be carefully selected to provide end-use data on location and structural differences (two-bedroom versus one-bedroom, etc.) for units within a multifamily complex.

Process Evaluation Methodology

Program participants, local inspectors, and program implementation staff will be interviewed for the process evaluation. These interviews will focus on the construction and inspection processes of residences built to new standards. Site visits will be conducted as part of the engineering and metering data collection; additional site visits may be added at a later date if any installation problems are identified. Site visits will be used to determine if measures were installed as expected and to gather data for the engineering analysis of the homes as built. In addition to obtaining information on customer characteristics, the customer survey will ask questions about the effectiveness of program promotional activities, customer satisfaction with their homes, and whether the participants have encountered any problems with their new equipment.

Initially, the process evaluation will focus on program implementation, administration, and delivery. Interviews will be used to determine if the program is encouraging new construction practices and if the upstream market stakeholders and homeowners are finding the program informational and promotional materials useful. If there are difficulties in obtaining participation during the first year, the evaluation may be expanded to include focus group interviews with a larger sample of designers, builders, developers, and new homeowners.

After the first year, the process evaluation will assess how well program changes recommended during the first-year process evaluation are being implemented. The process evaluation will also continue to examine the program implementation and delivery process to determine if additional changes are required.

Program Schedule

This program is a newly recommended Core Plus program that would begin in PY 2015 and operate through PY 2019. The following table provides a schedule of key milestones:

Key Milestones	Timing
Assign internal program manager and staff	Anticipated in late 2013 or early 2014.
Select and contract with program implementation contractor(s)	2014, Q1
Finalize program design	2014, Q2
Pre-rollout program development: Build designer/builder network Develop designer/builder training curriculum and schedule Develop marketing strategies Develop procedures for tracking activities and documenting results	2014, Q3 and Q4
Program rollout:	2015, Q1
Prepare reports: Documentation of program activities and progress toward goals Reports to Commission	 Monthly throughout program implementation period Quarterly, and annually
Conclude program operation for this	2019

	planning cycle	

Estimated Participation

Participation and measure adoption estimates were developed based on the number of residential customers in the service territory and an assessment of the attainable market potential in the area, as well as past program performance and the experience of other organizations that have offered this type of program.

The Net to Gross Ratio for this program is modeled as 0.95.

Program NTG Ratio

Measure	NTG Ratio
Total Res NC	0.95

Program Yearly Projections

	2015	2016	2017	2018	2019
Total Number of Homes	74	82	99	109	118
Net kWh Savings/HH	2605	2337	2223	2166	2102
Gross kWh Savings/HH	2742	2460	2340	2280	2213
Program Cost/HH	$ 773	$ 774	$ 1,078	$ 1,062	$ 1,006

Projected Energy Savings

The estimated energy savings are given in terms of annual kWh by measure. The savings noted in each year are incremental, that is reflective of new measures installed by customers through the program in that year. This does *not* include the cumulative impact of measures still in operation from previous years.

Total Net Incremental Electricity Savings (kWh)

Total Net Incremental Energy Savings (kWh)					
Measure	**2015**	**2016**	**2017**	**2018**	**2019**
Total Res NC	192,566	192,552	220,291	236,366	248,191
TOTAL	**192,566**	**192,552**	**220,291**	**236,366**	**248,191**

Customer Incentives

The proposed incentives are designed to cover 50% of the incremental measure costs. Incremental cost is the additional cost of a high-efficiency measure beyond a standard-efficiency alternative. Program administrators can express this as a certain dollar incentive per package or tier level.

Administrative Requirements

The Residential New Construction program will be administered through an implementation contractor. The utility's role will be to ensure that:

- the implementation contractor performs all the activities associated with delivery of all components or the program, and
- Vectren's educational and program messages are delivered accurately and clearly to ensure the effectiveness of program delivery and maximize customer satisfaction with the program.

The program is expected to operate according to the following administrative and total utility budget:

Total Program Budget

Total Program Budget					
	2015	2016	2017	2018	2019
Program Staff Labor Cost	$10,000	$10,000	$10,000	$10,000	$10,000
Education & Marketing Cost	$4,714	$5,381	$9,686	$10,588	$10,883
Evaluation Cost	$1,571	$1,794	$3,229	$3,529	$3,628
Implementation Cost	$9,428	$10,762	$19,372	$21,175	$21,766
Incentive Costs	$31,425	$35,873	$64,573	$70,584	$72,552
Total Budget	**$57,138**	**$63,809**	**$106,859**	**$115,875**	**$118,828**

Cost-Effectiveness

The cost-effectiveness metrics of the Residential New Construction program are as follows:

Cost Effectiveness Tests						
	TRC Ratio	TRC Benefits	TRC Costs	UCT Ratio	PCT Ratio	RIM Ratio
Res NC	**1.02**	**$453,989**	**$443,548**	**1.23**	**9.82**	**0.42**

RESIDENTIAL MULTI-FAMILY DIRECT INSTALL PROGRAM

Program Description	The Residential Multi-Family Direct Install program provides targeted, highly cost-effective measures to multifamily households in a quickly deployable program delivery mechanism. This will provide energy savings to the multifamily segment, which is typically an underserved market with respect to energy efficiency programs. This is largely because of the preponderance of rental units with the so-called "split owner/renter barrier." In other words, since the landlord or owner does not pay the utility bill, there is very little incentive to purchase and install higher efficiency equipment. The program targets multifamily complexes with units that are both individually metered (residential ratepayers) and master metered (commercial ratepayers). Multi-family is defined as having more than 8 units. The program offers a set of high-impact, direct-install measures, as well as energy savings from additional, follow-on measures recommended by the home auditor and for which customers may obtain additional financial incentives. The Residential Multi-Family Direct Install program has several components: • Walk-Through Audits—These are free on-site inspections and tests used to identify energy efficiency opportunities; audit reports contain specific recommendations, including expected costs, energy savings, and resource referrals. • Direct Installation of Low-Cost Measures—During the audit visit, the auditor will install a package of low-cost energy-saving measures, at no additional charge to the customer, to immediately improve the energy performance of the household. These measures include: efficient light bulbs, low-flow water fixtures, and water heater tank insulation and pipe wrap. • Assistance with Additional Measure Installations—the program will provide cash rebates to audit participants who install follow-on measures recommended from the audit. • Workforce Training and Participation— program staff will provide for the training and utilization of qualified auditors and contractors located within the community to provide program services.
Objectives	The purpose of the Residential Multi-Family Direct Install program is to raise awareness of home energy savings opportunities among residential customers and to help them take action using incentives offered by the utilities and State programs. The program will achieve several objectives: • Improve customer understanding of how their homes use energy and how they can use it more effectively for less money, bridging the gap that often prevents efficiency actions particularly in the multifamily/renter community. • Procure immediate energy savings through installation of low-cost energy-saving measures • Encourage installation of additional energy-saving measures recommendations with additional incentives • Develop a workforce trained in assessing and improving home energy efficiency

	that can, ultimately, transform the market • Aid residential customers' perception of Vectren as their partner in reducing home energy use
Target Market	The target market for the Residential Multi-Family Direct Install program is residential customers that are living in 8+ multi-unit buildings Contractors who can provide quality audits and installation of recommended measures are also targeted for participation to deliver the program services. The program targets multifamily complexes with units that are both individually metered (residential ratepayers) and master metered (commercial ratepayers). Recruitment targets property-management companies as well as property owners to secure agreements to treat multiple properties through a single point of contact.
Implementation Strategy	<u>Overview of Activities</u> During the implementation of this program, program staff will be involved in several activity areas: • Audits and customer reports: ensuring that auditors prepare reports that are comprehensive and comply with guidelines. • Recruitment and training of audit and installation contractors; verifying that all contractors on the qualified list have appropriate testing equipment and data analysis software. • Monitoring of auditors who perform the walk-through audit and contractors who install recommended measures. This includes scheduling of home audit appointments and verification of inspections and measure installations. • Program marketing: including development and distribution of program materials in collaboration with other related marketing efforts within the portfolio and the broader marketplace. • Program education and outreach: including development of promotional campaigns to promote in coordination with other incentive programs. • Incentive processing: this includes payments to contractors for the installation of the low-cost measures during audits and to customers for installation of recommended weatherization measures. • Program activity tracking: including tracking of audit requests, audit activities, customer actions, and incentive tracking. • Reporting: development of documentation to meet reporting requirements for the Commission. <u>Education Overview</u> Education is a prominent element of the Residential Multi-Family Direct Install program. Education will be both publicly distributed and customer-specific. • The customer reports generated following the walk-through audits provide one-on-one educational opportunities. Using data from their own homes, residential customers will learn how they use energy and how they can use it more wisely. Tenants are educated about how low-cost measures and behaviors have a lasting impact on their energy and water consumption. • One of the key success factors of the program may rest upon highlighting of water savings benefits. Property managers and owners are typically responsible for water costs even if they are not liable for energy bills. Therefore, promoting water savings benefits is likely to drive program success. • The program will distribute educational materials to renters directly and through

property management companies in an effort to educate them about energy, money, and environmental benefits of using less water.

- ENERGY STAR provides a website that educates customers and contractors about what the program does, and legitimizes the program to customers; and provides cases studies that present results from customers and contractors who have participated in the program.
- The workforce training provides an opportunity to educate equipment and construction contractors about the benefits of energy efficiency and about the program.

Walk-Through Audits

- Trained auditors perform the inspection and, along with review of billing history, assess the energy performance of the house (where energy is used, where inefficiencies are); provide customers with itemized lists of energy efficiency improvements, their anticipated costs and savings, along with information on financial resources available to help defray first-costs.
- The assessments cover the entire home, including insulation, windows, heating and cooling systems, lighting and major appliances.

Direct Installation of Measures

- The auditor will install a package of low-cost measures, simple installations known to improve the energy efficiency of homes, during the walk-through audit.
- These measures will be installed at no additional charge to the audit participants.
- These installations will provide immediate benefit to participants and savings attributable to the program.

Assistance with Additional Measure Installations

Providing customers with help in implementing the audit recommendations is key to the success of the program. These services will be delivered beginning in 2015 through follow up touches by the network of qualified contractors and trade allies. This includes offering resources that include both financial incentives and installation assistance. Since the program was started in 2011, recruiting from the pool of previous participants and steering them toward follow-on measures and opportunities in the broader portfolio can also increase the program's success.

- Cash-back incentives to install weatherization measures, programmable thermostats, and common area lighting upgrades recommended during the audit.
- Access to incentives available from other Vectren programs to reduce the cost of installing remaining recommendations.
- Vectren will contract with an implementation contractor who will manage and oversee that contractors are qualified/certified to install other measures recommended in the walk-through audit.

If landlords and property owners wish to install other measures that may be beyond the scope of this program, such as HVAC systems, exterior lighting, efficient pool pumps, etc; the program implementers will be able to connect them with the appropriate rebate opportunities in the Residential Efficient Products or Business Custom programs.

Workforce Training and Participation

Vectren will make use of auditors qualified to perform the walk-through audits and contractors knowledgeable about energy-efficient products and other measures likely to

	be recommended in the audit report. This can be achieved through development of relationships with electrical and general contracting trade allies, and as well as community groups. The implementers will: • Provide training to ensure the walk-through auditors demonstrate an understanding of building science principles and understanding of the other EE programs in the portfolio. • Ensure that the walk-through auditors are familiar with all the incentives programs available to customers as well as provide education to customers to enhance their understanding of the whole home approach.
Issues, Risks, and Risk Management Strategies	All of the implementation activities—the educational component, together with outreach and marketing of the program, will address the following barriers to achieve the educational and energy savings goals of the program: • Contractor Participation—A limited supply of qualified contractors with the skills to diagnose and market whole-house energy efficiency improvements can limit program potential. A solution is the development of a local network of qualified professionals to provide audit and installation services and to promote the program to residential energy customers. The implementers will: o Offer technical training to participating home improvement trade contractors, including classroom and field sessions and cover building science principles, diagnostic testing and installation best practices. Consider including certification to ensure the training is effective and valuable as a selling point for the contractors. o Offer sales and business process training to help contractors succeed in selling and delivering home performance services, including procedures for quality assurance, employee training, and understanding program incentives or financing. • Marketing and Consumer Education—Consumers may not be familiar with energy efficiency and the benefits it can provide for improving comfort, as well as saving money. Marketing activities can educate them about the benefits. o Vectren will communicate known partner offers and make customers aware through bill inserts, web site or some targeted direct mail. These tactics can help educate homeowners about the benefits of the whole-house approach to energy improvements and how they can take advantage of the program. o The program implementation contractor will work to develop and enlist the help of participating contractors to promote and educate customers about the program. • Quality Assurance—Consumers should be assured that the program offers reliable, high quality services. o The program should have a quality assurance plan to aid delivery of the program services, provide protocols for contractor reporting, and support program evaluation. o Participating auditors and contractors have sufficient training to perform program audits and installations and sets standards for the number of work inspections completed by participation contractors.
Marketing and Outreach	Marketing and outreach in the Residential Multi-Family Direct Install program will employ the following strategies: • Vectren will develop awareness through direct marketing—e.g., bill inserts, newsletters, website, broadcast and print media, direct mail, advertising in

	Apartment Guides, and cold calling of apartment management companies. • The program will be marketed via apartment associations and face-to-face meetings with property-management firms and owners. As needed, apartment associations will be identified and targeted for presentations. • It is particularly important to deliver marketing messages to landlords and owners stressing the increased tenant retention and satisfaction that comes with program participation and lower utility bills. • Walk-Through auditors—part of auditors' services can and should include making customers aware of this program and the incentives available for installation of high-efficiency measures. • Coordination of marketing efforts with other related Vectren programs.
Evaluation, Measurement and Verification Requirements	The evaluation methodology and data collection proposed for the Residential Multi-Family Direct Install program are guidelines that reflect current measurement and verification (M&V) practices. The ultimate M&V requirements for this program will conform with the State protocols. <u>Metrics for Gauging Program Success</u> Primary: • Number of participating multifamily units • Improvement in customer understanding of the whole-house approach to improving energy efficiency • Number of walk-through audits completed • Number of audits that result in documented energy efficiency improvements • Number of participating audit and energy efficiency improvement contractors • Customer satisfaction with the program and the products • Participation in other Vectren programs Secondary: • Energy usage reduction in homes that have had home performance audits • Program implementation costs incurred <u>Data Collection Approaches</u> Vectren will collect and submit data that meet the reporting requirements. The participating contractors who conduct the audits and/or perform the energy improvements will provide much of the data. The contractors should provide at least the following: • Name, address, and contact information (including email address if possible) of owner and renter • Home assessment summary report • Recommended improvements • Estimated cost of improvement • Estimated energy savings • Summary of completed improvements Data will also be collected through surveys of Vectren residential customers and participating contractors to aid the process and impact evaluation, assess participant satisfaction, and identify opportunities for program improvement. The surveys may be conducted by the implementation and M&V contractors. Customer billing data prior to and following program participation will be required to

assess energy use and improvement opportunities, and assess and/or verify savings for the payment of customer incentives.

The program will have a tracking system to house the program activity information and enable regulatory reporting.

Impact Evaluation Methodology

The first step is to establish a pre-participation energy use "baseline" based on customer bills, followed by post-participation tracking of energy use through bills. This, together with information on exact measures installed during the audit and additional weatherization measures installed as provided by the installation contractors, would allow assessment of customer energy savings.

The M&V contractor will determine the appropriate means of estimating savings attributable to the program; that is, net savings, including both free-ridership and spillover. Spillover may be particularly relevant to this program. Because the major thrust of the program is to encourage customers to think about the home as an entire system and consider how the structure, and all their energy-using equipment, affects the energy performance of the home, it would not be surprising to find that customers continue to make additional energy-related improvements on their own (i.e., without incentives) after participation in the program.

Process Evaluation Methodology

The Residential Multi-Family Direct Install program is a relatively complex program, involving home visits, direct installation of measures, delivery of an audit report with additional recommendations, and even subsequent installations with either the implementation contractor or other contractors. Process evaluations throughout the program will be critical to ensure that the program is operating as intended and to provide information that can enable improvements in both the program design and delivery of services.

Process evaluations will assess customer understanding, attitude about, and satisfaction with the program and with Vectren's other educational activities and materials. They will obtain feedback from the contractors who perform installations and audits. The evaluations will make use of survey data collected by the implementation and M&V contractors. Process evaluation will be conducted throughout the program by the implementation and M&V contractors selected by Vectren.

Program Schedule

The Residential Multi-Family Direct Install program is currently a part of the Vectren portfolio, and will continue to operate during PY 2015 and 2016. Due to the expectation of market saturation, i.e. – exhausting the available supply of participants, the program is scheduled to sunset in 2017. The following table provides a schedule of key milestones:

Key Milestones	Timing
Assign internal program manager and staff	Anticipated in late 2013 or early 2014.
Select and contract with program implementation contractor(s)	2014, Q2 or immediately upon program approval
Finalize program design	2014, Q2
Pre-rollout program development: Auditor/contractor training and recruitment	2014, Q3 and Q4
Program rollout: Re-launch consumer marketing and outreach	2015, Q1

Perform audits and improvements	
Prepare reports: Documentation of program activities and progress toward goals Reports to Commission	Monthly throughout program implementation period Quarterly, and annually
Conduct assessment of market saturation. If untapped customers are in short supply, conclude program operation for this planning cycle.	2016, Q4

Estimated Participation

Participation and measure adoption estimates were developed based on the number of residential customers in the service territory and an assessment of the attainable market potential in the area, as well as past program performance and the experience of other organizations that have offered this type of program.

Total Estimated Participation (# of Units, Bulbs, or Fixtures)

Measure	Option	No. of Gross Installations*	NTG Ratio	No. of Net Installations*
Water Heater <= 55 gal	EF 0.95	105	1.00	105
Screw-in	CFL	7,000	1.00	7,000
Specialty	CFL	1,400	1.00	1,400
Water Heater - Tank Insulation		263	1.00	263
Water Heater - Pipe Wrap		263	1.00	263
Insulation - Infiltration Control		263	1.00	263
Thermostat - Clock/Programmable		263	1.00	263
Water Heater - Faucet Aerators		2,100	1.00	2,100
Water Heater - Low-Flow Showerheads		2,100	1.00	2,100
Dehumidifier		105	1.00	105

Total Estimated Participation (# of Households)

Number of Households Participating					
	2015	2016	2017	2018	2019
Gross HH's	800	600	0	0	0
Net HH's	800	600	0	0	0

Projected Energy Savings

The estimated energy savings are given in terms of annual kWh by measure. The savings noted in each year are incremental, that is reflective of new measures installed by customers through the program in that year. This does *not* include the cumulative impact of measures still in operation from previous years.

Total Net Incremental Electricity Savings (kWh)

Total Net Incremental Energy Savings (kWh)						
Measure	**Option**	**2015**	**2016**	**2017**	**2018**	**2019**
Water Heater <= 55 gal	EF 0.95	5,882	4,401	-	-	-
Screw-in	CFL	209,974	151,105	-	-	-
Specialty	CFL	44,885	33,629	-	-	-
Water Heater - Tank Insulation		11,850	8,888	-	-	-
Water Heater - Pipe Wrap		7,650	5,738	-	-	-
Insulation - Infiltration Control		26,546	19,785	-	-	-
Thermostat - Clock/Programmable		6,234	4,642	-	-	-
Water Heater - Faucet Aerators		52,826	39,153	-	-	-
Water Heater - Low-Flow Showerheads		241,028	178,644	-	-	-
Dehumidifier		2,750	2,040	-	-	-
TOTAL		**609,625**	**448,023**	-	-	-

Customer Incentives

Under this program, incentives are provided in several forms and to both customers and contractors who provide the audit and direct installation services. Incentives go to customers in the form of direct installation of measures during the audit visit and in the form of rebates for installation of recommended measures.

Audit contractors are also eligible to receive incentives under this program. Vectren will pay for the cost of materials for the measures that auditors install during the audits. This means that the auditor receives payment from the customer for the cost of the audit and from Vectren for the cost of materials in the package of measures installed during the audit. Customers are also free to contract with the same contractor to install additional measures, for additional cost, if the contractor offers this service.

Administrative Requirements

Vectren will administer the Residential Multi-Family Direct Install program through an implementation contractor. Vectren's role will be to ensure that:

- the implementation contractor performs all the activities associated with delivery of all components or the program, and
- educational and program messages are delivered accurately and clearly to ensure the effectiveness of program delivery and maximize customer satisfaction with the program.

The program is expected to operate according to the following administrative and total utility budget:

Total Program Budget

Total Program Budget					
	2015	2016	2017	2018	2019
Program Staff Labor Cost	$25,000	$25,000	$ -	$ -	$ -
Education & Marketing Cost	$10,333	$7,750	$ -	$ -	$ -
Evaluation Cost	$6,889	$5,166	$ -	$ -	$ -
Implementation Cost	$34,443	$25,832	$ -	$ -	$ -
Incentive Costs	$68,885	$51,664	$ -	$ -	$ -
Total Budget	**$145,549**	**$115,412**	**$ -**	**$ -**	**$ -**

Cost-Effectiveness

The cost-effectiveness metrics of the Residential Multi-Family Direct Install program are as follows:

Cost Effectiveness Tests						
	TRC Ratio	TRC Benefits	TRC Costs	UCT Ratio	PCT Ratio	RIM Ratio
Res MF Direct Install	**1.47**	**$383,335**	**$260,561**	**1.69**	**20.72**	**0.41**

RESIDENTIAL HOME ENERGY ASSESSMENT PROGRAM

Program Description	The Residential Home Energy Assessment program is a Core program that provides education, an on-site audit, and direct install measures to help single family customers reduce their energy bills. The program is designed to go beyond providing financial incentives to residential customers and aims to make them well-educated energy consumers. The services the program will provide, including in-home audits and referrals to contractors and financial resources, aim to help them gain a better understanding of their home energy use and achieve savings while also improving the comfort of their homes. The program offers a set of high-impact, direct-install measures, as well as energy savings from additional, follow-on measures recommended by the home auditor and for which customers may obtain additional financial incentives. The Residential Home Energy Assessment program has several components: • Walk-Through Audits—These are on-site inspections used to identify energy efficiency opportunities; audit reports contain specific recommendations, including expected costs, energy savings, and resource referrals. • Direct Installation of Low-Cost Measures—During the audit visit, the auditor will install a package of low-cost energy-saving measures, at no additional charge to the customer, to immediately improve the energy performance of the household. These measures include: efficient light bulbs, low-flow water fixtures, and water heater tank insulation and pipe wrap. • Referral to Other Programs for Additional Measure Installations—Vectren will provide information to customers on how to access rebates offered under other programs for measures recommended in the audit. • Workforce Training and Participation—The program will provide for the training and utilization of qualified auditors and contractors located within the community to provide program services.
Objectives	The purpose of the Residential Home Energy Assessment program is to help residential customers view the energy performance of their homes as more than the sum of independent decisions about individual components. It reflects the view that reducing residential energy use is more than a series of actions; it is an attitude and plan borne of knowledge. This is a “big picture” approach. The services are designed to bring customers to a more holistic view of home energy performance. The program is part of a long-term strategy to raise awareness of home energy savings opportunities among residential customers and to help them take action using incentives offered by the utilities and State programs. The program will achieve several objectives: • Improve customer understanding of how their homes use energy and how they can use it more effectively for less money • Procure immediate energy savings through installation of low-cost energy-saving measures • Encourage installation of additional energy-saving measures available through other programs

	• Develop a workforce trained in assessing and improving home energy efficiency that can, ultimately, transform the market • Aid residential customers' perception of Vectren as their partner in reducing home energy use
Target Market	The target market for the Residential Home Energy Assessment program is residential customers. While the primary market is single-family homeowners, multi-family homes up to 8 units are eligible to participate. Contractors who can provide quality audits and installation of recommended measures are also targeted for participation to deliver the program services.
Implementation Strategy	The implementation strategy will incorporate the following components: <u>Walk-Through Audits</u> • Trained auditors provide households with a walk-through examination of their home using standard audit software for identifying existing conditions related to electric energy usage. The auditor will identify specific energy saving opportunities that could be installed by the contractor upon approval of a job scope by the customer. The auditor will review the billing history of the customer, anticipated costs and savings of the measures, along with information on financial resources available to help defray first-costs. • The assessments cover the entire home, including insulation, windows, heating and cooling systems, lighting and major appliances. <u>Direct Installation of Measures</u> • The auditor will install a package of low-cost measures, simple installations known to improve the energy efficiency of homes, during the walk-through audit. • These measures will be installed at no additional charge to the audit participants. • These installations will provide immediate benefit to participants and savings attributable to the program. • At the conclusion of the site visit, customers will be provided with a check list of preliminary recommendations from the audit, to be followed within one week by a full report generated by the audit software. The program will take credit for only the installed measures at the time of the audit. <u>Workforce Training and Participation</u> Vectren will make use of auditors qualified to perform the walk-through audits and contractors knowledgeable about measures likely to be recommended in the audit report. This can be achieved through development of relationships with electrical and general contracting trade allies, as well as community groups. Under the program, The implementers will: • Provide training to ensure the walk-through auditors demonstrate an understanding of building science principles and understanding of the Vectren programs. • Ensure that the walk-through auditors are familiar with all the incentives programs available to customers as well as provide education to customers. <u>Overview of Implementation Activities</u> During implementation, program staff will be involved in several activity areas: • Audits and customer reports: ensuring that auditors prepare reports that are

	comprehensive and comply with guidelines. • Recruitment and training of audit and installation contractors; verifying that all contractors on the qualified list have appropriate testing equipment and data analysis software. • Monitoring of auditors who perform the walk-through audit and contractors who install recommended measures. This includes scheduling of home audit appointments and verification of inspections and measure installations. • Program marketing: including development and distribution of program materials in collaboration with Vectren, and promotional campaigns in collaboration with upstream participants. • Program education and outreach: including development of promotional campaigns to promote in coordination with other incentive programs. • Incentive processing: payments to contractors for the installation of the low-cost measures during audits . • Program activity tracking: including tracking of audit requests, audit activities, customer actions, and incentive tracking. • Reporting: development of documentation to meet reporting requirements for the Commission. <u>Education Overview</u> Education is most of what the Residential Home Energy Assessment program is about. Education will be both publicly distributed and customer-specific. • The customer reports generated following the walk-through audits provide one-on-one educational opportunities. Using data from their own homes, residential customers will learn how they use energy and how they can use it more wisely. • ENERGY STAR provides a website that educates customers and contractors about what the program does, and legitimizes the program to customers; and provides cases studies that present results from customers and contractors who have participated in the program. • The workforce training provides an opportunity to educate equipment and construction contractors about the benefits of energy efficiency and about the program.
Issues, Risks, and Risk Management Strategies	All of the implementation activities—the educational component, together with outreach and marketing of the program, will address the following barriers to achieve the educational and energy savings goals of the program: • Contractor Participation—A limited supply of qualified contractors with the skills to diagnose and market whole-house energy efficiency improvements can limit program potential. A solution is the development of a local network of qualified professionals to provide audit and installation services and to promote the program to residential energy customers. The implementers will: o Offer technical training to participating home improvement trade contractors, including classroom and field sessions and cover building science principles, diagnostic testing and installation best practices. Consider including certification to ensure the training is effective and valuable as a selling point for the contractors. o Offer sales and business process training to help contractors succeed in selling and delivering home performance services, including

	procedures for quality assurance, employee training, and understanding program incentives or financing. • Marketing and Consumer Education—Consumers may not be familiar with the whole-house approach and the benefits it can provide for improving comfort, as well as saving energy. Marketing activities can educate them about the benefits. o Vectren will communicate known partner offers and make customers aware through bill inserts, web site or some targeted direct mail. These tactics can help educate homeowners about the benefits of the whole-house approach to energy improvements and how they can take advantage of the program. o The program implementation contractor will work to develop and enlist the help of participating contractors to promote and educate customers about the program. • Quality Assurance—Consumers should be assured that the program offers reliable, high quality services. o The program should have a quality assurance plan to aid delivery of the program services, provide protocols for contractor reporting, and support program evaluation. o Participating auditors and contractors have sufficient training to perform program audits and installations and sets standards for the number of work inspections completed by participation contractors. • Challenges with Customer Engagement – If participants begin to demonstrate that they are not engaging with follow-on measures or further audit recommendations, or that they are not fully invested in the program, the implementer may consider adding a nominal audit fee of $50, simply to discourage participation by households that have no intention of fully utilizing the program. The audit fee may be credited back to the customer if they proceed with further installation of the measures.
Marketing and Outreach	Marketing and outreach in the Residential Home Energy Assessment program will employ the following strategies: • Vectren will develop awareness through direct marketing—e.g., bill inserts, newsletters, website, broadcast and print media, and direct mail. The program information may need to be mailed frequently to customers. • Walk-Through auditors—part of auditors' services can and should include making customers aware of this program and the incentives available for installation of high-efficiency measures. • Coordination of marketing efforts with the Residential Efficient Products, Whole House Plus and other Vectren programs.
Evaluation, Measurement and Verification Requirements	The evaluation methodology and data collection proposed for the Residential Home Energy Assessment program are guidelines that reflect current measurement and verification (M&V) practices. The ultimate M&V requirements for this program will conform with the State protocols. <u>Metrics for Gauging Program Success</u> Primary: • Improvement in customer understanding of the whole-house approach to improving energy efficiency • Number of walk-through audits completed

- Number of direct installation packages delivered
- Number of audits that result in documented energy efficiency improvements in other Vectren programs
- Number of participating audit and energy efficiency improvement contractors
- Periodic summary of 'before' and 'after' audit data from the implementation contractor
- Projected energy savings from the audit
- Number of customer audit fees received and reimbursed
- Customer satisfaction with the program and the products
- Participation in other Vectren programs

Secondary:

- Information related to which of the recommended measures were installed
- Energy usage reduction in homes that have had home performance audits
- Program implementation costs incurred

<u>Data Collection Approaches</u>

Vectren will collect and submit data that meet the reporting requirements. The participating contractors who conduct the audits and/or perform the energy improvements will provide much of the data. The contractors should provide at least the following:

- Name, address, and contact information (including email address if possible) of homeowner
- Home assessment summary report
- Recommended improvements
- Estimated cost of improvement
- Estimated energy savings
- Summary of completed improvements and test-out results

Data will also be collected through surveys of Vectren residential customers and participating contractors to aid the process and impact evaluation, assess participant satisfaction, and identify opportunities for program improvement. The surveys may be conducted by the implementation and M&V contractors.

The program will have a tracking system to house the program activity information and enable regulatory reporting.

<u>Impact Evaluation Methodology</u>

The energy savings and demand reduction resulting from measures installed by the program implementation contractor can be evaluated through records of installations performed and follow-up surveys with recipient households to assess retention of the installations. Deemed per-unit savings can be applied to the retained installations to obtain final savings estimates.

The M&V contractor will determine the appropriate means of estimating savings attributable to the program; that is, net savings, including both free-ridership and spillover. Spillover may be particularly relevant to this program. Because the major thrust of the program is to encourage customers to think about the home as an entire system and consider how the structure, from roof to basement and all their energy-using equipment, affects the energy performance of the home, it would not be surprising to

find that customers continue to make additional energy-related improvements on their own (i.e., without incentives) after participation in the program.

Process Evaluation Methodology

The Residential Home Energy Assessment program is a relatively complex program, involving home visits, direct installation of measures, and delivery of an audit report with additional recommendations. Process evaluations throughout the program will be critical to ensure that the program is operating as intended and to provide information that can enable improvements in both the program design and delivery of services.

Process evaluations will assess customer understanding, attitude about, and satisfaction with the program and with Vectren's other educational activities and materials. They will obtain feedback from the contractors who perform installations and audits. The evaluations will make use of survey data collected by the implementation and M&V contractors. Process evaluation will be conducted throughout the program by the implementation and M&V contractors selected by Vectren.

Program Schedule

This program is a Core program and is already part of the current Vectren portfolio and will continue to operate through PY 2019. The following table provides a schedule of key milestones:

Key Milestones	Timing
Assign internal program manager and staff	Anticipated in late 2013 or early 2014.
Select and contract with program implementation contractor(s)	2014, Q2 or immediately upon program approval
Finalize program design	2014, Q2
Pre-rollout program development: Auditor/contractor training and recruitment	2014, Q3 and Q4
Program rollout: Re-launch consumer marketing and outreach Perform audits and improvements	2015, Q1
Prepare reports: Documentation of program activities and progress toward goals Reports to Commission	Monthly throughout program implementation period Quarterly, and annually
Conclude program operation for this planning cycle	2019

Estimated Participation

Participation and measure adoption estimates were developed based on the number of residential customers in the service territory and an assessment of the attainable market potential in the area, as well as past program performance and the experience of other organizations that have offered this type of program.

Total Estimated Participation (# of Units, Bulbs, or Fixtures)

Measure	Option	No. of Gross Installations*	NTG Ratio	No. of Net Installations*
Screw-in	CFL	132,200	1.00	132,200
Specialty	CFL	46,000	1.00	46,000
Screw-in	LED	28,800	1.00	28,800
Water Heater - Tank Insulation		2,875	1.00	2,875
Water Heater - Pipe Wrap		2,875	1.00	2,875
Water Heater - Faucet Aerators		23,000	1.00	23,000
Water Heater - Low-Flow Showerheads		11,500	1.00	11,500

Total Estimated Participation (# of Households)

Number of Households Participating					
	2015	2016	2017	2018	2019
Gross HH's	4200	4400	4600	4800	5000
Net HH's	4200	4400	4600	4800	5000

Projected Energy Savings

The estimated energy savings are given in terms of annual kWh by measure. The savings noted in each year are incremental, that is reflective of new measures installed by customers through the program in that year. This does *not* include the cumulative impact of measures still in operation from previous years.

Total Net Incremental Electricity Savings (kWh)

Total Net Incremental Energy Savings (kWh)						
Measure	Option	2015	2016	2017	2018	2019
Screw-in	CFL	1,228,004	1,216,060	870,651	898,576	936,016
Specialty	CFL	293,794	307,794	322,436	337,024	351,758
Screw-in	LED	-	-	448,893	469,067	489,618
Water Heater - Tank Insulation		41,475	43,450	45,425	47,400	49,375
Water Heater - Pipe Wrap		26,775	28,050	29,325	30,600	31,875
Water Heater - Faucet Aerators		663,600	695,200	726,800	758,400	790,000
Water Heater - Low-Flow Showerheads		592,200	620,400	648,600	676,800	705,000
TOTAL		**2,845,848**	**2,910,954**	**3,092,130**	**3,217,866**	**3,353,643**

Customer Incentives

Under this program, incentives are provided in several forms and to both customers and contractors who provide the audit and direct installation services. Incentives go to customers in the form of direct installation of measures during the audit visit.

Audit contractors are also eligible to receive incentives under this program. Vectren will pay for the cost of materials for the measures that auditors install during the audits. This means that the auditor receives payment from the customer for the cost of the audit and from Vectren for the cost of materials in the package of measures installed during the audit. Customers are also free to contract with the same contractor to install additional measures, for additional cost, if the contractor offers this service.

Administrative Requirements

Vectren will administer the Residential Home Energy Assessment program through an implementation contractor. Vectren's role will be to ensure that

- the implementation contractor performs all the activities associated with delivery of all components or the program, and
- educational and program messages are delivered accurately and clearly to ensure the effectiveness of program delivery and maximize customer satisfaction with the program.

The program is expected to operate according to the following administrative and total utility budget:

Total Program Budget

Total Program Budget					
	2015	2016	2017	2018	2019
Program Staff Labor Cost	$50,000	$50,000	$50,000	$50,000	$50,000
Education & Marketing Cost	$26,788	$28,064	$56,588	$57,336	$56,158
Evaluation Cost	$17,859	$18,709	$37,726	$38,224	$37,439
Implementation Cost	$160,730	$168,384	$339,531	$344,019	$336,948
Incentive Costs	$178,589	$187,093	$377,256	$382,243	$374,387
Total Budget	**$433,966**	**$452,250**	**$861,101**	**$871,822**	**$854,931**

Cost-Effectiveness

The cost-effectiveness metrics of the Residential Home Energy Assessment program are as follows:

Cost Effectiveness Tests						
	TRC Ratio	TRC Benefits	TRC Costs	UCT Ratio	PCT Ratio	RIM Ratio
Res HEA	**1.90**	**$5,286,017**	**$2,783,242**	**1.90**	**-**	**0.42**

RESIDENTIAL SCHOOL KIT

Program Description	The Residential School Kit program is a Core program that incorporates an educational module provided to 5th graders, along with a take-home kit of energy efficiency measures. Measures include CFLs, low-flow water fixtures, an air filter alarm, and an LED nightlight. It targets students to help them learn about energy efficiency and how they can apply it at school and at home. Participating schools will receive education in the classroom and take-home kits filled with energy efficiency saving devices. The program is designed to educate both the students and their parents about simple energy efficiency and conservation practices, driving grassroots market transformation throughout the service territory.
Objectives	The program has several objectives: • Increase consumers' awareness of the breadth of energy efficiency opportunities in their homes. • Lay the foundation for future energy stewardship by educating young students. • Make significant contribution to portfolio energy savings goals. • Strengthen customer trust in Vectren as their partner in saving energy.
Target Market	The target market for the Residential School Kit program is students in the Fifth Grade, and therefore all residential households in Vectren's service territory with Fifth Graders.
Implementation Strategy	Overview of Activities An educational module is provided to 5th graders, along with a take-home kit of energy efficiency measures. These measures will include: • CFL light bulbs • Low-flow showerheads and faucet aerators • A thermometer to measure water and refrigerator temperature, to help customers set their thermostats in line with recommended best practices. 3,000 kits are planned for delivery in each year. The educational module will consist of an interactive presentation with visual aids, demonstrations of how to use and install the measures, background material on energy and conservation, and dialogue with the students. Education Overview Children will be provided with energy education materials to enhance their understanding of energy-saving behaviors and measures in hopes that they will carry that information forward themselves into their adulthood, as well as pass on the information directly and immediately to their parents, who are the primary energy decision-makers. Efforts will also be made to increase awareness of other EE programs in the portfolio, as well as other State and local resources available to assist them.
Issues, Risks, and Risk Management Strategies	The primary risk in the program is that of the measures in the kit are not installed at home correctly or at all.

Marketing and Outreach	The Residential Schools Kit program will be marketed to schools and teachers of 5th grade students. This will entail a simple compilation of eligible schools within the service territory and the accompanying outreach and scheduling activities. The Schools program in the business portfolio is a natural partner for this program's delivery. That program provides financial and technical assistance to achieve significant electricity savings in public schools. The program offers the same financial incentives to reduce energy use as in other nonresidential facilities, along with providing assistance in identifying key improvement opportunities and addressing the special planning and purchasing protocols of public schools.
Evaluation, Measurement and Verification Requirements	The evaluation methodology and data collection proposed for the Residential School Kit program are guidelines that reflect current measurement and verification (M&V) practices. The ultimate M&V requirements for this program will conform with the state protocols. <u>Metrics for Gauging Program Success</u> Primary: • Number of kits distributed • Number of measures installed • Energy savings associated with installed measures • Customer satisfaction with the program and the products • Program implementation costs incurred Secondary: • Increase in the knowledge of the benefits of energy efficiency. • Participation in other Vectren programs by the homeowner. <u>Data Collection Approaches</u> • Impact Evaluation o Tracking system data for all projects o On-site inspection of a sample of projects to verify installation as reported o Customer surveys to verify installation of measures in the kit and identify post-participation purchases outside the program (free-rider and free-driver impacts) • Process Evaluation—Evaluation of program design and implementation will be conducted by gathering and analyzing data through a variety of surveys and interviews, including: o Surveys of target market customers (participants and nonparticipants) o Surveys of teachers o Interviews with program staff and implementation contractor o Review of program documents and tracking system data <u>Impact Evaluation Methodology</u> The program will record energy savings and peak load reductions from the rebate applications processed, using the per-unit deemed savings values. Because measures are established technologies and data are available demonstrating the reliability of savings, it will not be necessary to conduct customer-level billing analyses or metering studies. However, some projects will be inspected for independent verification of installation and operation as reported.

Post-Surveys with participating customers will be used to estimate the net-to-gross ratio accounting for free-riders and free-drivers. Customers will be asked to provide information regarding whether they would have purchased the rebated items without the promotion, whether they installed the items, and whether they subsequently purchased additional rebate-eligible items at full cost. This outline of the self-report methodology for the assessment of net impacts describes only the basic approach. The selected M&V contractor will develop the complete plan that ensures the appropriate measurement of savings in compliance with industry and state protocols.

Process Evaluation Methodology

Program process evaluation is important to ensure that the program is operating as intended and to provide information that can enable improvements in both the program design and implementation. Process evaluation will be undertaken and conducted throughout the program.

Process evaluation will assess customer understanding, attitudes about, and satisfaction with the program and with Vectren's other educational activities. The evaluations will make use of survey data collected by program and M&V staff..

Interviews with Vectren program staff and/or implementation contractors will be conducted to assess satisfaction with the program and to identify problems and possible program services/implementation improvements.

The M&V contractor will also help Vectren assess the performance of the program design and delivery of the products and services featured in the program, including effectiveness of the marketing and educational materials, effectiveness of advertising and promotional campaigns and messages, and whether implementation milestones are met adequately and on schedule.

Program Schedule

This program is a Core program and is already part of the current Vectren portfolio and will continue to operate through PY 2019. The following table provides a schedule of key milestones:

Key Milestones	Timing
Assign internal program manager and staff	Anticipated in late 2013 or early 2014.
Select and contract with program implementation contractor(s)	2014, Q2 or immediately upon program approval
Finalize program design	2014, Q2
Pre-rollout program development: Prepare list of school contacts, marketing materials, and kit supply	2014, Q3 and Q4
Program rollout: Re-launch education modules and kit distribution	2015, Q1
Prepare reports: Documentation of program activities and progress toward goals Reports to Commission	Monthly throughout program implementation period Quarterly, and annually
Conclude program operation for this planning cycle	2019

Estimated Participation

Participation and measure adoption estimates were developed based on the number of residential customers in the service territory and an assessment of the attainable market potential in the area, as well as past program performance and the experience of other organizations that have offered this type of program.

Total Estimated Participation (# of Units, Bulbs, or Fixtures)

Measure	Option	No. of Gross Installations*	NTG Ratio	No. of Net Installations*
Air Filter Alarm		15,000	0.70	10,500
Screw-in	LED Nightlight	15,000	0.70	10,500
Screw-in	CFL	30,000	0.70	21,000
Water Heater - Faucet Aerators		15,000	0.70	10,500
Water Heater - Low-Flow Showerheads		7,500	0.70	5,250

Total Estimated Participation (# of Kits or Households)

Number of Kits					
	2015	2016	2017	2018	2019
Gross Kits (Distributed)	3000	3000	3000	3000	3000
Net Kits (Correctly Installed)	2100	2100	2100	2100	2100

Projected Energy Savings

The estimated energy savings are given in terms of annual kWh by measure. The savings noted in each year are incremental, that is reflective of new measures installed by customers through the program in that year. This does *not* include the cumulative impact of measures still in operation from previous years.

Total Net Incremental Electricity Savings (kWh)

Total Net Incremental Energy Savings (kWh)						
Measure	Option	2015	2016	2017	2018	2019
Air Filter Alarm		86,100	86,100	86,100	86,100	86,100
Screw-in	LED Nightlight	65,100	65,100	65,100	65,100	65,100
Screw-in	CFL	171,231	160,310	158,988	157,251	157,251
Water Heater - Faucet Aerators		103,828	102,748	101,772	100,676	99,629
Water Heater - Low-Flow Showerheads		315,178	311,900	308,936	305,609	302,432
TOTAL		**741,437**	**726,158**	**720,896**	**714,735**	**710,512**

Customer Incentives

The customer incentive for this program will be the take-home kit of efficiency measures that the children receive after their educational module. The program will cover the entire cost of the kits.

Administrative Requirements

The program administration role will be to ensure that:

- the implementation contractor performs all the activities associated with delivery of all components or the program, and
- Vectren's educational and program messages are delivered accurately and clearly to ensure the effectiveness of program delivery and maximize customer satisfaction with the program.

The program is expected to operate according to the following administrative and total utility budget:

Total Program Budget

Total Program Budget					
	2015	2016	2017	2018	2019
Program Staff Labor Cost	$25,000	$25,000	$25,000	$25,000	$25,000
Education & Marketing Cost	$67,200	$67,200	$67,200	$67,200	$67,200
Evaluation Cost	$8,400	$8,400	$8,400	$8,400	$8,400
Implementation Cost	$67,200	$67,200	$67,200	$67,200	$67,200
Incentive Costs	$84,000	$84,000	$84,000	$84,000	$84,000
Total Budget	**$251,800**	**$251,800**	**$251,800**	**$251,800**	**$251,800**

Cost-Effectiveness

The cost-effectiveness metrics of the Residential Schools program are as follows:

Cost Effectiveness Tests						
	TRC Ratio	TRC Benefits	TRC Costs	UCT Ratio	PCT Ratio	RIM Ratio
Res School Kit	**1.14**	**$1,165,755**	**$1,024,230**	**1.14**	**-**	**0.38**

RESIDENTIAL WHOLE HOUSE PLUS PROGRAM

Program Description	The Residential Whole House Plus program is designed to provide energy savings through household products and services that are typically associated with onsite installation or implementation by contractors and vendors. This includes such energy efficiency measures as weatherization, increased insulation, or installing efficient heating, ventilation, and air conditioning equipment. The program offers cash rebates to residential customers who install these measures, while simultaneously engaging equipment suppliers, contractors, and trade allies to promote the rebate-eligible equipment.
Objectives	The purpose of the Residential Whole House Plus program is to increase the penetration of high-efficiency measures in the homes of residential customers. The program enables the adoption of these energy efficiency measures by offering cash rebates for the purchase and installation of qualifying measures affecting cooling and heating. Other core objectives are: • Provide a robust set of follow-on or expansion options for participants in other Vectren programs that wish to "dig deeper" into energy efficiency savings. • Increase consumers' awareness of the breadth of energy efficiency opportunities in their homes. • Make significant contribution to portfolio energy savings goals. • Strengthen customer trust in Vectren as their partner in saving energy. The Residential Whole House Plus program is well-suited for accomplishing these objectives because the rebate-eligible measures are proven technologies about which customers can readily find supporting information; customers are familiar with cash-back rebates from other types of purchases they make, and the list of included measures affords Vectren the opportunity to strengthen relationships with upstream suppliers and influence stocking decisions.
Target Market	The target market for the Residential Whole House Plus program is all residential customers in Vectren' service territory and, in particular, those customers who have participated in other Vectren programs such as the Home Energy Assessment program. This would include customers with existing equipment that needs replacing or those who can be persuaded to replace early. The target market also includes customers in existing single-family homes or multifamily dwellings, both owners and renters.
Implementation Strategy	<u>Overview of Activities</u> During the implementation of this program, the implementers will be involved in several activity areas: • Development of upstream supplier network to stock and promote program • Program marketing and education: including development and distribution of program materials in collaboration upstream allies; and promotional campaigns in coordination with other Vectren programs • Rebate processing: including receive, review and verify applications; and pay

	rebates • Program performance tracking and improvement: including tracking availability of qualifying products, rebate submittals and payments, opportunities to improve the program • Reporting: including reporting of program activities to meet regulatory and internal requirements, in particular progress toward program goals. The program is designed so that customers can easily submit rebate applications on their own. However, equipment suppliers and contractors can be very instrumental in achieving program success. Using the rebates and ENERGY STAR quality assurance as selling points, these allies can increase sales of qualifying equipment. They can further assist by aiding in the submittal of the rebate application. <u>Education Overview</u> Under the program, Vectren will educate local contractors about program procedures and benefits. To further promote good communication, the utilities may conduct seminars to familiarize participating contractors with the structure and procedures of the program. Handouts will likely include specific information about rebate schedules and lists of qualifying measures. Consumer education will be combined with program awareness activities. Through the use of bill inserts, newsletters, on-line information, and direct mail, customers will receive educational information regarding the benefits of and opportunities to save money on energy efficiency upgrades.
Issues, Risks, and Risk Management Strategies	Contractor Participation—A limited supply of qualified weatherization and HVAC contractors with the skills to market whole-house energy efficiency improvements can limit program potential. A solution is the development of a local network of qualified professionals to provide installation services and to promote the program to residential energy customers. The implementers will: o Offer technical training to participating home improvement trade contractors, including classroom and field sessions and cover building science principles, diagnostic testing and installation best practices. Consider including certification to ensure the training is effective and valuable as a selling point for the contractors. o Offer sales and business process training to help contractors succeed in selling and delivering home performance services, including procedures for quality assurance, employee training, and understanding program incentives or financing. Consumer Financing and Incentives—The up-front costs of making the recommended improvements may limit customer participation in the program or delay projects unless customers have a way to get them done and to pay for them. o Some program sponsors partner with financial institutions to provide low-interest loans. o Some program sponsors offer cash rebates directly through the program or in collaboration with other program. o Additionally, having easy access to contractors who can complete the work provides incentive to act. Offering referrals or a list of qualified/participating contractors can be a help. Marketing and Consumer Education—Consumers may not be familiar with energy efficiency and the benefits it can provide for improving comfort, as well as saving money. Marketing activities can educate them about the benefits.

	○ Vectren will communicate known partner offers and make customers aware through bill inserts, web site or some targeted direct mail. These tactics can help educate homeowners about the benefits of the whole-house approach to energy improvements and how they can take advantage of the program. ○ The program implementation contractor will work to develop and enlist the help of participating contractors to promote and educate customers about the program. Quality Assurance—Consumers should be assured that the program offers reliable, high quality services. ○ The program should have a quality assurance plan to aid delivery of the program services, provide protocols for contractor reporting, and support program evaluation. ○ Participating contractors have sufficient training to perform program installations and sets standards for the number of work inspections completed by participation contractors.
Marketing and Outreach	The Residential Whole House Plus program will be marketed mainly through direct contact between Vectren and its customers as well as trade allies and other upstream suppliers. • Vectren develop awareness through direct marketing—e.g., bill inserts, newsletters, website, broadcast and print media, direct mail; and pays the participant rebates. • The Residential Home Energy Assessment program is a natural channel for this program. The walk-through audit recommendations will include resource information for the recommended measures, including rebates available under this and the Residential Efficient Products program. • The Residential New Construction program is also a natural channel for this program. That program will offer rebates for the installation of packages of measures, rather than individual measures. Owners or builders who participate in the new construction program will be made aware of additional measures that can be installed after construction to further improve the home performance. • Equipment contractors/installers may be engaged to promote awareness of and use rebate offers to help sell qualifying equipment; they may also provide or pre-fill rebate forms to help customers obtain rebates. These allies are most likely to include: ○ Weatherization contractors ○ Residential air conditioning and heating equipment dealers and installers ○ Small electrical equipment dealers ○ Implementation contractors that will implement the program on Vectren's behalf, providing assistance with their direct marketing; working with upstream suppliers to stock qualifying measures, promote the program, and assist with rebate applications; providing rebate fulfillment services; and tracking and reporting program activities and achievements toward goals.
Evaluation, Measurement	The evaluation methodology and data collection proposed for the Residential Whole House Plus program are guidelines that reflect current measurement and verification

and Verification Requirements	(M&V) practices. The ultimate M&V requirements for this program will conform with the state protocols. Metrics for Gauging Program Success Primary: • Net number of measures purchased/installed • Energy savings associated with purchased/installed measures • Customer satisfaction with the program and the products • Program implementation costs incurred Secondary: • Distribution of measure popularity and cost-effectiveness of the program • Increase in number and variety of suppliers who stock qualified products Data Collection Approaches • Impact Evaluation o Tracking system data for all projects o On-site inspection of a sample of projects to verify operation as reported o Customer billing data prior to and following program to assess energy use and improvement opportunities, and assess and/or verify savings for the payment of customer incentives. o Customer surveys to assess likelihood of purchase without availability of program services and incentives and identify post-participation purchases outside the program (free-rider and free-driver impacts) • Process Evaluation—Evaluation of program design and implementation will be conducted by gathering and analyzing data through a variety of surveys and interviews, including: o Surveys of target market customers (participants and nonparticipants) o Surveys of contractors who participate and/or promote the program o Interviews with Vectren program staff and implementation contractor o Review of program documents and tracking system data Impact Evaluation Methodology The first step is to establish a pre-participation energy use “baseline” based on customer bills, followed by post-participation tracking of energy use through bills. This, together with information on exact measures installed during the audit and additional weatherization measures installed as provided by the installation contractors, would allow assessment of customer energy savings. Ex Post Surveys with participating customers will be used to estimate the net-to-gross ratio accounting for free-riders and free-drivers. Customers will be asked to provide information regarding whether they would have purchased the rebated items without the Vectren promotion, whether they installed the items, and whether they subsequently purchased additional rebate-eligible items at full cost. This outline of the self-report methodology for the assessment of net impacts describes only the basic approach. The selected M&V contractor will develop the complete plan that ensures the appropriate measurement of savings in compliance with industry and state protocols. Process Evaluation Methodology Program process evaluation is important to ensure that the program is operating as

intended and to provide information that can enable improvements in both the program design and implementation. Process evaluation will be undertaken and conducted throughout the program. Often issues uncovered by process evaluation early in the program year can be addressed immediately, helping to ensure program success.

Process evaluation will assess customer understanding, attitudes about, and satisfaction with the program and with Vectren's other educational activities. The evaluations will make use of survey data collected by Vectren and/or implementation contractors, and M&V contractors. These surveys will include both customers known to have participated in the program and eligible nonparticipants.

Interviews with Vectren program staff and/or implementation contractors will be conducted to assess satisfaction with the program and to identify problems and possible program services/implementation improvements.

The M&V contractor will also help Vectren assess the performance of the program design and delivery of the products and services featured in the program, including effectiveness of the marketing and educational materials, effectiveness of advertising and promotional campaigns and messages, effectiveness of the trade ally involvement, and whether implementation milestones are met adequately and on schedule. These evaluations will use sales and promotion data maintained by Vectren and/or the implementation contractor and customer survey data.

Program Schedule

This program is a newly recommended Core Plus program that would begin in PY 2015 and operate through PY 2019. The following table provides a schedule of key milestones:

Key Milestones	Timing
Assign internal program manager and staff	Anticipated in late 2013 or early 2014.
Select and contract with program implementation contractor(s)	2014, Q2 or immediately upon program approval
Finalize program design	2014, Q2
Pre-rollout program development: Develop contractor network Prepare marketing materials and rebate forms Develop activity and rebate processing protocols	2014, Q3 and Q4
Program rollout: Launch all program services	2015, Q1
Prepare reports: Documentation of program activities and progress toward goals Reports to Commission	Monthly throughout program implementation period Quarterly, and annually
Conclude program operation for this planning cycle	2019

Estimated Participation

Participation and measure adoption estimates were developed based on the number of residential customers in the service territory and an assessment of the attainable market potential in the area, as well as the experience of other organizations that have offered this type of program.

Total Estimated Participation (# of Households)

Measure	Option	No. of Gross Installations*	NTG Ratio	No. of Net Installations*
Room AC	EER 11.5	2,300	0.70	1,610
Air-Source Heat Pump	SEER 15, HSPF 8.2	4,600	0.70	3,220
Central AC		6,900	0.70	4,830
ECM		2,300	0.70	1,610
Insulation - Ceiling		85	0.70	60
Insulation - Ducting		411	0.70	287
Insulation - Foundation		612	0.70	429
Insulation - Infiltration Control		934	0.70	654
Insulation - Radiant Barrier		309	0.70	216
Ducting - Repair and Sealing		3,537	0.70	2,476
Windows - Install Reflective Film		739	0.70	517
Doors - Storm and Thermal		2,406	0.70	1,684
Roofs - High Reflectivity		35	0.70	24
Whole-House Fan - Installation		200	0.70	140
Ceiling Fan - Installation		446	0.70	312
Thermostat - Clock/Programmable		1,916	0.70	1,341
Electronics - Smart Power Strips		1,106	0.70	774

Projected Energy Savings

The estimated energy savings are given in terms of annual kWh by measure. The savings noted in each year are incremental, that is reflective of new measures installed by customers through the program in that year. This does *not* include the cumulative impact of measures still in operation from previous years.

Total Net Incremental Electricity Savings (kWh)

Total Net Incremental Energy Savings (kWh)						
Measure	Option	2015	2016	2017	2018	2019
Room AC	EER 11.5	49,953	52,334	54,861	57,384	59,911
Air-Source Heat Pump	SEER 15, HSPF 8.2	341,628	357,896	374,164	390,432	406,700
Central AC		463,050	485,100	507,150	529,200	551,250
ECM		111,720	117,040	122,360	127,680	133,000
Insulation - Ceiling		768	845	912	965	1,007
Insulation - Ducting		3,151	3,460	3,729	3,946	4,114
Insulation - Foundation		43,394	47,764	51,566	54,618	56,976
Insulation - Infiltration Control		15,152	16,687	18,021	19,093	19,922

Insulation - Radiant Barrier		2,107	2,320	2,504	2,653	2,769
Ducting - Repair and Sealing		164,677	180,979	195,142	206,489	215,239
Windows - Install Reflective Film		79,048	86,782	93,505	98,935	103,148
Doors - Storm and Thermal		10,832	11,918	12,863	13,622	14,209
Roofs - High Reflectivity		627	688	741	784	818
Whole-House Fan - Installation		6,602	7,253	7,818	8,275	8,630
Ceiling Fan - Installation		13,797	15,161	16,342	17,299	18,043
Thermostat - Clock/Programmable		36,214	39,873	43,049	45,609	47,595
Electronics - Smart Power Strips		-	-	2,288	2,412	2,507
TOTAL		**1,342,719**	**1,426,100**	**1,507,015**	**1,579,398**	**1,645,837**

Customer Incentives

Incentives will be paid in the form of cash-back rebates. Incentives for the individual measures account for 50% of the incremental measure cost. Incremental cost is the additional cost of a high-efficiency measure beyond a standard-efficiency alternative. When the program design is finalized, the rebate application form can allow for incentives that vary by measure or even within a measure. For example, for room air conditioning, higher incentives can be offered for higher EER levels.

Administrative Requirements

The program administrative staff's role will be to ensure that

- the implementation contractor performs all the activities associated with delivery of all components or the program, and
- Vectren educational and program messages are delivered accurately and clearly to ensure the effectiveness of program delivery and maximize customer satisfaction with the program.

The program is expected to operate according to the following administrative and total utility budget:

Total Program Budget

Total Program Budget					
	2015	**2016**	**2017**	**2018**	**2019**
Program Staff Labor Cost	$25,000	$25,000	$25,000	$25,000	$25,000
Education & Marketing Cost	$34,841	$37,482	$40,007	$42,132	$43,992
Evaluation Cost	$34,841	$37,482	$40,007	$42,132	$43,992
Implementation Cost	$174,205	$187,412	$200,033	$210,658	$219,959
Incentive Costs	$696,822	$749,649	$800,133	$842,633	$879,837
Total Budget	**$965,710**	**$1,037,026**	**$1,105,180**	**$1,162,555**	**$1,212,780**

Cost-Effectiveness

The cost-effectiveness metrics of the Residential Whole House Plus program are as follows:

Cost Effectiveness Tests						
	TRC Ratio	TRC Benefits	TRC Costs	UCT Ratio	PCT Ratio	RIM Ratio
Res Whole House Plus	**1.07**	**$8,212,627**	**$7,653,155**	**1.85**	**2.47**	**0.66**

RESIDENTIAL APPLIANCE RECYCLING PROGRAM

Program Description	The Residential Appliance Recycling program pursues energy savings by offering a bounty payment to customers to remove their old, inefficient appliances and recycle them. This includes aging refrigerator and freezer units. The program offers free pickup of units from residences plus customer incentives and education about the benefits of secondary unit disposal, to encourage their participation. There are no costs to participating customers. The contractor will pick-up, disable, and recycle the units. Once Vectren receives verification that a unit has been recycled, the customer will receive a $30 incentive payment. In addition to educating residential customers about the benefits of secondary unit disposal, the program provides services to enable disposal of the units. The major program components are: <u>Customer Incentives</u> • Complimentary removal of existing or potential secondary units from customer's home. Pickup will be by scheduling appointments directly with the program implementation contractor. • The program implementation contractor mails incentive checks to customers after units have been removed. • To qualify, refrigerator or freezer units must be in working condition, meet minimum size requirements, and be readily accessible for removal. <u>Environmental Disposal of Units</u> • Units will be removed to a collection facility and disassembled for environmentally responsible disposal of CFCs in the refrigerant and recycling of other materials such as metal and plastic components.
Objectives	The purpose of the Residential Appliance Recycling program is to eliminate a very inefficient usage of electricity in homes: the retention of refrigerators and freezers for use as secondary units. This is a two-pronged goal: to remove existing secondary units from operation and to prevent existing primary refrigerators and freezers from being retained and used as secondary units when customers purchase new units. The program has several objectives: • Transform attitudes about retaining older, less efficient refrigerators and freezers as secondary units. • Accrue electricity consumption and demand savings toward Vectren's savings goals. • Demonstrate Vectren's commitment to good stewardship of the environment by sponsoring proper disposal of units. Appliance Recycling is well-suited for accomplishing these objectives because: consumers are more willing than ever to help safeguard the environment and adopt behaviors that save energy without compromising their lifestyles. The program makes it convenient and cost-effective for customers to dispose of these older units, overcoming a past barrier to getting rid of them.
Target Market	The eligible population for the Residential Appliance Recycling program is all residential

	customers in Vectren's service territory. The target markets are residential customers who currently own and operate secondary refrigerator or freezer units and customers who are purchasing new replacement units.
Implementation Strategy	Overview of Activities During the implementation of this program, Vectren and the implementation contractor will be involved in several activity areas: • Development of facilities and protocols for removal and disposal of qualifying units • Program marketing and education: including development and distribution of program materials in collaboration with Vectren; education and engagement of appliance dealers; and program promotion • Scheduling of pickups from customer homes, verification of unit qualification for complimentary removal and incentive payment, pickup and proper disposal of units • Rebate Processing: fulfillment house to receive, review and verify documentation; and either pay incentives or submit incentives to Vectren for payment • Program performance tracking and improvement: including tracking of unit qualification, removal and disposal; rebate submittals and payments; and opportunities to improve the program • Reporting: including reporting of program activities to meet regulatory and internal requirements, in particular progress toward program goals
Issues, Risks, and Risk Management Strategies	The Residential Appliance Recycling program is perhaps the simplest program to operate from the portfolio administrator's perspective. Vectren will select an implementation contractor with a demonstrated record of providing the services to be offered in this program and responsibly disposing of the units. It is likely that a single provider can be engaged to perform or subcontract for performance of all the necessary services. Experience at other utilities and discussions with contractors, however, suggest that the cost effectiveness of this program hinges on volume. Unit disposal costs can be reduced by ensuring higher volumes. The implementation contractor will need to use extensive and effective marketing to obtain the volumes. Removal of old units requires site-to-site pickups. If the distances involved in more remote pickups will significantly increase unit costs, the program can target particular urban regions and be marketed community by community with mailings and local newspaper and radio advertisements. Customer demographic data can be used to determine if some areas have greater-than-average saturations of secondary refrigerators and freezers. If so, these areas would be effective places to initiate this component of the program. The net-to-gross ratio is key issue for this program, which affects program cost-effectiveness. After program pick-up of secondary refrigerator, it seems probable that residents will simply buy a new unit and move their former primary unit into the garage or basement to replace the one being disposed. This will lead to a lowering of the planned savings amount.
Marketing and Outreach	The Residential Appliance Recycling program will be marketed through the following strategies: • Vectren develops awareness through direct marketing—e.g., bill inserts, newsletters, website, broadcast and print media, direct mail; and pays the

	participant incentives. • Appliance dealers/distributors are excellent channels to provide information about this program because they interact with the target market at the time of replacement purchase decisions. Since many dealers offer free removal of existing units to close a sale, utilizing the services of the program contractor to remove the old units can save them money. • The program implementation contractor will provide assistance with Vectren's direct marketing and advertising, providing consumer education, recruiting participants, providing rebate fulfillment services, tracking program activities, and reporting activities and achievements toward goals. • The program will be also be promoted to participants of the other Vectren energy efficiency programs.
Evaluation, Measurement and Verification Requirements	The evaluation methodology and data collection proposed for the Appliance Pickup program are guidelines that reflect current measurement and verification (M&V) practices. The ultimate M&V requirements for this program will conform with the state protocols. <u>Metrics for Gauging Program Success</u> • Number of existing secondary units removed • Number of primary units replaced and prevented from operation as secondary units • Energy savings associated with removed units • Customer satisfaction with the program • Program implementation costs incurred • Increase in awareness and receptivity to secondary appliance turn-in <u>Data Collection Approaches</u> Data for evaluating the program will come from the following sources: • Engineering estimates of measure savings • Local weather data • Follow-up surveys of residential customers contacted from customer information provided on the rebate applications and from Vectren customer information system (for nonparticipants) • Tracking of dealers engaged in promoting the program and assisting customers with rebate application submittal • Program implementer/Vectren staff surveys <u>Impact Evaluation Methodology</u> The program will use deemed per-unit savings estimates to determine savings. The impact evaluation can either accept these values or use engineering estimates to calculate the savings associated with the reduction in refrigerator, freezer load, and air conditioner loads that result from the program. Additional data will be obtained from program records and a survey of program participants. The additional data will include information on customer operating conditions before the units are recycled as part of the program. Post-participation surveys with participating customers will be used to review and revise as necessary the net-to-gross ratio accounting for free-riders and free-drivers. Customers will be asked to provide information regarding whether they would have disposed of the qualifying units without the Vectren incentives, and whether they subsequently disposed

of additional units on their own.

The critical issue in the impact evaluation will be the acquisition of valid and reliable survey data. The process evaluation will be used to monitor the data-tracking system that the recycling contractor uses to ensure the validity of the impact evaluation calculations. This outline of the self-report methodology for the assessment of net impacts describes only the basic approach. The selected M&V contractor will develop the complete plan that ensures defensible measurement of savings in compliance with industry and state protocols.

Process Evaluation Methodology

The process evaluation will focus on program delivery, administration, implementation and customer response. Key issues will include assessment of the marketing and promotional efforts, monitoring of the contractor data-tracking system, and implementation procedures to ensure that the program is being implemented as designed.

The data collection techniques for the process evaluation will include in-person interviews with utility staff and the recycling contractors, on-site inspection of a sample of participant homes, and a survey of sample of participant homes. The interviews will focus on program implementation and administrative procedures. Site visits will be used to review contractor implementation procedures.

The participant survey will include questions on customer characteristics, equipment operating conditions, reasons for participation, program satisfaction, and response to promotional efforts.

In the first year of the program, the focus of the process evaluation will be to assess if the program is operating as planned and if the contractor is carefully maintaining records on program-related equipment. In the second year, the process evaluation will assess how well any program recommendations from the first-year process evaluation are being implemented. In subsequent years, the evaluation will continue to monitor program implementation.

Program Schedule

The Residential Appliance Recycling program is already part of the current Vectren portfolio and will continue to operate through PY 2019. The following table provides a schedule of key milestones:

Key Milestones	Timing
Assign internal program manager and staff	Anticipated in late 2013 or early 2014.
Select and contract with program implementation contractor(s)	2014, Q2 or immediately upon program approval
Finalize program design	2014, Q2
Pre-rollout program development: Establish disposal site(s) and procedures Develop relationships with appliance retailers Develop procedures for tracking activities and documenting results	2014, Q3 and Q4
Program re-launch: Re-launch consumer marketing and outreach	2015, Q1

Pick up and dispose of units	
Prepare reports: Documentation of program activities and progress toward goals Reports to Commission	 Monthly throughout program implementation period Quarterly, and annually
Conclude program operation for this planning cycle	2019

Estimated Participation

Participation and measure adoption estimates were developed based on the number of residential customers in the service territory and an assessment of the attainable market potential in the area, as well as the experience of other organizations that have offered this type of program.

Total Estimated Participation (# of Units Decommissioned)

Measure	No. of Gross Installations*	NTG Ratio	No. of Net Installations*
Refrigerator - Remove Second Unit	4,683	0.70	3,278
Freezer - Remove Second Unit	1,264	0.70	885

Total Estimated Participation per year (# of Units Decommissioned)

	2015	2016	2017	2018	2019
Refrigerator - Remove Second Unit	971	971	971	914	857
Freezer - Remove Second Unit	262	262	262	247	231

Projected Energy Savings

The estimated energy savings are given in terms of annual kWh by measure. The savings noted in each year are incremental, that is reflective of new measures installed by customers through the program in that year. This does *not* include the cumulative impact of measures still in operation from previous years.

Total Net Incremental Electricity Savings (kWh)

Total Net Incremental Energy Savings (kWh)					
Measure	**2015**	**2016**	**2017**	**2018**	**2019**
Refrigerator - Remove Second Unit	446,477	446,477	446,477	420,214	393,950
Freezer - Remove Second Unit	114,861	114,861	114,861	108,104	101,348
TOTAL	**561,338**	**561,338**	**561,338**	**528,318**	**495,298**

Customer Incentives

In addition to cash incentives, customers receive the added benefit of no-cost removal of units from their homes. The following table shows the incentives for each measure.

Measure	Incentive
Refrigerator – Removal of Second Unit	$30 per unit plus free removal of old unit
Freezer – Removal of Second Unit	$30 per unit plus free removal of old unit

Administrative Requirements

Vectren will administer the Residential Appliance Recycling program through an implementation contractor. Vectren's role will be to ensure that

- the implementation contractor performs all the activities associated with delivery of all components or the program, and
- Vectren's educational and program messages are delivered accurately and clearly to ensure the effectiveness of program delivery and maximize customer satisfaction with the program.

The program is expected to operate according to the following administrative and total utility budget:

Total Program Budget

Total Program Budget					
	2015	2016	2017	2018	2019
Program Staff Labor Cost	$10,000	$10,000	$10,000	$10,000	$10,000
Education & Marketing Cost	$10,357	$10,357	$10,357	$9,747	$9,138
Evaluation Cost	$5,918	$5,918	$5,918	$5,570	$5,222
Implementation Cost	$-	$-	$-	$-	$-
Incentive Costs	$147,952	$147,952	$147,952	$139,249	$130,546
Total Budget	**$174,227**	**$174,227**	**$174,227**	**$164,566**	**$154,906**

Cost-Effectiveness

The cost-effectiveness metrics of the Residential Appliance Recycling program are as follows:

Cost Effectiveness Tests						
	TRC Ratio	TRC Benefits	TRC Costs	UCT Ratio	PCT Ratio	RIM Ratio
Res Appliance Recycling	**1.05**	**$723,032**	**$686,727**	**1.05**	**-**	**0.40**

RESIDENTIAL BEHAVIORAL FEEDBACK TOOLS PROGRAM

Program Description	The Residential Behavioral Feedback Tools program provides individualized energy use information to customers, simultaneously offering recommendations on how to save energy and money by making small changes to energy consumption. The information is updated and provided regularly throughout the year. A key component is a peer comparison, where they are shown their own energy usage relative to similar, nearby households. Peoples' intrinsic social competitiveness enhances the energy reductions and effectiveness of this program.
Objectives	The purpose of the Residential Behavioral Feedback Tools program is to reduce energy consumption through socially-driven and information-driven behavioral change. Another very important objective of the program is to raise general awareness regarding energy efficiency and to cross-sell and market other programs within the portfolio.
Target Market	The target market for the Residential Behavioral Feedback Tools program is residential single family homes in the service territory that have electric space heating and electric water heating systems. This will target the program on customers with relatively large electric baseline loads from which larger savings can be subtracted. Both owners and renters are eligible to participate in the program.
Implementation Strategy	<u>Overview of Activities</u> • Customer usage data is collected by the Utility and a data transfer protocol is developed. • An experimental or treatment group of customers is selected from the target market to receive the energy usage information. These homes are then matched with an appropriately-sized control group, also from the target market, that will not receive the information. Savings will be measured by comparing the changes in energy consumption between these two groups. • The energy information is given along with strategically-chosen program marketing, messaging, and education, with the goal of increasing awareness of the portfolio and cross-selling services within the other programs. <u>Education Overview</u> This program should be used as a key touch point to cross-sell and market other programs within the portfolio. This is a prime avenue to feature promotions, contests, and special announcements that can spur enhancements in overall portfolio performance.
Issues, Risks, and Risk Management Strategies	This program should be monitored carefully, as it is difficult to achieve and sustain savings. Relatively little is known about the specific actions that customers perform to reduce their energy usage in this program, and it may undergo meaningful change in customer responsiveness and evaluation paradigms in the coming years. Savings under this program will not persist after the program is ended and the information is no longer available. The savings must be continually renewed each year with additional cost and effort, whereas the savings from a capital equipment measure can last 10 to 20 years. This makes for relatively low-cost energy savings when

<table>
<tr><td></td><td>considered on a first-year basis, but relatively high-cost energy savings on a lifetime or levelized cost basis.</td></tr>
<tr><td>Marketing and Outreach</td><td>The program in and of itself is a marketing and outreach endeavor, so the energy information provided to the customer will comprise the marketing and outreach strategy.</td></tr>
<tr><td>Evaluation, Measurement and Verification Requirements</td><td>The program structure has a built-in scientific design due to its utilization of an experimental and a control group. Net program effects will be measured by comparing the energy consumption of these two groups side by side. Great care should be taken to ensure the experimental and control groups are randomly selected and have comparable demographics and characteristics, and that the data transfer and energy analysis processes have been rigorously tested and verified. The ultimate M&V requirements for this program will conform with the state protocols.
<u>Metrics for Gauging Program Success</u>
• Energy savings associated with the energy information
• Customer satisfaction with the program and the products
• Program implementation costs incurred
• Participation in other Vectren programs.
<u>Data Collection Approaches</u>
• Impact Evaluation
o Tracking system data for all projects
o Billing analysis
o Because the experimental design, in theory, isolates the program effect, the net-to-gross ratio is assumed to be 1.00
• Process Evaluation—Evaluation of program design and implementation will be conducted by gathering and analyzing data through a variety of surveys and interviews, including:
o Surveys of target market customers (participants and nonparticipants)
o Interviews with Vectren program staff and implementation contractor
o Review of program documents and tracking system data</td></tr>
<tr><td>Program Schedule</td><td>The Residential Behavioral Feedback Tools program is already part of the current Vectren portfolio and, pending the cost effectiveness evaluations, will continue to operate through PY 2019. The following table provides a schedule of key milestones:
<table>
<tr><th>Key Milestones</th><th>Timing</th></tr>
<tr><td>Assign internal program manager and staff</td><td>Anticipated in late 2013 or early 2014.</td></tr>
<tr><td>Select and contract with program implementation contractor(s)</td><td>2014, Q2 or immediately upon program approval</td></tr>
<tr><td>Finalize program design</td><td>2014, Q2</td></tr>
<tr><td>Pre-rollout program development:
Develop data transfer requirements and protocols for customer consumption and usage
Prepare marketing materials and messaging</td><td>2014, Q3 and Q4</td></tr>
<tr><td>Program re-launch:</td><td>2015, Q1</td></tr>
</table></td></tr>
</table>

All program services	
Prepare reports: Documentation of program activities and progress toward goals Reports to Commission Cost-effectiveness assessment and "go or no go" decision on whether to continue program	 Monthly throughout program implementation period Quarterly, and annually Annually
Conclude program operation for this planning cycle	2019

Estimated Participation

Participation and measure adoption estimates were developed based on the number of residential customers in the service territory and an assessment of the attainable market potential in the area, as well as the experience of other organizations that have offered this type of program.

Estimated NTG Ratio

Measure	NTG Ratio
Res Behavioral Feedback Tools	1.00

Total Estimated Participation (# of Households)

	2015	2016	2017	2018	2019
Res Behavioral Feedback Tools	25000	25000	25000	25000	25000

Projected Energy Savings

The estimated energy savings are given in terms of annual kWh by measure. The savings noted in each year are incremental, that is reflective of new measures installed by customers through the program in that year. This does *not* include the cumulative impact of measures still in operation from previous years.

Total Net Incremental Electricity Savings (kWh)

Total Net Incremental Energy Savings (kWh)					
Measure	**2015**	**2016**	**2017**	**2018**	**2019**
Res Behavioral Feedback Tools	4,659,300	5,177,000	5,177,000	5,177,000	5,177,000
TOTAL	**4,659,300**	**5,177,000**	**5,177,000**	**5,177,000**	**5,177,000**

Customer Incentives

The program subsidizes the cost of acquiring customer data, processing and analyzing it, and using it to create and send customer reports. There is no monetary incentive directly given to the customer.

Administrative Requirements

Vectren will administer the Residential Behavioral Feedback Tools program through an implementation contractor. Vectren's role will be to ensure that

- the implementation contractor performs all the activities associated with delivery of all components or the program, and
- Vectren's educational and program messages are delivered accurately and clearly to ensure the effectiveness of program delivery and maximize customer satisfaction with the program.

The program is expected to operate according to the following administrative and total utility budget:

Total Program Budget

Total Program Budget					
	2015	2016	2017	2018	2019
Program Staff Labor Cost	$25,000	$25,000	$25,000	$25,000	$25,000
Education & Marketing Cost	$-	$-	$-	$-	$-
Evaluation Cost	$25,000	$25,000	$25,000	$25,000	$25,000
Implementation Cost	$-	$-	$-	$-	$-
Incentive Costs	$250,000	$250,000	$250,000	$250,000	$250,000
Total Budget	**$300,000**	**$300,000**	**$300,000**	**$300,000**	**$300,000**

Cost-Effectiveness

The cost-effectiveness metrics of the Residential Behavioral Feedback Tools program are as follows:

Cost Effectiveness Tests						
	TRC Ratio	TRC Benefits	TRC Costs	UCT Ratio	PCT Ratio	RIM Ratio
Res Behavioral Feedback Tools	**1.18**	**$1,442,788**	**$1,220,290**	**1.18**	**-**	**0.42**

BUSINESS PRESCRIPTIVE PROGRAM

Program Description	The Business Prescriptive Rebate program is a core program designed to encourage and assist non-residential customers in improving the energy efficiency of their existing facilities through a broad range of energy efficiency options that address all major end uses and processes. This program offers incentives to customers who install high-efficiency electric equipment and engages equipment suppliers and contractors to promote the incentive-eligible equipment. The program has the following components, to accommodate the variety of customer needs and facilities in this sector: • Prescriptive Incentives—deemed per-unit savings for itemized measures; easy and appropriate for relatively low-cost or simple measures. • Specialized outreach to promote and enable prescriptive measures best suited to smaller facilities. • Customer referrals to qualified energy audit providers who can help customers identify appropriate and cost-effective retrofit opportunities. <u>Prescriptive Measure Incentives</u> • Quick and easy incentive application for measures with known and reliable energy savings. No pre-approval required. • Customers purchase and install qualified products from retailers and/or contractors. • Customers or their contractors submit incentive form to Vectren with information that documents the qualifying sale/installation. The form allows customers to see the exact incentive they can receive. Vectren mails rebate checks to customers or their contractors. • The prescriptive incentives are cash-back rebates that generally cover a portion of the incremental cost of the qualifying models; that is, the cost premium of qualifying models over less-efficient models available. In additional to prescriptive rebates for customers, the program will engage in upstream "buydowns" of certain products such as compact fluorescent lamps so that customers pay a lower price at the point of purchase without needing to apply for a rebate. The upstream buydown activity is a component of the program's focus on market transformation that will increase the demand for high efficiency products, and eventually decrease the availability of lower-efficiency products in the marketplace. This program, along with the Business Custom program, is likely to provide the bulk of the energy savings from business customers. It should be noted that since business energy efficiency efforts are very project-centric, there are many projects that may fit partially under both the Prescriptive and Custom programs. Therefore, a flexible delivery approach should be employed, with a method to share or allocate projects between the two programs.
Objectives	The purpose of the Business Prescriptive Rebate program is to increase awareness of energy savings opportunities and assist customers in acting on those opportunities to decrease energy usage in commercial and industrial facilities. This program is designed

	for retrofit and replacement projects. The program has several objectives: • Increase consumers' awareness and understanding of the breadth of energy efficiency opportunities in their facilities. • Make it easier for customers to adopt more energy-efficient equipment and behaviors. • Make a significant contribution to attainment of Vectren's energy savings goals. • Strengthen customer trust in Vectren as their partners in saving energy.
Target Market	The eligible customer population for the Business Prescriptive Rebate program is all existing commercial and industrial accounts, including master-metered multifamily housing facilities, provided with electricity by Vectren.[1] Within the target market, the focus for this program is the equipment retrofit or change-out market; that is, customers with existing equipment that needs replacing or who can be persuaded to replace their equipment early.
Implementation Strategy	<u>Overview of Activities</u> The implementers will be involved in several activity areas: • Development of relationships with equipment and maintenance suppliers to make eligible equipment and services available, to implement upstream buy down of high efficiency products, and to promote their participation in the program • Program marketing: including development and distribution of program materials and assistance with direct mail or other promotion in collaboration with other contractors • Participant recruitment and assistance: including assisting customers and contractors with selection of measures and incentive application submittal • Rebate processing: including a fulfillment house to receive, review and verify applications; and either pay or submit the financial incentives to Vectren for payment • Program performance tracking and improvement: including tracking availability of qualifying products, rebate submittals and payments, and opportunities to improve the program • Reporting: including reporting of program activities to meet regulatory and internal requirements, including progress toward program goals • Integration with Business Custom Incentives Program: Business energy efficiency efforts are very project-centric, with many large projects participating in a hybrid of standard/prescriptive rebates and custom project incentives. Thus, it may be useful to follow an integrated delivery approach for the Business Prescriptive and the Business Custom Incentives program. Vectren will not provide direct technical services, but will maintain a list of qualified Energy Service Contractors (ESCOs) that can provide those services. The list will be provided to interested customers. ESCOs will provide customers with technical expertise to determine what equipment is most appropriate for them. <u>Education Overview</u> The program will provide and leverage education provided by other groups to ensure

[1] Public Schools will be covered in the separately organized Schools Program as part of the State of Indiana Core Program delivery.

	that participants have the understanding and tools to make the program successful. These are mainly focused on educating equipment suppliers and contractors, and include: • Training sessions for trade allies and other providers of products and services — these are to provide technical information regarding the applicability and benefits of the measures, information about how the program works, and their role in and incentives for having their customers participate in the program. • Since referrals to auditors who can help identify energy efficiency opportunities is part of the program, having trained and qualified auditors available is important. Many utility-sponsored programs rely upon outside training organizations to ensure that auditors are well-versed in building science principles and whole-building concepts for energy performance. For example, the Building Performance Institute (BPI) and Residential Energy Services Network (RESNET) have set widely-used standards for auditor training.
Issues, Risks, and Risk Management Strategies	There are several issues associated with providing an energy efficiency program to commercial and industrial customers. Key ones are identified below, along with how the Business Prescriptive Rebate program can address them. • This is a very diverse market sector, both in size and makeup. The final program design should include multiple tracks, for smaller businesses and for larger commercial and industrial customers, in order to provide the structure to develop specific outreach activities and educational/promotional messages that resonate with each group. • The energy uses of industrial customers are also diverse and often site-specific. The implementation contractor must have expertise to understand or engage the services of process experts to assist industrial customers in particular with project development as well as to perform pre- and post-installation inspections. • Equipment vendors and installation contractors have considerable influence in equipment purchase decisions. This effectively makes these trade allies part of the participant target market. To engage them in promoting and having their clients' projects participate in the program, it may be necessary and appropriate to structure the incentive payments so that part or all the incentive is directed to them or split with the customer.
Marketing and Outreach	Effective implementation of the program depends on marketing and outreach activities working effectively. This includes making qualifying products available, distributing information about the products and the program, promoting the program adequately, and educating those influential in making product selection and purchasing decisions. Also, as noted earlier, an integrated marketing approach needs to be followed for this program and other relevant programs in the portfolio like the Business Custom Incentives program. • Product Supply o Equipment suppliers—Vendors are influential in equipment selection in commercial and industrial facilities. They can be and should be engaged to recommend rebate-eligible models of equipment for retrofit and replacement projects. As appropriate, the incentives for equipment purchased under the program can be split or directed to these vendors. o Other trade allies—Installation and maintenance contractors can

provide services associated with some of the qualifying measures, such as HVAC diagnostic tune-ups, identifying and sealing air and duct leaks, and refrigeration system maintenance. Again, as appropriate, incentives offered on qualifying measures can be directed to or split with these providers to encourage them to promote program participation.

- Program and Product Information Distribution
  - Trade allies—As both deliverers of program products and potential participants in the program, all vendors of the qualifying equipment and service measures should be engaged to receive and also provide to their public sector clients information about the program measure benefits, how the program works, and assistance with the incentive process.
  - Utility staff—While Vectren will engage a contractor to implement the program, the staff has ongoing contact with all key account customers. The staff will provide information about the program benefits, measures, and process.
  - Business associations- Advertising in business association publications will provide information and awareness to prospective customers.
  - The implementation contractor will develop and distribute information about the qualifying products and participation assistance by establishing and leveraging existing relationships with the product and service suppliers.
- Program Promotion
  - Trade allies—All vendors of the qualifying equipment and service measures should be engaged to make their clients aware of the program and encourage their participation by recommending high-efficiency equipment models and diagnostic services.
  - Facility auditors—Part of auditors' services can and should include making customers aware of this program and the incentives available for installation of high-efficiency measures.
  - Bill inserts to all and direct mail to sub-segments within this target market; e.g., small businesses.
  - A key responsibility of the implementation contractor is outreach and effective promotion of the program to the target market.
- Education: Opportunities to educate both the trade allies, who themselves are potential participants and delivery channels, and facility managers include:
  - Bill inserts and/or direct mail
  - Trade publication articles on the benefits of specific measures, technologies, and diagnostic tune-ups, as well as whole facility assessments
  - Trade industry meetings leveraged to include product and program education as part of them
  - Workshops provided by government agencies for commercial and industrial businesses to understand how to improve energy use in their facilities
  - Facility audit reports

	○ Industry and technology experts who meet individually with facility decision makers during outreach and project development Specialized outreach activities will be undertaken for specific customer segments to promote and enable prescriptive measures best suited for high-impact/high-need customers such as municipal buildings, hospitals, food service, and hospitality industry to influence implementation of high efficiency equipment that would not have taken place without the program. For example, for the small hospitality sector, the program could be delivered through a specialized vendor. The specialized program vendors will be primarily responsible for marketing activities, and for contacting and recruiting participants. Direct mail and company website information are effective channels for outreach activities.
Evaluation, Measurement and Verification Requirements	The evaluation methodology and data collection proposed for the program are guidelines that reflect current measurement and verification (M&V) practices. The ultimate M&V requirements for this program will conform with the state protocols. <u>Metrics for Gauging Program Success</u> Primary: • Number of program measures installed • Energy savings associated with installed measures • Customer satisfaction with the program and the products • Program implementation costs incurred Secondary: • Distribution of measure popularity and cost-effectiveness of program, to enable program improvement • Number and variety of suppliers/contractors who stock qualified products <u>Data Collection Approaches</u> Data for evaluating the program will come from the following sources: • Impact Evaluation ○ Tracking system data for all projects ○ Data on customer electrical equipment, hours of operation, life of the equipment, etc. ○ On-site inspection and metering of a sample of projects to verify operation as reported ○ Vectren customer energy consumption data for engineering or statistical analyses of impacts • Process Evaluation Evaluation of program design and implementation process will be conducted by gathering and analyzing data through a variety of surveys and interviews, including: ○ Follow-up surveys of C&I customers contacted from customer information provided on the incentive applications and from Vectren customer information system (for nonparticipants) ○ Surveys of upstream suppliers engaged in promoting the program and assisting customers with project development and incentive application submittal ○ Interviews with the implementation contractor and program staff ○ Review of program documents and tracking system data

Impact Evaluation Methodology

The program will record energy savings and peak load reductions from the rebate applications processed. For prescriptive measures, recorded savings will use the per-unit deemed savings values. Because prescriptive measures are established technologies and data are available demonstrating the reliability of savings, it will not be necessary to conduct customer-level billing analyses or metering studies on these projects. However, some number of projects will be inspected for independent verification of installation and operation as reported.

Assessment of free-rider and free-driver effects, if deemed appropriate, may be conducted using customer billing and survey data in conjunction with established M&V methodologies and procedures.

Process Evaluation Methodology

Evaluation of the program implementation is important to ensure that the program is operating as intended and to provide information that can enable improvements in both the program design and implementation. Process evaluation will be undertaken and conducted throughout the program by the implementation and the M&V contractor(s) selected by Vectren.

Process evaluation will assess customer understanding of, attitudes about, and satisfaction with both the program and with Vectren's broader educational activities. The evaluations will make use of survey data collected by the implementation and M&V contractors. These surveys will include both customers known to have participated in the program and eligible nonparticipants. The diversity of customers in this target market, including small businesses, master-metered multifamily housing facilities, general office as well as specialty facilities, and factories, means that survey content and fielding will need to accommodate a wide variety of participation experiences.

Interviews with program service providers will be conducted to assess satisfaction with the program and to identify problems and possible program services/implementation improvements.

The M&V contractor will also help Vectren assess the performance of the program design and delivery of the products and services featured in the program, including effectiveness of the educational materials, effectiveness of promotional campaigns and messages, effectiveness of the trade ally involvement, and whether implementation milestones are met adequately and on schedule. These evaluations will use sales and promotion data maintained by the implementation contractor, information provided by Vectren, and customer survey data.

Program Schedule

The Business Prescriptive Rebate program is a Core program and is already part of the current Vectren portfolio and will continue to operate through PY 2019. The following table provides a schedule of key milestones:

Key Milestones	Timing
Assign internal program manager and staff	Anticipated in late 2013 or early 2014.
Select and contract with program implementation contractor(s)	2014, Q2 or immediately upon program approval
Finalize program design	2014, Q2
Pre-rollout program development: Prepare marketing materials and incentive applications Develop activity and incentive	2014, Q3 and Q4

processing protocols Identify qualified auditors, contractors, and trade allies	
Program re-launch: Launch consumer education, marketing, and outreach All program services	2015, Q1
Prepare reports: Documentation of program activities and progress toward goals Reports to Commission	Monthly throughout program implementation period Quarterly, and annually
Conclude program operation for this planning cycle	2019

Estimated Participation

Participation and measure adoption estimates were developed based on the number of commercial and industrial customers in the service territory and an assessment of the attainable market potential in the area, as well as past program experience and the experience of other organizations that have offered this type of program.

Total Estimated Participation (# of SqFt or Employees)

Measure	Option	No. of Gross Installations*	NTG Ratio	No. of Net Installations*
Air-Cooled Chiller	0.97 kw/ton, COP 3.6	1,239,100	0.80	991,280
Geothermal Heat Pump	EER 30, COP 5.0	446,233	0.80	356,986
Other Cooling	EER 11.5	657,493	0.80	525,994
Geothermal Heat Pump	EER 16, COP 3.5	35,484	0.80	28,387
Water Heating	EF 2.4	7,054,478	0.80	5,643,583
Screw-in	Mix of LEDs/CFLs	79,107,356	0.80	63,285,884
High-Bay Fixtures	T5	8,878,099	0.80	7,102,479
Linear Fluorescent	T5	38,971,985	0.80	31,177,588
HID	T5	21,870,608	0.80	17,496,486
Oven	Energy Star	4,691,465	0.80	3,753,172
Dishwasher	Energy Star	1,074,848	0.80	859,878
Desktop Computer	Energy Star	12,666,803	0.80	10,133,443
Laptop	Energy Star	14,133,986	0.80	11,307,189
Server	Energy Star	30,118,938	0.80	24,095,151
Monitor	Energy Star	3,843,697	0.80	3,074,957
Printer/Copier/Fax	Energy Star	4,162,765	0.80	3,330,212
Non-HVAC Motors	Premium (NEMA)	-	0.80	-
Non-HVAC Motors	Premium (NEMA 2015)	7,202,779	0.80	5,762,223
Air Source Heat Pump	EER 11.0, COP 3.3	5,706	0.80	4,565

Other Cooling	EER 10.2	615,891	0.80	492,713
Fryer	Energy Star	3,880,818	0.80	3,104,655
Hot Food Container	Energy Star	3,403,939	0.80	2,723,152
Roof top AC	EER 12.0	1,567,638	0.80	1,254,110
Pool Pump	High Efficiency, Multi-Speed	185,686	0.80	148,549
Pool Heater	Heat Pump	45,585	0.80	36,468
Geothermal Heat Pump	EER 18, COP 3.8	23,317	0.80	18,654
Air Source Heat Pump	EER 12.0, COP 3.4	217,592	0.80	174,074
Air Source Heat Pump	EER 11.7, COP 3.4	74,297	0.80	59,438
Traffic Lights	LED	140	0.80	112
Crosswalk Lights	LED	25	0.80	20
Roof top AC	Ductless Minisplit	462	0.80	370
Air-Source Heat Pump	Ductless Minisplit	9	0.80	7
Compressed Air	High Efficiency	7,057	0.80	5,645
Air-Cooled Chiller - Maintenance		89,736	0.80	71,789
Water-Cooled Chiller - Maintenance		67,126	0.80	53,701
RTU - Maintenance		3,154,423	0.80	2,523,539
Heat Pump - Maintenance		2,330,283	0.80	1,864,226
Water Heater - Faucet Aerators/Low Flow Nozzles		8,456,777	0.80	6,765,422
Exterior Lighting - Daylighting Controls		18,565,236	0.80	14,852,189
Office Equipment - ENERGY STAR Power Supplies		104,648,914	0.80	83,719,131
Thermostat - Clock/Programmable		5,773,848	0.80	4,619,078
HVAC - Occupancy Sensors		975,423	0.80	780,338
PC Power Management Software		64,122,133	0.80	51,297,706
Pre-rinse Sprayer		506,627	0.80	405,301
Interior Lighting - LED Exit Lighting		20,984,567	0.80	16,787,653
Interior Lighting - Occupancy Sensors		32,107,043	0.80	25,685,634
Interior Lighting - Timeclocks and Timers		22,991,753	0.80	18,393,402
Water Heater - Install Timer		122,902	0.80	98,322
Water Heater - Tank Blanket/Insulation		1,131,697	0.80	905,357
Refrigerator - Anti-Sweat Heater		288,379	0.80	230,703
Interior Lighting - Daylighting Controls		1,970,634	0.80	1,576,507
Refrigerator - Strip Curtain		274,017	0.80	219,214
Interior Lighting - Skylights		2,252	0.80	1,802
Compressed Air - Compressor		1,226	0.80	981

Replacement				
Compressed Air - System Maintenance		4,178	0.80	3,343
Pumping System - Maintenance		2,904	0.80	2,323
Fan System - Maintenance		3,622	0.80	2,897
Motors - Efficient Rewind		6,043	0.80	4,834

Projected Energy Savings

The estimated energy savings are given in terms of annual kWh by measure. The savings noted in each year are incremental, that is reflective of new measures installed by customers through the program in that year. This does *not* include the cumulative impact of measures still in operation from previous years.

Total Net Incremental Electricity Savings (kWh)

Total Net Incremental Energy Savings (kWh)						
Measure	**Option**	**2015**	**2016**	**2017**	**2018**	**2019**
Air-Cooled Chiller	0.97 kw/ton, COP 3.6	165,676	203,238	239,694	259,406	236,138
Geothermal Heat Pump	EER 30, COP 5.0	49,552	68,140	86,461	136,405	148,811
Other Cooling	EER 11.5	16,104	21,416	27,159	33,247	36,321
Geothermal Heat Pump	EER 16, COP 3.5	2,314	-	-	4,297	5,408
Water Heating	EF 2.4	486,120	589,800	708,140	792,953	842,442
Screw-in	Mix of LEDs/CFLs	2,011,212	2,096,414	2,156,219	2,464,153	2,770,309
High-Bay Fixtures	T5	292,179	287,182	309,397	77,816	34,238
Linear Fluorescent	T5	1,299,506	1,703,232	2,109,387	2,561,684	2,757,385
HID	T5	844,161	819,854	774,384	221,530	104,914
Oven	Energy Star	37,433	49,908	62,291	71,563	66,919
Dishwasher	Energy Star	29,849	39,843	49,760	61,687	66,017
Desktop Computer	Energy Star	503,615	533,970	574,553	325,389	130,892
Laptop	Energy Star	80,981	150,251	62,531	29,283	17,746
Server	Energy Star	856,004	327,703	121,229	73,264	62,669
Monitor	Energy Star	17,634	32,430	12,599	5,148	2,880
Printer/Copier/Fax	Energy Star	22,154	23,348	24,231	44,102	15,382
Non-HVAC Motors	Premium (NEMA)	-	-	-	-	-
Non-HVAC Motors	Premium (NEMA 2015)	7,206	9,112	11,109	13,404	14,239

Air Source Heat Pump	EER 11.0, COP 3.3	299	542	840	1,282	1,578
Other Cooling	EER 10.2	5,303	7,134	9,044	11,084	12,114
Fryer	Energy Star	20,472	27,300	34,048	39,125	36,544
Hot Food Container	Energy Star	98,518	104,559	108,316	114,404	106,736
Roof top AC	EER 12.0	17,302	58,637	77,529	91,922	89,257
Pool Pump	High Efficiency, Multi-Speed	49	65	81	100	205
Pool Heater	Heat Pump	46	62	77	95	196
Geothermal Heat Pump	EER 18, COP 3.8	498	6,480	8,186	677	737
Air Source Heat Pump	EER 12.0, COP 3.4	5,802	7,761	9,790	11,906	19,031
Air Source Heat Pump	EER 11.7, COP 3.4	-	2,466	3,201	3,947	-
Traffic Lights	LED	3,078	2,078	1,216	26,065	8,790
Crosswalk Lights	LED	1,679	1,134	663	300	209
Roof top AC	Ductless Minisplit	182,980	249,125	295,429	325,685	299,115
Air-Source Heat Pump	Ductless Minisplit	2,252	5,138	6,876	8,815	9,925
Compressed Air	High Efficiency	18,206	21,906	25,437	29,490	30,512
Air-Cooled Chiller - Maintenance		46,220	56,475	67,688	78,899	83,765
Water-Cooled Chiller - Maintenance		44,972	54,956	65,926	77,011	81,814
RTU - Maintenance		524,563	635,944	756,261	874,712	921,113
Heat Pump - Maintenance		125,641	152,162	181,118	209,822	221,432
Water Heater - Faucet Aerators/Low Flow Nozzles		34,666	41,796	49,325	56,549	58,856
Exterior Lighting - Daylighting Controls		249,493	291,081	337,204	392,439	410,975
Office Equipment - ENERGY STAR Power Supplies		17,657	21,316	25,399	29,612	31,503
Thermostat - Clock/Programmable		102,378	125,490	150,872	176,339	189,143
HVAC - Occupancy Sensors		13,224	16,353	19,820	23,343	25,004
PC Power Management Software		779,370	938,820	1,114,267	1,296,709	1,377,505

Pre-rinse Sprayer		7,349	8,837	10,404	11,902	12,393
Interior Lighting - LED Exit Lighting		5,254	6,298	7,439	8,508	21,488
Interior Lighting - Occupancy Sensors		2,100,450	2,537,907	3,023,613	3,468,701	3,645,655
Interior Lighting - Timeclocks and Timers		270,951	326,498	387,866	444,509	466,292
Water Heater - Install Timer		8,639	10,421	12,300	14,100	14,687
Water Heater - Tank Blanket/Insulation		7,950	9,598	11,339	13,009	13,559
Refrigerator - Anti-Sweat Heater		14,645	17,496	20,478	23,313	24,149
Interior Lighting - Daylighting Controls		244,392	295,325	352,059	404,172	425,185
Refrigerator - Strip Curtain		804	934	1,068	1,193	1,219
Interior Lighting - Skylights		126,543	153,297	183,213	210,408	221,683
Compressed Air - Compressor Replacement		236,240	290,445	350,089	410,154	437,071
Compressed Air - System Maintenance		91,998	113,109	136,340	159,734	170,219
Pumping System - Maintenance		98,985	121,713	146,727	171,925	183,236
Fan System - Maintenance		50,794	62,457	75,292	88,223	94,027
Motors - Efficient Rewind		28,208	34,684	41,810	48,989	52,210
TOTAL		**12,309,568**	**13,773,638**	**15,437,791**	**16,534,502**	**17,111,839**

Customer Incentives

Incentives will be paid in the form of rebates. Incentives for the individual measures account for 40% of the incremental measure cost. Incremental cost is the additional cost of a high-efficiency measure beyond a standard-efficiency alternative.

Administrative Requirements

Program administrative staff's role will be to ensure that:

- the implementation contractor performs all the activities associated with delivery of all components or the program, and
- educational and program messages are delivered accurately and clearly to ensure the effectiveness of program delivery and maximize customer satisfaction with the program.

The program is expected to operate according to the following administrative and total utility budget:

Total Program Budget

Total Program Budget					
	2015	2016	2017	2018	2019
Program Staff Labor Cost	$75,000	$75,000	$75,000	$75,000	$75,000
Education & Marketing Cost	$146,050	$184,664	$217,423	$246,570	$245,323
Evaluation Cost	$73,025	$92,332	$108,712	$123,285	$122,662
Implementation Cost	$365,125	$461,660	$543,558	$616,425	$613,309
Incentive Costs	$1,460,502	$1,846,642	$2,174,233	$2,465,700	$2,453,234
Total Budget	**$2,119,703**	**$2,660,299**	**$3,118,927**	**$3,526,980**	**$3,509,528**

Cost-Effectiveness

The cost-effectiveness metrics of the Business Prescriptive Rebate program are as follows:

Cost Effectiveness Tests						
	TRC Ratio	TRC Benefits	TRC Costs	UCT Ratio	PCT Ratio	RIM Ratio
Bus Prescriptive	**2.06**	**$50,575,254**	**$24,584,518**	**4.21**	**3.91**	**0.83**

BUSINESS CUSTOM INCENTIVES PROGRAM

Program Description	The Business Custom Incentives program is designed to encourage and assist nonresidential customers to save energy through customizable projects that are too complex to fit in the standard rebate offering. The program will affect the purchase and installation of efficient technologies and/or implementation of process improvements by working directly with key end-use customers and market providers. The program has the following components, to accommodate the variety of customer needs and facilities in this sector: • Custom Incentives—paid on fixed dollar per first-year-kWh-saved basis; appropriate for large and complex projects, often with multiple measures. • Emphasis on flexibility of custom projects to address variety of business and industrial process energy improvements. • Customer referrals to qualified energy audit providers who can help customers identify appropriate and cost-effective retrofit opportunities. <u>Custom Project Incentives</u> • Provides financial incentives on projects not suitable for prescriptive incentives because of size or multiple types of equipment involved. • More complex offering, with the following services and requirements: o Review design/specification and savings estimates for completeness and applicability of incentives o Pre- and post-project inspections to estimate and verify savings o Incentives paid on a fixed $/kWh basis • Examples of custom projects include energy management systems, air compressor system optimization, building envelope improvements, and experimental technologies. This program, along with the Business Prescriptive program, is likely to provide the bulk of the energy savings from business customers. It should be noted that since business energy efficiency efforts are very project-centric, there are many projects that may fit partially under both the Prescriptive and Custom programs. Therefore, an flexible delivery approach should be employed, with a method to share or allocate projects between the two programs.
Objectives	The purpose of the Business Custom Incentives program is to increase awareness of energy savings opportunities and assist customers in acting on those opportunities to decrease energy usage in commercial and industrial facilities. This program is designed for retrofit and replacement projects. The program has several objectives: • Increase consumers' awareness and understanding of the breadth of energy efficiency opportunities in their facilities. • Make it easier for customers to adopt more energy-efficient equipment and equipment maintenance. • Make a significant contribution to attainment of Vectren's energy savings goals.

	• Strengthen customer trust in Vectren as their partner in saving energy.
Target Market	The eligible customer population for the Business Custom Incentives program is all existing commercial and industrial accounts, including master-metered multifamily housing facilities, provided with electricity by Vectren.[2] Within the target market, the focus for this program is the equipment retrofit or change-out market; that is, customers with existing equipment that needs replacing or who can be persuaded to replace their equipment early.
Implementation Strategy	<u>Overview of Activities</u> The implementers will be involved in several activity areas: • Development of relationships with equipment and maintenance suppliers to make incentive-eligible equipment and services available and to promote their participation in the program • Program marketing: including development and distribution of program materials and assistance with direct mail or other promotion in collaboration with other Vectren contractors • Participant recruitment and assistance: including assisting customers and contractors with selection of measures and incentive application submittal, assisting customers and contractors with custom engineering calculations for development of savings estimates, payback, and documentation for approval of custom measure projects • The implementation contractor will work with Vectren to identify the top energy consumers and continue outreach with EE service providers that are familiar with the program. The established EE service providers include mechanical contractors, commercial equipment distributors, energy service companies, architects, and engineers. • Rebate processing: including a fulfillment house to receive, review and verify applications; and either pay or submit the financial incentives to Vectren for payment • Program performance tracking and improvement: including tracking availability of qualifying products, rebate submittals and payments, and opportunities to improve the program • Reporting: including reporting of program activities to meet regulatory and internal requirements, including progress toward program goals Specialized outreach activities will be undertaken for specific customer segments to promote and enable prescriptive measures best suited for high-impact/high-need customers such as municipal buildings, hospitals, food service, and the hospitality industry to influence implementation of high efficiency equipment that would not have taken place without the program. For example, for the small hospitality sector, the program could be delivered through a specialized vendor. The specialized program vendors will be primarily responsible for marketing activities, and for contacting and recruiting participants. Direct mail and company website information are effective channels for outreach activities. <u>Education Overview</u> The program will provide and leverage education provided by other groups to ensure that program channels and participants have the understanding and tools to make the

[2] Public Schools will be covered in the separately organized Schools Program as part of the State of Indiana Core Program delivery.

	program successful. These are mainly focused on educating equipment suppliers and contractors, and include: • Training sessions for trade allies and other providers of products and services — these are to provide technical information regarding the applicability and benefits of the measures, information about how the program works, and their role in and incentives for having their customers participate in the program. • Since referrals to auditors who can help identify energy efficiency opportunities is part of the program, having trained and qualified auditors available is important. Many utility-sponsored programs rely upon outside training organizations to ensure that auditors are well-versed in building science principles and whole-building concepts for energy performance. For example, the Building Performance Institute (BPI) and Residential Energy Services Network (RESNET) have set widely-used standards for auditor training.
Issues, Risks, and Risk Management Strategies	Key issues are identified below, along with how the Business Custom Incentives program can address them. • This is a very diverse market sector, both in size and makeup. The final program design should include multiple tracks, for smaller businesses and for larger commercial and industrial customers, in order to provide the structure to develop specific outreach activities and educational/promotional messages that resonate with each group. • The energy uses of industrial customers are also diverse and often site-specific. The implementation contractor must have expertise to understand or engage the services of process experts to assist industrial customers in particular with project development as well as to perform pre- and post-installation inspections. • Equipment vendors and installation contractors have considerable influence in equipment purchase decisions. This effectively makes these trade allies part of the participant target market. To engage them in promoting and having their clients' projects participate in the program, it may be necessary and appropriate to structure the incentive payments so that part or all the incentive is directed to them or split with the customer.
Marketing and Outreach	Effective implementation of the program depends on marketing and outreach activities working effectively. This includes making qualifying products available, distributing information about the products and the program, promoting the program adequately, and educating those influential in making product selection and purchasing decisions. Success of custom projects is dependent upon referrals and networking with trade allies and utility staff to identify projects. Trade allies receive reminder packets in mail and follow-up telephone calls, followed by in-person visits by the implementation contractor with market providers at their place of business in order to obtain support in providing referrals of custom incentive projects. • Product Supply o Equipment suppliers—Vendors are influential in equipment selection in commercial and industrial facilities. They can be and should be engaged to recommend equipment and controls that can reduce customers' energy use. As appropriate, the incentives for equipment purchased under the program can be split or directed to these vendors. o Other trade allies—Installation and maintenance contractors can

provide services associated with some of the qualifying measures. Again, as appropriate, incentives offered on qualifying measures can be directed to or split with these providers to encourage them to promote program participation.

- Program and Product Information Distribution
  - Trade allies—As both deliverers of program products and potential participants in the program, all vendors of high efficiency equipment, controls and service measures should be engaged to receive and also provide to their public sector clients information about the benefits of high efficiency, how the program works, and assistance with the incentive process.
  - Utility staff—While Vectren will engage a contractor to implement the program, the staff has ongoing contact with all key account customers. The staff will provide information about the program benefits, measures, and process.
  - The implementation contractor will develop and distribute information about the program and participation assistance by establishing and leveraging existing relationships with the product and service suppliers.
- Program Promotion
  - A key responsibility of the implementation contractor is outreach and effective promotion of the program to the target market. The implementation contractor will work with Vectren sales consultants to generate joint awareness of the prescriptive and custom programs through direct contact with key customers and service providers.
  - Outreach efforts will be focused on: Networking with Vectren Commercial Sales Consultants, product sales representatives, service contractors, and energy services companies. These efforts can be performed by Trade Ally Service Representatives who undertake recruitment of participants, provide sales assistance, and present at trade seminars.
  - Trade Ally Service Representatives will be an important channel to promote the program at industry events, contractor association meetings, and directly to trade allies. Examples of events for program promotion include: The Midwest Healthcare Engineering Conference, the Indiana Building Green Symposium, and the Midwest Petroleum and Convenience Show, along with monthly meetings with industry trades. In addition to attending and presenting at these seminars, program marketing materials can be distributed at other forums such as ASHRAE seminars.
  - Trade allies—All vendors of high efficiency equipment, controls and service measures should be engaged to make their clients aware of the program and encourage their participation by recommending high-efficiency equipment models and diagnostic services.
  - Facility auditors—Part of auditors' services can and should include making customers aware of this program and the incentives available for installation of high-efficiency measures.
  - Direct customer outreach targeting decision makers within the customers' organization including energy managers, facility managers,

	financial and operations managers, chief engineer and facility/property managers, maintenance supervisors and building operators. • Education: Opportunities to educate both the trade allies, who themselves are potential participants and delivery channels, and facility managers include: o Bill inserts and/or direct mail o Trade publication articles on the benefits of specific measures, technologies, and diagnostic tune-ups, as well as whole facility assessments o Trade industry meetings leveraged to include product and program education as part of them o Workshops provided by government agencies for commercial and industrial businesses to understand how to improve energy use in their facilities o Facility audit reports o Industry and technology experts who meet individually with facility decision makers during outreach and project development
Evaluation, Measurement and Verification Requirements	The evaluation methodology and data collection proposed for the program are guidelines that reflect current measurement and verification (M&V) practices. The ultimate M&V requirements for this program will conform with the state protocols. <u>Metrics for Gauging Program Success</u> Primary: • Number of program measures installed • Number of participating customers • Energy savings associated with installed measures • Customer satisfaction with the program and the products • Program implementation costs incurred Secondary: • Distribution of measure popularity and cost-effectiveness of program, to enable program improvement • Number and variety of suppliers/contractors who stock qualified products <u>Data Collection Approaches</u> Data for evaluating the program will come from the following sources: • Impact Evaluation o Tracking system data for all projects o On-site inspection and metering of a sample of projects to verify operation as reported. Data requirements will vary with project specifications. In certain cases, utility billing meter information may be sufficient, while in other cases spot metering or other types of assessment may be required. o Customer energy consumption data for engineering or statistical analyses of impacts • Process Evaluation Evaluation of program design and implementation process will be conducted by gathering and analyzing data through a variety of surveys and interviews, including:

	o Follow-up surveys of C&I customers contacted from customer information provided on the incentive applications and from customer information system (for nonparticipants) o Surveys of upstream suppliers engaged in promoting the program and assisting customers with project development and incentive application submittal o Interviews with the implementation contractor and program staff o Review of program documents and tracking system data <u>Impact Evaluation Methodology</u> The program will record energy savings and peak load reductions from the rebate applications processed. For custom measure projects, the gross savings need to be estimated based on engineering models and estimates. The M&V assessment will necessarily require pre/post building simulation modeling, billing analyses and/or metering to verify the project savings. For program impact assessment, this can be accomplished through verification of a sample of projects that account for a large portion of the reported savings and are most representative of projects by the different target market segments. Assessment of free-rider and free-driver effects, if deemed appropriate, may be conducted using customer billing and survey data in conjunction with established M&V methodologies and procedures. <u>Process Evaluation Methodology</u> Evaluation of the program implementation is important to ensure that the program is operating as intended and to provide information that can enable improvements in both the program design and implementation. Process evaluation will be undertaken and conducted throughout the program by the implementation and the M&V contractor(s) selected by Vectren. Process evaluation will assess customer understanding of, attitudes about, and satisfaction with both the program and with Vectren's broader educational activities. The evaluations will make use of survey data collected by the implementation and M&V contractors. These surveys will include both customers known to have participated in the program and eligible nonparticipants. The diversity of customers in this target market, including small businesses, master-metered multifamily housing facilities, general office as well as specialty facilities, and factories, means that survey content and fielding will need to accommodate a wide variety of participation experiences. Interviews with program service providers will be conducted to assess satisfaction with the program and to identify problems and possible program services/implementation improvements. The M&V contractor will also help Vectren assess the performance of the program design and delivery of the products and services featured in the program, including effectiveness of the educational materials, effectiveness of promotional campaigns and messages, effectiveness of the trade ally involvement, and whether implementation milestones are met adequately and on schedule. These evaluations will use sales and promotion data maintained by the implementation contractor, information provided by Vectren, and customer survey data.
Program Schedule	The Business Custom Incentives program will operate during PY 2015 through PY 2019. The following table provides a schedule of key milestones:

Key Milestones	Timing
Assign internal program manager and staff	Anticipated in late 2013 or early 2014.
Select and contract with program implementation contractor(s)	2014, Q2 or immediately upon program approval
Finalize program design	2014, Q2
Pre-rollout program development: Prepare marketing materials and incentive applications Develop activity and incentive processing protocols Identify qualified auditors, contractors, and trade allies	2014, Q3 and Q4
Program re-launch: Launch consumer education, marketing, and outreach All program services	2015, Q1
Prepare reports: Documentation of program activities and progress toward goals Reports to Commission	Monthly throughout program implementation period Quarterly, and annually
Conclude program operation for this planning cycle	2019

Estimated Participation

Participation and measure adoption estimates were developed based on the number of commercial and industrial customers in the service territory and an assessment of the attainable market potential in the area, as well as past program experience and the experience of other organizations that have offered this type of program.

Total Estimated Participation (# of SqFt or Employees)

Measure	No. of Gross Installations*	NTG Ratio	No. of Net Installations*
Total Business Custom Incentives	145,443,198	0.85	123,626,718

Projected Energy Savings

The estimated energy savings are given in terms of annual kWh by measure. The savings noted in each year are incremental, that is reflective of new measures installed by customers through the program in that year. This does *not* include the cumulative impact of measures still in operation from previous years.

Total Net Incremental Electricity Savings (kWh)

Total Net Incremental Energy Savings (kWh)					
Measure	**2015**	**2016**	**2017**	**2018**	**2019**
Total Business Custom Incentives	12,905,765	14,890,860	16,800,675	18,697,829	20,595,234
TOTAL	**12,905,765**	**14,890,860**	**16,800,675**	**18,697,829**	**20,595,234**

Customer Incentives

For implementation purposes, the incentive payout is $0.13 per annual kWh saved in the first year of the project life. This corresponds with a planning and budgeting assumption where the customer incentives are set to cover 40% of the incremental cost of measures.

Incentives are capped at $100,000 per customer. Research has shown that most C&I custom programs have an incentive cap as either a fixed amount or a percentage of project cost. Caps range from $67,000 - $250,000 and/or 30 – 70% of the project cost, with a percentage approach as more popular than the fixed amount. Vectren has current language in the tariff that gives some flexibility in making exceptions to the cap if necessary, but if program participation decreases or if requests are frequently received from customers with projects that would exceed the cap, it may be prudent to investigate raising or revisiting the caps.

Administrative Requirements

Program administrative staff's role will be to ensure that:

- the implementation contractor performs all the activities associated with delivery of all components or the program, and
- educational and program messages are delivered accurately and clearly to ensure the effectiveness of program delivery and maximize customer satisfaction with the program.

The program is expected to operate according to the following administrative and total utility budget:

Total Program Budget

Total Program Budget					
	2015	**2016**	**2017**	**2018**	**2019**
Program Staff Labor Cost	$75,000	$75,000	$75,000	$75,000	$75,000
Education & Marketing Cost	$168,812	$196,312	$223,118	$251,578	$277,124
Evaluation Cost	$118,168	$137,418	$156,183	$176,105	$193,987
Implementation Cost	$675,248	$785,247	$892,472	$1,006,312	$1,108,498
Incentive Costs	$1,688,121	$1,963,117	$2,231,180	$2,515,780	$2,771,245
Total Budget	**$2,725,350**	**$3,157,094**	**$3,577,953**	**$4,024,774**	**$4,425,855**

Cost-Effectiveness

The cost-effectiveness metrics of the Business Custom Incentives program are as follows:

Cost Effectiveness Tests						
	TRC Ratio	TRC Benefits	TRC Costs	UCT Ratio	PCT Ratio	RIM Ratio
Bus Custom Incentives	**2.52**	**$70,292,200**	**$27,918,583**	**4.87**	**5.25**	**0.82**

BUSINESS RETROFIT AND UPGRADE FOR SCHOOLS

Program Description	The Business Retrofit and Upgrade program for Schools is essentially a combination of the Business Prescriptive and the Custom Incentives program, targeted toward public schools. This program offers the same financial incentives and technical assistance to reduce energy use as in other nonresidential facilities, along with providing assistance in identifying key improvement opportunities and addressing the special planning and purchasing protocols of public schools. The program has the following components: • Prescriptive and custom measure rebates—includes rebates for installation of a full array of energy efficiency improvements. Prescriptive measures include lighting, HVAC, motors, and building shell. Examples of custom measures include HVAC controls, energy management systems, water/wastewater efficiency upgrades, and very large or complex versions of any of the prescriptive measures listed above. • Audits with cost reimbursement for installation of recommended measures—designed to assist facility operators to identify energy-saving opportunities and prioritize projects to fit with planning cycles and leverage other funding sources in addition to Vectren incentives. The program is designed to make it as easy as possible for public schools and their contractors to obtain rebates for prescriptive measures, while also providing flexibility in accommodating the diversity of energy-savings opportunities and varying complexities of projects likely in this sector with custom measure incentives. The program provides something close to a one-stop shop for obtaining energy efficiency assistance through audits offered to help customers and their influential contractors in this target market identify and prioritize their energy-savings opportunities.
Objectives	The purpose of the Business Schools program is to achieve energy savings in this segment. The program has several objectives: • Substantially improve the energy efficiency of public school facilities. • Facilitate the monitoring of energy efficiency projects toward the goal. • Enable eligible customers to identify and implement all cost effective energy-saving opportunities. This program provides all of the same services offered to commercial customers in other programs. Additionally, it provides assistance with obtaining facility audits. The key difference is that for the public school segment, all the energy efficiency related services are offered within a single program. This includes retrofits and new construction.
Target Market	The target market for the Business Schools program is all public schools within the applicable service territory.
Implementation Strategy	<u>Overview of Activities</u> The implementers will be involved in several activity areas: • Development of relationships with public school equipment and maintenance suppliers to make incentive-eligible equipment and services available and to promote their participation in the program

	• Program marketing: including development and distribution of program materials and assistance with direct mail or other advertising in collaboration with other Vectren contractors • Participant recruitment and assistance: including scheduling audits with qualified auditors, assisting customers and contractors with incentive application submittal, and assisting customers and contractors with the development of estimates and documentation for approval of custom measure projects • Rebate processing: fulfillment house to receive, review and verify applications; and either pay or submit rebates to Vectren for payment • Program performance tracking and improvement: including tracking of all program activities, rebate submittals and payments, and opportunities to improve the program • Reporting: including reporting of program activities to meet regulatory and internal requirements, in particular progress toward program goals A single ESCO delivery model may be pursued for energy efficiency implementation in schools. This approach may help overcome barriers toward implementing energy efficiency measures in schools related to shortage of funds for energy efficiency upgrades and carrying through on energy efficiency plans. One of the unique features related to implementation of energy efficiency programs in schools is the development of a performance contract. The performance contracting vehicle will allow schools to "ride" the contract any year for specific energy efficiency projects. <u>Education Overview</u> The program will provide and leverage education provided by other groups to ensure that program channels and participants have the understanding and tools to make the program successful. These include: • Vectren will offer a series of forums designed to educate and inform public school leaders about programs and incentives. • Training sessions for trade allies and other providers of products and services — these are to provide technical information regarding the applicability and benefits of the measures, information about how the program works, customers' role in and incentives for participating, and issues related to public school procurement practices. • The audit component of the program will also provide one-on-one customer education about energy efficiency benefits in general and the recommended measure benefits more specifically, the state's commitment to reducing energy use in public schools, and the availability of resources designed to enable energy efficiency improvement projects. • Training and qualification of auditors is important. Many utility-sponsored programs rely upon outside training organizations to ensure that auditors are well-versed in building science principles and whole-building concepts for energy performance. For example, the Building Performance Institute (BPI) and Residential Energy Services Network (RESNET) have set widely-used standards for auditor training.
Issues, Risks, and Risk Management	There are several issues associated with providing an energy efficiency program to the public school segment. Key ones are identified below, along with how the Business Schools program can address them.

Strategies	• Similar to other public agencies, schools typically have more complex procurement practices than private businesses. For implementation of the program to be successful, the outreach, project scheduling, incentive fulfillment process, and trade ally involvement strategies used by the implementation contractor all need to reflect understanding and accommodation of these practices. • Public schools will need help identifying and prioritizing energy-saving opportunities. The audit component will directly address this need, but a full-scale commercial building audit often costs about $20,000. While the program will provide at least partial reimbursement of this cost to customers who install recommended measures, the up-front cost will be borne by the customer unless "bought down" by the contractor who will perform the work. • The program will require the availability of a sufficient number of qualified auditors. This means that training needs to be procured prior to the launch of other program components. This should not be difficult but needs immediate attention, well before program launch. Furthermore, the issue of how the training will be paid for needs to be worked out. In many areas with similar programs, contractors are fully responsible for the cost of their training, though the training provider or program sponsor may cover some or all of the cost if certain conditions are met; e.g., purchase of blower door or other diagnostic equipment, completion of a certain number of audits.
Marketing and Outreach	Effective implementation of the program depends on marketing and outreach activities working effectively. This includes distributing information about the products and the program, promoting the program adequately, and educating those influential in making product selection and purchasing decisions. Specialized outreach activities will be undertaken to promote and enable prescriptive measures best suited for schools to influence implementation of high efficiency equipment that would not have taken place without the program. For schools, a single contract ESCO approach may be followed, who works closely with customers in trying to overcome funding barriers for energy efficiency upgrades and difficulties carrying through on energy efficiency plans, commonly occurring in schools. The specialized program vendors will be primarily responsible for marketing activities, and for contacting and recruiting participants. Direct mail and company website information are effective channels for outreach activities. For schools, say, Vectren will need to work with schools and school districts to develop the program. The basic concept of the program will be addressed in the development of a memorandum of understanding between the two utilities and the school administration. A technical description and a promotional brochure for circulation to individual districts and schools will need to be developed. This program will engage the following channels for delivery of these key aspects the program: • Product Supply o Equipment suppliers—public agencies often have contracts or standing agreements with equipment vendors. These vendors are influential in equipment selection. They should be educated about energy-efficient alternatives and incentives available to make these alternatives cost-competitive. Suppliers provide the most direct link between the program and the consumers in this sector's existing facilities. As appropriate, the incentives for equipment purchased under the

program can be split or directed to these vendors.

- Architects and engineers—for major renovations, expansions, and new building construction, the A&Es are most influential in the decisions that affect a facility's energy use. Properly educated and convinced to use building efficiency best practices, they can specify qualifying program measures to public sector construction projects.
- Other trade allies—installation and maintenance contractors can provide services associated with some of the qualifying measures, such as HVAC diagnostic tune-ups, identifying and sealing air and duct leaks, and refrigeration system maintenance. Again, as appropriate, incentives offered on qualifying measures can be directed to or split with these providers to encourage them to promote program participation.

- Program and Product Information Distribution
  - Trade allies & affinity groups—as both deliverers of program products and potential participants in the program, all vendors of the qualifying equipment and service measures should be engaged to receive and also provide to their public school clients information about the program measure benefits, how the program works, and assistance with the incentive process.
  - Utility staff—while Vectren will engage a contractor to implement the program, the staff (e.g. account managers) has ongoing contact with many of these customers. The staff will provide information about the program benefits, measures, and process.
  - Implementation contractor will develop and distribute information about the qualifying products and participation assistance by establishing and leveraging existing relationships with the product and service suppliers.
- Program Promotion
  - Trade allies & affinity groups —all vendors of high efficiency equipment and service measures should be engaged to make their public school clients aware of the program and encourage their participation by recommending high-efficiency equipment models and diagnostic services.
  - Public agency news publications—leverage existing communication channels used by public schools to make facility managers aware of the program opportunities.
  - Direct mail—there is a limited and known target market that can be reached by mail with specially crafted letters, program applications, and other promotional materials.
  - A key responsibility of the implementation contractor is outreach and effective promotion of the program to the target market.
- Education

  Opportunities to educate both the trade allies, who themselves are both potential participants and delivery channels, and public school facility managers include:
  - Bill inserts and/or direct mail
  - Agency and industry training sessions (piggybacking program

	education on these meetings) o Industry and technology experts who meet individually with facility decision makers and provide auditor training o Facility audit reports
Evaluation, Measurement and Verification Requirements	The evaluation methodology and data collection proposed for the program are guidelines that reflect current measurement and verification (M&V) practices. The ultimate M&V requirements for this program will conform with the state protocols. <u>Metrics for Gauging Program Success</u> • Energy savings from completed projects • Number of participating facilities or projects • Number of facility audits requested/completed • The percent of recommended measures installed per completed audit • Understanding of and satisfaction with the program by target market customer and upstream providers/participants <u>Data Collection Approaches</u> Data for evaluating the program will come from the following sources: • Impact Evaluation o Tracking system data for all projects o On-site inspection and sub-metering of a sample of custom projects to verify operation as reported o customer energy consumption data for engineering or statistical analyses of impacts • Process Evaluation Evaluation of program design and implementation performance will be conducted by gathering and analyzing data through a variety of surveys and interviews, including: o Surveys of target market customers (participants and nonparticipants) o Surveys of public facility equipment suppliers and service providers who participate and/or promote the program o Interviews with the implementation contractor and program staff o Review of program documents and tracking system data <u>Impact Evaluation Methodology</u> The program will record energy savings and peak load reductions from the rebate applications processed. For prescriptive measures, recorded savings will use the per-unit deemed savings values. Because prescriptive measures are established technologies and data are available demonstrating the reliability of savings, it will not be necessary to conduct customer-level billing analyses or metering studies on these projects. However, some projects will be inspected for independent verification of installation and operation as reported. For custom measure projects, the gross savings need to be estimated based on engineering models and estimates. The M&V assessment will necessarily require pre/post building simulation modeling, billing analyses and/or sub-metering of select projects to verify savings. Assessment of free-rider and free-driver effects, if deemed appropriate, may be conducted using customer billing and survey data in conjunction with established M&V

methodologies and procedures.

Process Evaluation Methodology

Evaluation of the program implementation is important to ensure that the program is operating as intended and to provide information that can enable improvements in both the program design and implementation. Process evaluations will be undertaken and conducted throughout the program by the implementation and the M&V contractor(s) selected by Vectren.

Process evaluations will assess customer understanding, attitudes about, and satisfaction with both the program and with Vectren's broader educational activities. The evaluations will make use of survey data collected by the implementation and M&V contractors. These surveys will include both customers known to have participated in the program and eligible nonparticipants. The diversity of customers in this target market, including large and small government agencies, traffic signal and street light operators, local schools and public colleges, public health facilities, and other non-profit agencies means that survey content and fielding will need to accommodate a wide variety of participation experiences.

Interviews with program service providers, including auditors, will be conducted to assess satisfaction with the program and to identify problems and possible program services/implementation improvements.

The M&V contractor will also help Vectren assess the performance of the program design and delivery of the products and services featured in the program, including effectiveness of the marketing and educational materials, effectiveness of advertising and promotional campaigns and messages, effectiveness of the trade ally involvement, and whether implementation milestones are met adequately and on schedule. These evaluations will use data maintained by the implementation contractor, information provided by Vectren, and customer survey data.

Program Schedule

The Business Schools program is a Core program and is already part of the current Vectren portfolio and will continue to operate through PY 2019. The following table provides a schedule of key milestones:

Key Milestones	Timing
Assign internal program manager and staff	Anticipated in late 2013 or early 2014.
Select and contract with program implementation contractor(s)	2014, Q2 or immediately upon program approval
Finalize program design	2014, Q2
Pre-rollout program development: Prepare marketing materials and incentive applications Develop activity and incentive processing protocols Identify qualified auditors, contractors, and trade allies	2014, Q3 and Q4
Program re-launch: Launch consumer education, marketing, and outreach All program services	2015, Q1
Prepare reports: Documentation of program activities and progress toward	Monthly throughout program

goals Reports to Commission	implementation period Quarterly, and annually
Conclude program operation for this planning cycle	2019

Estimated Participation

Participation and measure adoption estimates were developed based on the number of commercial and industrial customers in the service territory and an assessment of the attainable market potential in the area, as well as past program experience and the experience of other organizations that have offered this type of program.

Total Estimated Participation (# of SqFt or Employees)

Measure	No. of Gross Installations*	NTG Ratio	No. of Net Installations*
Total Bus Schools Program	64,817,453	0.85	55,094,835

Projected Energy Savings

The estimated energy savings are given in terms of annual kWh by measure. The savings noted in each year are incremental, that is reflective of new measures installed by customers through the program in that year. This does *not* include the cumulative impact of measures still in operation from previous years.

Total Net Incremental Electricity Savings (kWh)

Total Net Incremental Energy Savings (kWh)					
Measure	2015	2016	2017	2018	2019
Total Bus Schools Program	719,028	839,189	919,210	938,075	1,027,002
TOTAL	**719,028**	**839,189**	**919,210**	**938,075**	**1,027,002**

Customer Incentives

The incentives for this program align with those from the Custom Program.

For implementation purposes, the incentive payout is $0.13 per annual kWh saved in the first year of the project life. This corresponds with a planning and budgeting assumption where the customer incentives are set to cover 40% of the incremental cost of measures.

Administrative Requirements

Program administrative staff's role will be to ensure that:

- the implementation contractor performs all the activities associated with delivery of all components or the program, and
- educational and program messages are delivered accurately and clearly to ensure the effectiveness of program delivery and maximize customer satisfaction with the program.

The program is expected to operate according to the following administrative and total utility budget:

Total Program Budget

Total Program Budget					
	2015	2016	2017	2018	2019
Program Staff Labor Cost	$10,000	$10,000	$10,000	$10,000	$10,000
Education & Marketing Cost	$-	$-	$-	$-	$-
Evaluation Cost	$8,009	$9,750	$11,211	$12,772	$13,753
Implementation Cost	$50,058	$60,939	$70,068	$79,824	$85,957
Incentive Costs	$200,233	$243,756	$280,271	$319,297	$343,827
Total Budget	**$268,301**	**$324,445**	**$371,549**	**$421,893**	**$453,537**

Cost-Effectiveness

The cost-effectiveness metrics of the Business Schools program are as follows:

Cost Effectiveness Tests						
	TRC Ratio	TRC Benefits	TRC Costs	UCT Ratio	PCT Ratio	RIM Ratio
Bus Schools Program	**0.69**	**$2,168,631**	**$3,155,364**	**1.46**	**1.96**	**0.45**

BUSINESS STRATEGIC ENERGY MANAGEMENT PROGRAM

Program Description	The Business Strategic Energy Management program provides energy education, technical assistance, and company-wide coaching for large commercial and industrial customers in order to drive behavioral change and transformation of company culture; thereby producing measureable improvements in energy efficiency and utilization. We recommend two SEM Improvement program tracks that use different delivery mechanisms: • One-on-One Consultative Strategic Energy Management (Consultative SEM) provides the customer with access to an energy expert who works intensively with the customer to integrate energy management into the organization's business practices by helping the customer to set up an energy management process and to implement improvements. The participating customer receives frequent and personalized attention throughout the implementation period. Touch points and milestones are agreed upon between the two parties. • Strategic Energy Management Cohort (SEM Cohort) places companies into groups that work alongside each other for one year or longer, coming together in periodic workshops, approximately quarterly, and working on their own in-between these sessions. The group setting enhances participant action as they strive to perform in front of their peers. Structured groups are composed of approximately 5 to 12 program participants sharing best practices and learning together in a group setting. The cohort is typically filled with participants from non-competing industries; however, if mutual agreement is established, competitors may participate in the same cohort. The cohort is typically established for a geographic area, as the cohort participants are expected to convene in person for workshop events. A method is developed early in the engagement to forecast baseline levels of energy consumption for each participant, and savings goals are created and measured against this baseline. To isolate energy savings attributable to the SEM efforts, any savings from equipment measures installed under other programs in the portfolio can be netted out of these savings.
Objectives	The Business Strategic Energy Management program involves appointment of an energy liaison(s) and a team within participating organizations who will regularly correspond with program representatives. The SEM program supports a systematic approach to integrating energy management into an organization's business practices and creating lasting energy management processes that produce reliable energy savings. SEM has been shown to produce larger and longer lasting energy savings when compared to other energy management offerings. Few customers, however, have the internal resources to pursue and sustain these initiatives on their own, without the support of a utility program such as this.
Target Market	The target market for the SEM program includes customers with high energy use and who generally have a BMS or other monitoring systems. Based on experience with

	similar programs offered by other entities, the best possible candidates are likely to have the following attributes: • Large manufacturing companies or commercial facilities with greater than 300 kW peak demand. • Companies with multiple sites, with operations or offices in another state or country, as they are typically more accustomed to strategic types of efforts. These customer types may have an interest in translating their practices to other locations. • Institutional customers with multiple sites, such as government, universities, or school districts. • Customers with commitment to sustainability and environmental stewardship. • Customers in regulated industries, as they tend to have a high familiarity with process improvement. • Companies that have well established management systems like quality or safety, or those using continuous improvement practices like Lean or Six Sigma. • On-going participation in other EE programs in the portfolio, as they will already be familiar with the concepts. • Companies in a stable or rapid growth mode, as they are likely to have significant resources dedicated towards expansion and optimization. Market research completed for this study indicates that 35% of large C&I customers have an individual on staff that is charged with managing the efficiency of energy operations. This statistic shows that there are companies with an eye toward these issues already that may be prime candidates for participation. It also shows that there is much room for further expansion and adoption of these concepts.
Implementation Strategy	The design relies on a Program Administrator and Energy Management Providers, with roles as described below. **Program Administrator** refers to the staff that delivers the program and manages its administrative functions, such as marketing, customer recruitment, and results tracking. This will be handled by Vectren staff, along with a third-party contractor. **Energy Management Providers** (EMPs) are firms and personnel with specific knowledge and expertise who work with customers to achieve SEM savings. Due to the specialized nature of the SEM consulting, Energy Management Providers must have a combination of the following: • Experience in customer consulting and change management. • Experience with continuous improvement methodologies such as LEAN and Six Sigma. • Experience in engaging customer personnel at all levels, particularly executives. • Experience in using and deploying management systems such as quality, environmental impact, and safety; these can be at the third-party certification level, such as for ISO 9001, ISO 14001 or OSHAS 18001, respectively. Ideally the contractor would have familiarity in deploying the ISO 50001 standard for energy management systems. • Technical expertise for understanding production process and operations to identify energy savings opportunities. • Established track record in deploying utility-based SEM programs, driving energy savings along with customer change and customer satisfaction.

	Overview of Activities During the implementation of this program, the program staff will be involved in several activity areas: • Recruitment and screening of customers- The Program Administrator will create initial outreach plans and preliminary customer target lists. Potential SEM program participants will be screened on the size of their connected load and also on factors including history of implementing energy efficiency projects, experience with other continuous improvement programs, general responsiveness of plant personnel, etc. Screening will take place through discussions with account managers and preliminary conversations with prospective customers. • Gaining customer commitment- As part of the screening process, participating customers will commit to the following: o An on-site executive-level sponsor o Dedicated program budget o Access to key human resources (such as time allocation and training) o The inclusion of an energy continuous improvement statement within existing corporate goals o A training program for new and existing personnel • Assignment of an Energy Management Provider (EMP) – An Energy Management Provider will be assigned to each customer. In many cases, the Energy Management Provider will have been involved during customer recruitment. The Energy Management Provider will have primary responsibility for implementing the program and working with customers and will have three roles: o SEM Project manager — coordinate customer communication and meetings, develop all program reports o Organizational Facilitator(s) — conduct initial Energy Management Assessment (EMA), provide ongoing customer coaching, maintain customer satisfaction, and provide input to energy maps and savings models. The EMP will be responsible for identifying and cultivating an energy champion or team leader. o Savings modeler — develops energy maps and savings models, create energy savings memos. The EMP provides technical assistance to participating customers to understand current energy use, identify opportunities to reduce energy use, and to set energy-use reduction goals. Integration with other programs The SEM program delivery will be integrated with other programs. Customers that have already completed capital equipment upgrades under existing programs or are currently participating in capital measure programs can gain further efficiency gains through SEM programs. If capital measures are identified during the course of participation in SEM programs, they can be submitted for incentives under the appropriate existing capital measure programs.
Issues, Risks, and Risk Management Strategies	The most challenging aspect of a SEM program is maintaining long-term customer commitment because it directly affects savings persistence. To ensure customer commitment, the customer must clearly understand the following:

	• The level of staff time, management review, and other resources they are committing • The services such as consulting and training they will receive • The benefits they will obtain, such as a more systematic and proactive approach to managing energy In addition, the customer participation agreement, expectation management, and robust measurement and verification approach reinforce the customer commitment to the program. <u>Managing Expectations</u> Successful efforts involve setting rigorous expectations through ongoing meetings between the participating customer and the EMP, as well as the Program Administrator and Vectren staff. • <u>Participating Customer and Program Administrator</u>. To ensure that the customer maintains momentum and arrives at an agreed upon success point, a Stage-gate approach is recommended. This includes clearly defined stages based on progress indicators such as the existence of an energy goal, consistent meetings of an energy team, and the engagement of employees in energy awareness. • <u>Program Administrator and Vectren.</u> A periodic review meeting on a quarterly basis brings together Vectren staff, the Program Administrator, and the Energy Management Provider to discuss each SEM participant with respect to successes, challenges, and overall progress. If it is determined that a customer's progress is lagging, they will agree to next steps, including increased engagement scope and discussions with the customer to ensure that they understand program support may be withdrawn if they do not improve performance. <u>Data Confidentiality</u> Working with customers' energy and production data is vital to the tracking of progress in this program. These data are frequently proprietary and competition-sensitive, so steps must be taken to establish a secure mechanism and procedure for sharing and storage of data.
Marketing and Outreach	Customers will be recruited into the SEM program through one-on-one contacts. To achieve goals, the program will likely need to target two- to three-times the participation goal. This recruitment process will build an SEM customer participant pipeline, wherein potential SEM participants can be monitored as their priorities and business situations change over time. The one-on-one recruiting process builds on familiarity and trust, providing the basis for successful engagements. Often, utility relationships with customers are concentrated at the facility or maintenance-manager level. The strategic and organizational nature of SEM usually requires that the decision around program participation be made at the executive level. Therefore, customer recruiting requires a two-prong approach at both the facility management level and the executive level. Vectren should leverage the highest-level relationships it has with its large customers, including any peer relationships that Vectren executives may have with customer executives. Attendance or participation in meetings or conferences on sustainable business practices or on Lean Manufacturing, as well as participation in trade associations may also aid in recruiting participants. The key marketing message should be that Vectren is supporting customers to more strategically manage energy, and is asking that its customers invest in their future by

	building an organizational foundation for energy management. Vectren provides the consultative resources to support its customers as they go through this change, and will provide incentives for energy saved as a result of this effort. Given the specific and targeted nature of this effort, marketing will rely heavily upon presentations and letter templates, supported by brochures and case study materials. It is important for the marketing materials to: • Provide a basic understanding of the concept of SEM and the program. • Outline the compelling business case (benefits and costs) of participation. • Connect the SEM offering to the existing portfolio of Vectren programs. • Include case studies and success stories. • Identify the two tracks for participation in the program: Consultative and Cohort. For the Cohort SEM program, the message should reflect that via participation in the cohort, customers gain peer group benefits, such as sharing results and ideas and positive peer pressure from cohort presentations. This addresses the lower degree of the individualized support that is provided in Consultative SEM.
Evaluation, Measurement and Verification Requirements	A method is developed early in the engagement to forecast baseline levels of energy consumption for each participant, and savings goals are created and measured against this baseline. To isolate energy savings attributable to the SEM efforts, any savings from equipment measures installed under other programs in the portfolio can be netted out of these savings. <u>Site-Level Data Requirements</u> Ensuring that appropriate information is in place and subsequently managed will support the customer's use of data to manage energy as a controllable cost and enable to properly demonstrate true savings. Example data requirements include: • The customer authorizes Vectren to provide their energy usage data to the Program Administrator and Energy Management Provider. While hourly usage data are not required, the hourly data, together with hourly production data, enable development of better facility-wide energy models, provide more detailed information about actual facility performance, and also makes it easier to demonstrate change. If hourly usage data are available, but production data is only available monthly, then the hourly usage data are somewhat less valuable. • The customer will provide the Vectren Program Manager and Energy Management Provider with production data as well as any other energy driver data such as headcount, operating hours, and weather. • The customer will provide this data for the three years, or as much history as is available, preceding program participation. • The customer will work with the Energy Management Provider to develop a facility energy model. This effort involves supporting the program team during an onsite Energy Map exercise, providing information regarding energy efficiency measures installed prior to and during program participation, and answering other questions related to energy performance. • After participation in the Vectren energy management program, the customer will continue to acquire and analyze energy related data, and make energy management decisions based on this information.

EM&V Requirements

Because the program design recommends that incentives be paid on verified energy savings, third-party verification of reported project-level savings will be required. The program design assumes that this function will be provided by an independent evaluation firm under contract to the Program Administrator.

In addition, an independent third-party contractor will be hired to evaluate the impact of the program. The contractor will use the measurement and verification data collected by the program implementer to determine gross savings by project and customer for both demand and energy.

A comprehensive process evaluation will be conducted in the first year to develop program logic models, identify strategies that have been successful, customer satisfaction, and opportunities to improve program participation and increase savings. The evaluation contractor will use best practice methodologies when conducting process evaluations including, but not limited to, stakeholder interviews, customer surveys, program-ally interviews, tracking systems review, and assessment of quality assurance and quality control. Subsequent evaluation will be done in the third year to determine the effect of program improvements.

Impact evaluation data will include the hourly data collected as part of customer measurement and verification, production data, operating conditions, any significant changes to the facilities that would affect energy use, such as a new building addition or change in process.

Program Schedule

The Business Strategic Energy Management program is a newly recommended Core Plus program that would begin in PY 2015 and operate through PY 2019. The following table provides a schedule of key milestones:

Key Milestones	Timing
Assign internal program manager and staff	Anticipated in late 2013 or early 2014.
Select and contract with program implementation contractor(s)	2014, Q1
Finalize program design	2014, Q2
Pre-rollout program development: Prepare marketing materials and messaging Identify energy management partners/liaisons Identify list of likely participants	2014, Q3 and Q4
Program rollout: Launch consumer education, marketing, and outreach. All program services	2015, Q1
Prepare reports: Documentation of program activities and progress toward goals Reports to Commission	Monthly throughout program implementation period Quarterly, and annually
Conclude program operation for this planning cycle	2019

Estimated Participation

Participation and measure adoption estimates were developed based on the number of commercial and industrial customers in the service territory and an assessment of the attainable market potential in the area, as well as past program experience and the experience of other organizations that have offered this type of program.

Total Estimated Participation (# of SqFt or Employees)

Measure	No. of Gross Installations*	NTG Ratio	No. of Net Installations*
SEM	8,903,615	0.85	7,568,073

Projected Energy Savings

The estimated energy savings are given in terms of annual kWh by measure. The savings noted in each year are incremental, that is reflective of new measures installed by customers through the program in that year. This does *not* include the cumulative impact of measures still in operation from previous years.

Total Net Incremental Electricity Savings (kWh)

Total Net Incremental Energy Savings (kWh)					
Measure	**2015**	**2016**	**2017**	**2018**	**2019**
SEM	831,550	1,663,100	2,757,200	3,588,750	3,588,750
TOTAL	**831,550**	**1,663,100**	**2,757,200**	**3,588,750**	**3,588,750**

Customer Incentives

Incentives provided to the customer will cover the cost of supporting that customers' participation in program, including education, energy coaching, periodic meetings, and the like.

Administrative Requirements

The Business Strategic Energy Management program will be administered through an implementation contractor. The Utility's role will be to ensure that:

- the implementation contractor performs all the activities associated with delivery of all components or the program, and
- Vectren's educational and program messages are delivered accurately and clearly to ensure the effectiveness of program delivery and maximize customer satisfaction with the program.

The program is expected to operate according to the following administrative and total utility budget:

Total Program Budget

Total Program Budget					
	2015	**2016**	**2017**	**2018**	**2019**
Program Staff Labor Cost	$75,000	$75,000	$50,000	$50,000	$50,000
Education & Marketing Cost	$8,316	$16,631	$27,572	$35,888	$35,888
Evaluation Cost	$8,316	$16,631	$27,572	$35,888	$35,888
Implementation Cost	$16,631	$33,262	$55,144	$71,775	$71,775
Incentive Costs	$41,578	$83,155	$137,860	$179,438	$179,438
Total Budget	**$149,840**	**$224,679**	**$298,148**	**$372,988**	**$372,988**

Cost-Effectiveness

The cost-effectiveness metrics of the Business Strategic Energy Management program are as follows:

Cost Effectiveness Tests						
	TRC Ratio	TRC Benefits	TRC Costs	UCT Ratio	PCT Ratio	RIM Ratio
Bus SEM	**1.61**	**$1,821,203**	**$1,133,881**	**1.61**	**-**	**0.43**

BUSINESS AND MULTIFAMILY NEW CONSTRUCTION PROGRAM

Program Description	The Business and Multi Family New Construction program is designed to accelerate the incorporation of energy efficient design, construction, and operation in new business and multifamily residential buildings. The program provides facility designers, builders, and owner-builders with training, design assistance, and incentives for installing high efficiency end-use equipment and building envelope measures in newly constructed and renovated facilities. The program has the following components, directed mainly to the commercial and industrial design and construction community: training, design assistance, and financial incentives. <u>Training</u> • General training in best practices—provides technical workshops and other technical developmental activities for the design and engineering community to familiarize and educate them on energy efficient design methods and new technologies. <u>Design Assistance</u> • Directed to upstream providers of design and construction services—architects and engineers (A&E), designers/builders, and contractors. • Project-specific assistance—will provide a participant with the services of a consulting engineer to evaluate the cost-effectiveness of energy-saving measures under consideration and to recommend measures that may have been overlooked. • The program will also provide design and engineering consultants with validation of their prospective energy efficiency projects in presentations to clients. <u>Incentives</u> • Directed to upstream providers of design and construction services but also available to facility owners. • Custom rebates payable on a per-kWh-saved basis when compared with “standard” design and equipment installations. • Participant must submit project energy savings generated by approved building energy modeling software to be eligible for installation rebate. The program is currently available to commercial and industrial customers, but would incorporate a new component to target the multifamily market in 2015.
Objectives	The purpose of the Business and Multi Family New Construction program is to greatly improve the energy efficiency of all newly constructed facilities and facilities that are completely renovated or reconstructed in the Vectren service territory. It aims to instill and accelerate adoption of design and construction practices so that new commercial and industrial facilities are more energy efficient than the current stock. The focus of the program is on integrated design.

	The program has several objectives: • Change building design and construction practices used by architects and engineers, contractors, and owners to include all cost-effective energy efficiency designs and equipment. • Capture "lost opportunities" to reduce electric demand and energy usage in the commercial and industrial sector by providing participants with design assistance and custom rebates or performance contracting for the construction of energy-efficient buildings and facilities.
Target Market	The target market for the Business and Multi Family New Construction program is decision makers for the design and/or construction of new facilities and renovation contractors and developers. This program will cover both new constructions and buildings/facilities undergoing "major renovation," defined as buildings where multiple major systems are undergoing significant upgrades. While the energy and peak load savings resulting from this program will be accrued by the building owners/tenants, the key target market of the program are the professionals most responsible for the design and equipment decisions—architects and engineers, design/builders, developers, and contractors.
Implementation Strategy	<u>Overview of Activities</u> The implementers will be involved in several activity areas: • Identification and recruitment of upstream market actors for program participation and delivery channel activities • Education: including development and operation of training seminars for A&Es, designers, builders, and developers; and development and distribution of educational publications • Marketing: including development and distribution of program materials in collaboration with Vectren, and design and construction professionals who will be both program participants and promoters • Design and Project Assistance: engineering and technical support for project development, and cost-effectiveness assessment, and estimation of financial incentives; design review and post-installation inspections • Rebate Processing: fulfillment house to receive, review and verify applications; and either pay or submit rebates to Vectren for payment • Program Performance Tracking and Improvement: including project tracking and documentation of project measures, rebate submittals and payments, opportunities to improve the program • Reporting: including reporting of program activities to meet regulatory and internal requirements, in particular progress toward program goals <u>Education Overview</u> Education is a key component of the Business and Multi Family New Construction program. The market will change through training, education and demonstration. The program will increase confidence in the performance and benefits of increased energy efficiency (better performance, lower fuel bills, increased comfort, reduced maintenance, etc.). Designers and builders will be encouraged to implement more energy-efficient strategies to increase energy efficiency through the program. Emphasis on the additional benefits of comprehensive energy efficiency improvements and continual maintenance to retain savings will demonstrate an overall cost-effectiveness that can be achieved without the need for financial incentives over the longer term.

	Ongoing deployment of these strategies will become "standard" practice by these same designers and builders in additional projects, affecting long-term market transformation. To accomplish this, the program will offer several forms of education as noted above: • Training seminars will be taught by experts in specific aspects of high-efficiency building design and construction. Many utilities offer these no-fee sessions on an ongoing basis. In addition to teaching key principles and an understanding of the program, they will provide Vectren with an excellent opportunity to develop strong relationships and build trust with this influential group, which is also the key target market for the program. • Vectren will consider linking the training activities with nationwide certification programs for builders, inspectors, lighting designers and with continuing education programs for architects and engineers. • Publications with technical information, practical advice, and persuasive messages will be developed. These can be included in newsletters directed to design/build, published in trade journals, sent in direct mail, distributed at seminars, and made available on a website page designed for this audience.
Issues, Risks, and Risk Management Strategies	Currently, several market barriers inhibit the participation in new construction programs. Such barriers, which the program implementation activities will address, include: • Perception of Increased Cost: Many designers and builders feel that increased building performance costs more, and that it is not cost-effective. • Risk Aversion: Historically, the commercial design and engineering community has been particularly slow to adopt new technologies or solutions. A&Es prefer to design and install systems and buildings using familiar technologies and designs. Liability issues are also a concern. • First Cost vs. Lifecycle Cost Considerations: Building developers are very concerned with first cost considerations as they often must build within a pre-determined budget. As such, they are reluctant to consider high-efficiency measures, which usually cost more. • Limited Technical Information: Designers and owners have limited familiarity with new products, technologies and their applications, and their associated benefits that extend beyond energy savings (comfort, durability, health, productivity and maintenance). ENERGY STAR and other available training programs are whittling away at this problem. • Inadequate Operational Procedures: Building systems are usually not tested to ensure that they perform as designed. In addition, owners frequently fail to implement an ongoing maintenance and quality assurance procedure to properly operate the equipment. <u>A special note on multifamily participants.</u> • Because multifamily buildings are a hybrid between residential and business customers, it is important to ensure that program tariffs and eligibility requirements are inclusive of both residential and commercial rate classes, such that potential participants are not stuck in limbo when they apply. Equally as important is to clearly delineate responsibility for implementation contractors who will be servicing this hybrid customer group.
Marketing and Outreach	Effective implementation of the program depends on marketing and outreach activities working effectively. • Because they are the key decision makers in new commercial and industrial facility design, it will be advantageous for Vectren to work "upstream"—with

	the design and construction community. Direct personal relationship building is a key component of outreach activities. For the program to be effective, Vectren must educate these professionals on how and why to upgrade their building practices. Once convinced, these design and construction influencers can promote the program and the efficiency benefits to their clients as well as to their suppliers and subcontractors. These professionals are really both participants and delivery channels for the program. • Articles and advertising in building design and engineering trade publications. • Bill inserts to existing commercial and industrial customers to alert them to opportunities available for major renovations and expansions to their facilities. • A program implementation contractor will implement the program on behalf of Vectren, including providing assistance with the utilities' direct marketing; recruiting and providing education to upstream channels; providing rebate fulfillment services; and tracking and reporting program activities and achievements toward goals.
Evaluation, Measurement and Verification Requirements	The data collection guidelines proposed for the program reflects current measurement and verification (M&V) practices. The M&V requirements and methods used to evaluate this program will conform to the state protocols. <u>Metrics for Gauging Program Success</u> • Number of projects completed • Energy savings associated with facilities built through participation in the program • Number of training seminar attendees and/or trades people certified in energy-efficient building principles • Increase in receptivity/adoption of energy-efficient building practices by designers, builders, and developers to measure the effectiveness of the marketing and education activities and progress towards market transformation <u>Data Collection Approaches</u> The data required for evaluating the program will depend on the methodology chosen. They will likely include the following sources and information: • Billing and/or metered use data • Engineering estimates of measure savings • Local weather data • Program tracking system for measures installed, rebates paid, and building characteristics • Upstream and building owner surveys regarding program awareness, satisfaction with the program and with the project results, understanding and perceived savings from measures, tenant characteristics, and program influence on design and construction decisions • Program implementer, and Vectren staff surveys <u>Impact Evaluation Methodology</u> The impact evaluation will likely use a variety of techniques to assess energy savings due to the program in new facilities/buildings. The analysis techniques will likely include performing engineering analyses and perhaps metering as well, to determine whether the participant facilities operate as designed and achieve the expected savings. Site visits will be conducted as part of the engineering and metering data collection; additional site visits may be added at a later date if any installation problems are identified. Site visits

will be used to determine if measures were installed as expected and to gather data for the engineering analysis of the homes as built. For this program perhaps above all others, the understanding and availability of baseline values for facility consumption will be critical to an assessment of energy savings.

Assessment of free-rider and free-driver effects, if deemed appropriate, may be conducted using survey data in conjunction with established M&V methodologies and procedures.

Process Evaluation Methodology

Program participants, local inspectors, and program implementation staff will be interviewed for the process evaluation. These interviews will focus on the construction and inspection processes of facilities built to new standards. In addition to obtaining information on facility characteristics, the participant (builder and/or owner) survey will ask questions about the effectiveness of program promotional activities, participant and occupant satisfaction with the facility, and whether the occupants have encountered any problems with their new equipment.

During the first year, the process evaluation will focus on program implementation, administration, and delivery. Interviews will be used to determine if the program is encouraging new construction practices and if the upstream market stakeholders and facility owners are finding the education useful. If there are difficulties in obtaining participation during the first year, the evaluation may be expanded to include focus group interviews with a larger sample of designers, builders, developers, and facility owners. During the second year, the process evaluation will assess how well program changes recommended during the first-year process evaluation are being implemented.

Program Schedule

The Business and Multi Family New Construction program will operate during PY 2015 through PY 2019. This is a Core Plus program that is ongoing in Vectren's current portfolio, but a new multifamily component will come online in 2015. The following table provides a schedule of key milestones:

Key Milestones	Timing
Assign internal program manager and staff	Anticipated in late 2013 or early 2014.
Select and contract with program implementation contractor(s)	2014, Q1
Finalize program design	2014, Q2
Pre-rollout program development: Build designer/builder network Develop designer/builder training curriculum and schedule Develop marketing strategies Develop procedures for tracking activities and documenting results	2014, Q3 and Q4
Program re-launch: All program services Offer designer/builder education Offer design assistance and rebates	2015, Q1
Prepare reports: Documentation of program activities and progress toward goals	Monthly throughout program implementation period

Reports to Commission	Quarterly, and annually
Development of multifamily component	2014, Q1 to Q4
Program launch of multifamily component	2015, Q1
Conclude program operation for this planning cycle	2019

Estimated Participation

Participation and measure adoption estimates were developed based on the number of commercial and industrial customers in the service territory and an assessment of the attainable market potential in the area, as well as past program experience and the experience of other organizations that have offered this type of program.

Total Estimated Participation (# of SqFt or Employees)

Measure	No. of Gross Installations*	NTG Ratio	No. of Net Installations*
Total Bus & MF NC	38,226,677	0.95	36,315,343

Projected Energy Savings

The estimated energy savings are given in terms of annual kWh by measure. The savings noted in each year are incremental, that is reflective of new measures installed by customers through the program in that year. This does *not* include the cumulative impact of measures still in operation from previous years.

Total Net Incremental Electricity Savings (kWh)

Total Net Incremental Energy Savings (kWh)					
Measure	**2015**	**2016**	**2017**	**2018**	**2019**
Total Bus & MF NC	1,108,657	1,385,749	1,530,080	1,902,365	2,008,604
TOTAL	**1,108,657**	**1,385,749**	**1,530,080**	**1,902,365**	**2,008,604**

Customer Incentives

Customer incentives will cover 40% of the incremental cost of measures. Also, program administrators can express this as a certain dollar incentive per package or tier level.

Administrative Requirements

Program administrative staff's role will be to ensure that:

- the implementation contractor performs all the activities associated with delivery of all components or the program, and
- educational and program messages are delivered accurately and clearly to ensure the effectiveness of program delivery and maximize customer satisfaction with the program.

The program is expected to operate according to the following administrative and total utility budget:

Total Program Budget

Total Program Budget					
	2015	2016	2017	2018	2019
Program Staff Labor Cost	$25,000	$25,000	$25,000	$25,000	$25,000
Education & Marketing Cost	$22,523	$27,925	$30,468	$37,440	$38,576
Evaluation Cost	$10,511	$13,032	$14,218	$17,472	$18,002
Implementation Cost	$90,091	$111,700	$121,873	$149,762	$154,305
Incentive Costs	$150,151	$186,166	$203,121	$249,603	$257,174
Total Budget	**$298,276**	**$363,822**	**$394,680**	**$479,277**	**$493,057**

Cost-Effectiveness

The cost-effectiveness metrics of the Business and Multi Family New Construction program are as follows:

Cost Effectiveness Tests						
	TRC Ratio	TRC Benefits	TRC Costs	UCT Ratio	PCT Ratio	RIM Ratio
Bus & MF NC	**2.06**	**$5,972,921**	**$2,896,189**	**3.66**	**5.04**	**0.75**

SMALL BUSINESS DIRECT INSTALL PROGRAM

Program Description	The Business Direct Install program provides a suite of targeted, highly cost-effective measures to small businesses in a quickly deployable program delivery mechanism, along with education and program support to help business customers reduce their energy bills. The program will provide several direct-install measures free of charge, such as lighting replacements, pre-rinse sprayers, programmable thermostats, pipe wrap, vending machine controls, and smart power strips. The program also connects customers with other programs in the portfolio and a network of qualified trade allies/contractors that can install follow-on measures to provide deeper energy savings. The Business Direct Install program has several components: • Walk-Through Audits—These are on-site assessments used to identify energy efficiency opportunities; audit reports contain specific recommendations, including expected costs, energy savings, and resource referrals. • Direct Installation of Measures—During the audit visit, the auditor will install a package of low-cost energy-saving measures, at no additional charge to the customer, to immediately improve the energy performance of the building. • Assistance with Additional Measure Installations—Vectren will provide cash rebates to audit participants who install additional measures recommended from the audit, as well as assistance on how to access rebates offered under other Vectren programs for additional recommended measures. • Workforce Training and Participation—The program will provide for the training and utilization of qualified auditors and contractors located within the community to provide program services. • Focus on Non-Profit Customers—Customers in the underserved category of qualifying 501c3, non-profit organizations will receive focused recruitment and technical assistance, enhanced direct-install measures suites, and higher incentive levels for follow-on measures.
Objectives	The program is part of a long-term strategy to raise awareness of energy savings opportunities among business customers and to help them take action using incentives offered by the utilities and state programs. The program will achieve several objectives: • Improve customer understanding of how their buildings use energy and how they can use it more effectively for less money • Procure immediate energy savings through installation of energy-saving measures • Encourage installation of additional energy-saving measures recommendations with additional incentives • Develop a workforce trained in assessing and improving building energy efficiency that can, ultimately, transform the market • Aid business customers' perception of Vectren as their partner in reducing energy use
Target Market	The target market for the Business Direct Install program is small business customers,

	defined as those who do not exceed 150 kW in energy demand per month. A special sub-focus of the program is helping non-profit businesses save energy. Contractors who can provide quality audits and installation of recommended measures are also targeted for participation to deliver the program services.
Implementation Strategy	The implementation strategy will incorporate the following components: Walk-Through Audits • Trained auditors provide businesses with a walk-through examination of their building using standard audit software for identifying existing conditions related to electric energy usage. The auditor will identify specific energy saving opportunities that could be installed by the contractor upon approval of a job scope by the customer. The auditor will review the billing history of the customer, anticipated costs and savings of the measures, along with information on financial resources available to help defray first-costs. Direct Installation of Measures • The auditor will install a package of measures, simple installations known to improve the energy efficiency of buildings, during the walk-through audit. • These measures will be installed at no charge to the audit participants. • These installations will provide immediate benefit to participants and savings attributable to the program. • At the conclusion of the site visit, customers will be provided with a check list of preliminary recommendations from the audit, to be followed within one week by a full report generated by the audit software. The program will take credit for only the installed measures at the time of the audit and verified installed measures recommended by the audit. Assistance with Additional Measure Installations • Providing customers with help in implementing the audit recommendations is key to the success of the program. The program will offer resources that include both financial incentives and installation assistance. • The customer will have access to incentives available from other Vectren programs to reduce the cost of installing remaining recommendations. • Vectren will contract with an implementation contractor who will manage and oversee that contractors are qualified/certified to install other measures recommended in the walk-through audit. Workforce Training and Participation Vectren will make use of auditors qualified to perform the walk-through audits and contractors knowledgeable about energy-efficient products and other measures likely to be recommended in the audit report. This can be achieved through development of relationships with electrical and general contracting trade allies, as well as community groups. Under the program, The implementers will: • Provide training to ensure the walk-through auditors demonstrate an understanding of building science principles and understanding of the Vectren programs. • Ensure that the walk-through auditors are familiar with all the incentives programs available to customers as well as provide education to customers. Overview of Implementation Activities

	During implementation, program staff will be involved in several activity areas: • Audits and customer reports: ensuring that auditors prepare reports that are comprehensive and comply with guidelines. • Recruitment and training of audit and installation contractors; verifying that all contractors on the qualified list have appropriate testing equipment and data analysis software. • Monitoring of auditors who perform the walk-through audit and contractors who install recommended measures. This includes scheduling of home audit appointments and verification of inspections and measure installations. • Program marketing: including development and distribution of program materials in collaboration with Vectren, and promotional campaigns in collaboration with upstream participants. • Program education and outreach: including development of promotional campaigns to promote in coordination with other incentive programs. • Incentive processing: this includes payments to contractors for the installation of the measures during audits and to customers for installation of recommended measures. • Program activity tracking: including tracking of audit requests, audit activities, customer actions, and incentive tracking. • Reporting: development of documentation to meet reporting requirements for the Commission. <u>Education Overview</u> Education is a large component of the Business Direct Install program, and will be both publicly distributed and customer-specific. • The customer reports generated following the walk-through audits provide one-on-one educational opportunities. Using data from their buildings, customers will learn how they use energy and how they can use it more wisely. • The workforce training provides an opportunity to educate equipment and construction contractors about the benefits of energy efficiency and about the program.
Issues, Risks, and Risk Management Strategies	All of the implementation activities—the educational component, together with outreach and marketing of the program, will address the following barriers to achieve the educational and energy savings goals of the program: • Contractor Participation—A limited supply of qualified contractors with the skills to diagnose and market energy efficiency improvements can limit program potential. A solution is the development of a local network of qualified professionals to provide audit and installation services and to promote the program to residential energy customers. The implementers will: o Offer technical training to participating trade contractors, including classroom and field sessions and cover building science principles, diagnostic testing and installation best practices. Consider including certification to ensure the training is effective and valuable as a selling point for the contractors. o Offer sales and business process training to help contractors succeed in selling and delivering energy efficiency services, including procedures for quality assurance, employee training, and understanding program incentives or financing.

	• Consumer Financing and Incentives—The up-front costs of making the recommended improvements may limit customer participation in the program or delay projects unless customers have a way to get them done and to pay for them. o Some program sponsors partner with financial institutions to provide low-interest loans. o Some program sponsors offer cash rebates directly through the program or in collaboration with other program. o Additionally, having easy access to contractors who can complete the work provides incentive to act on the audit recommendations. Offering referrals or a list of qualified/participating contractors can be a help. • Marketing and Education—Customers may not be familiar with energy efficiency and the benefits it can provide for improving comfort, as well as saving energy. Marketing activities can educate them about the benefits. o Vectren will communicate known partner offers and make customers aware through bill inserts, web site or some targeted direct mail. These tactics can help educate businesses about the benefits of the energy improvements and how they can take advantage of the program. o The program implementation contractor will work to develop and enlist the help of participating contractors to promote and educate customers about the program. • Quality Assurance—Consumers should be assured that the program offers reliable, high quality services. o The program should have a quality assurance plan to aid delivery of the program services, provide protocols for contractor reporting, and support program evaluation. o Participating auditors and contractors have sufficient training to perform program audits and installations and sets standards for the number of work inspections completed by participation contractors. • Challenges with Customer Engagement – If participants begin to demonstrate that they are not engaging with follow-on measures or further audit recommendations, or that they are not fully invested in the program, the implementer may consider adding a nominal audit fee of $50, simply to discourage participation by businesses that have no intention of fully utilizing the program. The audit fee may be credited back to the customer if they proceed with further installation of the measures.
Marketing and Outreach	Marketing and outreach in the Business Direct Install program will employ the following strategies: • Vectren will develop awareness through direct marketing—e.g., bill inserts, newsletters, website, broadcast and print media, and direct mail. The program information may need to be mailed frequently to customers. • Walk-Through auditors—part of auditors' services can and should include making customers aware of this program and the incentives available for installation of high-efficiency measures. • Coordination of marketing efforts with the Business Prescriptive and other Vectren programs.
Evaluation,	The evaluation methodology and data collection proposed for the Business Direct Install

Measurement and Verification Requirements	program are guidelines that reflect current measurement and verification (M&V) practices. The ultimate M&V requirements for this program will conform with the State protocols. Metrics for Gauging Program Success Primary: • Improvement in customer understanding how to improving energy efficiency • Number of walk-through audits completed • Number of direct installation packages delivered • Number of audits that result in documented energy efficiency improvements in this and other Vectren programs • Number of participating audit and energy efficiency improvement contractors • Periodic summary of 'before' and 'after' audit data from the implementation contractor • Results of all diagnostics tests • Projected energy savings from the audit • Number of customer audit fees received and reimbursed • Customer satisfaction with the program and the products • Participation in other Vectren programs Secondary: • Information related to which of the recommended measures were installed • Energy usage reduction in buildings that have had audits • Program implementation costs incurred Data Collection Approaches Vectren will collect and submit data that meet the reporting requirements. The participating contractors who conduct the audits and/or perform the energy improvements will provide much of the data. The contractors should provide at least the following: • Name, address, and contact information (including email address if possible) of customer • Results of assessment and diagnostic tests • Recommended improvements • Estimated cost of improvement • Estimated energy savings • Summary of completed improvements and test-out results Data will also be collected through surveys of Vectren business customers and participating contractors to aid the process and impact evaluation, assess participant satisfaction, and identify opportunities for program improvement. The surveys may be conducted by the implementation and M&V contractors. Customer billing data prior to and following program participation will be required to assess energy use and improvement opportunities, and assess and/or verify savings for the payment of customer incentives. The program will have a tracking system to house the program activity information and enable regulatory reporting.

Impact Evaluation Methodology

The first step is to establish a pre-participation energy use "baseline" based on customer bills, followed by post-participation tracking of energy use through bills. This, together with information on exact measures installed during the audit and additional measures installed as provided by the installation contractors, would allow assessment of customer energy savings.

The M&V contractor will determine the appropriate means of estimating savings attributable to the program; that is, net savings, including both free-ridership and spillover. Spillover may be particularly relevant to this program. Because the major thrust of the program is to encourage customers to think about the building as an entire system, it would not be surprising to find that customers continue to make additional energy-related improvements on their own (i.e., without incentives) after participation in the program.

Process Evaluation Methodology

The Business Direct Install program is a relatively complex program, involving audits, direct installation of measures, delivery of an audit report with additional recommendations, and even subsequent installations with either the implementation contractor or other contractors. Process evaluations throughout the program will be critical to ensure that the program is operating as intended and to provide information that can enable improvements in both the program design and delivery of services.

Process evaluations will assess customer understanding, attitude about, and satisfaction with the program and with Vectren's other educational activities and materials. They will obtain feedback from the contractors who perform installations and audits. The evaluations will make use of survey data collected by the implementation and M&V contractors. Process evaluation will be conducted throughout the program by the implementation and M&V contractors selected by Vectren.

Program Schedule

The Business Direct Install program is already part of the current Vectren portfolio and will continue to operate through PY 2019. The following table provides a schedule of key milestones:

Key Milestones	Timing
Assign internal program manager and staff	Anticipated in late 2013 or early 2014.
Select and contract with program implementation contractor(s)	2014, Q2 or immediately upon program approval
Finalize program design	2014, Q2
Pre-rollout program development: Auditor/contractor training and recruitment	2014, Q3 and Q4
Program re-launch: Launch consumer marketing and outreach Perform audits and improvements	2015, Q1
Prepare reports: Documentation of program activities and progress toward goals Reports to Commission	Monthly throughout program implementation period Quarterly, and annually
Conclude program operation for this	2019

	planning cycle	

Estimated Participation

Participation and measure adoption estimates were developed based on the number of commercial and industrial customers in the service territory and an assessment of the attainable market potential in the area, as well as past program experience and the experience of other organizations that have offered this type of program.

Total Estimated Participation (# of SqFt or Employees)

Measure	Option	No. of Gross Installations*	NTG Ratio	No. of Net Installations*
Screw-in	Mix of LEDs/CFLs	16,830,146	1.00	16,830,146
High-Bay Fixtures	T5	2,202,586	1.00	2,202,586
Linear Fluorescent	T5	9,475,524	1.00	9,475,524
HID	T5	5,440,731	1.00	5,440,731
Air-Cooled Chiller - Maintenance		85,151	1.00	85,151
Water-Cooled Chiller - Maintenance		63,648	1.00	63,648
RTU - Maintenance		2,997,662	1.00	2,997,662
Heat Pump - Maintenance		2,215,022	1.00	2,215,022
Water Heater - Faucet Aerators/Low Flow Nozzles		7,781,406	1.00	7,781,406
Thermostat - Clock/Programmable		5,318,525	1.00	5,318,525
Pre-rinse Sprayer		386,913	1.00	386,913
Interior Lighting - LED Exit Lighting		18,904,650	1.00	18,904,650

Projected Energy Savings

The estimated energy savings are given in terms of annual kWh by measure. The savings noted in each year are incremental, that is reflective of new measures installed by customers through the program in that year. This does *not* include the cumulative impact of measures still in operation from previous years.

Total Net Incremental Electricity Savings (kWh)

Total Net Incremental Energy Savings (kWh)						
Measure	Option	2015	2016	2017	2018	2019
Screw-in	Mix of LEDs/CFLs	570,652	564,428	552,655	632,858	704,515
High-Bay Fixtures	T5	95,265	88,684	90,545	23,922	11,144
Linear Fluorescent	T5	431,375	534,412	625,594	764,478	818,081
HID	T5	276,246	253,897	227,170	68,226	33,529
Air-Cooled Chiller - Maintenance		7,633	8,766	9,902	11,522	12,176
Water-Cooled Chiller -		5,464	6,305	7,165	8,469	8,970

Maintenance						
RTU - Maintenance		278,696	320,036	361,465	420,353	442,040
Heat Pump - Maintenance		160,786	183,905	207,386	241,035	253,574
Water Heater - Faucet Aerators/Low Flow Nozzles		43,553	49,623	55,507	63,865	66,259
Thermostat - Clock/Programmable		92,950	107,546	122,423	143,494	153,889
Pre-rinse Sprayer		7,598	8,668	9,703	11,169	11,596
Interior Lighting - LED Exit Lighting		6,467	7,320	8,189	9,392	9,777
TOTAL		**1,976,684**	**2,133,588**	**2,277,704**	**2,398,782**	**2,525,551**

Customer Incentives

Under this program, incentives are provided in several forms and to both customers and contractors who provide the audit and direct installation services. Incentives go to customers in the form of direct installation of measures during the audit visit and in the form of rebates for installation of recommended, follow-on measures that fall under the umbrella of other programs.

Audit contractors are also eligible to receive incentives under this program. Vectren will pay for the cost of materials for the measures that auditors install during the audits. This means that the auditor receives payment from the customer for the cost of the audit and from Vectren for the cost of materials in the package of measures installed during the audit. Customers are also free to contract with the same contractor to install additional measures, for additional cost, if the contractor offers this service.

Administrative Requirements

Vectren will administer the Business Direct Install program through an implementation contractor. Vectren's role will be to ensure that

- the implementation contractor performs all the activities associated with delivery of all components or the program, and
- educational and program messages are delivered accurately and clearly to ensure the effectiveness of program delivery and maximize customer satisfaction with the program.

The program is expected to operate according to the following administrative and total utility budget:

Total Program Budget

Total Program Budget					
	2015	2016	2017	2018	2019
Program Staff Labor Cost	$25,000	$25,000	$25,000	$25,000	$25,000
Education & Marketing Cost	$50,847	$57,250	$63,079	$71,441	$73,621
Evaluation Cost	$25,423	$28,625	$31,540	$35,720	$36,810
Implementation Cost	$127,117	$143,125	$157,699	$178,602	$184,052
Incentive Costs	$508,468	$572,498	$630,794	$714,410	$736,206
Total Budget	**$736,856**	**$826,498**	**$908,112**	**$1,025,174**	**$1,055,689**

Cost-Effectiveness

The cost-effectiveness metrics of the Residential Home Energy Assessment program are as follows:

Cost Effectiveness Tests						
	TRC Ratio	TRC Benefits	TRC Costs	UCT Ratio	PCT Ratio	RIM Ratio
Bus Direct Install	**1.85**	**$6,808,569**	**$3,675,085**	**1.85**	**-**	**0.56**

About EnerNOC

EnerNOC's Utility Solutions Consulting team is part of EnerNOC's Utility Solutions, which provides a comprehensive suite of demand-side management (DSM) services to utilities and grid operators worldwide. Hundreds of utilities have leveraged our technology, our people, and our proven processes to make their energy efficiency (EE) and demand response (DR) initiatives a success. Utilities trust EnerNOC to work with them at every stage of the DSM program lifecycle – assessing market potential, designing effective programs, implementing those programs, and measuring program results.

EnerNOC's Utility Solutions deliver value to our utility clients through two separate practice areas – Implementation and Consulting.

- Our Implementation team leverages EnerNOC's deep "behind-the-meter expertise" and world-class technology platform to help utilities create and manage DR and EE programs that deliver reliable and cost-effective energy savings. We focus exclusively on the commercial and industrial (C&I) customer segments, with a track record of successful partnerships that spans more than a decade. Through a focus on high quality, measurable savings, EnerNOC has successfully delivered hundreds of thousands of MWh of energy efficiency for our utility clients, and we have thousands of MW of demand response capacity under management.
- The Consulting team provides expertise and analysis to support a broad range of utility DSM activities, including: potential assessments; end-use forecasts; integrated resource planning; EE, DR, and smart grid pilot and program design and administration; load research; technology assessments and demonstrations; evaluation, measurement and verification; and regulatory support.

The team has decades of combined experience in the utility DSM industry. The staff is comprised of professional electrical, mechanical, chemical, civil, industrial, and environmental engineers as well as economists, business planners, project managers, market researchers, load research professionals, and statisticians. Utilities view EnerNOC's experts as trusted advisors, and we work together collaboratively to make any DSM initiative a success.

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DSM Growth Rate Summary		Notes
2016 Levelized Cost	$0.03322	
Growth Rate Down	4.00%	
Growth Rate Across 1st Four Blocks	1.00%	
Growth Rate between blocks 4 and 5	9.00%	**Aligns with updated MPS (Low/Recommended achievable)**
Growth Rate Across blocks 6-8	4.5%	**Aligns with updated MPS (Recommend/High achievable)**

	Levelized cost			% Increase	
	Low Potential	Recommended Potential	High Potential	% increase from low to rec	% increase from rec to high
2018	$0.026	$0.029	$0.031	9%	9%
2019	$0.026	$0.028	$0.030	10%	8%
2020	$0.026	$0.028	$0.031	7%	11%

	Potential as a percent of eligible sales			Difference	
	Low Potential	Recommended Potential	High Potential	Low and Rec	Rec and High
2018	1.09%	1.38%	1.93%	0.29%	0.55%
2019	1.17%	1.44%	2.08%	0.27%	0.64%
2020	1.09%	1.39%	1.94%	0.30%	0.55%

Projected Cost Per kWh for Gross Impacts								
	Block 1	Block 2	Block 3	Block 4	Block 5	Block 6	Block 7	Block 8
2016	$0.03322	$0.03355	$0.03389	$0.03423	$0.03731	$0.03899	$0.04074	$0.04257
2017	$0.03455	$0.03489	$0.03524	$0.03560	$0.03880	$0.04055	$0.04237	$0.04428
2018	$0.03593	$0.03629	$0.03665	$0.03702	$0.04035	$0.04217	$0.04406	$0.04605
2019	$0.03737	$0.03774	$0.03812	$0.03850	$0.04197	$0.04385	$0.04583	$0.04789
2020	$0.03886	$0.03925	$0.03964	$0.04004	$0.04364	$0.04561	$0.04766	$0.04980
2021	$0.04042	$0.04082	$0.04123	$0.04164	$0.04539	$0.04743	$0.04957	$0.05180
2022	$0.04203	$0.04245	$0.04288	$0.04331	$0.04721	$0.04933	$0.05155	$0.05387
2023	$0.04372	$0.04415	$0.04459	$0.04504	$0.04909	$0.05130	$0.05361	$0.05602
2024	$0.04546	$0.04592	$0.04638	$0.04684	$0.05106	$0.05335	$0.05576	$0.05826
2025	$0.04728	$0.04776	$0.04823	$0.04872	$0.05310	$0.05549	$0.05799	$0.06060
2026	$0.04917	$0.04967	$0.05016	$0.05066	$0.05522	$0.05771	$0.06031	$0.06302
2027	$0.05114	$0.05165	$0.05217	$0.05269	$0.05743	$0.06002	$0.06272	$0.06554
2028	$0.05319	$0.05372	$0.05426	$0.05480	$0.05973	$0.06242	$0.06523	$0.06816
2029	$0.05531	$0.05587	$0.05643	$0.05699	$0.06212	$0.06491	$0.06784	$0.07089
2030	$0.05753	$0.05810	$0.05868	$0.05927	$0.06460	$0.06751	$0.07055	$0.07372
2031	$0.05983	$0.06043	$0.06103	$0.06164	$0.06719	$0.07021	$0.07337	$0.07667
2032	$0.06222	$0.06284	$0.06347	$0.06411	$0.06988	$0.07302	$0.07631	$0.07974
2033	$0.06471	$0.06536	$0.06601	$0.06667	$0.07267	$0.07594	$0.07936	$0.08293
2034	$0.06730	$0.06797	$0.06865	$0.06934	$0.07558	$0.07898	$0.08253	$0.08625
2035	$0.06999	$0.07069	$0.07140	$0.07211	$0.07860	$0.08214	$0.08583	$0.08970
2036	$0.07279	$0.07352	$0.07425	$0.07499	$0.08174	$0.08542	$0.08927	$0.09328