TENNESSEE VALLEY AUTHORITY POTENTIAL STUDY

VOLUME 1: EXECUTIVE SUMMARY

Final Report

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Global Energy Partners™
An EnerNOC Company

Global Energy Partners
An EnerNOC Company
500 Ygnacio Valley Road, Suite 450
Walnut Creek, CA 94596

P: 925.482.2000
F: 925.284.3147
E: gephq@gepllc.com

This report was prepared by

Global Energy Partners
An EnerNOC Company
500 Ygnacio Valley Blvd., Suite 450
Walnut Creek, CA 94596

Project Team:
I. Rohmund, Director
J. Borstein, Project Manager
D. Costenaro
A. Duer
D. Ghosh
K. Kolnowski
K. Marrin
F. Nguyen
A. Sanchez
S. Yoshida

Subcontractor*:*
The Brattle Group
353 Sacramento Street, Suite 1140
San Francisco, CA 94111

Dr. A. Faruqui
Dr. S. Sergici

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CHAPTER | 1

INTRODUCTION

Background

The Tennessee Valley Authority (TVA) has contracted with Global Energy Partners (Global) to conduct a potential study to assess 20-year potentials for energy efficiency (EE) and demand response (DR). TVA has an aspirational goal to lead the southeast in energy efficiency, and believes this leadership can be accomplished through the development and implementation of action plans for EE, DR, and end-use generation. This potential study will provide information to assist TVA in meeting that goal.

Toward this end, Global conducted a detailed, bottom-up assessment of the TVA market to deliver forecasts of energy use and peak demand, as well as forecasts of energy and peak-demand savings achievable through energy efficiency and demand response programs. The 20-year potentials study addresses the residential, small commercial, large commercial, and industrial sectors. Results of this task are discussed in two volumes, one for energy efficiency and one for demand response, as described below in the report organization.

Global also compared the results of the potential savings to those from existing regional potential studies that are specific to the Southeast and other select studies. This analysis, which appears in both the energy efficiency and demand response reports, also compares these potential studies with regard to methodology, assumptions, approaches, estimated baselines, technical performance, adoption, and program/regulatory context.

This document is **Volume 1: Executive Summary,** an overview of the entire energy efficiency and demand response analysis. The other volumes are:

- Volume 2, Energy Efficiency Potential
- Volume 3, Demand Response Potential

Objectives

Key objectives for the study include:

- Conduct a 20-year bottom-up energy efficiency potential study to determine the potential for specific energy efficiency measures to reduce the consumption and peak demand of electricity in the TVA service territory.
- Conduct a demand response potential study to determine the potential for reduction in peak demand through demand response programs.
- Compare the potential study results with other national and regional studies, including details regarding assumptions used to develop each of the studies.

Definitions of Potential

In this study, we estimate the potential for energy efficiency savings. The savings estimates represent gross 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

[1] Savings in "gross" terms instead of "net" terms means that the baseline forecast does not include naturally occurring efficiency. In other words, the baseline assumes that energy efficiency levels remain fixed as they are today. This rule holds true except in cases where enactment of future codes and standards were on the books before January 2011, e.g., the effects of the EISA 2007 lighting efficiency standard.

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. For this reason, we developed a range of achievable potential. These 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 equipment failure, customers replace their equipment with the most efficient option available. In new construction, customers and developers also choose the most efficient equipment option. Examples of measures that make up technical potential 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 available other measure, where applicable. For example, it includes installation of high-efficiency windows in all new construction opportunities and air conditioner maintenance in all existing buildings with central and room air conditioning. The retrofit measures are phased in over a number of years, which is longer for higher-cost measures.

Economic potential represents the adoption of all ***cost-effective*** energy efficiency measures. In this analysis, the total resource cost (TRC) test, which compares lifetime energy and capacity benefits to the incremental cost of the measure, is applied. Economic potential assumes that customers purchase the most cost-effective option at the time of equipment failure and also adopt every other cost-effective and applicable measure.

Achievable - High potential takes into account expected program participation resulting from ideal implementation conditions and customer preferences for energy-efficient technologies and demand response programs. Achievable - High establishes a maximum target for the EE savings that a utility 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 represents a lower bound on Achievable potential. It reflects limited DSM budgets and significant barriers to customer acceptance.

CHAPTER | 2

ENERGY EFFICIENCY POTENTIAL

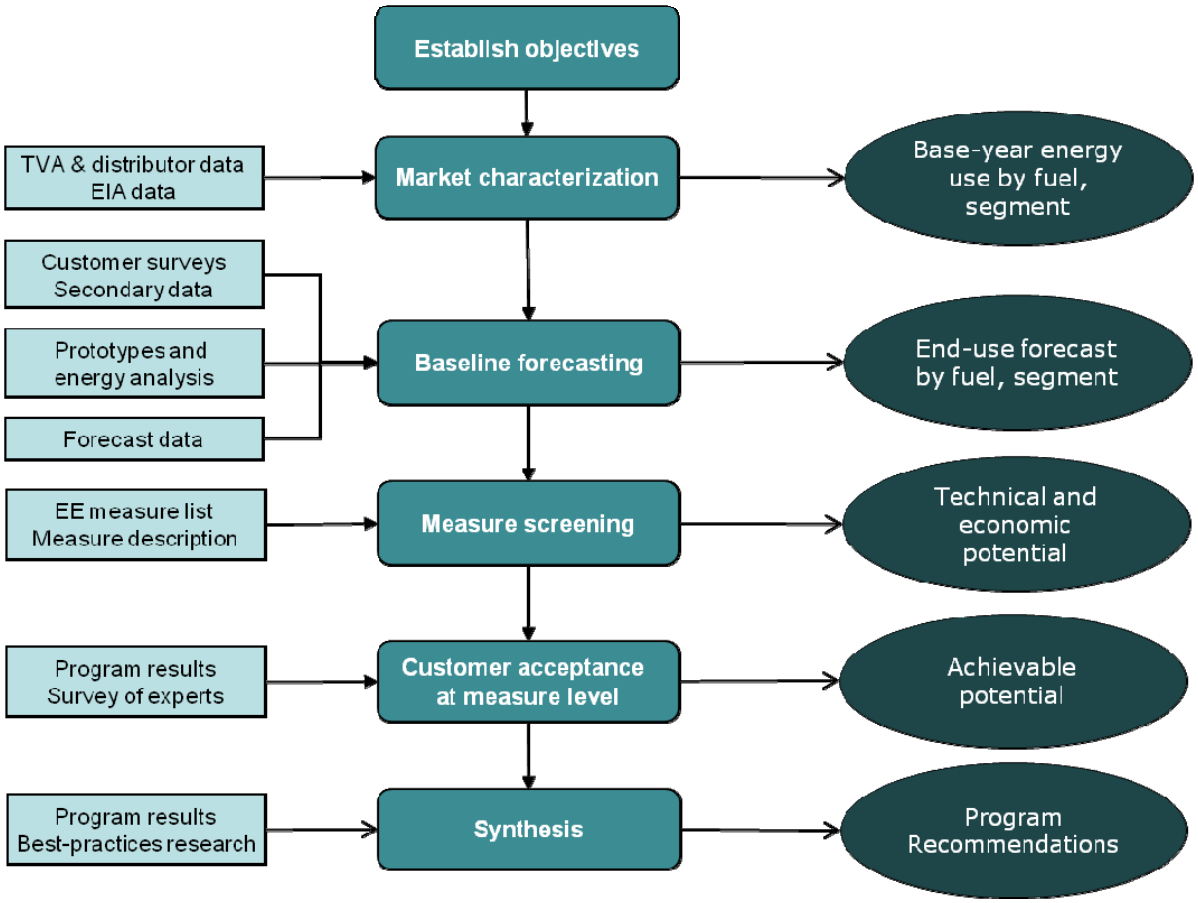
Analysis Approach

To perform the energy efficiency analysis, Global used a bottom-up analysis approach as shown in Figure 2-1. We took the following steps:

1. Held a meeting with the project team to refine the objectives that were identified in the TVA RFP. This resulted in a work plan for the study.
2. Performed a market characterization to describe sector-level electricity use for the residential, commercial, and industrial sectors for the base year, TVA 2009. (Note that all years referred to in this report are TVA fiscal years). This included using utility data and secondary data from sources such as the American Community Survey (ACS) and the Energy Information Administration (EIA).
3. Utilized TVA primary market research (such as TVA's 2010 residential market saturation survey) and secondary sources to understand how customers in the Tennessee Valley currently use electricity. Combining this information with the market characterization, we developed energy market profiles that describe energy use by sector, segment, and end use for 2009.
4. Developed a baseline electricity forecast by sector, segment, and end use for 2012 through 2032. Results presented in this volume are through 2030.
5. Identified and analyzed energy-efficiency measures appropriate for the Valley.
6. Estimated four levels of energy-efficiency potential, *Technical, Economic, Achievable - High,* and *Achievable - Low*.
7. Reviewed the current programs offered by TVA in light of the study findings to make strategic program recommendations for achieving savings.

The results from these steps are presented in the remainder of this chapter. Details are provided in Volume 2.

Figure 2-1 Overview of Analysis Approach



Market Characterization

The Tennessee Valley Authority (TVA) is the largest electric utility in the U.S. on the basis of energy sales, with annual sales of 174 billion kWh in 2010.[2] TVA serves as the wholesale provider for 155 power distributors and directly serves 59 industrial and federal facilities. Its service territory, with an approximate area of 80,000 square miles, encompasses more than 9 million people in seven southeastern states. It includes nearly the entire state of Tennessee as well as portions of Alabama, Georgia, Kentucky, Mississippi, North Carolina, and Virginia. Major cities are Memphis, Nashville, Knoxville, Huntsville, and Chattanooga. The top industries in the service territory are chemical products, primary metals, paper products, and food products.

Total electricity use for the residential, commercial and industrial sectors for TVA in 2009 was 146,118 GWh.[3] As shown in Figure 2-2, the largest sector is residential, accounting for 42%, or 62,246 GWh. The remaining use is split between the commercial and industrial sectors, at 39,561 GWh and 44,311 GWh respectively.

[2] http://www.tva.com/abouttva/index.htm

[3] Energy given "at-the-meter," i.e., does not include line losses. Also, totals do not include outdoor lighting, federal customers, or a small number of DSI customers as specified by TVA project management.

Figure 2-2 Sector-Level Electricity Use, 2009

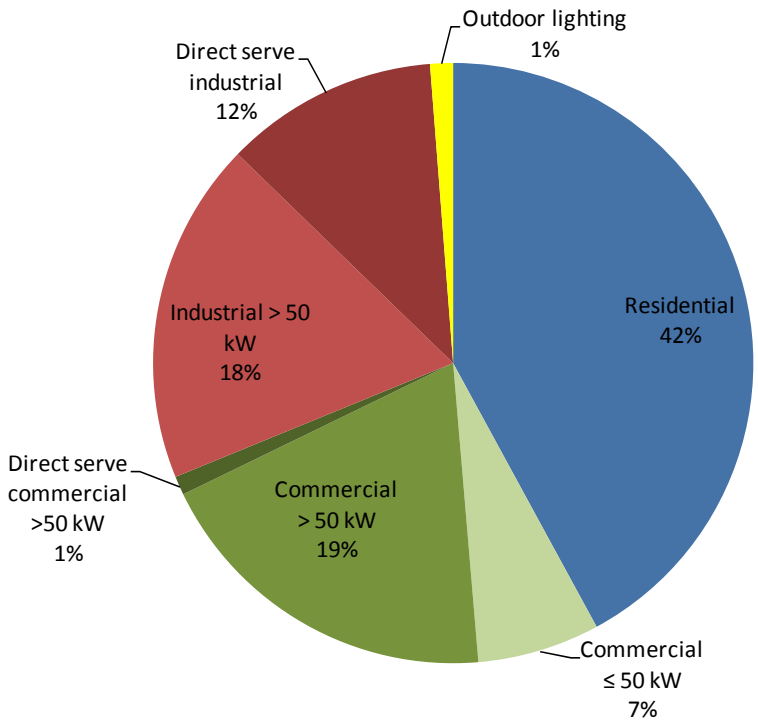


Figure 2-3 presents the end-use shares of residential electricity use for each housing type. Here, the single family segment is shown as a segment average as well as broken out into single family all-electric homes and single family other homes. The TVA territory has a large number of all-electric homes, roughly half of the single family homes in the Valley, with comparatively larger consumption in heating, water heating, and cooking.

Figure 2-3 End-Use Shares of Total Electricity Use by Housing Type, 2009

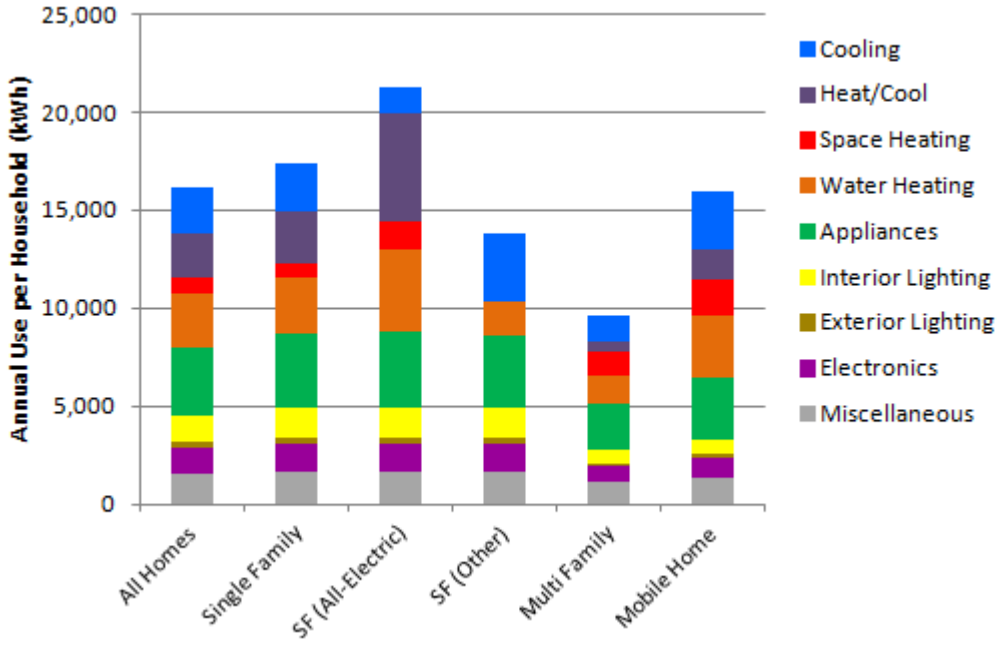


Figure 2-4 shows the breakdown of annual commercial electricity usage by end use. Cooling and lighting are the largest end uses in the commercial sector, accounting for over half of total usage.

Refrigeration and ventilation are the next largest end uses. Each of the remaining end uses accounts for 5% or less of total usage.

Figure 2-4 Commercial Electricity Consumption by End Use, 2009

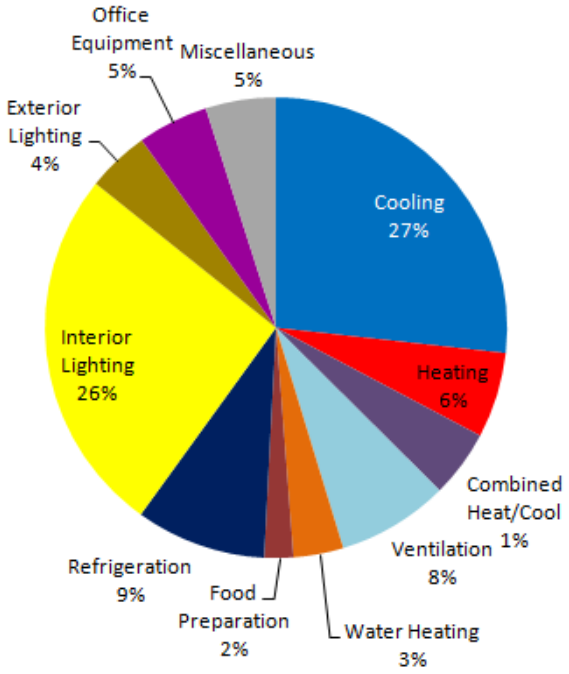
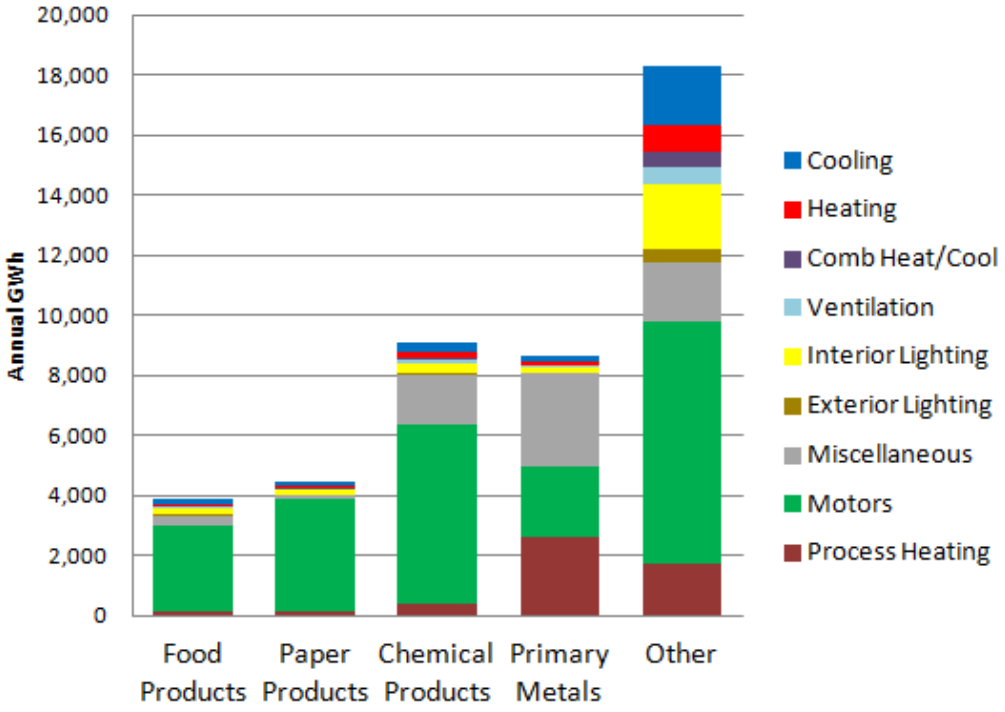


Figure 2-5 shows how the major industrial segments in the Valley used electricity in 2009. Machine drives dominate all segments, though process heating is more prevalent in the primary metals segment.

Figure 2-5 Industrial Electricity Use by End Use and Segment, 2009



Baseline Forecast

Prior to developing estimates of energy-efficiency potential, a baseline end-use forecast was developed to quantify how electricity is used by end use in the base year and what the consumption is likely to be in the future in absence of new utility programs and naturally occurring efficiency. The baseline forecast serves as the metric against which energy efficiency potentials; technical, economic, and achievable, are measured. The baseline forecast we developed for TVA was consistent with its official forecast from October 2011.

Figure 2-6 through Figure 2-8 present the baseline end-use forecasts for the residential, commercial and industrial sectors. Referring to Table 2-1 and Figure 2-9, electricity use across all three sectors is expected to increase by 24% between the base year, 2009, and 2030, for an average annual growth rate of 1.0%.

- The residential sector has the highest growth, with a 33% increase (1.4% annual growth rate) over the forecast horizon.
- The commercial sector has a dip in the short term and then recovers after 2015. Overall, it has the slowest growth at 0.6% per year on average.
- The industrial sector shows a steady increase in use throughout the forecast period with an average growth rate of 0.9% per year.

Figure 2-6 Residential Baseline Forecast by End Use

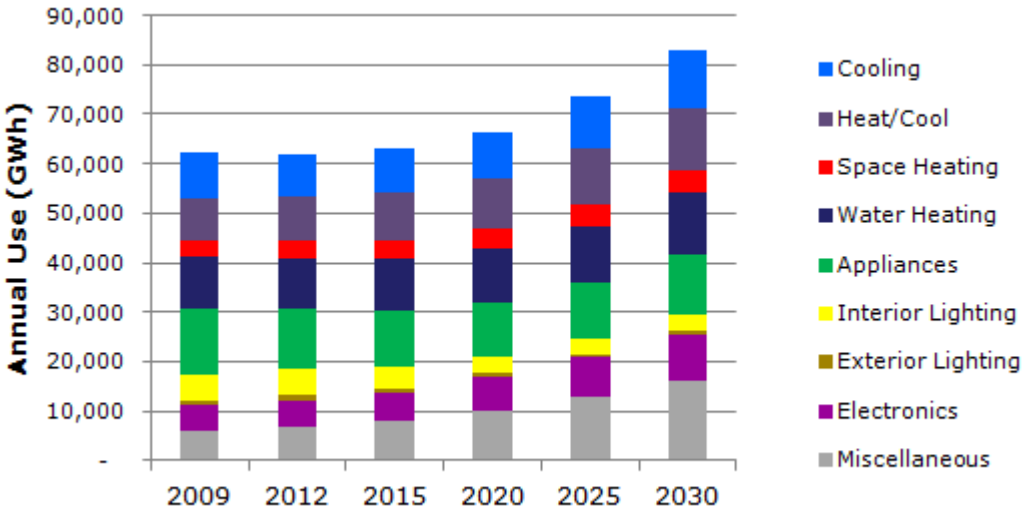


Figure 2-7 Commercial Baseline Electricity Forecast by End Use

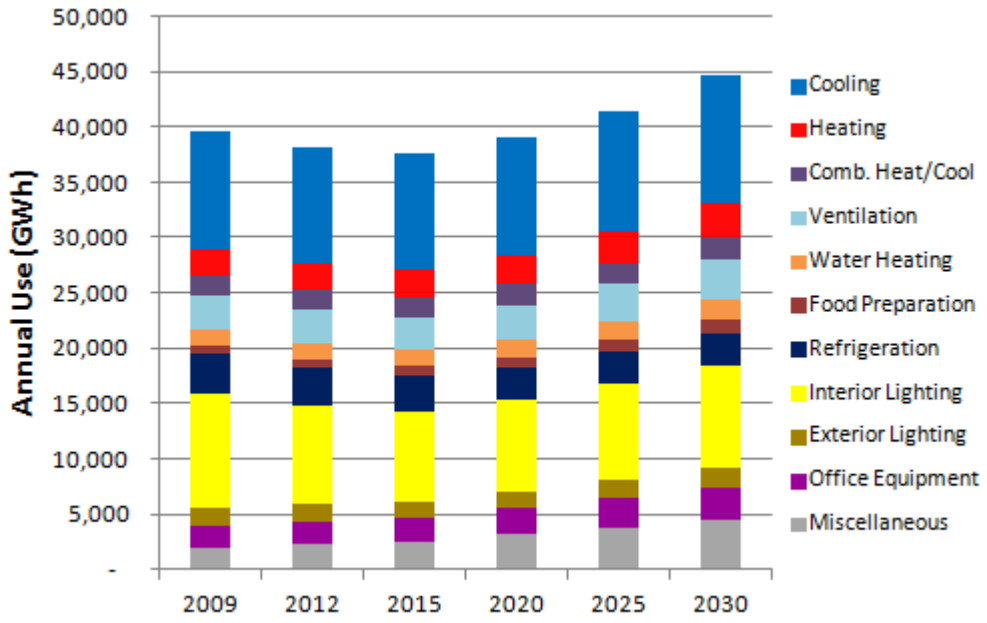


Figure 2-8 Industrial Baseline Electricity Forecast by End Use

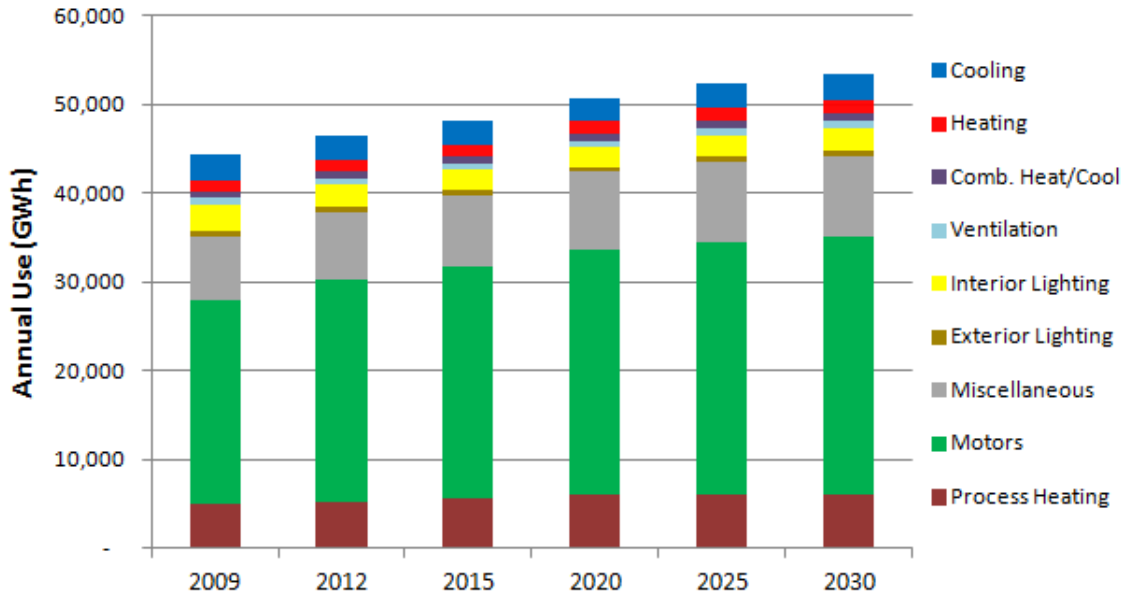
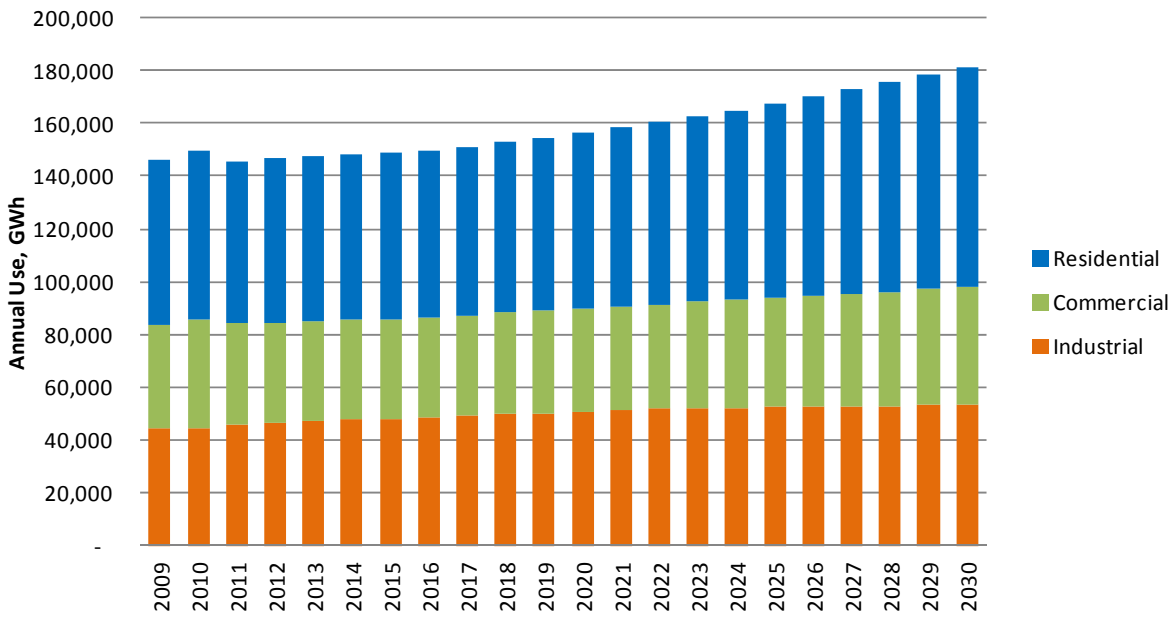


Table 2-1 Baseline Forecast Summary

Sector	2009	2012	2015	2020	2025	2030	% Change	Avg. growth rate
Residential	62,246	61,936	62,932	66,440	73,613	82,830	33%	1.4%
Commercial	39,561	38,176	37,587	39,026	41,485	44,718	13%	0.6%
Industrial	44,311	46,394	48,173	50,777	52,364	53,412	21%	0.9%
Total	**146,118**	**146,505**	**148,692**	**156,243**	**167,462**	**180,959**	**24%**	**1.0%**

Figure 2-9 Baseline Forecast Summary



Energy Efficiency Measures

The first step of the energy efficiency measure analysis was to identify the list of all relevant energy efficiency measures that should be considered for the TVA potential assessment. Sources for the measure assumptions were drawn from TVA's Measurement Manual and latest program evaluation results, Global's building modeling tool BEST, and Global's other measure databases from previous studies and program work.

The measures are categorized into two types according to the LoadMAP[4] taxonomy: equipment measures and non-equipment measures:

- ***Equipment measures,*** or efficient energy-consuming pieces of equipment, save energy by providing the same service with a lower energy requirement. An example is the replacement of a standard efficiency refrigerator with an ENERGY STAR model. For equipment measures, many efficiency levels are available for a specific technology that range 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 federal standard SEER 13 unit and spans a broad spectrum of efficiency, with the highest efficiency level represented by 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 the air conditioner only when people are home. Non-equipment measures fall into one of the following categories:
    - Building shell (windows, insulation, roofing material)
    - Equipment controls (thermostat, occupancy sensors)
    - Equipment maintenance (cleaning filters, changing setpoints)
    - Whole-building design (natural ventilation, passive solar lighting)
    - Lighting retrofits (included as a non-equipment measure because retrofits are performed prior to the equipment's normal end of life)

[4] Global's Load Management Analysis and Planning™ tool

- Displacement measures (ceiling fan to reduce use of central air conditioners)
- Commissioning and retrocommissioning

Table 2-2 summarizes the number of equipment and non-equipment measures evaluated for each sector.

Table 2-2 Number of Measures Evaluated

	Residential	Commercial	Industrial	Total Number of Measures
Equipment Measures Evaluated	102	126	85	**313**
Non-Equipment Measures Evaluated	42	52	74	**168**
Total Measures Evaluated	**144**	**178**	**159**	**481**

Energy Efficiency Potential Results

Table 2-3 and Figure 2-10 summarize the energy-efficiency savings for the different levels of potential relative to the baseline forecast. Figure 2-11 displays the energy-efficiency forecasts.

- ***Achievable - Low potential*** forms a lower point on the range of achievable potential. Across all sectors, this metric is 3,256 GWh in 2015 and increases to 19,093 by 2030. This represents 2.2% of the baseline forecast in 2015 and 10.6% in 2030. By 2030, Achievable – Low offsets 55% of the growth in the baseline forecast.
- ***Achievable - High potential*** forms the upper bound on the range of achievable potential. It is 7,494 GWh in 2015, which represents 5.0% of the baseline forecast. By 2030, the cumulative savings are 35,781 GWh, 19.8% of the baseline forecast, for an annual average of just over 1% per year. By 2030, Achievable – High completely offsets growth in the baseline forecast.
- ***Economic potential***, which reflects the savings when all cost-effective measures are taken, is 12,418 GWh in 2015. This represents 8.4% of the baseline energy forecast. By 2030, economic potential reaches 44,821 GWh, 24.8% of the baseline energy forecast.
- ***Technical potential***, which reflects the adoption of all energy efficiency measures regardless of cost-effectiveness, is a theoretical upper bound on savings. In 2015, energy savings are 15,347 GWh, or 10.3% of the baseline energy forecast. By 2030, technical potential reaches 57,244 GWh, 31.6% of the baseline energy forecast.

Table 2-3 Summary of Energy Efficiency Potential

	2012	2015	2020	2025	2030
Baseline Forecast (GWh)	146,505	148,692	156,243	167,462	180,959
Energy Savings (Cumulative GWh)					
Achievable - Low	811	3,256	7,963	13,420	19,093
Achievable - High	2,417	7,494	15,337	25,215	35,781
Economic	4,481	12,418	21,658	33,091	44,821
Technical	5,349	15,347	27,545	42,822	57,244
Energy Savings (% of Baseline)					
Achievable - Low	0.6%	2.2%	5.1%	8.0%	10.6%
Achievable - High	1.7%	5.0%	9.8%	15.1%	19.8%
Economic	3.1%	8.4%	13.9%	19.8%	24.8%
Technical	3.7%	10.3%	17.6%	25.6%	31.6%

Figure 2-10 Summary of Achievable Potential Energy Savings

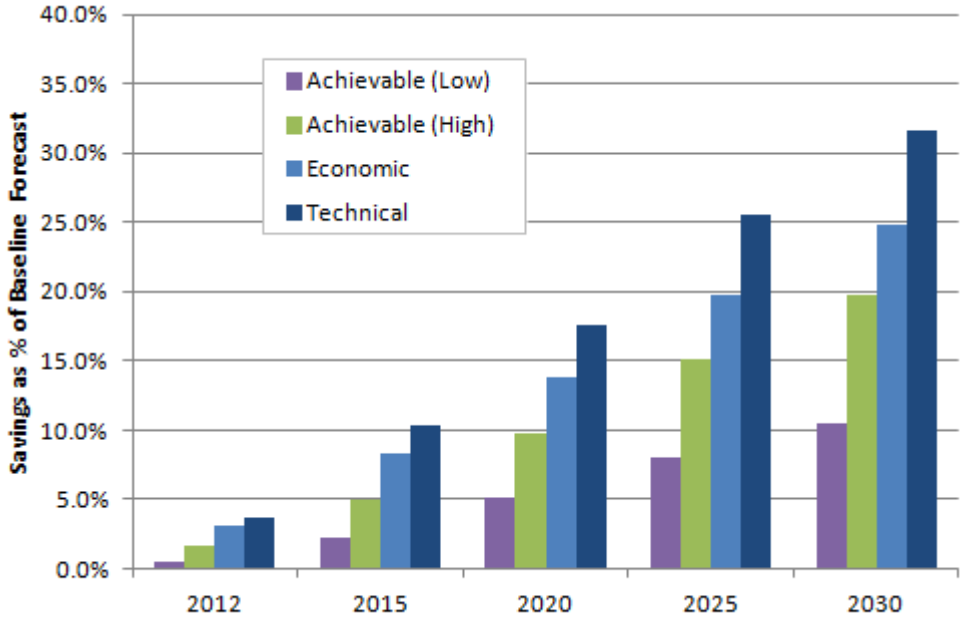


Figure 2-11 Energy Efficiency Potential Energy Forecasts (GWh)

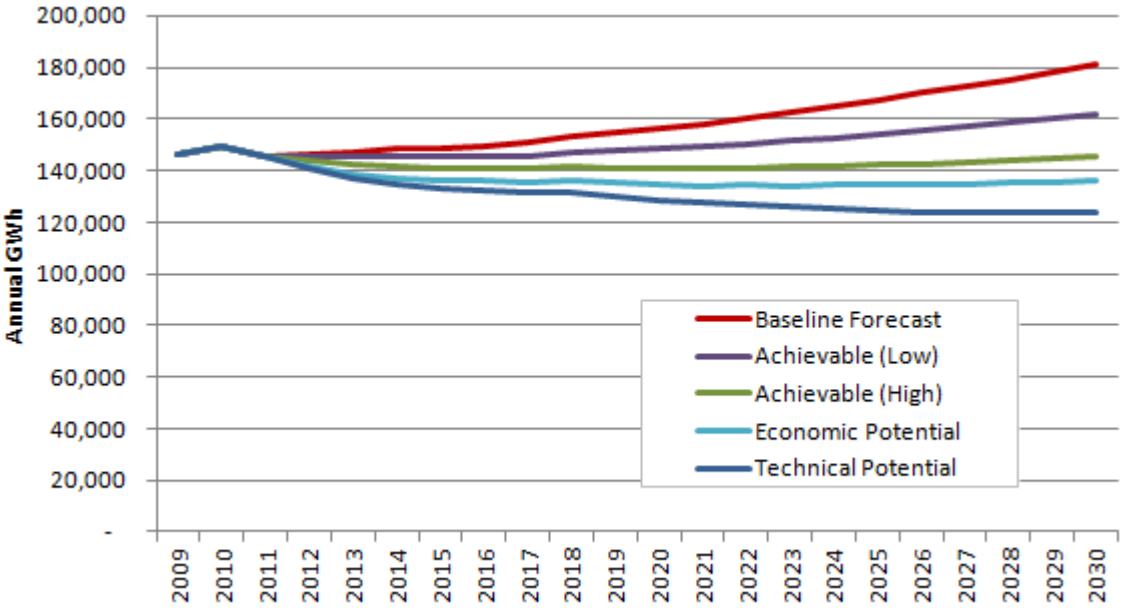


Table 2-4 summarizes the range of achievable potential by sector. The residential sector accounts for the largest portion of the savings, about half of the Achievable - Low potential, followed by the commercial and then the industrial sectors.

Table 2-4 Achievable Energy Efficiency Potential by Sector (GWh)

	2012	2015	2020	2025	2030
Achievable - Low Savings (GWh)					
Residential	384	1,444	3,216	5,652	8,307
Commercial	228	985	2,613	4,163	5,557
Industrial	199	826	2,134	3,604	5,229
Total	**811**	**3,256**	**7,963**	**13,420**	**19,093**
Achievable - High Savings (GWh)					
Residential	1,107	3,356	6,445	10,961	15,759
Commercial	660	2,181	4,693	7,419	10,130
Industrial	651	1,957	4,199	6,835	9,892
Total	**2,417**	**7,494**	**15,337**	**25,215**	**35,781**

Figure 2-12 focuses on the range of residential achievable potential in 2015 and 2030.

- Lighting equipment replacement accounts for the highest portion of the savings in the near term as a result of the efficiency gap between advanced incandescent lamps and CFL lamps.
- Water heating accounts for large savings in the long term because heat pump water heaters are found to be cost-effective.
- Electronics, appliances, and space conditioning measures also contribute significantly to the savings.

Figure 2-12 Residential Achievable Potential by End Use in 2015 and 2030

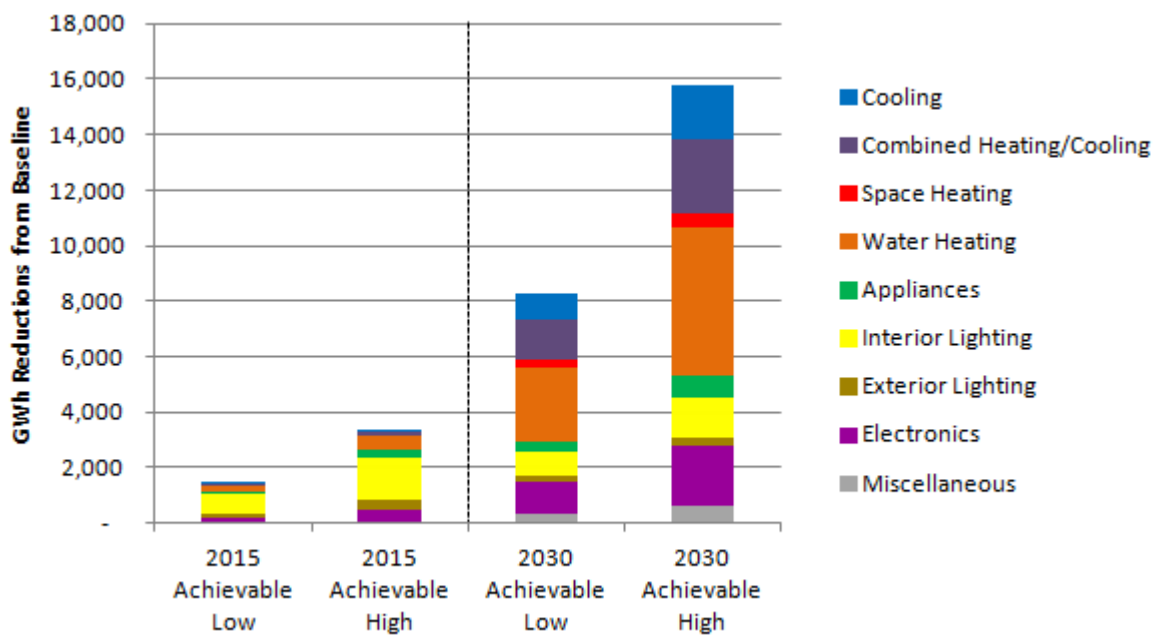


Figure 2-13 compares the range of potential in 2015 and 2030 for the commercial sector. Not surprisingly, interior lighting delivers the highest achievable savings throughout the study period. In 2015, exterior lighting is second, office equipment is third, and ventilation and cooling are next highest in terms of Achievable - Low potential. In 2030, though interior lighting still provides the greatest Achievable - Low potential, cooling is the second greatest source of savings, followed by refrigeration and exterior lighting.

Figure 2-13 Commercial Achievable Potential Savings by End Use in 2015 and 2030

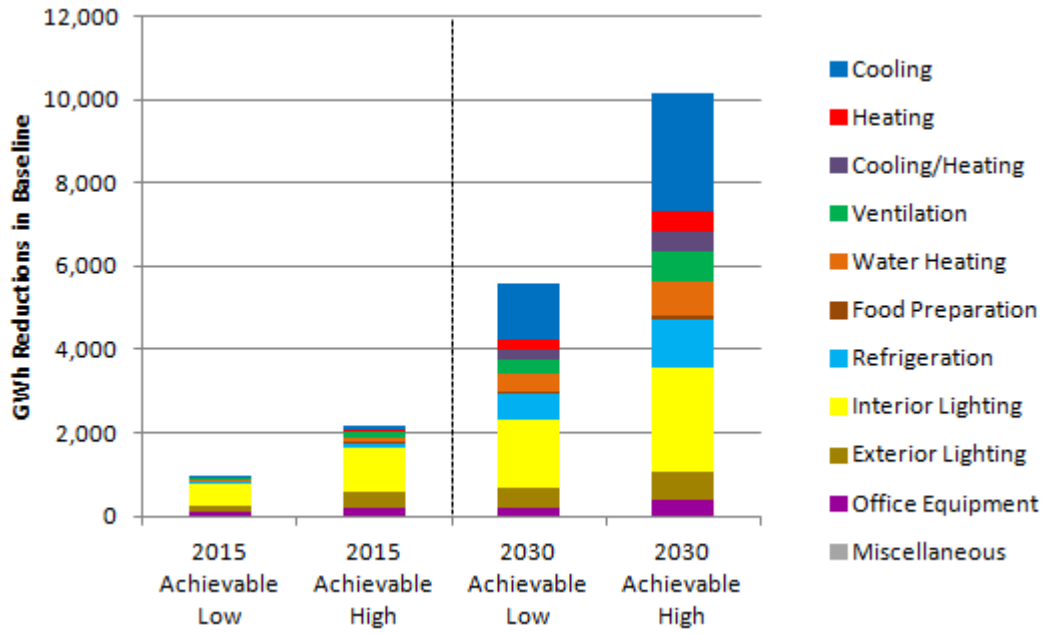
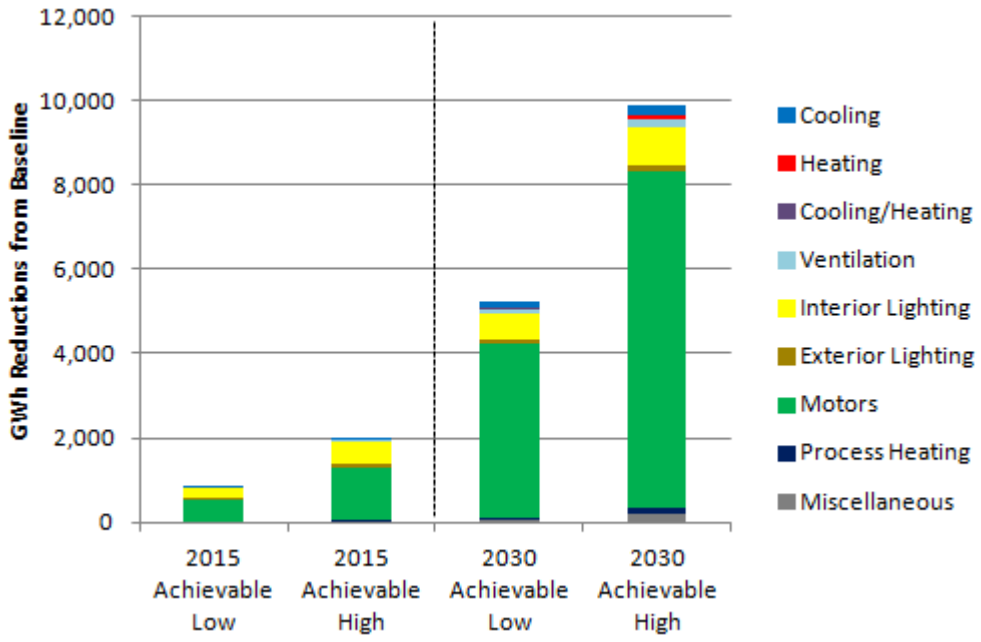


Figure 2-14 illustrates the range of achievable potential savings by end use in 2015 and 2030 for the industrial sector, reinforcing the dominance of the machine drive (motors) category. The specific measures that account for the largest savings in the industrial segment are:

- Integrated plant energy management: 45 MWh and 392 MWh of Achievable – Low potential in 2015 and 2030 respectively
- Fan and pump system measures, which include system optimization, energy management, and equipment upgrades: 135 GWh and 1,425 GWh of Achievable – Low potential in 2015 and 2030 respectively

Figure 2-14 Industrial Achievable Potential Savings by End Use in 2015 and 2030



EE Program Recommendations

The results of the EE assessment reveal that TVA has significant potential for energy efficiency resources over the next two decades. Our analysis has shown that TVA can realize an achievable range of reductions between 10.4% and 19.4% of the baseline forecast in 2030 with the measures represented in this report.

TVA's energy-efficiency programs are off to a strong start, with a comprehensive suite of programs currently moving from the planning phase to the implementation phase. Based on this study, Global provides the following recommendations to preserve and augment that momentum.

General Recommendations

- ***Coordinate distributor layer between TVA and end-user:*** As a wholesale provider for 155 power distributors, TVA's business landscape poses unique challenges for the administration of energy efficiency programs. Because of this arm's-length relationship with end users, TVA does not have the same level of information about customers as other utilities. TVA will need to coordinate closely with its power distributors. To facilitate better coordination, TVA should consider the hiring and training of dedicated personnel to serve as liaisons with the distributors.
- ***Maintain transparent stakeholder process:*** To date, TVA has been transparent and aboveboard with internal and external stakeholders. Continuing to involve stakeholders and cultivating a mutual understanding of continuous improvement is of paramount importance to the future success of programs. We recommend an open and transparent stakeholder process with regular touchpoints and workshops. Suggested workshop topics are: technical resource manual with deemed measure databases; evaluation, measurement, and verification protocols; emerging technologies; innovative program strategies; periodic reviews of program results; and sharing success stories from individual power distributors or customers.
- ***Create internal EE targets:*** TVA should continue to evolve and formulate its specific objectives regarding energy efficiency by creating targets and goals. Global recommends targets that fall within the range of achievable potentials identified in this study.
- ***Aggressively pursue lighting savings in the near-term:*** Lighting represents a bulk of the low-hanging fruit in the near term, with significant untapped potential in all sectors. Programs have not yet aggressively targeted lighting, beyond a limited CFL giveaway effort. Working upstream with trade allies and retailers will likely yield significant savings. In particular, as the EISA standards take effect, educational programs and coordination with retailers can help customers move beyond EISA-compliant lamps to more efficient CFL and LED technologies.
- ***Create targeted marketing messages:*** Energy prices in the Valley are cheaper than the national average. Correspondingly, the customer base does not have a long history of exposure to marketing and education regarding energy and sustainability issues like other jurisdictions around the nation. As a result, customers have not been strongly driven to consider energy efficiency measures, and awareness and adoption will be lower than national averages at first. Targeted marketing and education efforts should be developed with messages that speak to the customer base and cultivate shared attitudes.
- ***Expand knowledge of the customer base:*** TVA's pre-existing data regarding the customer base is minimal. Opportunities should be explored to expand this knowledge base. Not only will this information be valuable for program efforts, the results can be shared with distributors, many of whom are too small to conduct surveys on their own. Surveys should collect data in all sectors on end use equipment saturations, customer attitudes, and measure penetration.

Residential Recommendations

- ***Pursue CFLs:*** Significant, cost-effective potential is available with CFLs, in spite of the forthcoming EISA standards that will reduce their per-unit savings compared to the new baseline. Also, TVA should focus strong attention on specialty CFL programs, as these bulbs are not addressed in the EISA standard.
- ***Focus on all-electric homes:*** The prominence of all-electric homes, roughly 50%, has many implications for program design. Audit programs with direct install measures are one mechanism for reaching these customers. New construction incentives can help to boost the penetration of heat pumps, heat pump water heaters (HPWH), and advanced construction designs.
- ***Pursue heat pump water heaters:*** Heat pump water heaters offer significant potential, but educational efforts, for trade allies as well as homeowners, will be required to achieve this potential. Consider bundling HPWH with the existing and established space conditioning heat pump program to take advantage of the gains the heat pump programs have made in acquainting trade allies and targeted participants with heat pump technology.

Commercial and Industrial Recommendations

- ***Pursue lighting savings:*** 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.
- ***Create customized, multi-year plans for large, complex customers***: For large enough customers, large success can be obtained with strategic energy management (SEM)[5] initiatives over longer time horizons. This means a larger tracking and time commitment, but many jurisdictions are finding this to be a more effective method than a "one and done" installation and rebate approach. These relationships involve personalized plans, identification of metrics, goal-setting, technical assistance, and attention from account executives.
- ***Focus program efforts on motor controls and system optimizations:*** Low-cost retrofits can have significant, low-cost energy impacts with minimal disruption (and often times improvement) of business processes.

[5] Sometimes called Continuous Energy Improvement (CEI).

CHAPTER | 3

DEMAND RESPONSE POTENTIAL

Analysis Approach

The analysis approach for estimating demand response potential is, by necessity, different from the approach used for energy efficiency. Energy efficiency can occur outside of utility programs to the extent that it is naturally occurring or technology driven; but can be enhanced and enabled by utility programs. Demand response, however, does not exist without a utility program. A program-by-program analysis is therefore at the core of a demand-response potential study. The basic steps used to perform this assessment are as follows:

1. ***Characterize the market.*** The first step is to segment the market into the relevant customer segments. The first level of segmentation is by sector: residential and C&I customers. Within residential customers, we further segment the population by describing housing types and presence of end uses (such as single family homes with central air conditioning (CAC) and electric water heating). For C&I customers, the next level of segmentation is based on the maximum demand values, typically following utility rate schedules.
2. ***Identify baseline forecast.*** The second step is to identify what the peak demand forecast will be, absent any DR programs, for both summer and winter in the TVA service territory.
3. ***Define relevant DR options.*** The next step is to identify applicable DR options for each customer segment. DR options include direct load control (DLC), curtailable, demand reduction, capacity reduction, load shifting, pricing, and voltage reduction programs. Each of these options is mapped to the applicable customer segments. For some options, such as DLC, specific end uses can be controlled and they are identified. Also, enabling technologies, such as programmable communicating thermostats (PCT) are identified by customer segment.
4. ***Outline DR program participation hierarchy.*** For each customer segment that has more than one DR option, the next step is to define the participation hierarchy. This accounts for program overlaps and ensures that cross-participation in DR events and double counting does not take place.
5. ***Develop program parameters.*** Program parameters include participation rates, number of participants equipped with enabling technology, unit load reduction impacts, attrition rates, and DR event participation rates. Cost data are also developed for the analysis, including program development costs, customer marketing and recruitment costs, technology costs, customer incentives, operation and maintenance (O&M) costs, and program administrative costs.
6. ***Estimate preliminary potential and assess cost-effectiveness.*** The final step is to estimate the load reduction potential associated with each of the DR options by customer segment, and also at the aggregate level across programs and segment. Utility-provided avoided capacity costs are used to assess benefits from DR programs
7. ***Develop estimates of achievable potential.*** The final step is to estimate the load reduction potential associated with each of the DR options by customer segment, and also at the aggregate level across programs and segment. Achievable potential takes into account expected participation rates as well as cost-effectiveness of the program. For this study, we estimate a range of achievable potential:

- Achievable – High assumes higher participation rates that result from application of industry best practices in program design, higher budget limits for implementation, and does not incorporate the results of the cost effectiveness screen. Therefore, Achievable – High represents the upper bound of savings, regardless of cost.
- Achievable – Low assumes lower levels of participation as a result of limited budgets for program implementation and includes only those programs that pass the cost-effectiveness screen. Therefore the Achievable – Low represents a more realistic picture of DR potential given barriers to participation and cost constraints.

Unlike the energy-efficiency analysis, we do not consider technical or economic potential for demand response.

Matrix of Demand Response Options

For this study, a broad set of demand response options that combines traditional and emerging approaches was identified. They fall into eight groups: direct load control programs, curtailable programs, demand and capacity reduction programs, dynamic pricing programs, aggregator managed programs, load shifting programs, voltage regulation programs, and fast-DR. Table 3-1 translates the eight groups into eleven specific options by customer segment and identifies the enabling technology options and targeted end uses for each.

Table 3-1 Relevant DR Options Matrix

Demand Response Option	Brief Description	Eligible Customer Segments	Targeted End Uses
Residential Direct Load Control	Traditional DLC program utilizing either load control switches or programmable thermostats	Single Family residential customers with CAC, Water Heating, or Space Heating	CAC, Water Heating, Space Heating
C&I Direct Load Control	Traditional DLC program utilizing either load control switches or programmable thermostats	Small C&I customers with CAC, Water Heating, or Space Heating	CAC, Water Heating, Space Heating
Capacity Reduction	Voluntary load nomination program with capacity credits and energy credits	Small C&I, Medium C&I, Large C&I, Extra Large C&I (except 5&60 MR, > 500kW), Direct Serve	Customer Specific
Demand Reduction	Voluntary load nomination program with energy credits	Extra Large C&I, Direct Serve	Customer Specific
Curtailable	Contractual commitment to reduce load to a pre-specified level; capacity credits and non-performance provisions apply	Extra Large C&I, Direct Serve	Customer Specific
Dynamic Pricing	Voluntary time-variant pricing tariff (i.e., CPP)	Residential, Small C&I, Medium C&I, Large C&I, Extra Large C&I, Direct Serve	All
Fast DR	Load reduction with response time less than 10 minutes, suitable for providing ancillary services	All	Customer Specific
Third Party Aggregated	Represents primarily the existing TVA program	Medium C&I, Large C&I, Extra Large C&I	Customer Specific
Distributor Aggregated	Represents TVA's Distributor Aggregated Demand Response (DADR) Program	Residential, Small C&I, Medium C&I, Large C&I, Extra Large C&I	Customer Specific
Load Shifting	Represents TVA's 'Residential and Commercial Shift and Store Program	Residential, Small C&I, Medium C&I	Customer Specific
Voltage Regulation	Represents TVA's Conservation Voltage Regulation (CVR) and Dispatchable Voltage Regulation (DVR) Programs	Residential, Small C&I, Medium C&I	Not applicable

Load Impacts

Table 3-2 presents the load reductions per program participant (or unit impacts). Where current TVA DR programs exist, unit impacts are benchmarked to the values observed in those programs. Where there are no existing programs, unit impacts are based on the FERC study's Expanded Business as Usual (EBAU) scenario for Tennessee and values from Global's other recent potential studies.[6]

Table 3-2 Load Reduction Impact Assumptions [7]

DR Option	Unit of Impact	Residential	Small C&I	Medium C&I	Large C&I	Xlarge C&I	Direct Serve
AC DLC	kW load reduction per customer (summer)	1.0 kW	1.0 kW				
Space Heating DLC	kW load reduction per customer (winter)	1.0 kW	1.0 kW				
Water Heating DLC	kW load reduction per customer	0.5 kW	0.5 kW				
Capacity Reduction	Per Customer %Impact w/ tech		12%				
Capacity Reduction	Per Customer %Impact w/o tech		5%	12%	39%	100%*	100%*
Third Party Aggregated	Per Customer %Impact			40%	40%	40%	
Distributor Aggregated	Per Customer % Impact	30%	30%	40%	40%	40%	
Demand Reduction	Per Customer %Impact					100%*	100%*
Dynamic Pricing	Per Customer %Impact w/ tech	34%	15%	14%	14%	100%*	100%*
Dynamic Pricing	Per Customer %Impact w/o tech	17%	5%	9%	9%	100%*	100%*
Fast DR	Per Customer Summer %Impact w/ tech	30%	30%	39%	39%	100%*	100%*
Fast DR	Per Customer Winter %Impact w/ tech	30%	30%	39%			
Load Shifting	Per Customer %Impact	20%	25%	25%			
Curtailable	Per Customer %Impact					100%*	100%*

[6] Global has conducted numerous studies of DR potential in the last five years. We checked our input assumptions and analysis results against the results from these other studies which include AmerenUE, Los Angeles Department of Water and Power, and the State of New Mexico, and Avista Utilities.

[7] Gray shaded boxes indicate that a DR option is not applicable for that sector.
Xlarge and Direct serve % impacts are applied to eligible MW rather than eligible customers.
Impacts with asterisk (*) indicate programs for which 100% represents the expected interruptible load.

Demand Response Potential Results

Demand response has the potential to reduce peak demand by 1,504 MW to 1,520 MW in 2012. The achievable potential increases to a range of 3,870 MW to 4,579 MW in 2030.[8]

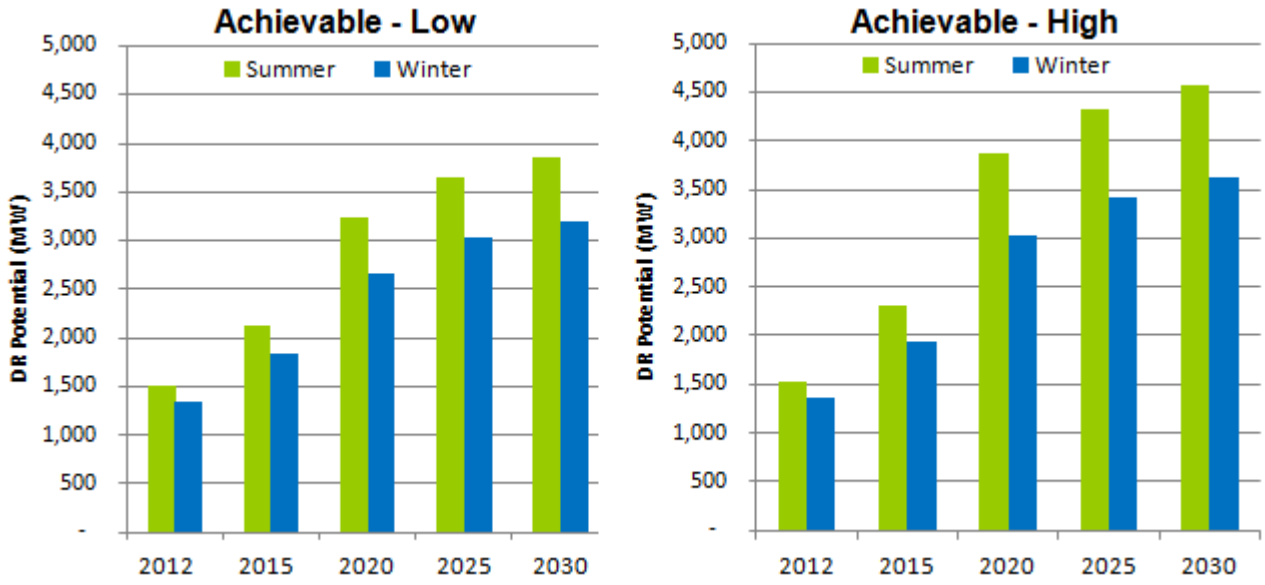
Table 3-3 presents the overall summary of demand response potential for the two cases. Figure 3-1 presents this information graphically. The primary observations are:

- In summer of 2012, achievable potential reduces peak demand by approximately 5%. This starting point takes into account the achievements in 2011 from TVA's current DR program portfolio.
- By summer of 2030, the achievable potential reduces peak demand by 10% to 12%. This level of savings represents an offset in growth of between 53% and 63%.
- In winter of 2012, achievable potential reduces peak demand by approximately 4%.
- By winter of 2030, the achievable potential reduces peak demand by 8% in the low case and 9% in the high case which represents an offset in growth of between 71% and 80%.

Table 3-3 Summary of Demand Response Savings for TVA

		2012	2015	2020	2025	2030
Summer	Peak Forecast (MW)	31,036	32,074	34,031	36,234	38,353
	Achievable - Low (MW)	1,504	2,137	3,245	3,662	3,870
	Achievable - High (MW)	1,520	2,301	3,872	4,331	4,579
	Achievable - Low (% of baseline)	***5%***	***7%***	***10%***	***10%***	***10%***
	Achievable - High (% of baseline)	***5%***	***7%***	***11%***	***12%***	***12%***
Winter	Peak Forecast (MW)	32,886	31,252	33,145	35,284	37,390
	Achievable - Low (MW)	1,353	1,782	2,618	3,030	3,199
	Achievable - High (MW)	1,363	1,881	2,985	3,422	3,616
	Achievable - Low (% of baseline)	***4%***	***6%***	***8%***	***8%***	***8%***
	Achievable - High (% of baseline)	***4%***	***6%***	***9%***	***9%***	***9%***

Figure 3-1 Summary of Demand Response Potential for TVA



[8] Fast DR is not included in the total potential estimates presented here. As discussed in more detail in Volume 3, Fast-DR events are considered distinct from traditional DR events. Customers can dual enroll in Fast DR and any other customer based dispatchable DR program, therefore the impacts associated with DR cannot be added to the total potential.

Potential Estimates by DR Program Type

Table 3-4and Table 3-5 show the range of achievable potential for each program type in both summer and winter. The primary observations from the analysis are:

- Capacity reduction has, by far, the largest contribution to the overall potential from all DR programs, with a 33% share in the total achievable potential in the high case in 2030. The achievable potential for this program represents a migration from the curtailable program to the capacity reduction program by 2016.[9]
- The Curtailable program is phased out completely by the year 2016 as all participants migrate into the Capacity Reduction option. In our experience, this trend is common in the industry as many utilities move away from emergency response programs and toward programs that can be integrated into wholesale markets based on economic dispatch models.
- While the total potential attributable to DLC varies widely from 645 MW and 17% in the low case to 1,174 MW and 26% in the high case DLC remains the second largest contributor to overall potential. The key difference between estimates of potential in the high and low case is the participation rates. The high case assumes an effective participation of 23.1% while the low case assumes an effective participation of 11.3%. DLC potential also varies from summer to winter; this is a result of the saturation of central air conditioning in the Tennessee Valley being higher than the saturation of electric heat.
- The Voltage Reduction programs also contribute substantially to the overall potential with CVR contributing 14% and DVR contributing 4% to overall potential.
- Savings from the Third Party Aggregated program come in fourth with an 11% share of the total potential in 2030. When combined with the Distributor Aggregated Program, which is very similar to the Third Party Program, the two programs represent 16% of the total potential in 2030.
- Savings from the Dynamic Pricing program are moderate with a total contribution of about 4% in 2030. Under a voluntary scenario, we assume a very conservative participation rate, which limits the potential of this program type.
- Load shifting has the smallest contribution to overall potential with about a 2% contribution in 2030.

[9] This migration is representative of the migration of customers from TVA's current 5MR and 60MR programs to the new Reserve Preservation program which falls within the capacity reduction program option for this study.

Table 3-4 Summary of Summer MW Savings by Program for TVA

DR Program	Type	2012	2015	2020	2025	2030
Direct Load Control	Achievable - Low	11	136	575	610	645
	Achievable - High	19	249	1,048	1,111	1,174
Curtailable	Achievable - Low	530	37	0	0	0
	Achievable - High	530	37	0	0	0
Capacity Reduction	Achievable - Low	441	1,086	1,283	1,369	1,452
	Achievable - High	447	1,117	1,360	1,453	1,543
Third Party Aggregator	Achievable - Low	395	518	520	522	523
	Achievable - High	395	518	520	522	523
Distributor Aggregator	Achievable - Low	61	86	129	134	139
	Achievable - High	62	96	173	181	188
Demand Reduction	Achievable - Low	1	16	68	73	77
	Achievable - High	1	16	68	73	77
Dynamic Pricing	Achievable - Low	2	29	132	161	191
	Achievable - High	2	33	141	171	203
Conservation Voltage Regulation	Achievable - Low	46	121	320	543	576
	Achievable - High	46	121	320	543	576
Dispatchable Voltage Regulation	Achievable - Low	16	42	112	190	202
	Achievable - High	16	42	112	190	202
Load Shifting	Achievable - Low	1	13	50	53	56
	Achievable - High	2	20	75	80	84
All Programs	**Achievable - Low**	**1,504**	**2,084**	**3,190**	**3,656**	**3,861**
	Achievable - High	**1,520**	**2,249**	**3,817**	**4,324**	**4,570**

Table 3-5 Summary of Winter MW Savings by Program for TVA

DR Program	Type	2012	2015	2020	2025	2030
Direct Load Control	Achievable - Low	5	62	259	275	290
	Achievable - High	9	115	481	510	539
Curtailable	Achievable - Low	507	34	0	0	0
	Achievable - High	507	34	0	0	0
Capacity Reduction	Achievable - Low	410	999	1,170	1,248	1,325
	Achievable - High	415	1,021	1,226	1,309	1,391
Third Party Aggregator	Achievable - Low	313	399	400	402	403
	Achievable - High	313	399	400	402	403
Distributor Aggregator	Achievable - Low	50	75	132	138	144
	Achievable - High	51	89	193	203	213
Demand Reduction	Achievable - Low	1	16	68	73	77
	Achievable - High	1	16	68	73	77
Dynamic Pricing	Achievable - Low	2	31	141	172	205
	Achievable - High	2	35	149	181	216
Conservation Voltage Regulation	Achievable - Low	47	115	300	502	524
	Achievable - High	47	115	300	502	524
Dispatchable Voltage Regulation	Achievable - Low	17	40	105	176	183
	Achievable - High	17	40	105	176	183
Load Shifting	Achievable - Low	1	11	42	45	47
	Achievable - High	1	16	62	66	70
All Programs	**Achievable - Low**	**1,353**	**1,782**	**2,618**	**3,030**	**3,199**
	Achievable - High	**1,363**	**1,881**	**2,985**	**3,422**	**3,616**

Figure 3-2 and Figure 3-3 show the range of achievable potential by customer class. The residential class has the largest contribution to overall potential at 41% in 2030 for the high achievable case. This is primarily due to participation in the DLC program option. Large C&I and Direct Serve come in second and third in overall contribution to potential, with 14% and 21% respectively, with their contribution being concentrated heavily in the capacity reduction program. Large, Medium C&I contribute 12% and 9% to overall potential respectively. Small C&I has the smallest contribution with 4%.

Figure 3-2 Achievable – Low Potential by Customer Class

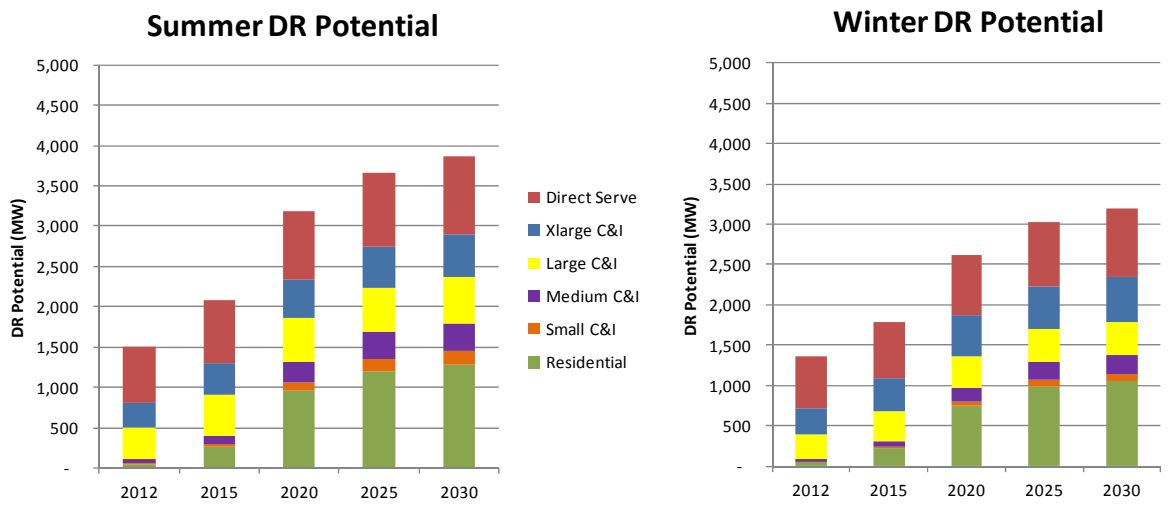
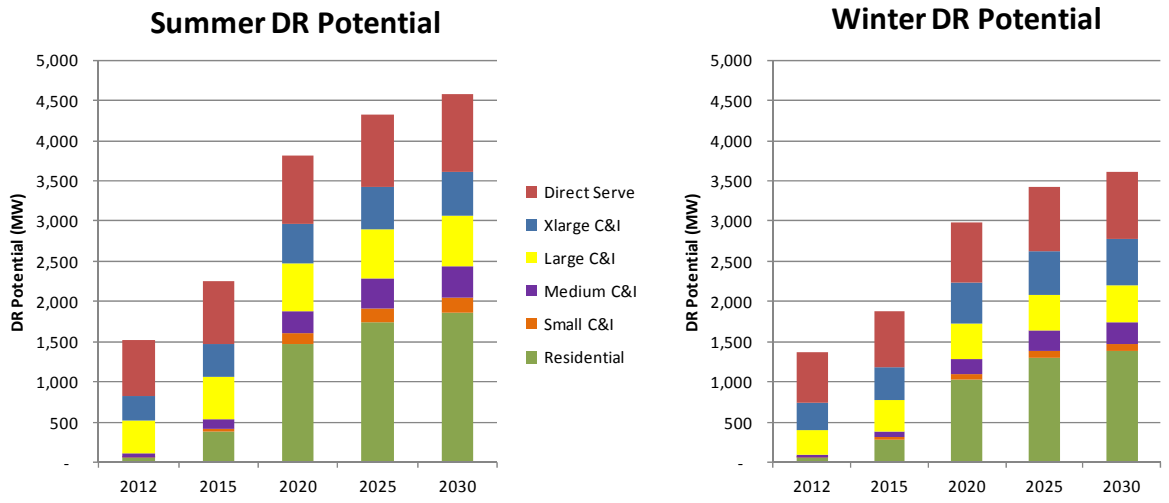


Figure 3-3 Achievable – High Potential by Customer Class



Summary of Cost-Effectiveness Analysis Results

Table 3-6 presents a summary of the cost-effectiveness results based on the TRC test for all programs.[10] The cost effectiveness tests were performed using a bottom up approach that employs cost assumptions based on secondary information and industry best practices.[11] The analysis was performed in this manner in order to provide TVA with realistic annual costs that can be passed on to distributors including: equipment costs, incentive costs, administrative, and marketing costs[12]. The results of the TRC test analysis show that the overall portfolio of DR programs is cost-effective.[13] The cost-effectiveness assessment is done for the Achievable - High level.

The most cost effective programs are Curtailable, Capacity Reduction, Demand Reduction, Dynamic Pricing and Fast DR. Curtailable has the highest B/C ratio due to a shortened program life of three years. Demand Reduction, Capacity Reduction, and Dynamic Pricing are also highly cost effective. These programs have lower administrative costs, and fewer equipment costs than the other non-aggregated programs. The voltage regulation programs are also considered cost effective, however it is important to note that costs for these programs are based solely on the incentive payment that TVA pays to the distributors. All equipment and implementation costs are assumed to be covered by that incentive and additional external (rate-based) costs and benefits to the distributor are not captured. The remaining programs; DLC, Third Party and Distributor Aggregated, and Load Shifting, are all cost effective with B/C ratios ranging from 1.05 to 1.31.

Table 3-6 Results of Cost-Effectiveness Screening (B/C ratios)

DR Option	Summer	Winter
DLC	2.07	2.02
Curtailable	18.15	17.22
Capacity Reduction	5.89	5.29
Third Party Aggregated	1.24	1.24
Distributor Aggregated	1.05	1.05
Demand Reduction	3.94	3.93
Dynamic Pricing	3.23	3.40
Fast DR	4.19	3.80
Conservation Voltage Regulation	1.60	1.60
Dispatchable Voltage Regulation	1.60	1.60
Load Shifting	1.31	1.09

DR Program Recommendations

The results of the DR assessment reveal that TVA has significant potential for demand response resources over the next two decades. Our analysis has shown that it is economically feasible for TVA to realize up to 11% reductions in summer peak and 9% reductions in winter peak by 2030 if it moves forward with the DR options represented in this report.

TVA's demand response programming efforts have a strong basis with large C&I customers in the field today. Moreover, a comprehensive suite of new programs is currently emerging from the planning phase and entering the implementation phase. In light of this study, Global provides the following recommendations to preserve and augment that momentum.

[10] Cost effectiveness results by program and customer segment are included in Appendix B.
[11] Cost effectiveness inputs and assumptions are included in Appendix A.
[12] While utility incentives are not included in the TRC test as costs, we provide estimates of incentives that could reasonably be assumed for each program in the appendix.
[13] The $/kW payment for the Distributor aggregated program was adjusted from the $63/kW year in the TVA provided program data sheet to $55/kW year in order for the program to pass the economic screen. The Distributor Aggregated program was not cost effective given our assumptions in the analysis at the higher incentive rate. Payments from the utility to aggregators for both the 3rd Party Aggregated and Distributor Aggregated programs are included as implementation costs in the TRC analysis.

- ***Expand programs to include smaller customers:*** TVA's current DR programs total approximately 1,300 MW of DR, which indicates that the potential for future success with new DR programs is very high. The majority of the currently installed DR capacity is concentrated in the Large, X-Large, and Direct Serve customers. Targeting the largest customers first is an excellent strategy for utilities as they begin their DR efforts, however, as portfolios mature it becomes necessary to target other customer segments such as residential and small and medium C&I.
- ***Focus efforts on programs with the largest potential:*** DLC and Capacity Reduction are the DR programs with the largest opportunity for savings among end-users. DLC is a program that can be targeted to residential and small commercial customers and has been shown to be very successful given the right combination of technology and incentives.[14] Capacity reduction is gaining ground on the west coast as a highly favorable program with commercial and industrial customers. Customers particularly like the monthly capacity payments they receive all year long and the flexibility to determine their own reduction bid. Marketing efforts to expand DR program participation to the smaller customers should focus on DLC and capacity reduction.
- ***Voltage regulation programs need carefully designed incentives:*** Voltage reduction has significant potential to reduce demand on the distribution side. This is a unique program in that it involves infrastructure improvements to optimize and reduce voltage levels without affecting the power quality ultimately distributed to end users. Sufficient incentives will be needed to encourage distributors to participate in this program and therefore more information on the cost of specific voltage regulation technologies will need to be gathered.
- ***Coordinate distributor layer between TVA and end user:*** Because TVA is a wholesale provider, maintaining a cohesive DR message to end users may be challenging, especially as DR programs focus on residential and small C&I customers. We recommend dedicated resources to ensure that TVA programs are marketed and implemented consistently across distributors.
- ***Create internal DR targets:*** TVA should continue to evolve and formulate its specific objectives regarding demand response by creating targets and goals. Global recommends targets that fall within the range of achievable potentials identified in this study.
- ***Consider limiting the number of programs:*** TVA has a longer list of DR programs than many utilities do. TVA may consider limiting the number and type of DR programs to facilitate distributor and end-user understanding. Customers are often overwhelmed by too many options when it comes to utility programs, and many utilities with a large number of programs are now focused on reducing or bundling programs to make participation simpler for customers. We recommend focusing on those programs with the highest potential: capacity reduction in the C&I sectors, DLC in the residential sector, and voltage reduction for the distributors.
- ***Provide market-friendly customer incentives***: Most customers are willing to offer their loads for participation in demand response programs if the utility is willing to compensate them for any inconvenience that they may realize due to the temporary service interruption. While incentive strategies must be structured in a way that ensures economic viability for the program, we have found that there is significant room to expand customer incentives while still maintaining cost-effectiveness.
- ***Provide enabling technology incentives:*** Enabling technology has been shown to improve the reliability of DR resources and to maximize load reduction in DR programs. It is therefore crucial to provide incentives to customers for adopting enabling technology in order to automate response to DR events.

[14] Southern California Edison, NV Energy, Florida Power & Light, and others all have very successful DLC programs with participation rates of 20% or more.

CHAPTER | 4

COMPARISON OF PREVIOUS POTENTIAL STUDIES

Analysis Approach

Previous studies of energy efficiency potential for the Valley and for the southeast region have produced a range of results. The objectives of this task are as follows:

- Develop a detailed report comparing the results of Task 1 to regional potential studies that are specific to the southeast.
- Consider the methodology, assumptions, approaches, estimated baselines, technical performance, adoption, and program/regulatory context of the studies.
- Create a matrix to enable side by side comparison of the studies.

List of Studies Considered

The reports Global reviewed are listed below.

- **EPRI National** — *Assessment of Achievable Potential from Energy Efficiency and Demand Response Programs in the U.S. (2010–2030)*
- **EPRI TVA** — *Assessment of Achievable Potential from Energy Efficiency and Demand Response Programs for the Tennessee Valley Authority (2010-2030)*
- **Georgia Tech** — *Meta-Review of Efficiency Potential Studies and Their Implications for the South*
- **Georgia Tech** — *Energy Efficiency in the South, a meta-study*
- **McKinsey** — *Unlocking Energy Efficiency in the U.S. Economy*
- **SEEA** — *Energy Efficiency in Appalachia "How Much More is Available, at What Cost, and by When?"*
- **REPP** — *Powering the South: A Clean & Affordable Energy Plan for the Southern United States*
- **PA Consulting** — *Tennessee Valley Authority: Energy Efficiency and Demand Response Plan 2008*
- **ACEEE** — *North Carolina's Energy Future: Electricity, Water, and Transportation Efficiency*
- **FERC** — *A National Assessment of Demand Response*
- **MISO** — *The Midwest ISO Study* (includes estimates of DR for regions within the Eastern Interconnection)

The review of these studies considered each study's analysis approach, the key input assumptions and sources for these assumptions, the relevant baseline, and the regulatory context. This report compares and contrast the studies listed above and the Global study for TVA with regard to these considerations.

This executive summary provides an at-a-glance overview of the comparison, with high-level conclusions and commentary. At the end of Volume 2, we examine each of the energy-efficiency studies in detail and compare them side by side with this Global study. In turn, at the end of Volume 3, we do the same for the demand-response studies.

Comparison Summary

Table 4-1 and Table 4-2 present a matrix of key elements from each of the studies considered in this task to provide a high-level overview.

Table 4-1 Energy Efficiency Studies at a Glance

Source	Area	Year Released	Type of Potential	10-yr Savings[15] Estimate	20-yr Savings Estimate
This Study: Global TVA	**TVA**	**2011**	**Economic**	**13.9%** ***21.7 TWh***	**24.8%** ***44.8 TWh***
			Achievable (High)	**9.8%** ***15.3 TWh***	**19.8%** ***35.8 TWh***
			Achievable (Low)	**5.1%** ***8.0 TWh***	**10.6%** ***19.1 TWh***
EPRI National, South Region	Southern region	2009	Economic	12.2%	13.4%
			MAP	10.0%	11.1%
			RAP	4.4%	8.1%
EPRI-TVA	TVA	2010	Economic	10%	10%
			RAP	4.6%	6.9%
Meta-Review of South EE Studies-Georgia Tech	Southern region	2009	MAP	1.18% per year	
			RAP	0.88% per year	
EE in the South-Georgia Tech	Southern region	2010	Program potential	12%	16%
McKinsey Study	U.S.	2009	NPV-positive	23%	
EE in Appalachia-SEEA	Appalachian region	2009	Program potential	11%	24%
Powering the South-REPP	SERC and FRCC regions	2002	Clean Power Plan potential	13.5%	22.9%
TVA- PA Consulting	TVA	2008	Program potential	*11.7 TWh*	*19.5 TWh*
North Carolina study- ACEEE	North Carolina	2010	Medium program	14.9%	
			High program	20.4%	

The most directly comparable studies to the Global TVA study are the EPRI National Study and EPRI's 2010 study of the TVA service territory. These both use a similar bottom-up modeling approach.

The most dissimilar studies are the REPP "Powering the South" study, because of its age, and the McKinsey study because of its different definitions and methodologies, as discussed in Volume 2.

As far as baseline forecasts, the assumptions used in the various studies are all relatively similar. Except for the REPP study mentioned above, all the baseline forecasts are relatively recent and

[15] 10-year and 20-year savings are approximations. Because several studies start one or two years earlier or later, they do not fit in these categories exactly, but this simplification is made for comparison purposes.

include the effects of the EISA lighting standards. However, Global's baseline forecast includes the appliance and equipment standards that were adopted in 2010, which was a major year for new standards. This has the most significant impact in the residential sector.

Overall, Global's savings estimates are higher than either of the EPRI studies. They are in line with the other studies to the extent they are comparable. Direct comparison from study to study should be made mindfully, taking into account the caveats and considerations spelled out in the EE and DR Volumes.

Table 4-2 Demand Response Studies at a Glance

Source	Area	Year Released	Type of Potential	10-yr Savings Estimate	20-yr Savings Estimate
This Study: Global TVA	**TVA**	**2011**	**Achievable (High)**	**11%** ***3.8 GW***	**12%** ***4.6 GW***
			Achievable (Low)	**10%** ***3.2 GW***	**10%** ***3.9 GW***
FERC National Assessment of DR	U.S.	2009	Economic	20%	
			Achievable	14%	
			Expanded BAU	9%	
MISO Assessment	MISO	2010	Program potential	7.6%	7.6%
	Eastern Interconnection			11.1%	10.8%

The more limited landscape of DR potential studies shows a fair amount of convergence on the range of achievable potentials. There is less complexity and variation in the way that DR potentials are analyzed. With the exception of some differences in definition of potentials in the FERC National study, these three studies are relatively comparable.

ABOUT GLOBAL

Global Energy Partners is a premier provider of energy and environmental engineering and technical services to utilities, energy companies, research organizations, government/regulatory agencies and private industry.

Global's offerings range from strategic planning to turn-key program design and implementation and technology applications.

Global is a wholly-owned subsidiary of EnerNOC, Inc committed to helping its clients achieve strategic business objectives with a staff of world-class experts, state of the art tools, and proven methodologies.

Global Energy Partners
An EnerNOC Company
500 Ygnacio Valley Road, Suite 450
Walnut Creek, CA 94596

P: 925.482.2000
F: 925.284.3147
E: gephq@gepllc.com

TENNESSEE VALLEY AUTHORITY POTENTIAL STUDY

VOLUME 2: ENERGY EFFICIENCY POTENTIAL STUDY

Final Report

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Global Energy Partners™
An EnerNOC Company

Global Energy Partners
An EnerNOC Company
500 Ygnacio Valley Road, Suite 450
Walnut Creek, CA 94596

P: 925.482.2000
F: 925.284.3147
E: gephq@gepllc.com

This report was prepared by

Global Energy Partners
An EnerNOC Company
500 Ygnacio Valley Blvd., Suite 450
Walnut Creek, CA 94596

Project Team:
I. Rohmund, Director
J. Borstein, Project Manager
D. Costenaro
A. Duer
D. Ghosh
K. Kolnowski
K. Marrin
F. Nguyen
A. Sanchez
S. Yoshida

Subcontractor*:*
The Brattle Group
353 Sacramento Street, Suite 1140
San Francisco, CA 94111

Dr. A. Faruqui
Dr. S. Sergici

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CHAPTER | 1

INTRODUCTION

Background

The Tennessee Valley Authority (TVA) has contracted with Global Energy Partners (Global) to conduct a potential study to assess 20-year potentials for energy efficiency (EE) and demand response (DR). TVA has an aspirational goal to lead the southeast in energy efficiency, and believes this leadership can be accomplished through the development and implementation of action plans for EE, DR, and end-use generation. This potential study will provide information to assist TVA in meeting that goal.

Toward this end, Global conducted a detailed, bottom-up assessment of the TVA market to deliver forecasts of energy use and peak demand, as well as forecasts of energy and peak-demand savings achievable through energy efficiency and demand response programs. The 20-year potentials study addresses the residential, small commercial, large commercial, and industrial sectors. Results of this task are discussed in two volumes, one for energy efficiency and one for demand response, as described below in the report organization.

Global also compared the results of the potential savings to those from existing regional potential studies that are specific to the Southeast and other select studies. This analysis, which appears in both the energy efficiency and demand response reports, also compares these potential studies with regard to methodology, assumptions, approaches, estimated baselines, technical performance, adoption, and program/regulatory context.

Objectives

Key objectives for the study include:

- Conduct a 20-year bottom-up energy efficiency potential study to determine the potential for specific energy efficiency measures to reduce the consumption and peak demand of electricity in the TVA service territory.
- Conduct a demand response potential study to determine the potential for reduction in peak demand through demand response programs.
- Compare the potential study results with other national and regional studies, including details regarding assumptions used to develop each of the studies.

Report Organization

This report is presented in 3 volumes as outlined below. This document is **Volume 2: Energy Efficiency Potential Study**.

- Volume 1, Executive Summary
- Volume 2, Energy Efficiency Potential Study
- Volume 3, Demand Response Potential Study

Definitions of Potential

In this study, we estimate the potential for energy efficiency savings. The savings estimates represent gross 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. For this reason, we developed a range of achievable potential. These 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 equipment failure, customers replace their equipment with the most efficient option available. In new construction, customers and developers also choose the most efficient equipment option. Examples of measures that make up technical potential 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 available other measure, where applicable. For example, it includes installation of high-efficiency windows in all new construction opportunities and air conditioner maintenance in all existing buildings with central and room air conditioning. The retrofit measures are phased in over a number of years, which is longer for higher-cost measures.

Economic potential represents the adoption of all ***cost-effective*** energy efficiency measures. In this analysis, the total resource cost (TRC) test, which compares lifetime energy and capacity benefits to the incremental cost of the measure, is applied. Economic potential assumes that customers purchase the most cost-effective option at the time of equipment failure and also adopt every other cost-effective and applicable measure.

Achievable - High potential takes into account expected program participation resulting from ideal implementation conditions and customer preferences for energy-efficient technologies and demand response programs. Achievable - High establishes a maximum target for the EE savings that a utility 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 represents a lower bound on Achievable potential. It reflects limited DSM budgets and significant barriers to customer acceptance.

[1] Savings in "gross" terms instead of "net" terms means that the baseline forecast does not include naturally occurring efficiency. In other words, the baseline assumes that energy efficiency levels remain fixed as they are today. This rule holds true except in cases where enactment of future codes and standards were on the books before January 2011, e.g. the effects of the EISA 2007 lighting efficiency standard.

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
AC	Air conditioning
ACS	American Community Survey
AEO	Annual Energy Outlook
B/C Ratio	Benefit to Cost Ratio
BEST	Global's Building Energy Simulation Tool
C&I	Commercial and Industrial
CFL	Compact Fluorescent Lamp
D&B	Dun and Bradstreet
DEEM	Database of Energy Efficiency Measures
DEER	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 lighting
HPWH	Heat Pump Water Heater
LED	Light Emitting Diode lamp
LoadMAP	Global's Load Management Analysis and Planning™ tool
MAR	Market Acceptance Rate
NWPCC	Northwest Power and Conservation Council
PIF	Program Implementation Factors
RTU	Roof top unit
Sq. ft.	Square feet
TRC	Total Resource Cost
UEC	Unit Energy Consumption
UCT	Utility Cost Test
RIM	Rate Impact Measure test

CHAPTER | 2

ANALYSIS APPROACH AND DATA DEVELOPMENT

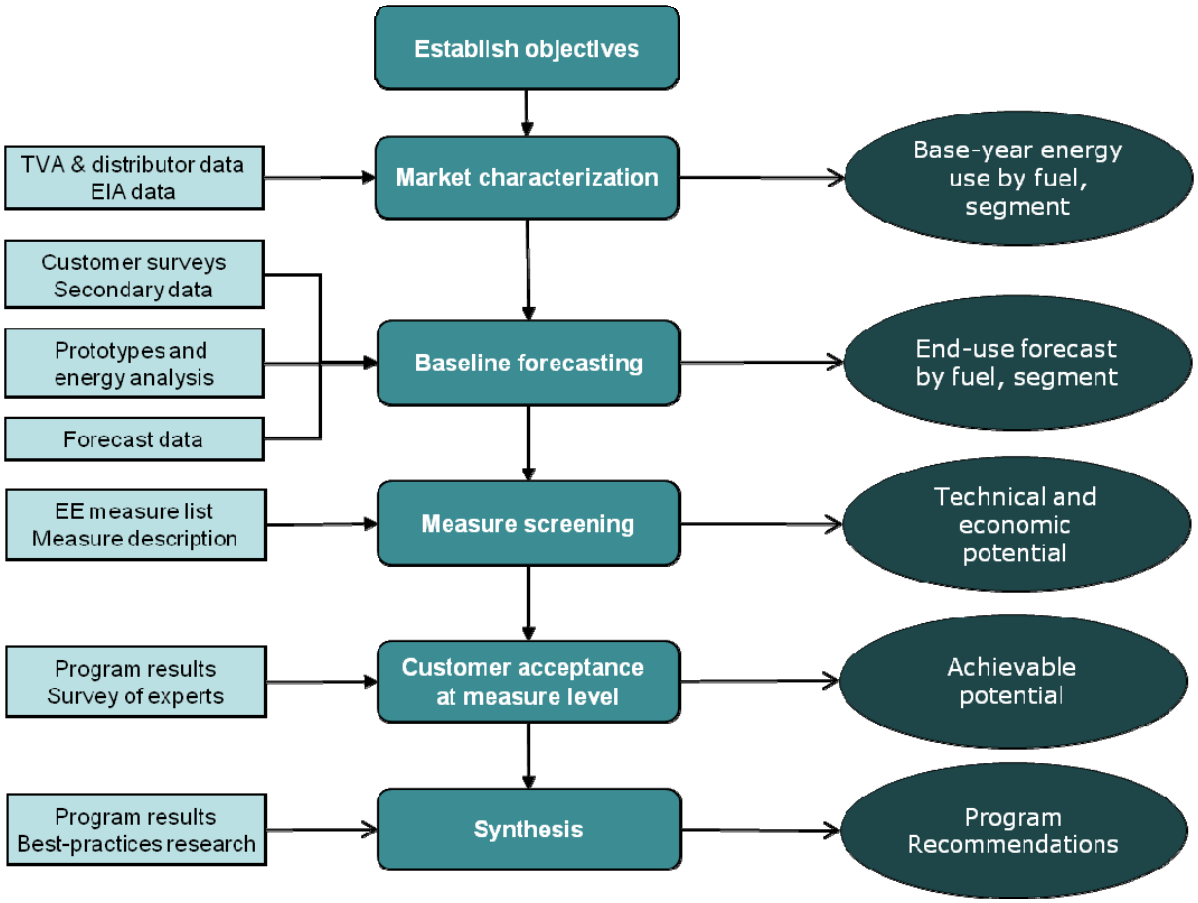
Analysis Approach

To perform the energy efficiency analysis, Global used a bottom-up analysis approach as shown in Figure 2-1. We took the following steps.

1. Held a meeting with the project team to refine the objectives that were identified in the TVA RFP. This resulted in a work plan for the study.
2. Performed a market characterization to describe sector-level electricity use for the residential, commercial, and industrial sectors for the base year, TVA 2009. (Note that all years referred to in this report are TVA fiscal years). This included using utility data and secondary data from sources such as the American Community Survey (ACS) and the Energy Information Administration (EIA).
3. Utilized TVA primary market research (such as TVA's 2010 residential market saturation survey) and secondary sources to understand how customers in the Tennessee Valley currently use electricity. Combining this information with the market characterization, we developed energy market profiles that describe energy use by sector, segment, and end use for 2009.
4. Developed a baseline electricity forecast by sector, segment, and end use for 2012 through 2032. Results presented in this volume are through 2030.
5. Identified and analyzed energy-efficiency measures appropriate for the Valley.
6. Estimated four levels of energy-efficiency potential, *Technical, Economic, Achievable - High,* and *Achievable - Low*.
7. Reviewed the current programs offered by TVA in light of the study findings to make strategic program recommendations for achieving savings.

These steps are described in further detail throughout the remainder of this chapter.

Figure 2-1 Overview of Analysis Approach



LoadMAP Model

We used Global's Load Management Analysis and Planning tool (LoadMAP™) version 3.0 to develop both the baseline forecast and the estimates of energy efficiency potential. Global developed LoadMAP version 1.0 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 2-2) is both accessible and transparent and has the following key features.

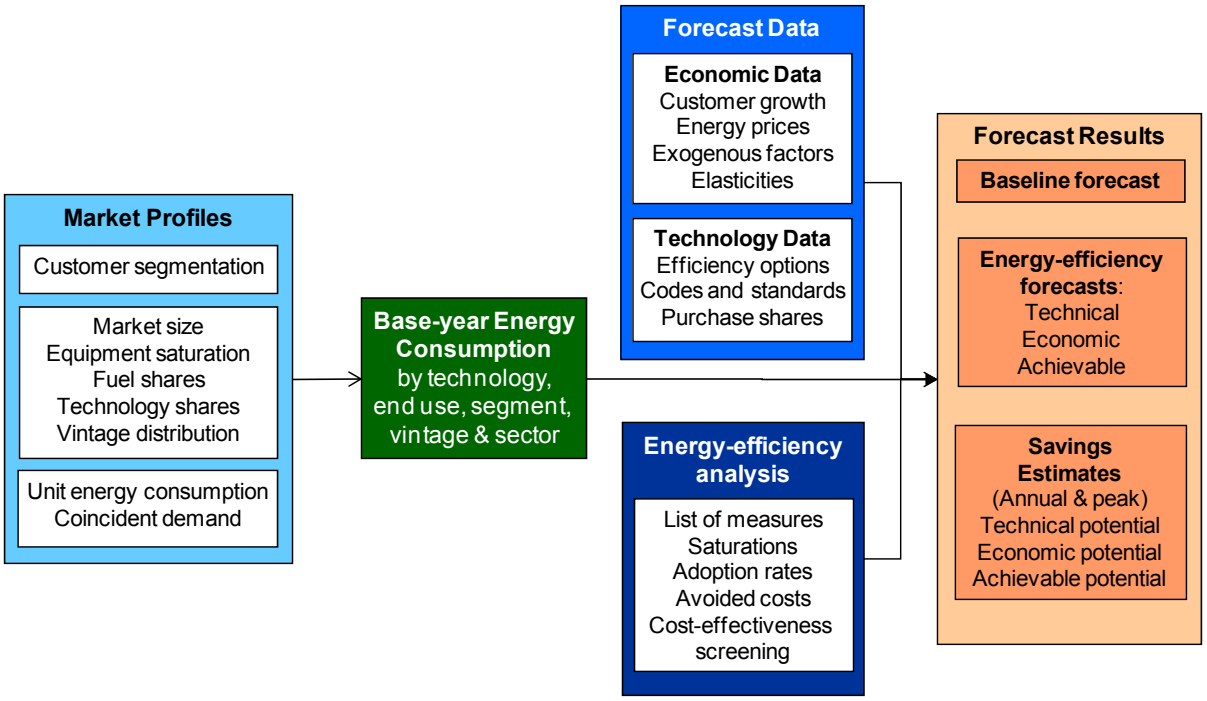
- Embodies the basic principles of rigorous end-use models (such as EPRI's REEPS and COMMEND) but in a more simplified, accessible form.
- Includes stock-accounting algorithms that treat older, less efficient appliance/equipment stock separately from newer, more efficient equipment. Equipment is replaced according to the measure life 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 equipment 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

Before assessing the potential savings from EE, it is critical to develop a good understanding of where TVA is today in terms of electricity use and customer behavior. The purpose of the market assessment is to develop market profiles that describe current electricity use in terms of sector, customer segment, and end use. The base year for this study is 2009 since that was the most recent year for which a complete set of utility data were available.

Segmentation for Modeling Purposes

The market assessment began by defining the market segments (building types, end uses, and other dimensions) that are relevant in the Valley. The segmentation scheme employed for this project is presented in Table 2-1.

[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).

Table 2-1 Overview of Segmentation Scheme for Potentials Modeling

Market Dimension	Segmentation Variable	Dimension Examples
Dimension 1	Sector	Residential, commercial, industrial
Dimension 2	Building type	Residential (Single family, Multi family, and Mobile home) Commercial (Office, Restaurant, Retail, etc.) Industrial (Chemical Products, Primary Metals, Paper Products, Food Products, and Other industrial)
Dimension 3	Vintage	Existing and new construction
Dimension 4	End uses	Cooling, lighting, water heat, motors, etc. (as appropriate by sector)
Dimension 5	Appliances/end uses and technologies	Technologies such as lamp type, air conditioning equipment, motors by size, etc.
Dimension 6	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 homes***. This segment includes single-family detached homes, townhouses, and duplexes or row houses.
- ***Multi-family homes.*** The multi-family segment includes apartments or condos in buildings with more than two units.
- ***Mobile homes.*** This segment includes mobile homes and manufactured homes

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

Table 2-2 Residential End Uses and Technologies

End Use	Technology
Cooling	Central Air Conditioning (CAC)
Cooling	Room Air Conditioning (RAC)
Combined Heating/Cooling	Air-Source Heat Pump
Combined Heating/Cooling	Geothermal Heat Pump
Space Heating	Electric Resistance
Space Heating	Electric Furnace
Water Heating	Water Heater
Interior Lighting	Screw-in Lamps
Interior Lighting	Linear Fluorescent Lamps
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	TV
Electronics	Printer/Fax/Copier
Electronics	Set-top Boxes/DVR/Audio
Electronics	Devices and Gadgets
Miscellaneous	Pool Pump
Miscellaneous	Pool Heater
Miscellaneous	Hot Tub / Spa
Miscellaneous	Well Pump
Miscellaneous	Furnace Fan
Miscellaneous	Miscellaneous

The commercial sector, which includes both distributor-served and directly served accounts, was characterized as small commercial and large commercial to correspond to TVA and distributor rate schedules. 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 15 building types:

- Small Commercial (less than or equal to 50 kW)
    - Small Office —all types of offices, including medical/dental offices
    - Restaurant — fast-food, sit-down and cafeteria-style restaurants
    - Small Retail — retail establishments such as small boutiques and mini-malls
    - Small Grocery — convenience stores and small markets
    - Warehouse — storage facilities, unrefrigerated
    - Small Miscellaneous — all remaining small building types, such as police stations, parking garages, etc.
- Large Commercial (greater than 50 kW)
    - Large Office — all types of offices including large government facilities
    - Large Retail — retail establishments such as large box retailers and malls
    - Large Grocery — supermarkets
    - Refrigerated Warehouse — climate-controlled cold storage
    - School — primary and secondary schools
    - College — colleges, universities and technical colleges
    - Health — hospitals and nursing homes
    - Lodging — motels, hotels, resorts and small inns
    - Large Miscellaneous — all remaining large building types, such as public assembly, amusement parks, etc.

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

Table 2-3 Commercial End Uses and Technologies

End Use	Technology
Cooling	Air-Cooled Chiller
Cooling	Water-Cooled Chiller
Cooling	Evaporative AC
Cooling	Roof Top AC
Cooling	Other Cooling
Combined Heating/Cooling	Roof Top Heat Pump
Space Heating	Electric Heating
Ventilation	Ventilation
Water Heating	Water Heating
Interior Lighting	Screw-in
Interior Lighting	High-Bay Fixtures
Interior Lighting	Linear Fluorescent
Exterior Lighting	Screw-in
Exterior Lighting	HID
Exterior Lighting	Linear Fluorescent
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

The industrial sector, which for this study includes both power distributor served and directly served accounts, is segmented by industry type. Because the industrial sector is complex and diverse, the study isolated for analysis the four largest industries, which accounted for 59% of total 2009 industrial electricity sales, and combined the remaining industries into a single category. The resulting segmentation is as follows:

- Chemical Products
- Primary Metals
- Paper Products
- Food Products
- Other Industrial

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

Table 2-4 Industrial End Uses and Technologies

End Use	Technology
Cooling	Roof Top AC
Cooling	Other Cooling
Combined Heating/Cooling	Roof Top Heat Pump
Space Heating	Electric Heating
Ventilation	Ventilation
Water Heating	Water Heating
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	1-5 HP
Motors	6-20 HP
Motors	21-50 HP
Motors	51-100 HP
Motors	101-200 HP
Motors	201-500 HP
Motors	501-1000 HP
Motors	1000+ HP
Process Heating	Process Heating
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 number of customers for residential segments, and the square footage or employee count for the

commercial and industrial segments. This information provided control totals (energy use and customers counts/square footage/employee totals) 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 buildings with the electric technologies. (e.g., homes with electric space heating, commercial floor space with space cooling).
- ***UEC (unit energy consumption) or EUI (energy-use index)*** describes the amount of electricity consumed in 2009 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 use for the technology across all homes in 2009. It is computed as the product of the saturation and the UEC and is defined as kWh/household. 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 in 2009.
- ***Usage*** is the annual electricity use by a technology/end use 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 use and peak demand for 2009 through 2032 by customer segment and end use without new utility programs or naturally occurring efficiency scenario. 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 2011 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
- TVA's internally developed forecasts for electricity sales

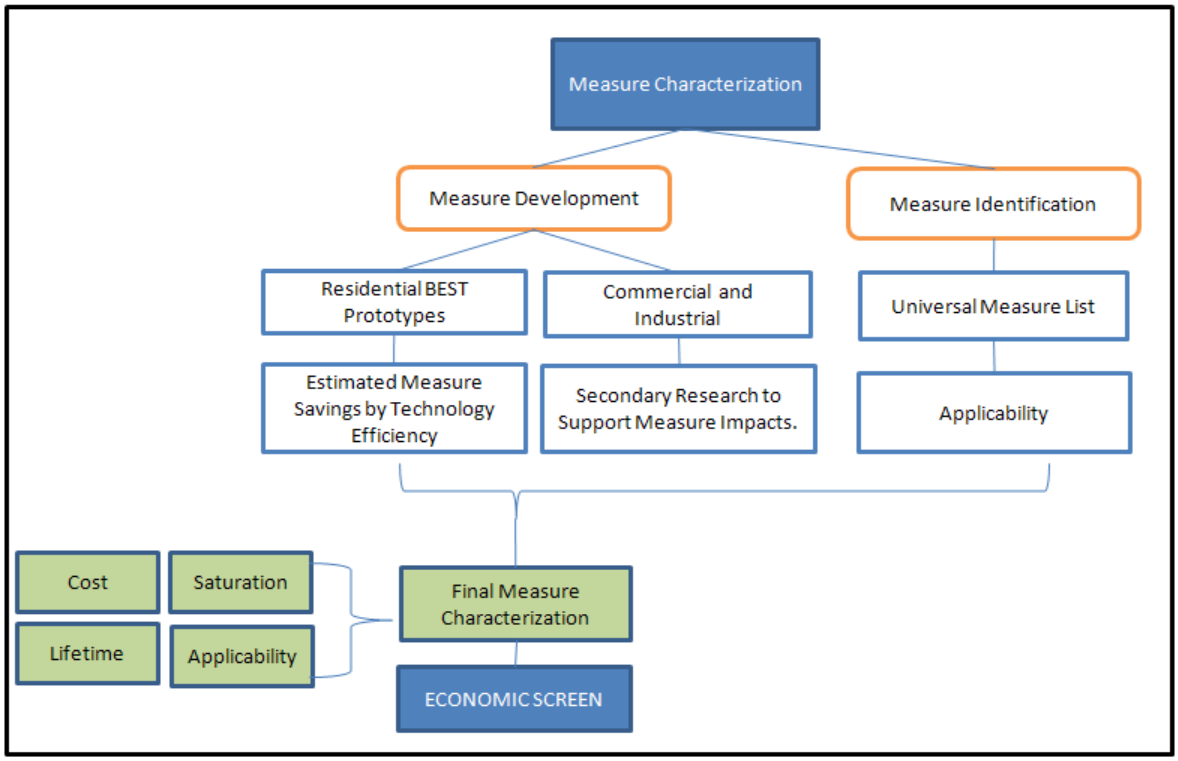
We present the results of the baseline forecast development in Chapter 4.

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, Global assembled information to reflect equipment performance, incremental costs, and equipment lifetimes. We used this information, along with TVA'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. Potential measures include the replacement of a unit that has failed or is at the end of its useful life with an efficient unit, retrofit/early replacement of equipment, improvements to the building envelope, the application of controls to optimize energy use, and other actions resulting in improved energy efficiency.

We compiled a robust list of energy efficiency measures for each customer sector, drawing upon a variety of TVA databases, TVA's Measurement Manual, Global tools, 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: equipment measures and non-equipment measures, according to the LoadMAP taxonomy:

- ***Equipment measures,*** or efficient energy-consuming pieces of equipment, save energy by providing the same service with a lower energy requirement. An example is the replacement of a standard efficiency refrigerator with an ENERGY STAR model. For equipment measures, many efficiency levels are available for a specific technology that range 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 federal standard SEER 13 unit and spans a broad spectrum of efficiency, with the highest efficiency level represented by 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 the air conditioner only when people are home. Non-equipment measures fall into one of the following categories:

- Building shell (windows, insulation, roofing material)
- Equipment controls (thermostat, occupancy sensors)
- Equipment maintenance (cleaning filters, changing setpoints)
- Whole-building design (natural ventilation, 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

Non-equipment measures can apply to more than one end use. For example, insulation levels will affect the energy use of both cooling and space heating.

We developed a preliminary list of EE measures for TVA's review. The final list included in the study is presented in Chapter 5.

Once we assembled the list of EE measures, the project team assessed their energy-saving characteristics. For each measure we 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 potential.

Representative Measure Data Inputs

To provide an example of the measure data, Table 2-5 and Table 2-6 present samples of the detailed data inputs behind both equipment and non-equipment measures, respectively, for the case of residential central air conditioning (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 Sample 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	$ 2,692	3,803	2009	2014
SEER 14 (ENERGY STAR)	15	$3,106	3,489	2009	n/a
SEER 15 (CEE Tier 2)	15	$3,727	3,368	2009	n/a
SEER 16 (CEE Tier 3)	15	$3,779	3,266	2009	n/a
Ductless Mini-split System	15	$6,342	3,180	2009	n/a
SEER 21	15	$6,212	2,933	2009	n/a

Table 2-6 lists some of the non-equipment measures affecting 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 are calculated for each year of the model 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 without attics, and in some homes with attics, it may not be feasible to install an attic fan because of lack of space.

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

End Use	Measure	Saturation in 2009[4]	Applica-bility	Lifetime (yrs)	Measure Installed Cost	Energy Savings (%)
Cooling	Central AC - Maintenance	15%	100%	4	$125	10.3%
Cooling	Ceiling Fan – Installation	56%	75%	15	$120	11.4%
Cooling	Whole-House Fan – Installation	4%	19%	20	$250	6.6%
Cooling	Insulation - Ducting	15%	75%	18	$500	3.4%
Cooling	Repair and Sealing – Ducting	12%	50%	18	$144	13.8%
Cooling	Insulation - Ceiling	16%	38%	20	$141	10.5%
Cooling	Windows – Install Reflective Film	5%	45%	10	$895	24.1%
Cooling	Windows - ENERGY STAR	24%	90%	20	$210	17.6%
Cooling	Thermostat - Clock/Programmable	46%	56%	12	$73	7.5%
Cooling	Home Energy Management System	0%	38%	20	$300	5.5%

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 total resource cost (TRC) test that compares the lifetime benefits (both energy and peak demand) of each applicable measure with its installed cost, which includes material, labor, and administration of a delivery mechanism, such as an energy efficiency program. 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. For economic screening of measures, incentives are not included because they represent a simple transfer from one party to another, but have no effect on the overall measure cost.

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.

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

Table 2-7 shows the results of the economic screen for CAC for selected years, as well as results for two interior lighting technologies. In 2012, the most cost-effective option is SEER 13. However, in 2015, due to federal energy efficiency standards, the SEER 13 unit goes off the market and SEER 14 becomes the standard efficiency unit. In 2015 and beyond, the economic screen selects the SEER 14 option because the marginal savings between the standard efficiency SEER 14 unit and the higher-efficiency options are not sufficient to make the higher-efficiency units economical. The table also shows how the economic choice for two of the lighting technology options varies over the study period. If the measure passes the screen (has a benefit-to-cost (B/C) ratio greater than or equal to 1.0), the measure is included in economic potential. Otherwise, it is screened out for that 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	2012	2015	2020	2025	2030
Central AC	SEER 13	SEER 14 (Energy Star)	SEER 14 (Energy Star)	SEER 14 (Energy Star)	SEER 14 (Energy Star)
Interior Lighting Screw-in	CFL	CFL	CFL	CFL	LED
Interior Lighting Linear Fluorescent	T8	T8	T8	T8	Super T8

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. Specifically, four types of potentials were developed as part of this study:

- ***Technical potential*** is a theoretical construct that assumes the highest efficiency measures that are technically feasible to install are adopted by customers, regardless of cost or customer preferences. Thus, determining the technical potential is relatively straightforward. LoadMAP "chooses" the most efficient equipment options for each technology at the time of equipment replacement. In addition, it installs all relevant non-equipment measures for each technology to calculate savings.

  For example, for residential central air conditioning (CAC), as shown in Table 2-5, the most efficient option is a SEER 21 system. If the technical potential scenario installs a SEER 21 unit, any non-equipment measure from Table 2-6 is then applied to the energy used by the SEER 21 system to further reduce CAC energy use. LoadMAP applies the savings due to the non-equipment measures one-by-one to avoid double counting of savings. The measures are evaluated in order of their B/C ratio, with the measure with the highest B/C ratio applied first. Each time a measure is applied, the baseline energy use for the end use is reduced and the percentage savings for the next measure is applied to the revised (lower) usage.

- ***Economic potential*** results from the purchase of the most efficient *cost-effective* option available for a given equipment or non-equipment measure as determined in the cost-effectiveness screening process described above. As with technical potential, economic potential is a phased-in approach. Economic potential is still a hypothetical upper-boundary of savings potential as it represents only measures that are economic but does not yet consider customer acceptance and other factors.

[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.

- ***Achievable potential*** defines the range of savings that is likely to occur.
    - ***Achievable – High*** reflects high awareness of efficiency options, minimal barriers to customer adoption, best-practices program design, and incentives that represent a substantial portion of the incremental cost combined with high administrative and marketing costs.
    - ***Achievable - Low*** reflects lower awareness of energy efficiency options, lower incentive levels and lower administrative and market costs.

The calculation of technical and economic potential is straightforward as described above. To develop estimates for ***achievable potential***, we specify adoption rates for each measure that reflect the combination of market acceptance rates (MARs) and program implementation factors (PIFs). We base the expected adoption rates on other relevant potential studies and market research.

Program Recommendations

In this final step, we review the potential estimates by measure, customer segment, and sector to develop a set of program recommendations for achieving the highest level of energy efficiency. The results of this review are presented in Chapter 8.

Data Development

This section details the data sources used in this study, followed by a discussion of how these sources were applied.

Data Sources

The data sources are organized into the following categories:

- Utility-provided data
- Global Energy Partners' databases and analysis tools
- Energy efficiency measure data
- Other secondary data and reports

Utility-provided Data

In order to appropriately characterize the market in the Valley, we asked TVA to provide the following:

- Utility 2009 billing data — customers, usage, revenue
- Coincident peak demand by rate class
- Energy and peak demand forecasts, at the sector level
- Customer growth forecast
- Price history and forecast
- Income and household size forecasts
- Cooling and heating degree day history and forecasts
- Recent saturation surveys for residential customers[6]
- Surveys on customer attitudes towards energy efficiency or demand response programs
- Avoided costs (peak capacity and energy)
- Discount rate

[6] TVA is in the process of conducting a survey of commercial customers, but results were not available at the time of this analysis.

- Escalation rate
- T&D line loss factors
- Program administration expenses
- Status of Automated Metering Infrastructure (AMI)
- Program data
    - Description of existing energy efficiency programs
    - Description of existing demand-response programs
- Recent energy efficiency potential studies
- TVA Measurement Manual

Global Energy Partners Databases, Analysis Tools, and Reports

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

- ***Energy Market Profiles Database.*** Since the late 1990s, Global staff has maintained a database of end-use profiles by sector, customer segment and region for electricity and natural gas. The database contains market size, fuel shares/saturations, UECs/EUIs, intensities, and total sales.
- ***Building Energy Simulation Tool (BEST)***. Global'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.
- ***Database of Energy Efficiency Measures (DEEM)***. Global maintains a database of energy efficiency measures for residential, commercial, and industrial segments across the U.S. This is analogous to the DEER database developed for California. Global updates the database on a regular basis as it conducts new energy efficiency potential studies.
- ***EnergyShape™ Database***. This database contains end-use load shapes for residential and commercial segments for nine regions in the U.S. For the non-HVAC end uses, we used the EnergyShape data to develop the peak factors that represent the fraction of annual energy use that occurs during the peak hour. The peak factors were calibrated to available utility data for the system peak. The final peak factors were applied to annual energy savings to calculate the peak-demand savings from EE measures.
- ***Recent Studies***. Global 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 AmerenUE, 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.

Energy Efficiency Measure Data

In addition to BEST and DEEM (described above), several other sources of data were used to characterize the energy efficiency measures.

- ***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.

- ***Cost data sources***
    - RS Means Facilities Maintenance and Repair Cost Data
    - RS Means Mechanical Construction Costs
    - RS Means Building Construction Cost Data
    - Sixth Northwest Conservation and Electric Power Plan (2010)
    - USGBC — LEED New Construction & Major Renovation (2008)
    - RS Means Green Buildings Project Planning & Cost Estimating Second Edition (2008)
    - Grainger Catalog Volume 398, (2007-2008)
    - EIA Technology Forecast Updates – Residential and Commercial Building Technologies, Navigant Consulting, 2008

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.

- ***U.S. Census Data***:
    - The American Community Survey (ACS) is an ongoing survey that provides data every year on household characteristics. http://www.census.gov/acs/www/
    - Census Bureau's Economic Census, which is conducted every five years, collects details on business characteristics. We used the 2007 version. http://www.census.gov/econ/census07/
    - The Census Bureau also provides a mapping of SIC to NAICS codes. http://www.census.gov/eos/www/naics/
- ***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 Global to conduct an assessment of the national potential for energy efficiency, with estimates derived for the four DOE regions (including the South region that includes the TVA territory).
- ***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.

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 data from TVA, the Annual Energy Outlook, American Community Survey, and Global's Energy Market Profiles Database:

- Historical customer billing data by sector (e.g., residential, commercial, industrial, and directly served)
- TVA's 2010 Residential Saturation Survey and American Community Survey to allocate residential customers by housing type
- TVA-provided data and Energy Market Profiles Database to allocate sales and square footage by building type for the commercial sector
- TVA-provided data on energy use by industry type and AEO data to allocate sales and employment for the industrial sector

Data Application for Market Profiles

To develop the market profiles for each segment, we used the following general approach:

1. Developed control totals for each segment. These include market size, segment-level annual electricity use, and annual intensity.
2. Used TVA's 2010 Residential Saturation Survey to incorporate information on existing appliance and equipment 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 TVA staff to vet the data against their knowledge and experience.

The specific data elements for the market profiles, together with the key data sources, are shown in Table 2-8.

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	• Utility billing 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)	• Utility data • 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	• TVA Residential Saturation Survey • 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 TVA • Non HVAC uses: Engineering analysis • Energy Market Profiles • Results from previous studies • California RASS and CEUS
Appliance/equipment vintage distribution	Age distribution for each technology	• Utility saturation surveys • Previous studies
Efficiency options for each technology	List of available efficiency options and annual energy use for each technology	• TVA Measurement Manual • DEEM • DEER • NWPCC workbooks • Annual Energy Outlook • Previous studies
Peak factors	Share of technology energy use that occurs during the peak hour	• Utility data • 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	• TVA customer growth forecast • AEO 2011 growth forecast
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 forecast assumptions[7] Appliance/efficiency standards analysis
Electricity prices	Forecast of average electricity prices	• TVA price forecasts
Utilization model parameters	Price elasticities, elasticities for other variables (income, weather)	• EPRI's REEPS and COMMEND models • TVA forecasting data • AEO 2011

In addition, we implemented assumptions for known future equipment standards as of January, 2011, as shown in Table 2-10 and Table 2-11.

[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

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				SEER 14										
	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 kWh/yr)		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

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.	• TVA Measurement Manual • BEST • EPRI National Study • DEEM • DEER • Other secondary sources
Peak Demand Impacts	Savings during the peak demand periods are specified for each measure. These impacts relate to the energy savings and depend on the extent to which each measure is coincident with the system peak.	• TVA Measurement Manual • BEST • EnergyShape
Costs	Equipment Measures: Includes the full cost of purchasing and installing the equipment on a per-unit, 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.	• DEEM • DEER • Other secondary sources
Measure Lifetimes	Estimates derived from the technical data and secondary data sources that support the measure demand and energy savings analysis.	• TVA Measurement Manual • DEEM • DEER • 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 • 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.	• Appliance, building codes, and standards 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 escalated for inflation at an annualized forecast GDP growth rate of 1.86%. Discount rates, line loss factors, avoided capacity, and avoided energy costs were provided by TVA. Administrative costs were assumed to be 10% of incremental costs for

purposes of the measure level economic screen. Other program cost assumptions are made for the portfolio cost effectiveness analysis discussed in Chapter 7.

Potentials Estimation

To estimate potentials, three sets of parameters were required.

- ***Adoption rates 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 are based on expert opinion and engineering review of how quickly the market could 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. These adoption rates are used within LoadMAP to generate the Technical and Economic potentials.
- ***Market acceptance rates (MARs)***. These factors are applied to Economic potential to estimate the upper bound: Achievable - High. The rates for this study were taken from the EPRI National Potential Study and capped at 85% in the few instances where the factors exceeded that number. This reflects nationwide estimates for all territories of the United States, some of which have aggressive DSM efforts and high levels of engagement. It is meant to comprise a high and aggressive upper bound on the potentials.
- ***Program implementation factors (PIFs)***. These factors are applied to Achievable – High potential to calculate Achievable – Low potential. These rates were developed from primary market and attitudinal research in a recent potential study for AmerenUE in Missouri, a region that faces similar challenges to DSM as the Valley: a short track record in DSM programming, low energy prices, and a social consciousness less focused on energy efficiency than some other areas in the country. This is meant to comprise a low bound on the potentials.

MARs and PIFs are presented in Appendix E.

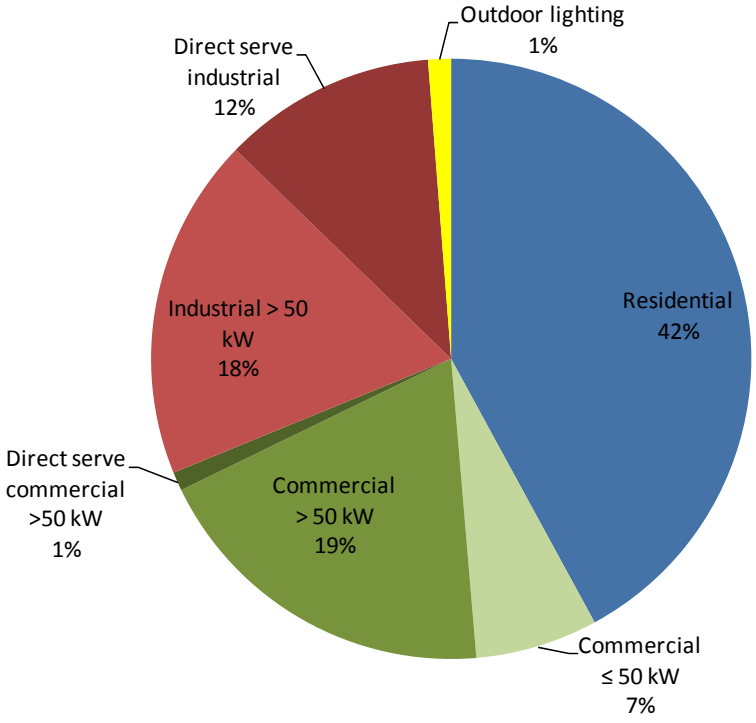
CHAPTER | 3

MARKET CHARACTERIZATION AND MARKET PROFILES

The Tennessee Valley Authority (TVA) is the largest electric utility in the U.S. on the basis of energy sales, with annual sales of 174 billion kWh in 2010.[8] TVA serves as the wholesale provider for 155 power distributors and directly serves 59 industrial and federal facilities. Its service territory, with an approximate area of 80,000 square miles, encompasses more than 9 million people in seven southeastern states. It includes nearly the entire state of Tennessee as well as portions of Alabama, Georgia, Kentucky, Mississippi, North Carolina, and Virginia. Major cities are Memphis, Nashville, Knoxville, Huntsville, and Chattanooga. The top industries in the service territory are chemical products, primary metals, paper products, and food products.

Total electricity use for the residential, commercial and industrial sectors for TVA in 2009 was 147,949 GWh.[9] As shown in Figure 3-1, the largest sector is residential, accounting for 42%, or 62,246 GWh. The remaining use is split between the commercial and industrial sectors, at 39,561 GWh and 44,311 GWh respectively.

Figure 3-1 Sector-Level Electricity Use, 2009



[8] http://www.tva.com/abouttva/index.htm

[9] Energy given "at-the-meter," i.e. does not include line losses. Totals do not include federal customers or a small number of DSI customers as specified by TVA project management.

Residential Sector

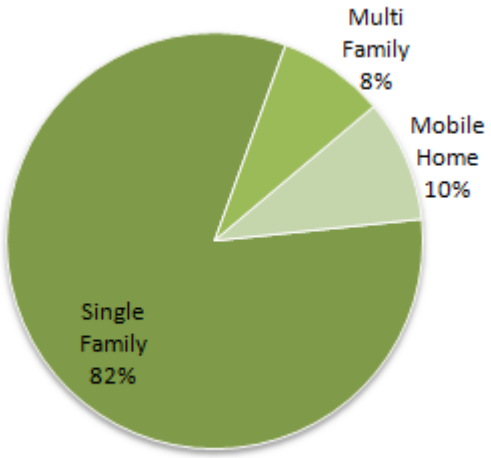
This section characterizes the residential market at a high level, and then provides a profile of how customers in each segment use electricity by end use.

Total residential electricity use in 2009 was 62,246 GWh. Customer information for each segment is shown in Table 3-1 and Figure 3-2.The single-family segment used the vast majority of the total residential sector electricity in 2009 as a result of the largest number of customers and the highest intensity. The mobile home segment also has a high usage per customer, almost as high as single family customers.

Table 3-1 Residential Sector Electricity Usage and Intensity by Segment Type

Segment	Number of Customers	Electricity Sales (GWh)	Avg. Use/ Customer (kWh)	% of Total Usage
Single Family	2,947,284	51,172	17,363	82.2%
Multi Family	540,078	5,178	9,588	8.3%
Mobile Home	370,339	5,895	15,918	9.5%
Total	**3,857,702**	**62,246**	**16,135**	**100%**

Figure 3-2 Residential Electricity Use by Customer Segment, 2009



As we describe in the previous chapter, the market profiles provide the foundation upon which we develop the baseline forecast. The market profile for the residential sector as a whole is presented in Table 3-2. The residential market profiles for each housing segment are presented in Appendix A.

Table 3-2 Market Profile for the Residential Sector

Average Residential Market Profile

End Use	Technology	Saturation	UEC (kWh)	Intensity (kWh/HH)	Usage (GWh)
Cooling	Central AC	49.1%	4,438	2,083	8,036
Cooling	Room AC	14.4%	1,833	277	1,070
Combined Heating/Cooling	Air-Source Heat Pump	32.6%	6,368	2,180	8,410
Combined Heating/Cooling	Geothermal Heat Pump	0.6%	5,628	38	147
Space Heating	Electric Resistance	1.8%	5,976	101	390
Space Heating	Electric Furnace	18.3%	5,415	761	2,935
Water Heating	Water Heater	71.6%	3,807	2,706	10,438
Interior Lighting	Screw-in	100.0%	1,202	1,202	4,639
Interior Lighting	Linear Fluorescent	100.0%	114	114	440
Exterior Lighting	Screw-in	100.0%	286	286	1,104
Appliances	Clothes Washer	93.1%	128	120	463
Appliances	Clothes Dryer	89.4%	962	865	3,336
Appliances	Dishwasher	69.5%	489	341	1,314
Appliances	Refrigerator	99.9%	920	919	3,546
Appliances	Freezer	49.9%	721	366	1,412
Appliances	Second Refrigerator	25.9%	1,071	283	1,094
Appliances	Stove	86.1%	552	475	1,831
Appliances	Microwave	96.5%	157	152	586
Electronics	Personal Computer	124.0%	317	396	1,528
Electronics	TV	253.6%	189	482	1,861
Electronics	Printer/Fax/Copier	45.5%	49	22	86
Electronics	Set-top Boxes/DVR/Audio	280.4%	129	366	1,410
Electronics	Devices and Gadgets	100.0%	51	51	196
Miscellaneous	Pool Pump	13.9%	1,638	230	886
Miscellaneous	Pool Heater	0.6%	6,237	39	149
Miscellaneous	Hot Tub / Spa	7.1%	1,038	74	284
Miscellaneous	Well Pump	4.9%	600	29	113
Miscellaneous	Furnace Fan	53.1%	209	107	412
Miscellaneous	Miscellaneous	100.0%	1,071	1,071	4,130
Total				**16,135**	**62,246**

Figure 3-3 presents the end-use breakout for the residential sector as a whole. The most prominent end uses are those related to space conditioning: cooling, heating, and combined heating/cooling (or heat pumps). Appliances and water heating comprise the next largest end uses. The electronics end use, which includes personal computers, TVs, home audio, etc., also contributes significantly to household electricity usage. The miscellaneous end use includes such devices as furnace fans, pool pumps, and other plug loads (hair dryers, power tools, coffee makers, etc.).

Figure 3-3 Residential Electricity Use by End Use, 2009

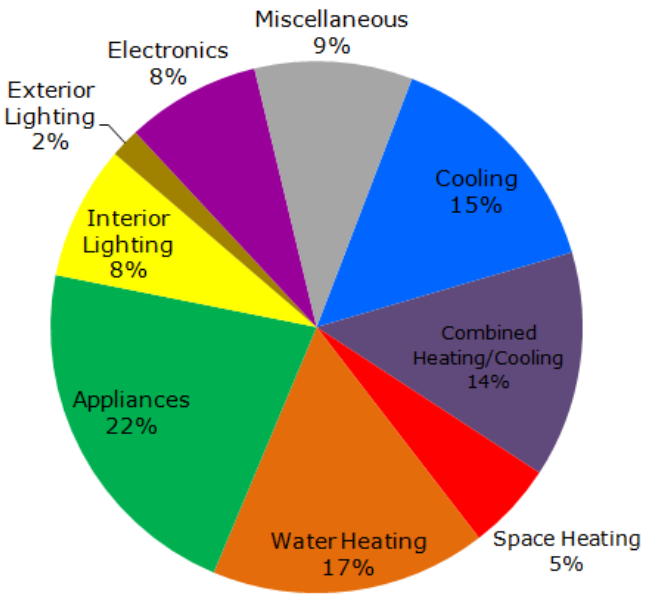
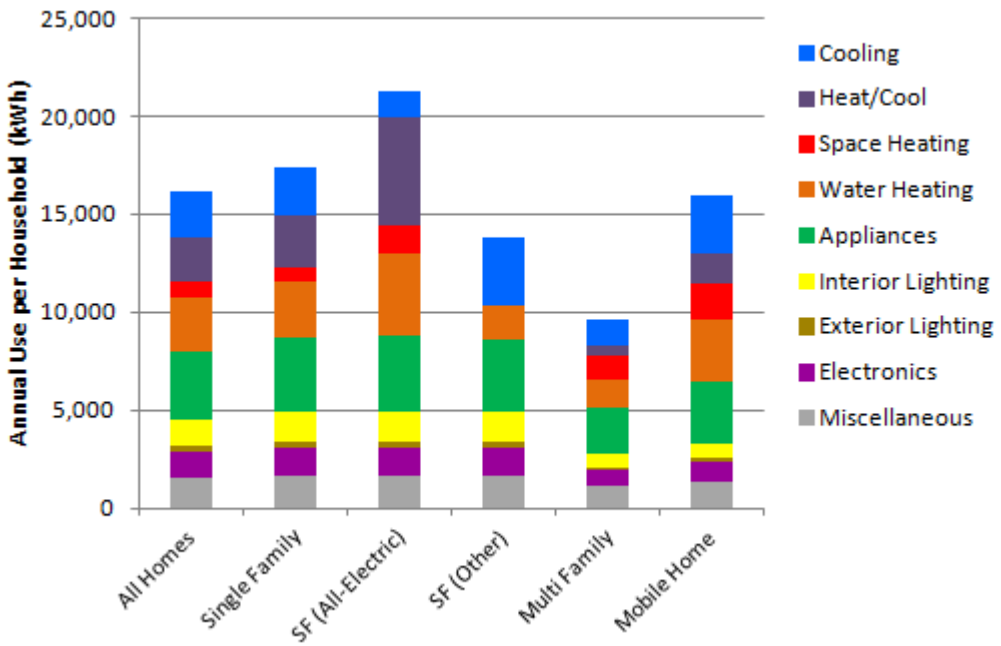


Figure 3-4 presents the end-use shares of residential electricity use for each housing type. Here, the single family segment is shown as a segment average as well as broken out into single family all-electric homes and single family other homes. The TVA territory has a large number of all-electric homes, roughly half of the single family homes in the Valley, with comparatively larger consumption in heating, water heating, and cooking.

Figure 3-4 End-Use Shares of Total Electricity Use by Housing Type, 2009



Commercial Sector

Total electricity use in the commercial sector in 2009 was 39,561 GWh. Using secondary sources, total commercial floor space is estimated at 2,191 million square feet, implying an average intensity of 18.1 kWh per square foot per year.

Table 3-3 presents the annual electricity use, floor space, and intensity estimates for each building type. The largest segments by energy usage are large office, large retail, and health. The largest segments by floor space are large retail and schools. Restaurants and groceries have the highest intensity due to the large amount of cooking and refrigeration. Warehouses, schools and the miscellaneous segment have the lowest intensities.

Table 3-3 Commercial Sector Market Characterization Results, 2009

Segment	Annual Use (GWh)	Floor Space (million sq. ft.)	Intensity (kWh/sq.ft.)
Small Commercial (≤50 kW)			
Small Office	2,563	133	19.3
Restaurant	1,967	37	53.6
Small Retail	3,501	225	15.5
Small Grocery	525	12	43.6
Warehouse	714	133	5.4
Small Miscellaneous	485	48	10.1
Large Commercial (>50 kW)			
Large Office	5,324	239	22.3
Large Retail	4,678	293	16.0
Large Grocery	3,695	72	51.6
Refrigerated Warehouse	816	34	24.0
School	2,731	291	9.4
College	2,199	142	15.5
Health	4,324	136	31.8
Lodging	2,759	144	19.1
Large Miscellaneous	3,281	252	13.0
Total	**39,561**	**2,191**	**18.1**

Table 3-4 shows the market profile for the commercial sector as a whole, representing a composite of all the building types. Overall, about 81% of commercial floor space is cooled. About 47% of commercial floor space is heated using electric equipment, either some form of resistance heating or heat pumps. Roof top AC units are the largest single energy-consuming technology in the commercial sector, closely followed by linear fluorescent lighting. Ventilation, screw-in lamps, and electric heating equipment are the next largest uses.

Market profiles for each building type are presented in Appendix A.

Table 3-4 Commercial Sector Composite Market Profile, 2009

Average Commercial Market Profile

End Use	Technology	Saturation	EUI (kWh)	Intensity (kWh/SqFt)	Usage (GWh)
Cooling	Air-Cooled Chiller	3.7%	9.13	0.34	745
Cooling	Water-Cooled Chiller	9.2%	7.26	0.66	1,457
Cooling	Roof Top AC	46.3%	6.75	3.13	6,856
Cooling	Other Cooling	12.0%	5.78	0.70	1,525
Heating	Electric Heating	38.4%	2.81	1.08	2,367
Cooling/Heating	Roof Top Heat Pump	9.3%	9.13	0.85	1,866
Ventilation	Ventilation	100.0%	1.41	1.41	3,099
Water Heating	Water Heating	48.5%	1.30	0.63	1,387
Interior Lighting	Screw-in	100.0%	1.12	1.12	2,456
Interior Lighting	High-Bay Fixtures	100.0%	0.79	0.79	1,737
Interior Lighting	Linear Fluorescent	100.0%	2.73	2.73	5,991
Exterior Lighting	Screw-in	100.0%	0.23	0.23	500
Exterior Lighting	HID	100.0%	0.51	0.51	1,113
Exterior Lighting	Linear Fluorescent	100.0%	0.05	0.05	116
Refrigeration	Walk-in Refrigerator	42.8%	1.56	0.67	1,465
Refrigeration	Reach-in Refrigerator	42.8%	0.10	0.04	98
Refrigeration	Glass Door Display	42.8%	1.32	0.56	1,235
Refrigeration	Open Display Case	42.8%	0.59	0.25	558
Refrigeration	Icemaker	42.8%	0.14	0.06	128
Refrigeration	Vending Machine	42.8%	0.15	0.06	140
Food Preparation	Oven	17.8%	0.44	0.08	171
Food Preparation	Fryer	17.8%	0.63	0.11	245
Food Preparation	Dishwasher	17.8%	0.78	0.14	304
Food Preparation	Hot Food Container	17.8%	0.22	0.04	86
Office Equipment	Desktop Computer	100.0%	0.46	0.46	1,007
Office Equipment	Laptop	100.0%	0.07	0.07	151
Office Equipment	Server	100.0%	0.20	0.20	435
Office Equipment	Monitor	100.0%	0.09	0.09	187
Office Equipment	Printer/Copier/Fax	100.0%	0.06	0.06	134
Office Equipment	POS Terminal	44.9%	0.05	0.02	48
Miscellaneous	Non-HVAC Motors	54.6%	0.09	0.05	110
Miscellaneous	Pool Pump	3.7%	0.01	0.00	1
Miscellaneous	Pool Heater	0.9%	0.02	0.00	0
Miscellaneous	Miscellaneous	100.0%	0.84	0.84	1,843
	Total			**15.5**	**39,561**

Figure 3-5 shows the breakdown of annual commercial electricity usage by end use. Cooling and lighting are the largest end uses in the commercial sector, accounting for over half of total usage. Refrigeration and ventilation are the next largest end uses. Each of the remaining end uses accounts for 5% or less of total usage.

Figure 3-5 Commercial Electricity Consumption by End Use, 2009

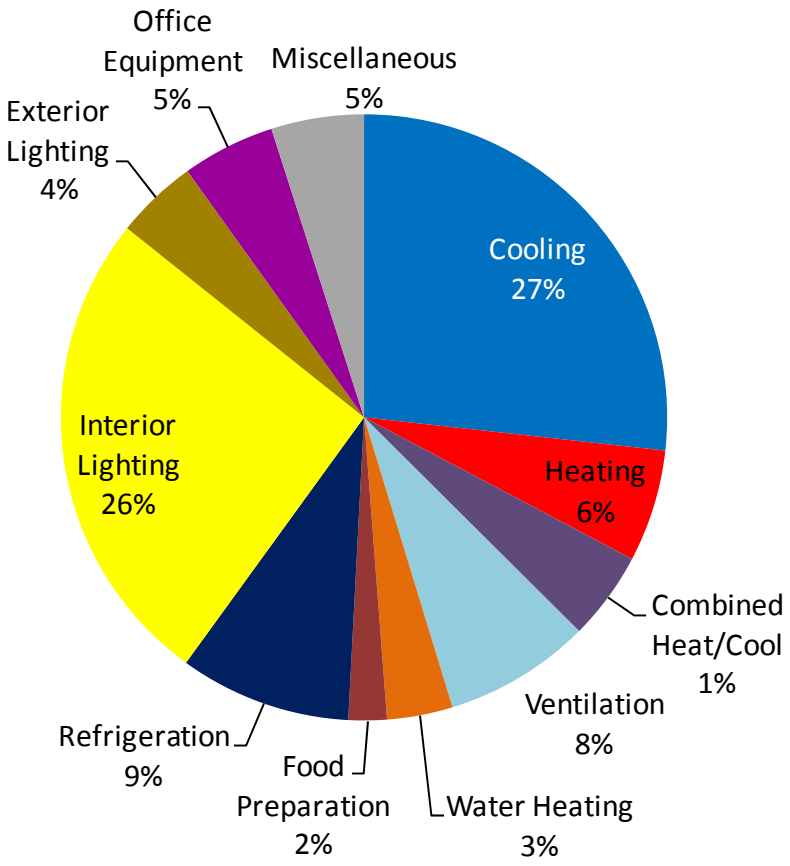
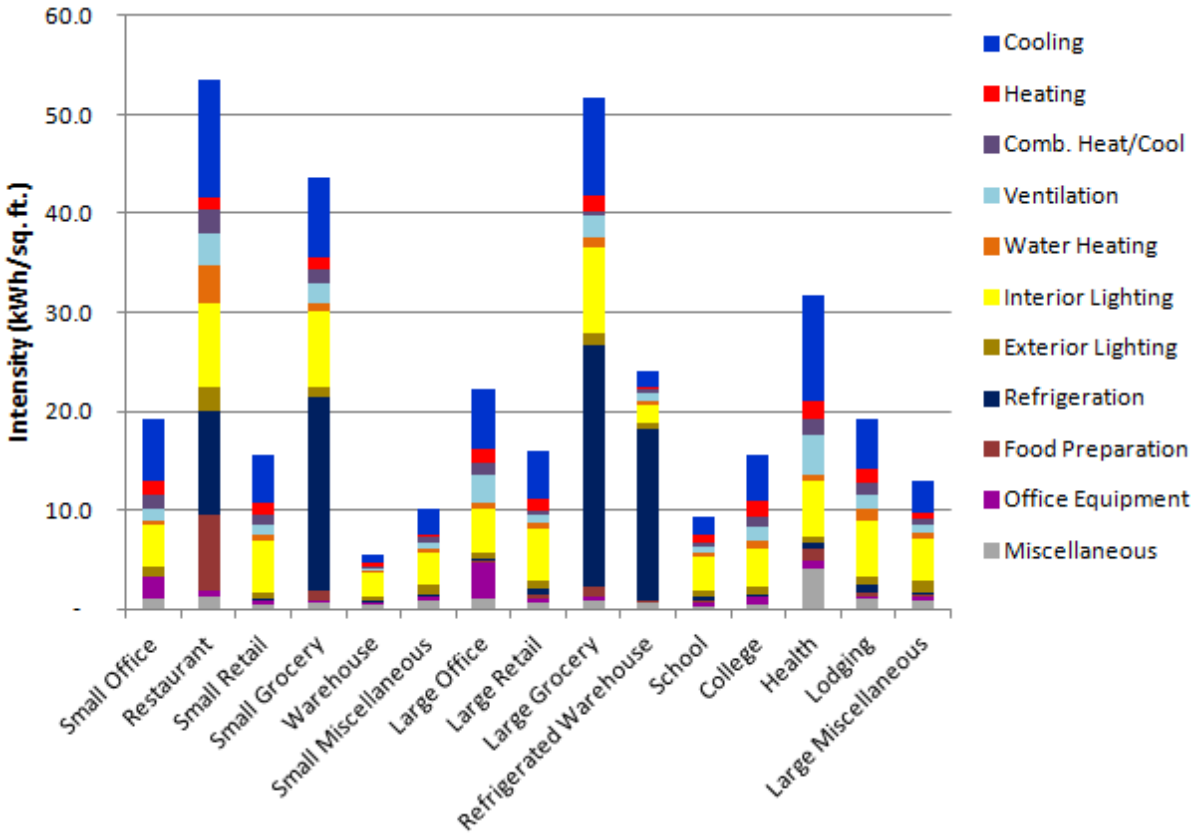


Figure 3-6 illustrates how the end-use composition of electricity use varies by building type. Observations include the following:

- Lighting and cooling are major end uses across all building types
- Refrigeration has a large share in grocery stores, refrigerated warehouses, and restaurants
- Office equipment has substantial use in large offices, small offices, and health
- Miscellaneous is highest in health since this end use includes medical equipment

Figure 3-6 Commercial End Use Intensities by Building Type, 2009



Industrial Sector

The industrial sector, at 44,311 GWh in 2009, accounts for almost one-third of total electricity sales. Chemical products, primary metals, paper products, and food products are the four largest industries throughout the Valley, accounting for 59% of total industrial sales in 2009. In order to capture measures that are specific to these industries we isolated them as separate segments, while combining the remaining industries into the Other Industrial category.

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 2009. Table 3-5 shows the composite market profiles for the industrial sector.

Table 3-5 Industrial Market Profile, 2009

Average Industrial Market Profile

End Use	Technology	Saturation	EUI (kWh)	Intensity (kWh/Employee)	Usage (GWh)
Cooling	Roof Top AC	17.6%	27,882	4,899	2,310
Cooling	Other Cooling	4.0%	25,840	1,035	488
Heating	Electric Heating	9.3%	28,575	2,651	1,250
Cooling/Heating	Roof Top Heat Pump	2.7%	55,203	1,507	711
Ventilation	Ventilation	100.0%	1,673	1,673	789
Interior Lighting	Screw-in	100.0%	656	656	309
Interior Lighting	High-Bay Fixtures	100.0%	4,721	4,721	2,227
Interior Lighting	Linear Fluorescent	100.0%	1,075	1,075	507
Exterior Lighting	Screw-in	100.0%	3	3	1
Exterior Lighting	HID	100.0%	1,208	1,208	570
Exterior Lighting	Linear Fluorescent	100.0%	0	0	0
Motors	1-5 HP	30.3%	9,588	2,906	1,370
Motors	6-20 HP	13.0%	45,791	5,936	2,800
Motors	21-50 HP	4.6%	144,389	6,666	3,144
Motors	51-100 HP	1.9%	348,431	6,451	3,042
Motors	101-200 HP	1.0%	753,014	7,273	3,430
Motors	201-500 HP	0.5%	1,464,824	7,255	3,422
Motors	501-1000 HP	0.2%	3,539,981	6,163	2,907
Motors	1000+ HP	0.1%	5,687,989	6,132	2,892
Process Heating	Process Heating	100.0%	10,418	10,418	4,913
Miscellaneous	Miscellaneous	100.0%	15,327	15,327	7,228
	Total			**93,957**	**44,311**

Figure 3-7 presents the end-use breakout for the industrial sector in 2009. Machine drive is the largest overall end use for the industrial sector, accounting for 52% of energy use. Note that this analysis includes a wide range of industrial equipment, such as air compressors and refrigeration compressors, pumps, and fans within the motors category. Since so many industrial applications are unique and defy high-level classification schemes, the miscellaneous category comprises the second largest end use at 16% of industrial energy use. Process heating accounts for 11% of energy use, while lighting, cooling, heating, and ventilation are all under 10%.

Figure 3-7 Industrial Electricity Use by End Use, 2009

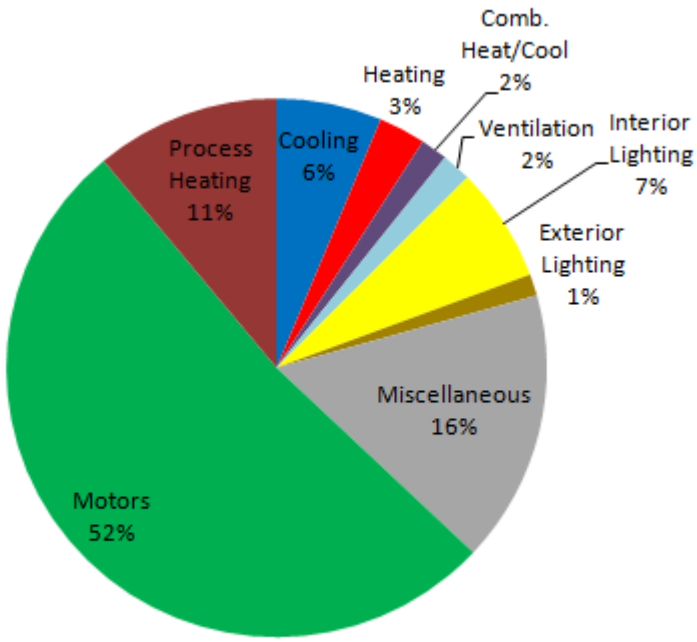
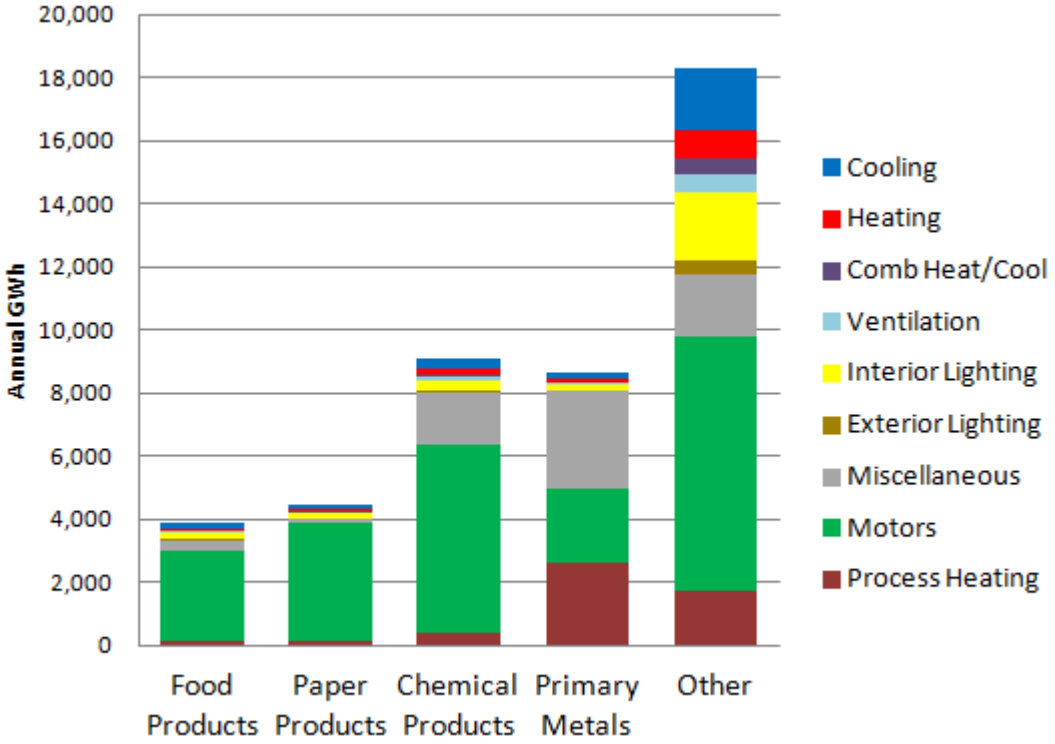


Table 3-6 and Figure 3-8 show how the major industrial segments in the Valley used electricity in 2009. Machine drives dominate all segments, though process heating is more prevalent in the primary metals segment.

Table 3-6 Industrial Electricity Use (GWh) by End Use and Segment, 2009

Electricity (GWh)	Food Products	Paper Products	Chemical Products	Primary Metals	Other	Total
Cooling	159.6	151.3	342.9	183.5	1,961.2	2,799
Heating	71.3	67.6	153.2	82.0	876.1	1,250
Comb Heat/Cool	40.5	38.4	87.1	46.6	498.0	711
Ventilation	45.0	42.6	96.7	51.7	552.9	789
Interior Lighting	210.7	143.0	317.9	165.3	2,206.1	3,043
Exterior Lighting	39.6	26.9	59.7	31.0	414.3	571
Miscellaneous	302.2	152.0	1,679.2	3,119.0	1,975.8	7,228
Motors	2,879.1	3,736.0	5,981.6	2,354.7	8,055.2	23,007
Process Heating	124.5	117.7	362.1	2,580.5	1,728.2	4,913
Grand Total	**3,873**	**4,475**	**9,080**	**8,614**	**18,268**	**44,311**

Figure 3-8 Industrial Electricity Use by End Use and Segment, 2009



BASELINE FORECAST

Prior to developing estimates of energy-efficiency potential, a baseline end-use forecast was developed to quantify how electricity is used by end use in the base year and what the consumption is likely to be in the future in absence of new utility programs and naturally occurring efficiency. The baseline forecast serves as the metric against which energy efficiency potentials; technical, economic, and achievable, are measured. The baseline forecast we developed for TVA was consistent with its official forecast from October 2011.

Residential Sector

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

Figure 4-1 presents the baseline forecast at the end-use level for the residential sector as a whole. Overall, residential use increases from 62,246 GWh in 2009 to 82,830 GWh in 2030, an increase of 33%, or an average growth of 1.4% per year.

Figure 4-1 Residential Baseline Forecast by End Use

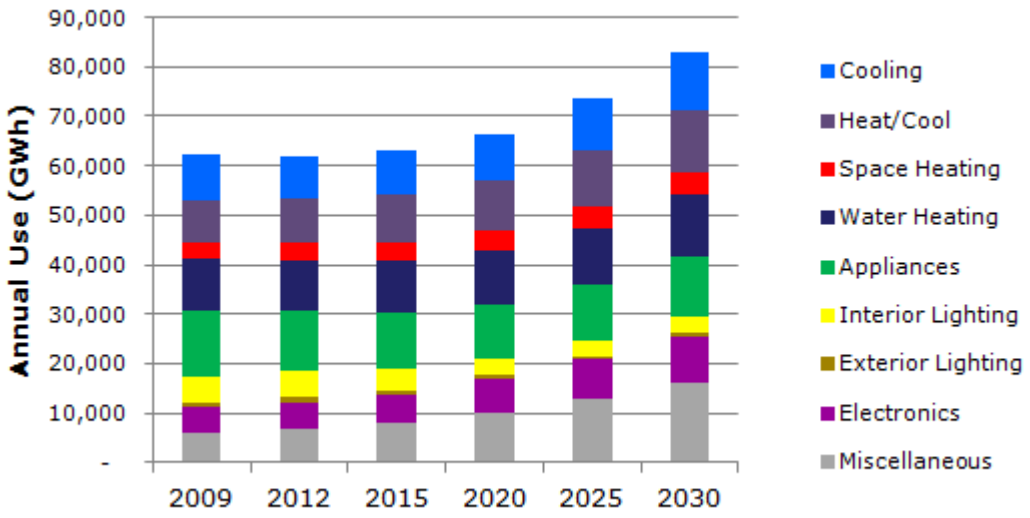


Figure 4-2 presents the forecast of use per household. Most noticeable is that lighting use decreases significantly after 2012, as the lighting standard from EISA comes into effect and as LED lamps begin to gain traction in the later years of the forecast.

Figure 4-2 Residential Baseline Electricity Use per Household by End Use

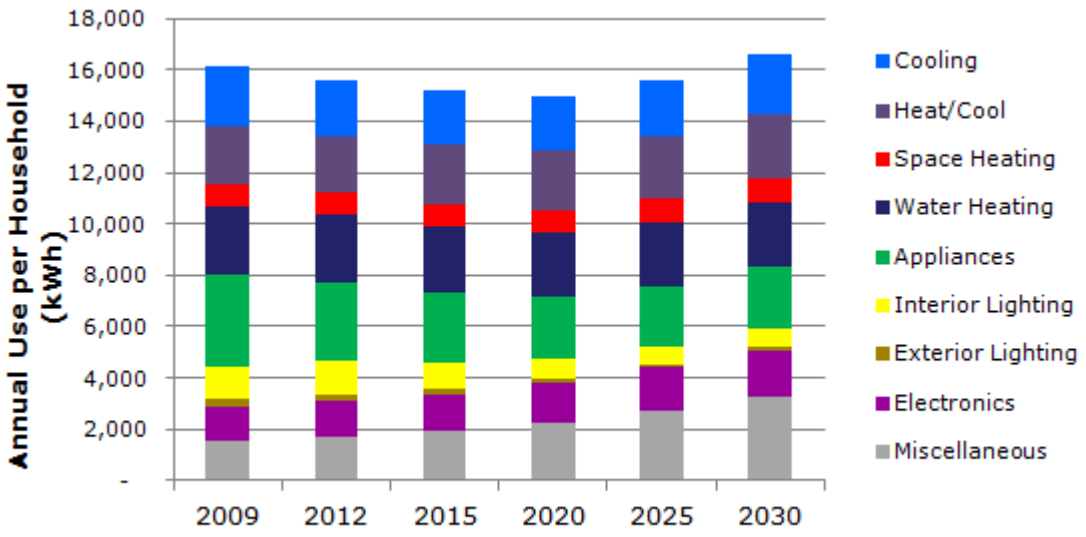


Table 4-1 shows the end-use forecast at the technology level. Specific observations include:

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. It causes a decline in interior screw-in lighting use by 38% over the forecast period.
2. Cooling increases over the forecast period due to higher saturations of central AC in new construction, but only slightly due to moderating effect of forthcoming appliance standards.
3. Electric water heating has a high saturation relative to other areas around the country, but grows only modestly over the forecast period, also offset by forthcoming appliance standards.
4. Appliance energy use decrease markedly, reflecting efficiency gains from standards, particularly in refrigeration appliances.
5. Growth in use in electronics is substantial and reflects an increase in the saturation of electronics and the trend toward higher-powered computers. This is tempered somewhat by the higher efficiency of televisions.
6. 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 4-1 Residential Baseline Electricity Forecast by End Use and Technology (GWh)

End Use	Technology	2009	2012	2015	2020	2025	2030	% Change 2009-2030
Cooling	Central AC	8,036	7,704	7,832	8,301	9,302	10,449	30%
	Room AC	1,070	1,052	1,046	1,024	1,049	1,093	2%
Combined Heating/Cooling	Geothermal Heat Pump	147	141	142	148	159	176	20%
	Air-Source Heat Pump	8,410	8,686	9,279	10,202	11,342	12,386	47%
Space Heating	Electric Furnace	2,935	3,018	3,221	3,550	3,918	4,278	46%
	Electric Resistance	390	394	407	427	449	469	20%
Water Heating	Water Heater	10,438	10,426	10,758	11,001	11,517	12,162	17%
Interior Lighting	Screw-in	4,639	4,602	3,768	2,862	2,578	2,868	-38%
	Linear Fluorescent	440	453	479	529	592	658	50%
Exterior Lighting	Screw-in	1,104	1,089	906	681	599	668	-40%
Appliances	Refrigerator	3,546	3,056	2,633	2,232	2,187	2,272	-36%
	Freezer	1,412	1,174	1,051	998	1,030	1,149	-19%
	Second Refrigerator	1,094	957	841	777	805	877	-20%
	Clothes Washer	463	360	292	202	144	137	-70%
	Clothes Dryer	3,336	3,107	3,009	2,921	3,085	3,346	0%
	Dishwasher	1,314	989	809	735	790	886	-33%
	Stove	1,831	1,891	1,994	2,166	2,349	2,523	38%
	Microwave	586	623	677	774	881	995	70%
Electronics	Devices and Gadgets	196	223	261	335	431	547	179%
	Personal Computer	1,528	1,665	1,801	2,076	2,399	2,743	80%
	TV	1,861	1,953	2,120	2,467	2,886	3,333	79%
	Printer/Fax/Copier	86	87	91	104	120	138	61%
	Set-top Boxes/DVR/Audio	1,410	1,503	1,622	1,858	2,142	2,448	74%
Miscellaneous	Furnace Fan	412	440	480	548	623	698	69%
	Pool Pump	886	935	1,009	1,132	1,273	1,413	59%
	Miscellaneous	4,130	4,834	5,790	7,700	10,187	13,257	221%
	Pool Heater	149	158	171	193	218	243	62%
	Hot Tub / Spa	284	298	321	359	403	447	58%
	Well Pump	113	116	123	137	154	171	51%
Grand Total		**62,246**	**61,936**	**62,932**	**66,440**	**73,613**	**82,830**	**33%**

Commercial Sector

Electricity use in the commercial sector grows modestly at 13% overall during the forecast horizon, an average of 0.6% per year. Usage starts at 39,561 GWh in 2009, decreases until 2015 and then increases to 44,718 GWh in 2030. Figure 4-3 and Table 4-2 present the baseline forecast at the end-use level for the commercial sector as a whole. Most end uses show modest growth over the forecast period. The exceptions are interior lighting, which declines due to the EISA 2007 lighting standards, and refrigeration, which is affected by the EPACT 2005 standards for refrigeration.

Figure 4-3 Commercial Baseline Electricity Forecast by End Use

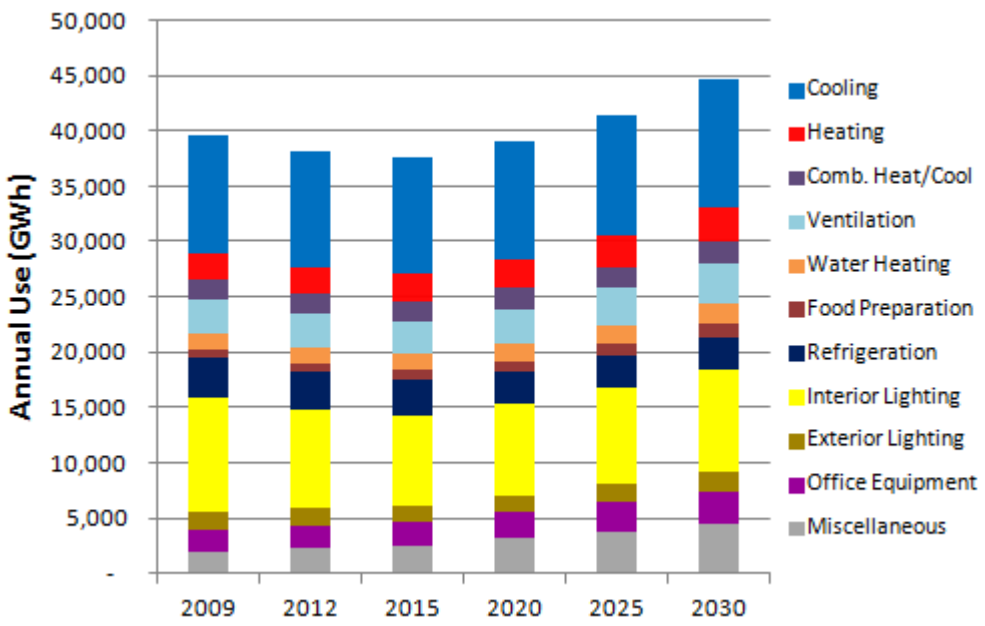


Table 4-2 Commercial Electricity Consumption by End Use (GWh)

End Use	2009	2012	2015	2020	2025	2030	% Change	Avg. Growth Rate
Cooling	10,582	10,520	10,477	10,636	10,982	11,691	10.5%	0.47%
Heating	2,367	2,384	2,456	2,609	2,784	2,962	25.1%	1.07%
Comb. Heat/Cool	1,866	1,847	1,852	1,896	1,962	2,085	11.7%	0.53%
Ventilation	3,099	3,012	2,986	3,109	3,303	3,505	13.1%	0.59%
Water Heating	1,387	1,416	1,462	1,564	1,682	1,806	30.2%	1.26%
Food Preparation	806	834	877	985	1,127	1,278	58.5%	2.19%
Refrigeration	3,624	3,436	3,182	2,930	2,845	2,903	-19.9%	-1.05%
Interior Lighting	10,184	8,846	8,107	8,189	8,686	9,283	-8.8%	-0.44%
Exterior Lighting	1,730	1,584	1,501	1,576	1,656	1,772	2.5%	0.12%
Office Equipment	1,962	2,056	2,129	2,378	2,642	2,909	48.3%	1.87%
Miscellaneous	1,955	2,241	2,558	3,153	3,816	4,525	131.5%	4.00%
Total	**39,561**	**38,176**	**37,587**	**39,026**	**41,485**	**44,718**	**13.0%**	**0.58%**

Table 4-3 presents the commercial sector forecast by technology. Interior screw-in lighting decreases significantly over the forecast period as a result of the lighting standard.

Table 4-3 Commercial Baseline Electricity Forecast by End Use and Technology (GWh)

End Use	Technology	2009	2012	2015	2020	2025	2030	% Change
Cooling	Air-Cooled Chiller	744.7	763.3	784.0	824.7	877.2	936.3	26%
	Water-Cooled Chiller	1,456.5	1,497.6	1,537.3	1,632.2	1,743.8	1,866.7	28%
	Roof Top AC	6,855.7	6,661.6	6,500.6	6,405.7	6,454.6	6,845.1	0%
	Other Cooling	1,525.2	1,597.7	1,654.9	1,773.8	1,906.7	2,042.4	34%
Heating	Electric Heating	2,367.5	2,383.8	2,455.9	2,609.5	2,783.7	2,962.3	25%
Cooling/Heating	Roof Top Heat Pump	1,866.0	1,847.2	1,852.4	1,895.8	1,962.1	2,084.6	12%
Ventilation	Ventilation	3,098.7	3,011.6	2,985.6	3,109.2	3,303.2	3,505.1	13%
Water Heating	Water Heating	1,387.1	1,416.5	1,462.0	1,563.5	1,681.6	1,805.7	30%
Food Preparation	Dishwasher	304.0	301.0	305.2	334.5	382.7	434.8	43%
	Fryer	245.4	267.3	292.7	337.5	385.9	436.0	78%
	Oven	171.1	187.3	206.0	239.3	275.5	313.0	83%
	Hot Food Container	85.7	77.9	72.8	74.0	83.1	93.7	9%
Refrigeration	Glass Door Display	1,235.0	1,241.0	1,176.2	1,094.5	1,033.0	994.6	-19%
	Open Display Case	557.5	569.2	566.3	574.4	588.8	612.0	10%
	Walk-in Refrigerator	1,464.8	1,280.7	1,119.3	958.5	914.0	965.5	-34%
	Reach-in Refrigerator	98.4	88.8	80.2	71.6	69.2	72.4	-26%
	Vending Machine	139.6	128.2	109.0	90.8	85.7	90.8	-35%
	Icemaker	128.1	127.6	131.2	140.8	153.9	168.0	31%
Interior Lighting	Linear Fluorescent	5,990.6	5,580.4	5,488.7	5,589.0	5,940.3	6,402.8	7%
	Screw-in	2,456.1	1,838.8	1,336.2	1,399.4	1,467.1	1,567.7	-36%
	High-Bay Fixtures	1,737.1	1,426.8	1,281.7	1,200.6	1,278.6	1,312.1	-24%
Exterior Lighting	Linear Fluorescent	116.4	110.0	112.5	119.0	126.9	137.6	18%
	Screw-in	500.2	478.5	428.4	451.0	438.3	470.5	-6%
	HID	1,112.9	995.6	960.4	1,005.9	1,091.0	1,164.1	5%
Office Equipment	Desktop Computer	1,006.9	1,055.1	1,080.9	1,199.7	1,324.0	1,448.0	44%
	Laptop	151.1	159.6	164.8	185.0	206.1	227.3	50%
	Monitor	186.5	190.2	199.2	223.5	248.9	274.4	47%
	Server	435.3	449.8	476.7	542.3	611.9	683.3	57%
	Printer/Copier/Fax	134.5	158.2	162.7	177.3	196.3	215.3	60%
	POS Terminal	47.7	43.3	45.1	49.8	55.0	60.4	27%
Miscellaneous	Pool Pump	0.8	0.9	0.9	1.0	1.1	1.2	50%
	Pool Heater	0.4	0.4	0.4	0.5	0.5	0.6	50%
	Non-HVAC Motors	110.3	114.5	119.6	130.2	141.8	153.6	39%
	Miscellaneous	1,843.2	2,125.2	2,437.1	3,021.2	3,672.6	4,369.3	137%
Total		**39,561**	**38,176**	**37,587**	**39,026**	**41,485**	**44,718**	**13%**

Industrial Sector

Figure 4-4 and Table 4-4 present the baseline forecast at the end-use level for the industrial sector as a whole. Overall, industrial annual energy use increases from 44,311 GWh in 2009 to 53,412 GWh in 2030, a 20.5% increase, or 0.9% average growth per year.

Figure 4-4 Industrial Baseline Electricity Forecast by End Use

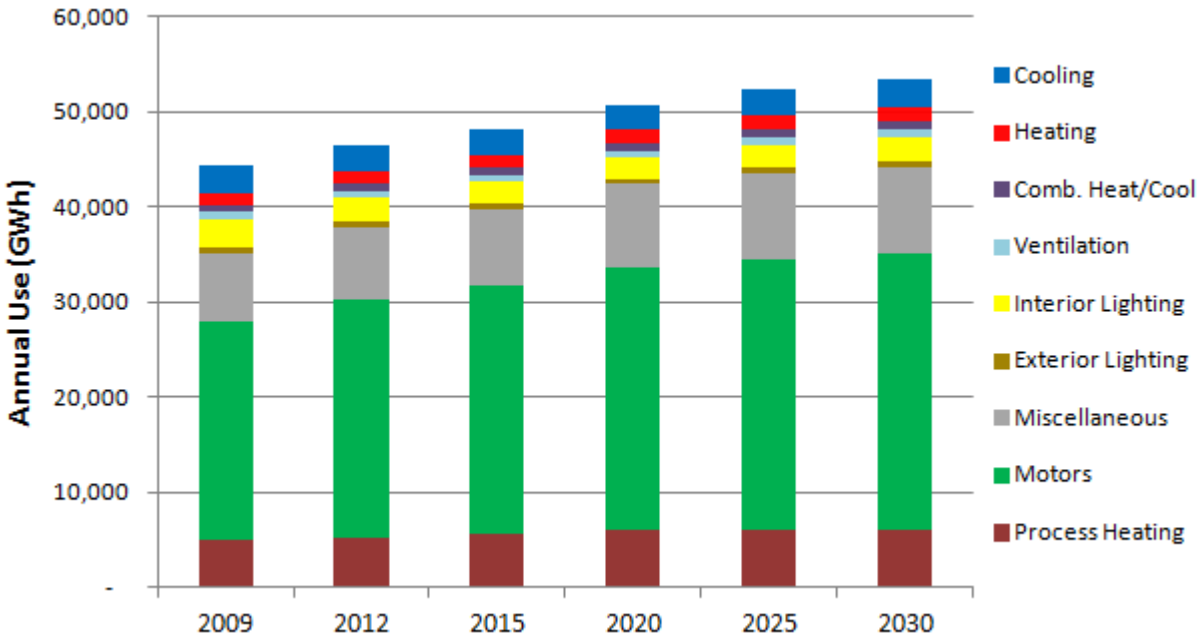


Table 4-4 Industrial Electricity Consumption by End Use (GWh)

End Use	2009	2012	2015	2020	2025	2030	% Change	Avg. Growth Rate
Cooling	2,799	2,736	2,716	2,700	2,758	2,869	2.5%	0.12%
Heating	1,250	1,285	1,346	1,428	1,507	1,576	26.1%	1.10%
Comb. Heat/Cool	711	706	712	726	747	777	9.3%	0.43%
Ventilation	789	752	734	749	783	814	3.2%	0.15%
Interior Lighting	3,043	2,541	2,312	2,257	2,438	2,540	-16.5%	-0.86%
Exterior Lighting	571	520	508	526	565	591	3.5%	0.16%
Miscellaneous	7,228	7,679	8,158	8,834	9,016	9,051	25.2%	1.07%
Motors	23,007	24,938	26,153	27,607	28,441	29,051	26.3%	1.11%
Process Heating	4,913	5,237	5,534	5,949	6,108	6,141	25.0%	1.06%
Grand Total	**44,311**	**46,394**	**48,173**	**50,777**	**52,364**	**53,412**	**20.5%**	**0.89%**

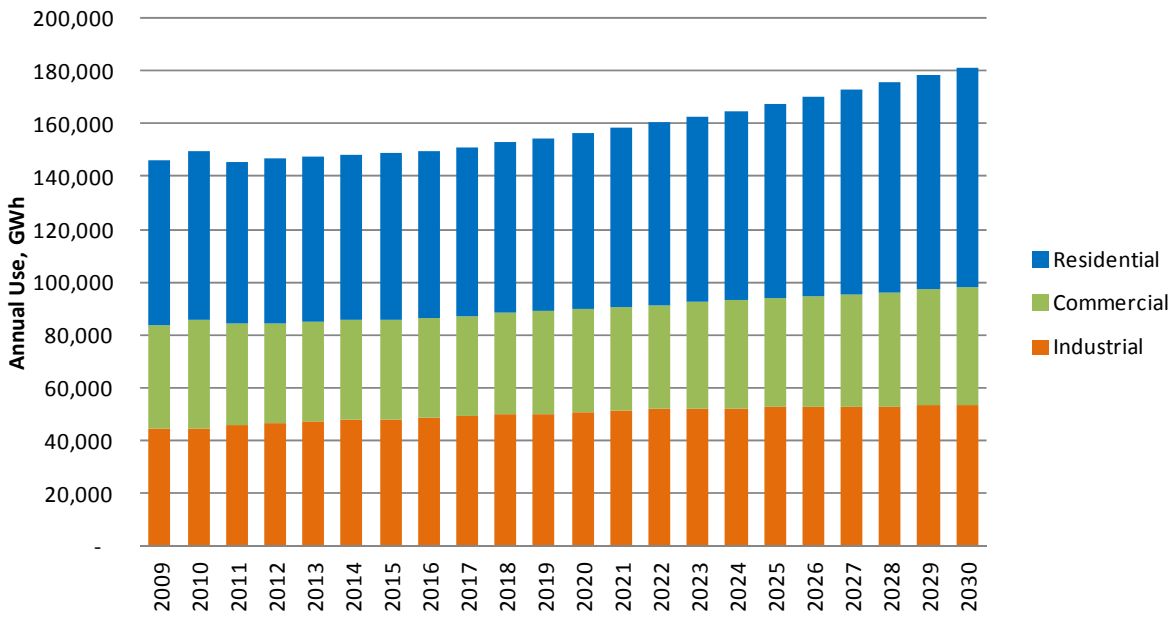
Baseline Forecast Summary

Table 4-5 and Figure 4-5 provide a summary of the baseline forecast by sector and for TVA as a whole. Overall, the forecast for the next two decades is steady, reflecting modest growth in customers and the industrial economy, which offsets reduced use due to appliance and equipment standards.

Table 4-5 Baseline Forecast Summary (GWh)

Sector	2009	2012	2015	2020	2025	2030	% Change	Avg. Growth Rate
Residential	62,246	61,936	62,932	66,440	73,613	82,830	33%	1.4%
Commercial	39,561	38,176	37,587	39,026	41,485	44,718	13%	0.6%
Industrial	44,311	46,394	48,173	50,777	52,364	53,412	21%	0.9%
Total	**146,118**	**146,505**	**148,692**	**156,243**	**167,462**	**180,959**	**24%**	**1.0%**

Figure 4-5 Baseline Forecast Summary (GWh)



CHAPTER | 5

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 TVA potential assessment.

For this study, Global prepared a preliminary list of measures for TVA to review. After incorporating feedback, we populated the full databases for the three sectors.

Sources for the measure assumptions were drawn from TVA's Measurement Manual and latest program evaluation results, Global's building modeling tool BEST, and Global's other measure databases from previous studies and program work.

- ***Residential Measures***. The residential measures span all end uses and vary significantly in the manner in which they impact energy consumption. Table 5-1 shows the residential equipment measure options and the segments for which they were modeled. Table 5-2 shows the residential non-equipment measure options. All residential measures considered for this study are described in Appendix B.
- ***Commercial Measures***. Table 5-3 and Table 5-4 present a summary of the commercial equipment and non-equipment measures, respectively. The measures shown were modeled for nearly all of the commercial building types, both new and existing, with only a few exceptions. For instance, hotel guestroom controls were only modeled for the lodging sector. All commercial measures considered for this study are described in Appendix C.
- ***Industrial Measures***. Table 5-5 presents a summary of the industrial equipment and non-equipment measures, respectively. All industrial measures considered for this study are described in Appendix D.

Table 5-1 Summary of Residential Equipment Measures

End Use	Technology	Efficiency Option	Single Family (existing & new)	Multi Family (existing & new)	Mobile Home (existing & new)
Cooling	Central AC	SEER 13	X	X	X
Cooling	Central AC	SEER 14 (Energy Star)	X	X	X
Cooling	Central AC	SEER 15 (CEE Tier 2)	X	X	X
Cooling	Central AC	SEER 16 (CEE Tier 3)	X	X	X
Cooling	Central AC	Ductless Minisplit	X	X	X
Cooling	Central AC	SEER 21	X	X	X
Cooling	Room AC	EER 9.8	X	X	X
Cooling	Room AC	EER 10.8 (Energy Star)	X	X	X
Cooling	Room AC	EER 11.0	X	X	X
Cooling	Room AC	EER 12.0	X	X	X
Combined Heating/Cooling	Air-Source Heat Pump	SEER 13	X	X	X
Combined Heating/Cooling	Air-Source Heat Pump	SEER 14 (Energy Star)	X	X	X
Combined Heating/Cooling	Air-Source Heat Pump	SEER 15 (CEE Tier 2)	X	X	X
Combined Heating/Cooling	Air-Source Heat Pump	SEER 16 (CEE Tier 3)	X	X	X
Combined Heating/Cooling	Air-Source Heat Pump	Ductless Minisplit	X	X	X
Combined Heating/Cooling	Geothermal Heat Pump	EER 14.1	X	X	X
Combined Heating/Cooling	Geothermal Heat Pump	EER 16	X	X	X
Combined Heating/Cooling	Geothermal Heat Pump	EER 18	X	X	X
Combined Heating/Cooling	Geothermal Heat Pump	EER 30	X	X	X
Space Heating	Electric Resistance	Standard	X	X	X
Space Heating	Electric Furnace	Standard	X	X	X
Water Heating	Water Heater	EF 0.9	X	X	X
Water Heating	Water Heater	EF 0.95	X	X	X
Water Heating	Water Heater	EF 2.3 (HP)	X	X	X
Water Heating	Water Heater	Solar	X	X	X
Interior Lighting	Screw-in	Incandescent	X	X	X
Interior Lighting	Screw-in	Infrared Halogen	X	X	X
Interior Lighting	Screw-in	Infrared Halogen (2020)	X	X	X
Interior Lighting	Screw-in	CFL	X	X	X
Interior Lighting	Screw-in	LED	X	X	X
Interior Lighting	Linear Fluorescent	T12	X	X	X
Interior Lighting	Linear Fluorescent	T8	X	X	X
Interior Lighting	Linear Fluorescent	Super T8	X	X	X
Interior Lighting	Linear Fluorescent	T5	X	X	X
Interior Lighting	Linear Fluorescent	LED	X	X	X
Exterior Lighting	Screw-in	Incandescent	X	X	X
Exterior Lighting	Screw-in	Infrared Halogen	X	X	X
Exterior Lighting	Screw-in	Infrared Halogen (2020)	X	X	X
Exterior Lighting	Screw-in	CFL	X	X	X
Exterior Lighting	Screw-in	LED	X	X	X
Appliances	Clothes Washer	Standard (1.26)	X	X	X
Appliances	Clothes Washer	Energy Star (1.72)	X	X	X
Appliances	Clothes Washer	AHAM (MEF 1.72)	X	X	X
Appliances	Clothes Washer	Energy Star (MEF 2.0)	X	X	X
Appliances	Clothes Washer	AHAM (MEF 2.0)	X	X	X
Appliances	Clothes Washer	Compact (MEF 2.79)	X	X	X
Appliances	Clothes Dryer	Baseline	X	X	X
Appliances	Clothes Dryer	High Efficiency	X	X	X
Appliances	Clothes Dryer	Baseline (2015+)	X	X	X
Appliances	Clothes Dryer	High Efficiency (2015+)	X	X	X
Appliances	Dishwasher	Standard (EF 0.46)	X	X	X

Table 5-1 Summary of Residential Equipment Measures (continued)

End Use	Technology	Efficiency Option	Single Family (existing & new)	Multi Family (existing & new)	Mobile Home (existing & new)
Appliances	Dishwasher	Standard (EF 0.63)	X	X	X
Appliances	Dishwasher	Energy Star (EF 0.69)	X	X	X
Appliances	Dishwasher	Energy Star (EF 0.73)	X	X	X
Appliances	Dishwasher	AHAM (EF 0.73)	X	X	X
Appliances	Dishwasher	Ultra Efficient (EF 1.1)	X	X	X
Appliances	Refrigerator	Standard	X	X	X
Appliances	Refrigerator	Energy Star	X	X	X
Appliances	Refrigerator	High Efficiency	X	X	X
Appliances	Refrigerator	AHAM (2014)	X	X	X
Appliances	Refrigerator	High Efficiency (2014)	X	X	X
Appliances	Freezer	Standard	X	X	X
Appliances	Freezer	Energy Star	X	X	X
Appliances	Freezer	High Efficiency	X	X	X
Appliances	Freezer	AHAM (2014)	X	X	X
Appliances	Freezer	High Efficiency (2014)	X	X	X
Appliances	Second Refrigerator	Standard	X	X	X
Appliances	Second Refrigerator	Energy Star	X	X	X
Appliances	Second Refrigerator	High Efficiency	X	X	X
Appliances	Second Refrigerator	AHAM (2014)	X	X	X
Appliances	Second Refrigerator	High Efficiency (2014)	X	X	X
Appliances	Stove	Baseline	X	X	X
Appliances	Stove	Convection	X	X	X
Appliances	Stove	Halogen Burner	X	X	X
Appliances	Stove	Induction	X	X	X
Appliances	Microwave	Standard	X	X	X
Electronics	Personal Computer	Standard	X	X	X
Electronics	Personal Computer	Energy Star	X	X	X
Electronics	TV	Standard	X	X	X
Electronics	TV	Energy Star (3.1)	X	X	X
Electronics	TV	Energy Star (4.1)	X	X	X
Electronics	TV	Energy Star (5.1)	X	X	X
Electronics	Printer/Fax/Copier	Standard	X	X	X
Electronics	Printer/Fax/Copier	Energy Star	X	X	X
Electronics	Set-top Boxes/DVR/Audio	Standard	X	X	X
Electronics	Set-top Boxes/DVR/Audio	Energy Star (2009)	X	X	X
Electronics	Set-top Boxes/DVR/Audio	Energy Star (2011)	X	X	X
Electronics	Devices and Gadgets	Standard	X	X	X
Miscellaneous	Pool Pump	Standard	X	X	X
Miscellaneous	Pool Pump	High Efficiency	X	X	X
Miscellaneous	Pool Pump	Two-Speed	X	X	X
Miscellaneous	Pool Heater	Electric Resistance	X	X	X
Miscellaneous	Pool Heater	Heat Pump (COP = 5.0)	X	X	X
Miscellaneous	Pool Heater	Solar	X	X	X
Miscellaneous	Hot Tub / Spa	Standard	X	X	X
Miscellaneous	Hot Tub / Spa	Efficient Pumps	X	X	X
Miscellaneous	Hot Tub / Spa	Improved Controls and Pumps	X	X	X
Miscellaneous	Well Pump	Baseline (40% EF)	X	X	X
Miscellaneous	Well Pump	High Efficiency (60% EF)	X	X	X
Miscellaneous	Furnace Fan	Standard	X	X	X
Miscellaneous	Furnace Fan	ECM	X	X	X
Miscellaneous	Miscellaneous	Miscellaneous	X	X	X

Table 5-2 Summary of Residential Non-equipment Measures

Measure	Single Family Existing	Single Family New Construction	Multi Family Existing	Multi Family New Construction	Mobile Home Existing	Mobile Home New Construction
Central AC - Maintenance	X	X	X	X	X	X
Attic Fan - Installation	X	X	X	X	X	X
Attic Fan - Photovoltaic	X	X	X	X	X	X
Ceiling Fan - Installation	X	X	X	X	X	X
Whole-House Fan - Installation	X	X	X	X	X	X
Central Heat Pump - Maintenance	X	X	X	X	X	X
Dehumidifier	X	X	X	X	X	X
Thermostat - Clock/Programmable	X	X	X	X	X	X
Ducting - Repair and Sealing	X	X	X	X	X	X
Insulation - Ducting	X	X	X	X	X	X
Insulation - Infiltration Control	X	X	X	X	X	X
Insulation - Ceiling	X	X	X	X	X	X
Insulation - Foundation		X		X		X
Insulation - Wall Cavity		X		X		X
Insulation - Wall Sheathing		X		X		X
Doors - Storm and Thermal	X	X	X	X	X	X
Windows - ENERGY STAR	X	X	X	X	X	X
Windows - Install reflective film	X	X	X	X	X	X
Roofs - High Reflectivity	X	X	X	X	X	X
Interior Lighting - Occupancy Sensor	X	X	X	X	X	X
Exterior Lighting - Photovoltaic - Installation	X	X	X	X	X	X
Exterior Lighting - Photosensor Control	X	X	X	X	X	X
Exterior Lighting - Timeclock Installation	X	X	X	X	X	X
Water Heater - Faucet Aerators	X	X	X	X	X	X
Water Heater - Pipe Insulation	X	X	X	X	X	X
Water Heater - Low-Flow Showerheads	X	X	X	X	X	X
Water Heater - Tank Blanket/Insulation	X	X	X	X	X	X
Water Heater - Thermostat Setback	X	X	X	X	X	X
Water Heater - Timer	X	X	X	X	X	X
Water Heater - Hot Water Saver	X	X	X	X	X	X
Water Heater - Drainwater Heat Recovery		X		X		X
Refrigerator - Remove Second Unit	X	X	X	X	X	X
Refrigerator - Maintenance	X	X	X	X	X	X
Freezer - Remove Second Unit	X	X	X	X	X	X
Freezer - Maintenance	X	X	X	X	X	X
Home Electronics - Reduce Standby Wattage	X	X	X	X	X	X
Pool - Pump Timer	X	X	X	X	X	X
Spa - Pump Timer	X	X	X	X	X	X
Home Energy Management System	X	X	X	X	X	X
Advanced New Construction Design		X		X		X
ENERGY STAR Homes		X		X		X
Energy Efficient Manufactured Home						X

Table 5-3 Summary of Commercial Equipment Measures

End Use	Technology	Efficiency Option
Cooling	Air-Cooled Chiller	1.5 kw/ton, COP 2.3
Cooling	Air-Cooled Chiller	1.3 kw/ton, COP 2.7
Cooling	Air-Cooled Chiller	1.26 kw/ton, COP 2.8
Cooling	Air-Cooled Chiller	1.0 kw/ton, COP 3.5
Cooling	Air-Cooled Chiller	0.97 kw/ton, COP 3.6
Cooling	Water-Cooled Chiller	0.75 kw/ton, COP 4.7
Cooling	Water-Cooled Chiller	0.60 kw/ton, COP 5.9
Cooling	Water-Cooled Chiller	0.58 kw/ton, COP 6.1
Cooling	Water-Cooled Chiller	0.55 kw/Ton, COP 6.4
Cooling	Water-Cooled Chiller	0.51 kw/ton, COP 6.9
Cooling	Water-Cooled Chiller	0.50 kw/Ton, COP 7.0
Cooling	Water-Cooled Chiller	0.48 kw/ton, COP 7.3
Cooling	Roof Top AC	EER 9.2
Cooling	Roof Top AC	EER 10.1
Cooling	Roof Top AC	EER 11.2
Cooling	Roof Top AC	EER 12.0
Cooling	Roof Top AC	Ductless Minisplit
Cooling	Other Cooling	EER 9.8
Cooling	Other Cooling	EER 10.0
Cooling	Other Cooling	EER 10.2
Cooling	Other Cooling	EER 10.4
Cooling	Other Cooling	EER 10.6
Cooling	Other Cooling	EER 10.8
Cooling	Other Cooling	EER 12.0
Heating	Electric Heating	Standard
Cooling/Heating	Roof Top Heat Pump	EER 9.3
Cooling/Heating	Roof Top Heat Pump	EER 10.3
Cooling/Heating	Roof Top Heat Pump	EER 11.0
Cooling/Heating	Roof Top Heat Pump	EER 11.7
Cooling/Heating	Roof Top Heat Pump	EER 12.0
Cooling/Heating	Roof Top Heat Pump	Ductless Minisplit
Cooling/Heating	Roof Top Heat Pump	Geothermal
Ventilation	Ventilation	Constant Volume
Ventilation	Ventilation	Constant Volume with ECM
Ventilation	Ventilation	Variable Air Volume
Ventilation	Ventilation	Variable Air Volume with ECM
Water Heating	Water Heating	EF .97
Water Heating	Water Heating	EF .98
Water Heating	Water Heating	EF 2.3
Interior Lighting	Screw-in	Incandescent
Interior Lighting	Screw-in	90W Halogen PAR-38
Interior Lighting	Screw-in	70W HIR PAR-38
Interior Lighting	Screw-in	CFL
Interior Lighting	Screw-in	LED
Interior Lighting	High-Bay Fixtures	Metal Halides
Interior Lighting	High-Bay Fixtures	LED
Interior Lighting	High-Bay Fixtures	T8
Interior Lighting	High-Bay Fixtures	High Pressure Sodium
Interior Lighting	High-Bay Fixtures	T5
Interior Lighting	Linear Fluorescent	T12
Interior Lighting	Linear Fluorescent	LED
Interior Lighting	Linear Fluorescent	T8
Interior Lighting	Linear Fluorescent	Super T8
Exterior Lighting	Screw-in	Incandescent
Exterior Lighting	Screw-in	90W Halogen PAR-38
Exterior Lighting	Screw-in	70W HIR PAR-38
Exterior Lighting	Screw-in	CFL
Exterior Lighting	Screw-in	LED
Exterior Lighting	HID	Metal Halides
Exterior Lighting	HID	LED
Exterior Lighting	HID	T8
Exterior Lighting	HID	High Pressure Sodium
Exterior Lighting	HID	T5

End Use	Technology	Efficiency Option
Exterior Lighting	Linear Fluorescent	T12
Exterior Lighting	Linear Fluorescent	LED
Exterior Lighting	Linear Fluorescent	T8
Exterior Lighting	Linear Fluorescent	Super T8
Exterior Lighting	Linear Fluorescent	T5
Refrigeration	Walk-in Refrigerator	14600 kWh/yr
Refrigeration	Walk-in Refrigerator	10800 kWh/yr
Refrigeration	Walk-in Refrigerator	10000 kWh/yr
Refrigeration	Walk-in Refrigerator	9000 kWh/yr
Refrigeration	Reach-in Refrigerator	3100 kWh/yr
Refrigeration	Reach-in Refrigerator	2500 kWh/yr
Refrigeration	Reach-in Refrigerator	2400 kWh/yr
Refrigeration	Reach-in Refrigerator	1500 kWh/yr
Refrigeration	Glass Door Display	15500 kWh/yr
Refrigeration	Glass Door Display	14480 kWh/yr
Refrigeration	Glass Door Display	11700 kWh/yr
Refrigeration	Glass Door Display	8400 kWh/yr
Refrigeration	Glass Door Display	6800 kWh/yr
Refrigeration	Open Display Case	7000 kWh/yr
Refrigeration	Open Display Case	6535 kWh/yr
Refrigeration	Open Display Case	5350 kWh/yr
Refrigeration	Open Display Case	5300 kWh/yr
Refrigeration	Open Display Case	4350 kWh/yr
Refrigeration	Icemaker	7.0 kWh/100 lbs
Refrigeration	Icemaker	6.3 kWh/100 lbs
Refrigeration	Icemaker	6.0 kWh/100 lbs
Refrigeration	Icemaker	5.5 kWh/100 lbs
Refrigeration	Vending Machine	3400 kWh/year
Refrigeration	Vending Machine	2400 kWh/year
Refrigeration	Vending Machine	1700 kWh/year
Food Preparation	Oven	Standard
Food Preparation	Oven	Energy Star
Food Preparation	Fryer	Standard
Food Preparation	Fryer	Energy Star
Food Preparation	Dishwasher	Standard
Food Preparation	Dishwasher	Energy Star
Food Preparation	Hot Food Container	Standard
Food Preparation	Hot Food Container	Energy Star
Office Equipment	Desktop Computer	Standard
Office Equipment	Desktop Computer	Energy Star
Office Equipment	Laptop	Standard
Office Equipment	Laptop	Energy Star
Office Equipment	Server	Standard
Office Equipment	Server	Energy Star
Office Equipment	Monitor	Standard
Office Equipment	Monitor	Energy Star
Office Equipment	Printer/Copier/Fax	Standard
Office Equipment	Printer/Copier/Fax	Energy Star
Office Equipment	POS Terminal	Standard
Office Equipment	POS Terminal	Efficient
Miscellaneous	Non-HVAC Motors	Standard (EPAct)
Miscellaneous	Non-HVAC Motors	Standard (EPAct 2015)
Miscellaneous	Non-HVAC Motors	High Efficiency
Miscellaneous	Non-HVAC Motors	High Efficiency (2015)
Miscellaneous	Non-HVAC Motors	Premium (NEMA)
Miscellaneous	Non-HVAC Motors	Premium (NEMA 2015)
Miscellaneous	Pool Pump	Standard
Miscellaneous	Pool Pump	High Efficiency
Miscellaneous	Pool Pump	Two-Speed
Miscellaneous	Pool Heater	Standard
Miscellaneous	Pool Heater	Heat Pump
Miscellaneous	Pool Heater	Solar
Miscellaneous	Miscellaneous	Standard

Table 5-4 Summary of Commercial Non-equipment Measures

Measure	Existing	New
Chiller - VSD	X	X
Chiller - Condenser Water Temperature Reset	X	X
Chiller - Economizer	X	X
Chiller - Thermal Energy Storage	X	X
Air-Cooled Chiller - High Efficiency Fans	X	X
Water-Cooled Chiller - Cooling Tower, High-Efficiency Fans	X	X
Water-Cooled Chiller - Condenser Water Temperature Reset	X	X
Heat Pump - Maintenance	X	X
RTU - Maintenance	X	X
Ventilation - Variable Speed Control	X	X
Ventilation - CO2 Controlled	X	X
Ventilation - Exhaust Hood Sensor Control	X	X
Fans - Energy-Efficient Motors	X	X
Pumps - High-Efficiency Motors	X	X
Pumps - Variable Speed Control	X	X
Insulation - Ducting	X	X
Insulation - Ceiling	X	X
Insulation - Wall Cavity	X	X
HVAC - Duct Repair and Sealing	X	X
Roofs - Cool Roof	X	X
Windows - High Efficiency	X	X
Energy Management System	X	X
Thermostat - Clock/Programmable	X	X
Hotel - Guest Room Controls	X	X
Interior Lighting - LED Exit Lighting	X	X
Interior Lighting - Occupancy Sensors	X	X
Interior Lighting - Task Lighting	X	X
Interior Lighting - Time Clocks and Timers (lighting)	X	X
Interior Lighting - Fluorescent Delamp and Install Reflectors	X	X
Interior Fluorescent - Bi-Level Fixture w/Occupancy Sensor	X	X
Interior Fluorescent - Photocell-Controlled Dimming Ballasts	X	X
Indoor Lighting - Daylighting Controls	X	X
Lighting Retrocommissioning	X	
Water Heating - Heat Trap	X	X
Water Heating - Faucet Aerators and Low Flow Nozzles	X	X
Water Heating - Pipe Insulation	X	X
Water Heating - Tank Blanket	X	X
Water Heating - Hot Water Saver	X	X
Water Heating - High Efficiency Circulation Pump	X	X
Water Heating - Install Timer	X	X
Water Heating - Thermostat Setback	X	X
Water Heating - Solar Water Heating System	X	X
Refrigerator - Decommissioning and Recycling	X	X
Refrigerator - Anti-Sweat Heater	X	X
Refrigerator - Door Gasket Replacement	X	X
Open Display Case - Night Covers	X	X
Display Case - LED Lighting	X	X
Vending Machine - Controller	X	X
Office Electronics - Plug Load Occupancy Sensors	X	X
Office Electronics - ENERGY STAR Power Supplies	X	X
Non-HVAC Motors - Variable Speed Control	X	X
Pool Pump - Timer	X	X

Table 5-5 Summary of Industrial Equipment Measures

End Use	Technology	Efficiency Option	Food Products (existing & new)	Paper Products (existing & new)	Chemical Products (existing & new)	Primary Metals (existing & new)	Other (existing & new)
Cooling	Roof Top AC	EER 9.2	X	X	X	X	X
Cooling	Roof Top AC	EER 10.1	X	X	X	X	X
Cooling	Roof Top AC	EER 11.2	X	X	X	X	X
Cooling	Roof Top AC	EER 12.0	X	X	X	X	X
Cooling	Roof Top AC	Ductless Minisplit	X	X	X	X	X
Cooling	Other Cooling	EER 9.8	X	X	X	X	X
Cooling	Other Cooling	EER 10.0	X	X	X	X	X
Cooling	Other Cooling	EER 10.2	X	X	X	X	X
Cooling	Other Cooling	EER 10.4	X	X	X	X	X
Cooling	Other Cooling	EER 10.6	X	X	X	X	X
Cooling	Other Cooling	EER 10.8	X	X	X	X	X
Cooling	Other Cooling	EER 12.0	X	X	X	X	X
Heating	Electric Heating	Standard	X	X	X	X	X
Cooling/Heating	Roof Top Heat Pump	EER 9.3	X	X	X	X	X
Cooling/Heating	Roof Top Heat Pump	EER 10.3	X	X	X	X	X
Cooling/Heating	Roof Top Heat Pump	EER 11.0	X	X	X	X	X
Cooling/Heating	Roof Top Heat Pump	EER 11.7	X	X	X	X	X
Cooling/Heating	Roof Top Heat Pump	EER 12.0	X	X	X	X	X
Cooling/Heating	Roof Top Heat Pump	Ductless Minisplit	X	X	X	X	X
Cooling/Heating	Roof Top Heat Pump	Geothermal	X	X	X	X	X
Ventilation	Ventilation	Constant Volume	X	X	X	X	X
Ventilation	Ventilation	Constant Volume with ECM	X	X	X	X	X
Ventilation	Ventilation	Variable Air Volume	X	X	X	X	X
Ventilation	Ventilation	Variable Air Volume with ECM	X	X	X	X	X
Interior Lighting	Screw-in	Incandescent	X	X	X	X	X
Interior Lighting	Screw-in	90W Halogen PAR-38	X	X	X	X	X
Interior Lighting	Screw-in	70W HIR PAR-38	X	X	X	X	X
Interior Lighting	Screw-in	CFL	X	X	X	X	X
Interior Lighting	Screw-in	LED	X	X	X	X	X
Interior Lighting	High-Bay Fixtures	Metal Halides	X	X	X	X	X
Interior Lighting	High-Bay Fixtures	LED	X	X	X	X	X
Interior Lighting	High-Bay Fixtures	T8	X	X	X	X	X
Interior Lighting	High-Bay Fixtures	High Pressure Sodium	X	X	X	X	X
Interior Lighting	High-Bay Fixtures	T5	X	X	X	X	X
Interior Lighting	Linear Fluorescent	T12	X	X	X	X	X
Interior Lighting	Linear Fluorescent	LED	X	X	X	X	X
Interior Lighting	Linear Fluorescent	T8	X	X	X	X	X
Interior Lighting	Linear Fluorescent	Super T8	X	X	X	X	X
Exterior Lighting	Screw-in	Incandescent	X	X	X	X	X
Exterior Lighting	Screw-in	90W Halogen PAR-38	X	X	X	X	X
Exterior Lighting	Screw-in	70W HIR PAR-38	X	X	X	X	X
Exterior Lighting	Screw-in	CFL	X	X	X	X	X
Exterior Lighting	Screw-in	LED	X	X	X	X	X
Exterior Lighting	HID	Metal Halides	X	X	X	X	X
Exterior Lighting	HID	LED	X	X	X	X	X
Exterior Lighting	HID	T8	X	X	X	X	X
Exterior Lighting	HID	High Pressure Sodium	X	X	X	X	X
Exterior Lighting	HID	T5	X	X	X	X	X
Exterior Lighting	Linear Fluorescent	T12	X	X	X	X	X
Exterior Lighting	Linear Fluorescent	LED	X	X	X	X	X
Exterior Lighting	Linear Fluorescent	T8	X	X	X	X	X
Exterior Lighting	Linear Fluorescent	Super T8	X	X	X	X	X
Exterior Lighting	Linear Fluorescent	T5	X	X	X	X	X

Table 5-5 Summary of Industrial Equipment Measures (Continued)

End Use	Technology	Efficiency Option	Food Products (existing & new)	Paper Products (existing & new)	Chemical Products (existing & new)	Primary Metals (existing & new)	Other (existing & new)
Motors	1-5 HP	Standard (EPACT)	X	X	X	X	X
Motors	1-5 HP	Standard (NEMA)	X	X	X	X	X
Motors	1-5 HP	High Efficiency	X	X	X	X	X
Motors	1-5 HP	Premium	X	X	X	X	X
Motors	6-20 HP	Standard (EPACT)	X	X	X	X	X
Motors	6-20 HP	Standard (EISA)	X	X	X	X	X
Motors	6-20 HP	High Efficiency	X	X	X	X	X
Motors	6-20 HP	Premium	X	X	X	X	X
Motors	21-50 HP	Standard (EPACT)	X	X	X	X	X
Motors	21-50 HP	Standard (EISA)	X	X	X	X	X
Motors	21-50 HP	High Efficiency	X	X	X	X	X
Motors	21-50 HP	Premium	X	X	X	X	X
Motors	51-100 HP	Standard (EPACT)	X	X	X	X	X
Motors	51-100 HP	Standard (EISA)	X	X	X	X	X
Motors	51-100 HP	High Efficiency	X	X	X	X	X
Motors	51-100 HP	Premium	X	X	X	X	X
Motors	101-200 HP	Standard (EPACT)	X	X	X	X	X
Motors	101-200 HP	Standard (EISA)	X	X	X	X	X
Motors	101-200 HP	High Efficiency	X	X	X	X	X
Motors	101-200 HP	Premium	X	X	X	X	X
Motors	201-500 HP	Standard (EPACT)	X	X	X	X	X
Motors	201-500 HP	Standard (EISA)	X	X	X	X	X
Motors	201-500 HP	High Efficiency	X	X	X	X	X
Motors	201-500 HP	Premium	X	X	X	X	X
Motors	501-1000 HP	Standard	X	X	X	X	X
Motors	501-1000 HP	High Efficiency	X	X	X	X	X
Motors	501-1000 HP	Premium	X	X	X	X	X
Motors	1000+ HP	Standard	X	X	X	X	X
Motors	1000+ HP	High Efficiency	X	X	X	X	X
Motors	1000+ HP	Premium	X	X	X	X	X
Process Heating	Process Heating	Standard	X	X	X	X	X
Miscellaneous	Miscellaneous	Standard	X	X	X	X	X

Table 5-6 Summary of Industrial Non-Equipment Measures

Measure	Food Products (existing & new)	Paper Products (existing & new)	Chemical Products (existing & new)	Primary Metals (existing & new)	Other (existing & new)
Central Chiller - Chiller Water Reset	X	X	X	X	X
Central Chiller - Economizer	X	X	X	X	X
Central Chiller - High Efficiency Fans	X	X	X	X	X
Central Chiller - Maintenance	X	X	X	X	X
Central Chiller - Temprature Reset	X	X	X	X	X
Central Chiller - VSD	X	X	X	X	X
RTU - Maintenance	X	X	X	X	X
Heat Pump - Maintenance	X	X	X	X	X
Ventilation - C02 Controls	X	X	X	X	X
HVAC - Duct Insulation	X	X	X	X	X
HVAC - Duct Repair and Sealing	X	X	X	X	X
Insulation - Ceiling	X	X	X	X	X
Insulation - Wall Cavity	X	X	X	X	X
Roofs - High Reflectivity	X	X	X	X	X
Clock/Programmable Thermostat	X	X	X	X	X
Energy Management System	X	X	X	X	X
Lighting Controls	X	X	X	X	X
Bi-Level Fixture w/Occupancy Sensor	X	X	X	X	X
Daylighting Controls - Photocell Controlled Dimming Ballasts	X	X	X	X	X
Delamp and Install Reflectors	X	X	X	X	X
LED Exit Lighting	X	X	X	X	X
Occupancy Sensors	X	X	X	X	X
Task Lighting	X	X	X	X	X
Time Clocks and Timers	X	X	X	X	X
Air Compressor Demand Reduction	X	X	X	X	X
Air Compressor Equipment2		X		X	
Cold Storage Retrofit	X				
Cold Storage Tuneup	X				
Efficient Centrifugal Fan		X			
Energy Project Management	X	X	X	X	X
Fan Energy Management	X	X	X	X	X
Fan Equipment Upgrade	X	X	X	X	X
Fan System Optimization	X	X	X	X	X
Food: Refrig Storage Tuneup	X				
Groc Dist Retrofit	X				
Groc Dist Tuneup	X				
Integrated Plant Energy Management	X	X	X	X	X
Motors: Rewind 20-50 HP	X	X	X	X	X
Motors: Rewind 51-100 HP	X	X	X	X	X
Motors: Rewind 101-200 HP	X	X	X	X	X
Motors: Rewind 201-500 HP	X	X	X	X	X
Motors: Rewind 501-1000 HP	X	X	X	X	X
Motors: Rewind 1000+ HP	X	X	X	X	X
Material Handling VFD2		X			
Paper: Efficient Pulp Screen		X			
Paper: Large Material Handling		X			
Paper: Material Handling		X			
Paper: Premium Control Large Material		X			
Paper: Premium Fan		X			

Table 5-6 Summary of Industrial Non-Equipment Measures (Continued)

Measure	Food Products (existing & new)	Paper Products (existing & new)	Chemical Products (existing & new)	Primary Metals (existing & new)	Other (existing & new)
Plant Energy Management	X	X	X	X	X
Pump Energy Management	X	X	X	X	X
Pump Equipment Upgrade	X	X	X	X	X
Pump System Optimization	X	X	X	X	X
Synchronous Belts	X	X	X	X	X
Transformers-New	X	X	X	X	X
Transformers-Retrofit	X	X	X	X	X
Machine Drive - Pumping System Controls	X	X	X	X	X
Machine Drive - Pumping System Maintenance	X	X	X	X	X
Machine Drive - Pumping System Optimization	X	X	X	X	X
Refrigeration System Controls	X	X	X	X	X
Refrigeration System Maintenance	X	X	X	X	X
Refrigeration System Optimization	X	X	X	X	X
Process Heating	X	X	X	X	X
Metal: New Arc Furnace				X	
Process - Compressed Air System Controls	X	X	X	X	X
Process - Compressed Air System Maintenance	X	X	X	X	X
Process - Compressed Air System Optimization and Improvements	X	X	X	X	X
Process - Fan System Controls	X	X	X	X	X
Process - Fan System Maintenance	X	X	X	X	X
Process - Fan System Optimization	X	X	X	X	X
Custom Utility Programs - Cooling	X	X	X	X	X
Custom Utility Programs - Int Lighting	X	X	X	X	X
Custom Utility Programs - Motors	X	X	X	X	X
Custom Utility Programs - Misc	X	X	X	X	X

Results of the Economic Screen

Table 5-7 summarizes the number of equipment and non-equipment measures evaluated for each segment within each sector.

Table 5-7 Number of Measures Evaluated

	Residential	Commercial	Industrial	Total Number of Measures
Equipment Measures Evaluated	102	126	85	**313**
Non-Equipment Measures Evaluated	42	52	74	**168**
Total Measures Evaluated	**144**	**178**	**159**	**481**

Appendix B gives results for the economic screening process by segment, vintage, end use and measure for the residential sector. Appendices C and D shows the equivalent information for the commercial and industrial sectors, respectively.

ENERGY EFFICIENCY POTENTIAL

This chapter presents the results of the energy-efficiency analysis. First, the overall potential is presented, followed by results for each sector.

Overall Energy Efficiency Potential

Table 6-1 presents the baseline forecasts of energy consumption and peak demand, as well as the levels of electric energy-efficiency potential across sectors. As discussed in detail in Chapter 4, the baseline forecast across all sectors increases over the 20-year study period of 2012 to 2031. The growth is highest in the residential sector, although all sectors have somewhat tempered forecasts due to appliance and equipment standards, building codes, and a sluggish economy in the near term. Key findings related to potentials are summarized below.

- ***Achievable - Low potential*** forms a lower point on the range of achievable potential. Across all sectors, this metric is 3,256 GWh in 2015 and increases to 19,093 by 2030. This represents 2.2% of the baseline forecast in 2015 and 10.6% in 2030. By 2030, Achievable – Low offsets 55% of the growth in the baseline forecast. Peak demand savings from energy-efficiency measures are 687 MW in 2015, which represents 2.1% of the baseline forecast of peak demand. By 2030, peak demand savings reach 4,816 MW, 12.6% of the baseline peak demand forecast.[10]
- ***Achievable - High potential*** forms the upper bound on the range of achievable potential. It is 7,494 GWh in 2015, which represents 5.0% of the baseline forecast. By 2030, the cumulative savings are 35,781 GWh, 19.8% of the baseline forecast, for an annual average of just over 1% per year. By 2030, Achievable – High completely offsets growth in the baseline forecast. Peak demand savings are 1,590 MW in 2015, which represents 5.0% of the baseline forecast of peak demand. By 2030, peak demand savings reach 9,007 MW, 23.5% of the baseline peak demand forecast.
- ***Economic potential***, which reflects the savings when all cost-effective measures are taken, is 12,418 GWh in 2015. This represents 8.4% of the baseline energy forecast. By 2030, economic potential reaches 44,821 GWh, 24.8% of the baseline energy forecast. Peak demand savings are 2,759 MW in 2015, which represents 8.6% of the baseline forecast of peak demand. By 2030, peak demand savings reach 11,438 MW, 29.8% of the baseline peak demand forecast.
- ***Technical potential***, which reflects the adoption of all energy efficiency measures regardless of cost-effectiveness, is a theoretical upper bound on savings. In 2015, energy savings are 15,347 GWh, or 10.3% of the baseline energy forecast. By 2030, technical potential reaches 57,244 GWh, 31.6% of the baseline energy forecast. Peak demand savings are 3,159 MW in 2015, which represents 9.9% of the baseline forecast of peak demand. By 2030, peak demand savings reach 13,817 MW or 36.0% of the baseline peak demand forecast.

Figure 6-1 summarizes the energy-efficiency savings for the different levels of potential relative to the baseline forecast. Figure 6-2 displays the energy-efficiency forecasts.

[10] This analysis is based on winter peak and assumes that TVA will continue to be a winter peaking system.

Table 6-1 Summary of Energy Efficiency Potential

	2012	2015	2020	2025	2030
Baseline Forecast (GWh)	146,505	148,692	156,243	167,462	180,959
Energy Savings (Cumulative GWh)					
Achievable - Low	811	3,256	7,963	13,420	19,093
Achievable - High	2,417	7,494	15,337	25,215	35,781
Economic	4,481	12,418	21,658	33,091	44,821
Technical	5,349	15,347	27,545	42,822	57,244
Energy Savings (% of Baseline)					
Achievable - Low	0.6%	2.2%	5.1%	8.0%	10.6%
Achievable - High	1.7%	5.0%	9.8%	15.1%	19.8%
Economic	3.1%	8.4%	13.9%	19.8%	24.8%
Technical	3.7%	10.3%	17.6%	25.6%	31.6%
Peak Savings (MW)					
Achievable - Low	166	687	1,881	3,389	4,816
Achievable - High	499	1,590	3,667	6,392	9,007
Economic	975	2,759	5,434	8,641	11,438
Technical	1,093	3,159	6,304	10,283	13,817
Peak Savings (% of Baseline)					
Achievable - Low	0.5%	2.1%	5.5%	9.4%	12.6%
Achievable - High	1.6%	5.0%	10.8%	17.6%	23.5%
Economic	3.1%	8.6%	16.0%	23.8%	29.8%
Technical	3.5%	9.9%	18.5%	28.4%	36.0%

Figure 6-1 Summary of Achievable Potential Energy Savings

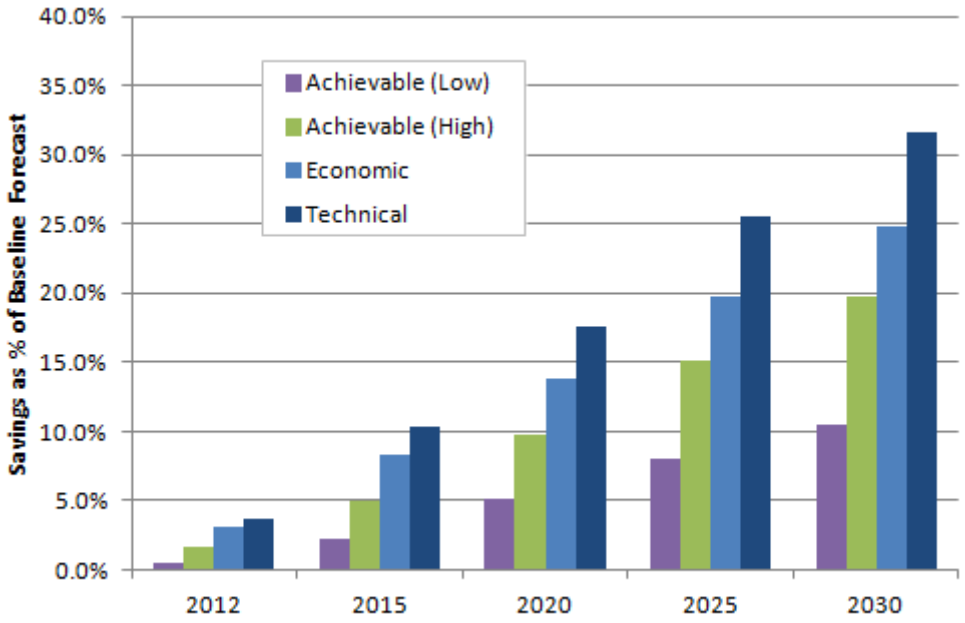


Figure 6-2 Energy Efficiency Potential Energy Forecasts (GWh)

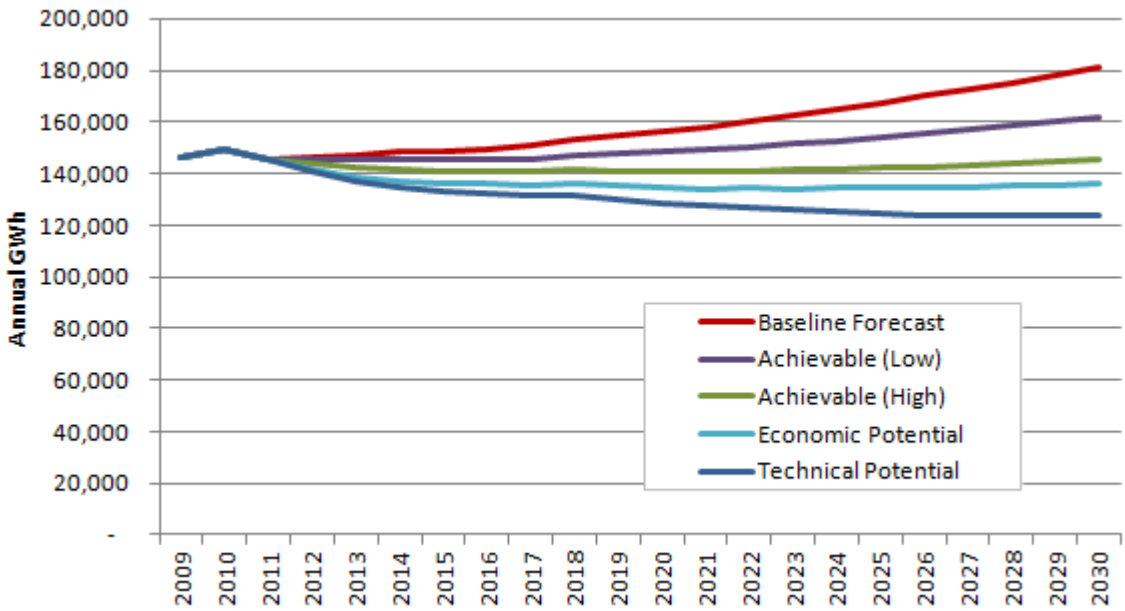
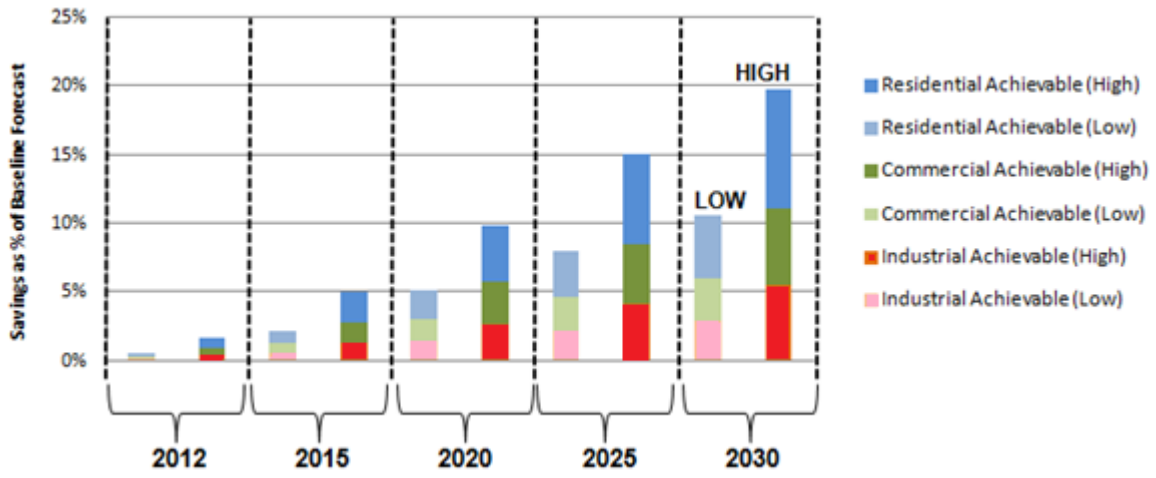


Table 6-2 and Figure 6-3 summarize the range of achievable potential by sector. The residential sector accounts for the largest portion of the savings, followed by the commercial and then the industrial sectors.

Table 6-2 Achievable Energy-efficiency Potential by Sector (GWh)

	2012	2015	2020	2025	2030
Achievable - Low Savings (GWh)					
Residential	384	1,444	3,216	5,652	8,307
Commercial	228	985	2,613	4,163	5,557
Industrial	199	826	2,134	3,604	5,229
Total	**811**	**3,256**	**7,963**	**13,420**	**19,093**
Achievable - High Savings (GWh)					
Residential	1,107	3,356	6,445	10,961	15,759
Commercial	660	2,181	4,693	7,419	10,130
Industrial	651	1,957	4,199	6,835	9,892
Total	**2,417**	**7,494**	**15,337**	**25,215**	**35,781**

Figure 6-3 Achievable Potential by Sector



Residential Sector

Table 6-3 presents estimates for the four types of potential. Figure 6-4 depicts the potential energy savings estimates graphically.

- ***Achievable - Low potential*** projects 1,444 GWh of energy savings in 2015, 2.3% of the baseline forecast. This increases to 8,307 GWh, 10.0% of the baseline forecast, in 2030. Peak demand savings under the Achievable - Low potential are projected to be 279 MW, 1.5% of the baseline peak demand forecast, in 2015. The savings increase to 2,557 MW by 2030 or 10.7% of the baseline forecast.
- ***Achievable - High potential*** is 3,356 GWh in 2015, which represents 5.3% of the baseline forecast. By 2030, the cumulative energy savings are 15,759 GWh, 19.0% of the baseline forecast. Peak demand savings are 651 MW, which represents 3.5% of the baseline forecast of peak demand. By 2030, peak demand savings reach 127 MW, 20.1% of the baseline peak demand forecast.
- ***Economic potential,*** which reflects the savings when all cost-effective measures are taken, is 5,955 GWh in 2015. This represents 9.5% of the baseline energy forecast. By 2030, economic potential reaches 20,540 GWh, 24.8% of the baseline energy forecast. Peak demand savings in 2015 are 1,302 MW, which represents 7.0% of the baseline forecast of peak demand. By 2030, peak demand savings reach 6,330 MW, 26.4% of the baseline peak demand 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 7,795 GWh, or 12.4% of the baseline energy forecast. By 2030, technical potential reaches 27,274 GWh, 32.9% of the baseline energy forecast. Peak demand savings are 1,623 MW in 2015, which represents 8.8% of the baseline forecast of peak demand. By 2030, peak demand savings reach 8,171 MW or 34.1% of the baseline peak demand forecast.

Figure 6-5 shows the forecasts under the four types of potential along with the baseline forecast.

Table 6-3 Electricity Energy Efficiency Potential for the Residential Sector

	2012	2015	2020	2025	2030
Baseline Forecast (GWh)	61,936	62,932	66,440	73,613	82,830
Energy Savings (GWh)					
Achievable - Low	384	1,444	3,216	5,652	8,307
Achievable - High	1,107	3,356	6,445	10,961	15,759
Economic	2,045	5,955	10,185	15,483	20,540
Technical	2,562	7,795	13,629	21,078	27,274
Energy Savings (% of Baseline)					
Achievable - Low	0.6%	2.3%	4.8%	7.7%	10.0%
Achievable - High	1.8%	5.3%	9.7%	14.9%	19.0%
Economic	3.3%	9.5%	15.3%	21.0%	24.8%
Technical	4.1%	12.4%	20.5%	28.6%	32.9%
Peak Savings (MW)					
Achievable - Low	68	279	858	1,741	2,557
Achievable - High	196	651	1,728	3,364	4,816
Economic	417	1,302	2,922	4,889	6,330
Technical	505	1,623	3,604	6,178	8,171
Peak Savings (% of Baseline)					
Achievable - Low	0.5%	1.8%	5.2%	9.6%	13.0%
Achievable - High	1.3%	4.2%	10.4%	18.6%	24.4%
Economic	2.8%	8.4%	17.6%	27.0%	32.1%
Technical	3.4%	10.5%	21.7%	34.1%	41.4%

Figure 6-4 Residential Energy Efficiency Potential Savings

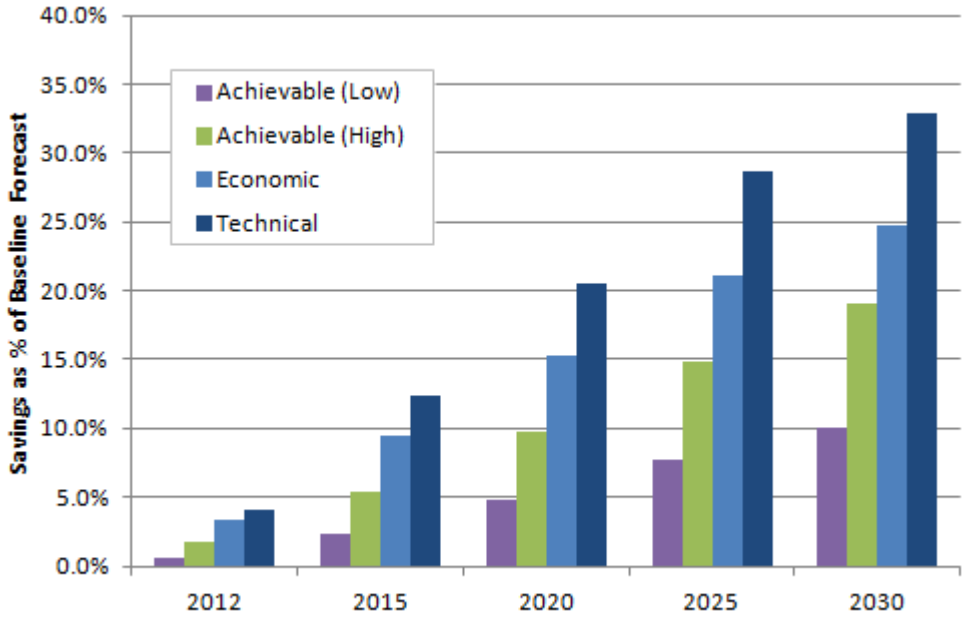
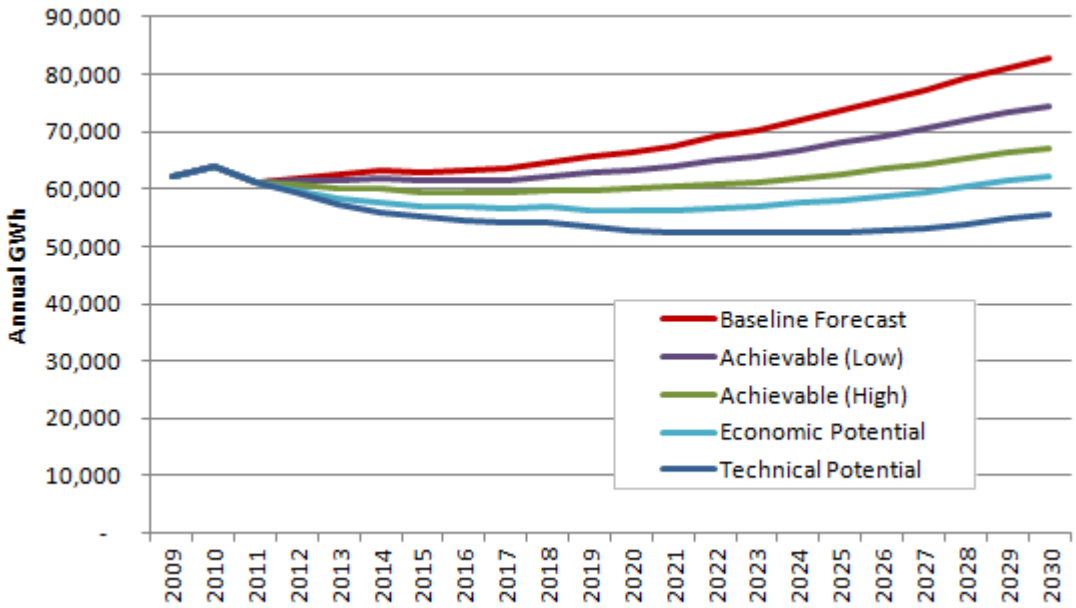


Figure 6-5 Residential Energy Efficiency Potential Forecast



Residential Potential by Market Segment

Single-family homes in the Valley 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 6-4, which shows results for 2015.

Table 6-5 shows the savings by end use and market segment in 2015. The segments are similar in terms of the distribution of savings opportunities by end use, but there are a few notable differences. Single-family homes have more exterior lighting and so have more savings potential for this end use. Similarly, single-family homes are more likely to have swimming pools and therefore have more potential for savings in pool pumps (captured in the miscellaneous end use). Multi-family homes have a relatively larger opportunity in home electronics and air conditioning compared to single-family homes, reflecting an older appliance stock.

Table 6-4 Residential Potential by Market Segment, 2015

	Single Family	Multi Family	Mobile Home	Total
Baseline Forecast (GWh)	51,626	5,300	6,006	62,932
Energy Savings (GWh)				
Achievable - Low	1,278	88	79	1,444
Achievable - High	2,972	201	182	3,356
Economic	5,290	341	324	5,955
Technical	6,551	604	640	7,795
Energy Savings (% of Baseline)				
Achievable - Low	2.5%	1.7%	1.3%	2.3%
Achievable - High	5.8%	3.8%	3.0%	5.3%
Economic	10.2%	6.4%	5.4%	9.5%
Technical	12.7%	11.4%	10.7%	12.4%

Table 6-5 Residential Achievable – Low Potential by End Use and Market Segment, 2015

Achievable – Low Energy Savings (GWh)	Single Family	Multi Family	Mobile Home	Total
Cooling	11	2	2	15
Combined Heating/Cooling	79	3	8	90
Space Heating	2	1	1	4
Water Heating	174	3	5	182
Appliances	116	6	5	127
Interior Lighting	587	45	32	664
Exterior Lighting	135	9	11	155
Electronics	149	16	12	177
Miscellaneous	25	3	2	30
Total	**1,278**	**88**	**79**	**1,444**

Residential Potential by End Use, Technology, and Measure Type

Table 6-6 provides estimates of savings for each end use and type of potential. Focusing first on technical and economic potential, there are significant savings that are both possible and economic in numerous end uses:

- ***Water Heating*** offers the highest technical potential, which reflects the across the board-installation of solar water heating. However, solar water heating does not become cost-effective, using the study's assumptions of equipment cost and avoided cost, during the forecast period. The technology with the next highest efficiency is the heat pump water heater (HPWH). HPWH's are cost effective throughout the entire study, and drive high economic potentials as a result. Also included in water heating potentials are measures such as faucet aerators and low flow showerheads.
- ***Cooling*** offers the second-highest technical potential, which reflects across-the-board installation of SEER 21 units in homes with central air conditioning, installation of room AC units with a EER of 12 in homes with room AC, central AC maintenance, installation of various insulation measures, installation of high-efficiency windows, and AC duct repair and maintenance. However, these most efficient equipment options do not pass the economic screen at any point during the forecast, nor do the higher levels of insulation. This results in economic potential that is less than half of technical potential.
- ***Combined Heating/Cooling,*** or heat pumps, has similar potential to Cooling, and follows similar dynamics. The Valley has a large number of all-electric homes with air-source heat pumps, and therefore offers large amounts of energy efficiency potential in this category. The technical potential implements ductless mini splits as the highest efficiency air-source heat pump and EER 30 systems as the highest efficiency geothermal heat pump.
- ***Home electronics*** also offer substantial savings opportunities. Technical potential reflects the purchase of ENERGY STAR units for all technologies.
- ***Interior lighting*** offers the largest potential savings in the earlier half of the time horizon. The lighting standard begins its phase-in starting in 2012, which coincides with the availability in the market place of advanced incandescent lamps that meet the minimum efficacy standard. The baseline forecast assumes that people will install both advanced incandescent and CFLs in screw-in lighting applications, and that traditional incandescent will still make up one fifth of the market for specialty lighting and other applications that are exempt from the lighting standard. For technical potential, LED lamps are the most efficient option, starting in 2012. However, LED lamps do not pass the economic screen until late in the time horizon, so CFLs dominate for most of the earlier years.

- ***Appliances*** also have significant technical potential savings. This reflects both the replacement of failed white-goods appliances with the highest-efficiency option and removal of second refrigerators in appliance recycling programs.

Figure 6-6 focuses on the range of residential achievable potential in 2015 and 2030.

- Lighting equipment replacement accounts for the highest portion of the savings in the near term as a result of the efficiency gap between advanced incandescent lamps and CFL lamps.
- Water heating accounts for large savings in the long term because heat pump water heaters are found to be cost-effective.
- Electronics, appliances, and space conditioning measures also contribute significantly to the savings.

Figure 6-6 Residential Achievable Potential by End Use in 2015 and 2030

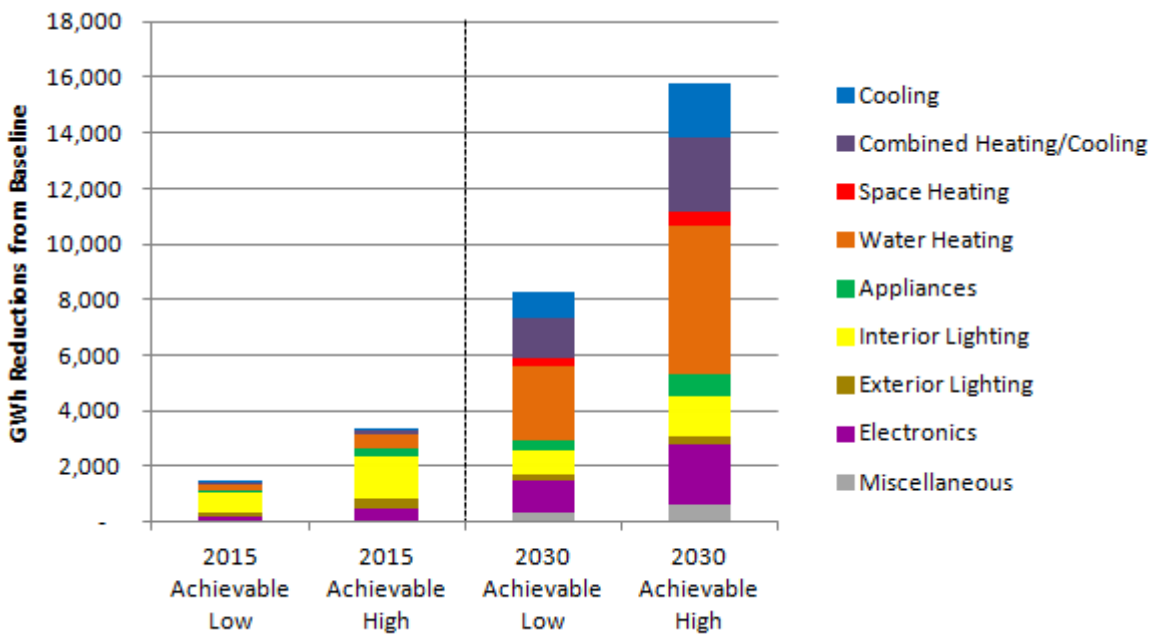


Table 6-6 Residential Savings by End Use and Potential Type (GWh)

End Use	Case	2012	2015	2020	2025	2030
Cooling	Achievable - Low	3	15	146	510	983
	Achievable - High	8	32	304	1,034	1,965
	Economic	26	86	542	1,455	2,479
	Technical	188	634	1,999	4,025	5,779
Combined Heating/Cooling	Achievable - Low	18	89	410	964	1,457
	Achievable - High	50	203	801	1,806	2,665
	Economic	146	504	1,481	2,689	3,474
	Technical	184	641	1,877	3,504	4,742
Space Heating	Achievable - Low	1	4	45	148	260
	Achievable - High	2	10	90	291	506
	Economic	7	25	156	396	625
	Technical	9	35	222	607	1,017
Water Heating	Achievable - Low	34	181	909	1,875	2,649
	Achievable - High	108	469	1,992	3,880	5,290
	Economic	294	1,055	3,265	5,643	7,127
	Technical	378	1,358	3,699	6,273	7,710
Appliances	Achievable - Low	83	128	170	268	414
	Achievable - High	241	273	337	520	797
	Economic	283	321	396	611	937
	Technical	373	617	1,002	1,388	1,783
Interior Lighting	Achievable - Low	164	664	643	601	867
	Achievable - High	474	1,534	1,165	1,005	1,445
	Economic	858	2,473	1,633	1,235	1,717
	Technical	969	2,907	2,063	1,753	2,044
Exterior Lighting	Achievable - Low	39	156	161	149	205
	Achievable - High	106	345	282	226	311
	Economic	192	558	390	263	363
	Technical	221	671	443	334	379
Electronics	Achievable - Low	37	177	627	918	1,113
	Achievable - High	104	424	1,277	1,808	2,168
	Economic	189	721	1,812	2,361	2,778
	Technical	189	721	1,812	2,361	2,778
Miscellaneous	Achievable - Low	5	30	105	219	358
	Achievable - High	14	65	196	390	612
	Economic	50	211	510	830	1,039
	Technical	50	211	511	833	1,042
Total	**Achievable - Low**	**384**	**1,444**	**3,216**	**5,652**	**8,307**
	Achievable - High	**1,107**	**3,356**	**6,445**	**10,961**	**15,759**
	Economic	**2,045**	**5,955**	**10,185**	**15,483**	**20,540**
	Technical	**2,562**	**7,795**	**13,629**	**21,078**	**27,274**

As described in Chapter 2, using our LoadMAP model, we develop separate estimates of potential for equipment and non-equipment measures. Table 6-7 presents Achievable – Low results for equipment at the technology level and Table 6-8 presents non-equipment measures for which Achievable - Low potential is greater than zero. The majority of the savings come from the equipment measures, with lighting and water heating leading the way. Electronics, heat pumps, and pool pumps/heaters provide significant savings as well.

Table 6-7 Residential Achievable - Low Potential by Technology – Selected years (GWh)

End Use	Technology	2012	2015	2020	2025	2030
Cooling	Central AC	-	-	-	-	-
	Room AC	0	0	0	0	0
Combined Heating/Cooling	Geothermal Heat Pump	0	2	8	16	23
	Air-Source Heat Pump	15	69	198	368	523
Space Heating	Electric Furnace	-	-	-	-	-
	Electric Resistance	-	-	-	-	-
Water Heating	Water Heater	29	152	733	1,448	2,032
Appliances	Clothes Dryer	-	-	-	-	-
	Clothes Washer	-	-	-	-	-
	Dishwasher	-	-	-	-	-
	Freezer	-	-	-	-	-
	Microwave	-	-	-	-	-
	Refrigerator	8	17	17	11	1
	Second Refrigerator	1	2	2	2	0
	Stove	-	-	-	-	-
Interior Lighting	Linear Fluorescent	0	1	2	2	20
	Screw-in	163	660	628	549	751
Exterior Lighting	Screw-in	39	156	161	149	205
Electronics	Devices and Gadgets	-	-	-	-	-
	Personal Computer	12	50	115	151	174
	TV	12	61	186	311	405
	Printer/Fax/Copier	0	0	0	0	0
	Set-top Boxes/DVR/Audio	12	62	148	208	250
Miscellaneous	Furnace Fan	0	2	8	17	29
	Miscellaneous	-	-	-	-	-
	Pool Pump	3	16	56	114	182
	Pool Heater	1	7	24	48	77
	Hot Tub / Spa	0	2	8	16	26
	Well Pump	0	2	6	11	17
Subtotal	**Equipment total**	**298**	**1,263**	**2,301**	**3,422**	**4,714**
Total	**Equipment and Non-Equipment measures**	**384**	**1,444**	**3,216**	**5,652**	**8,307**

Table 6-8 Residential Achievable - Low Savings for Non-equipment Measures (GWh)

Measure	2012	2015	2020	2025	2030
Advanced New Construction Design	-	-	-	-	-
Attic Fan - Installation	-	-	-	-	-
Attic Fan - Photovoltaic	-	-	-	-	-
Ceiling Fan - Installation	0.4	1.9	15.1	49.0	81.6
Central AC - Maintenance	-	-	-	-	0.3
Central Heat Pump - Maintenance	1.1	8.2	95.7	236.0	307.1
Dehumidifier	-	-	-	-	-
Doors - Storm and Thermal	-	-	-	-	-
Ducting - Repair and Sealing	1.7	11.9	132.8	320.8	413.8
Energy Efficient Manufactured Home	-	-	-	-	-
ENERGY STAR Homes	-	-	-	-	-
Exterior Lighting - Photosensor Control	-	-	-	-	-
Exterior Lighting - Photovoltaic - Installation	-	-	-	-	-
Exterior Lighting - Timeclock Installation	-	-	-	-	-
Freezer - Maintenance	-	-	-	-	-
Freezer - Remove Second Unit	1.4	4.2	17.9	60.3	133.2
Home Electronics - Reduce Standby Wattage	0.1	4.0	177.4	248.1	284.6
Home Energy Management System	1.4	5.9	47.2	195.1	388.4
Insulation – Ceiling	0.2	1.2	11.2	52.8	122.6
Insulation – Ducting	-	-	-	0.3	2.1
Insulation – Foundation	0.0	0.3	4.3	21.2	45.0
Insulation - Infiltration Control	0.9	3.6	25.8	119.2	298.7
Insulation - Wall Cavity	0.0	0.4	5.2	32.7	96.3
Insulation - Wall Sheathing	0.0	0.1	0.8	4.1	8.9
Interior Lighting - Occupancy Sensor	-	-	-	-	0.0
Pool - Pump Timer	0.0	0.4	2.8	12.0	27.2
Refrigerator - Maintenance	-	-	-	-	-
Refrigerator - Remove Second Unit	72.9	104.1	132.3	194.6	279.1
Roofs - High Reflectivity	-	-	-	-	-
Spa - Pump Timer	-	-	-	-	-
Thermostat - Clock/Programmable	0.7	3.5	34.2	110.9	165.3
Water Heater - Drainwater Heat Recovery	-	-	-	-	-
Water Heater - Faucet Aerators	0.7	3.8	22.8	58.1	78.5
Water Heater - Hot Water Saver	0.4	1.8	8.8	30.4	79.0
Water Heater - Low-Flow Showerheads	1.1	5.8	35.1	90.3	123.4
Water Heater - Pipe Insulation					
Water Heater - Tank Blanket/Insulation	1.1	7.8	49.5	78.3	78.1
Water Heater - Thermostat Setback	1.8	9.7	59.3	170.8	260.4
Water Heater - Timer	-	-	-	-	-
Whole-House Fan - Installation	-	0.0	0.2	0.6	1.9
Windows - ENERGY STAR	0.6	3.0	36.6	145.0	318.1
Windows - Install reflective film	-	-	-	0.1	0.7
Subtotal Non-Equipment Measures	**86**	**181**	**915**	**2,230**	**3,593**
Total Equipment and Non-Equipment Measures	**384**	**1,444**	**3,216**	**5,652**	**8,307**

Note: Values shown as 0.0 are non-zero but are very small.

Commercial Sector 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.

- ***Achievable - Low potential*** projects 985 GWh of energy savings in 2015 and 5,557 GWh in 2030. This corresponds to 2.6% of the baseline forecast in 2015 and 12.4% in 2030. Peak demand savings under Achievable - Low are projected to be 164 MW, 2.8% of the baseline peak demand forecast, in 2015. The savings increase to 835 MW or 11.7% of the baseline forecast by 2030.
- ***Achievable - High potential*** is 2,181 GWh in 2015, which represents 5.8% of the baseline forecast. By 2030, the cumulative energy savings are 10,130 GWh, 22.7% of the baseline forecast. In 2015, peak demand savings are 364 MW, which represents 6.2% of the baseline forecast of peak demand. By 2030, peak demand savings reach 1,509 MW, 21.1% of the baseline peak demand forecast.
- ***Economic potential***, which reflects the savings when all cost-effective measures are taken, is 3,475 GWh in 2015. This represents 9.2% of the baseline energy forecast. By 2030, economic potential reaches 12,142 GWh, 27.2% of the baseline energy forecast. Peak demand savings in 2015 are 580 MW, which represents 9.9% of the baseline forecast of peak demand. By 2030, peak demand savings reach 1814 MW, 25.3% of the baseline peak demand 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 4,221 GWh, or 11.2% of the baseline energy forecast. By 2030, technical potential reaches 16,053 GWh, 35.9% of the baseline energy forecast. Peak demand savings are 651 MW in 2015, which represents 11% of the baseline forecast of peak demand. By 2030, peak demand savings reach 2,278 MW or 31.8% of the baseline peak demand forecast.

Table 6-9 and Figure 6-7 present the savings associated with each level of potential. Figure 6-8 shows the commercial sector forecasts for the various levels of potential.

Table 6-9 Energy Efficiency Potential for the Commercial Sector

	2012	2015	2020	2025	2030
Baseline Forecast (GWh)	38,176	37,587	39,026	41,485	44,718
Savings (GWh)					
Achievable - Low	228	985	2,613	4,163	5,557
Achievable - High	660	2,181	4,693	7,419	10,130
Economic	1,244	3,475	6,106	9,145	12,142
Technical	1,460	4,221	7,795	12,033	16,053
Savings (% of Baseline)					
Achievable - Low	0.6%	2.6%	6.7%	10.0%	12.4%
Achievable - High	1.7%	5.8%	12.0%	17.9%	22.7%
Economic	3.3%	9.2%	15.6%	22.0%	27.2%
Technical	3.8%	11.2%	20.0%	29.0%	35.9%
Savings (MW)					
Achievable - Low	41	164	408	635	835
Achievable - High	117	364	738	1,128	1,509
Economic	220	580	981	1,404	1,814
Technical	243	651	1,141	1,706	2,278
Savings (% of Baseline)					
Achievable - Low	0.8%	3.3%	7.9%	11.5%	14.2%
Achievable - High	2.3%	7.4%	14.3%	20.5%	25.6%
Economic	4.4%	11.8%	19.0%	25.5%	30.7%
Technical	4.9%	13.2%	22.1%	31.0%	38.6%

Figure 6-7 Commercial Energy Efficiency Potential Savings

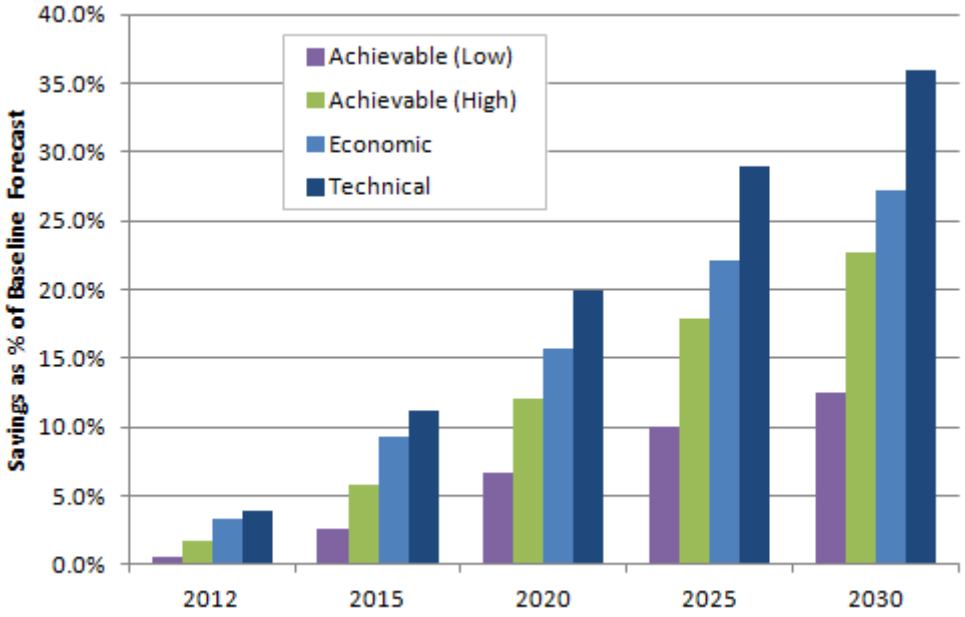
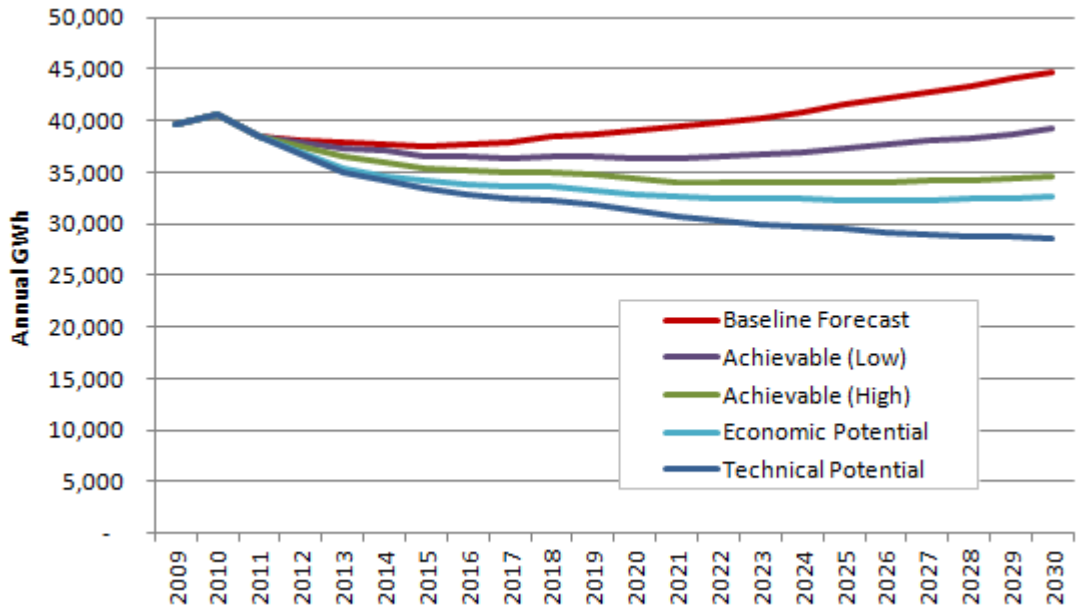


Figure 6-8 Commercial Energy Efficiency Potential Forecast



Commercial Potential by End Use, Technology, and Measure Type

Table 6-10 presents the commercial sector savings by end use and potential type. The end uses with the highest technical and economic potential are:

- Interior lighting, as a result of LED lighting that is now commercially available for screw-in applications, has the highest technical potential at 1,632 GWh in 2015. Moreover, most of the lighting equipment and measures are cost-effective resulting in economic potential of 1,561 GWh, which is 96% of technical potential. In the Achievable – Low case, roughly a third of the economic potential, 525 GWh can be captured in 2015.
- Cooling has the second highest savings for technical potential at 614 GWh in 2015. These savings result from installation of high-efficiency equipment and numerous thermal shell measures, HVAC control strategies, and retrocommissioning. Many of these measures are cost-effective, resulting in economic potential savings of 249 GWh in 2015, or 40% of technical potential savings. Achievable – Low potential is 53 GWh in 2015.
- Exterior lighting takes third place for technical potential savings at 529 GWh in 2015. The savings result from LED lighting that is commercially available. Nearly all of these measures are cost-effective, resulting in economic potential of 528 GWh in 2015. Achievable – Low potential is 169 GWh in 2015.

Ventilation, office equipment, water heating, combined heating and cooling, and refrigeration also have significant savings in terms of technical and economic potential. The savings potential from space heating, food preparation, and miscellaneous uses are relatively small.

Table 6-10 and Figure 6-9 focus on achievable potential savings. Figure 6-9 compares the range of potential in 2015 and 2030. Not surprisingly, interior lighting delivers the highest achievable savings throughout the study period. In 2015, exterior lighting is second, office equipment is third, and ventilation and cooling are next highest in terms of Achievable - Low potential. In 2030, though interior lighting still provides the greatest Achievable - Low potential, cooling is the second greatest source of savings, followed by refrigeration and exterior lighting.

Table 6-10 Commercial Potential by End Use and Potential Type (GWh)

End Use	Case	2012	2015	2020	2025	2030
Cooling	Achievable - Low	8.1	53.0	373.1	844.9	1,337.3
	Achievable - High	28.4	132.8	786.0	1,771.4	2,797.3
	Economic	71.2	248.6	1,019.4	2,205.9	3,421.2
	Technical	170.0	614.2	1,867.1	3,595.8	5,061.1
Space Heating	Achievable - Low	0.8	4.3	31.9	104.1	237.6
	Achievable - High	2.8	11.0	74.3	232.4	508.2
	Economic	7.2	19.7	92.1	283.9	611.2
	Technical	9.3	24.5	112.0	340.6	700.6
Combined Heating/Cooling	Achievable - Low	1.3	9.2	65.0	143.4	235.0
	Achievable - High	4.4	22.3	136.2	299.0	486.3
	Economic	11.5	43.0	176.1	372.0	593.8
	Technical	52.2	232.7	588.3	958.9	1,247.7
Ventilation	Achievable - Low	10.0	55.3	176.3	296.6	349.7
	Achievable - High	32.0	143.3	389.6	594.3	687.4
	Economic	91.5	338.6	711.1	850.0	920.2
	Technical	96.7	357.7	751.8	889.0	956.3
Water Heating	Achievable - Low	6.6	43.7	157.2	297.0	423.5
	Achievable - High	21.2	111.8	341.3	606.6	827.6
	Economic	57.3	240.2	551.8	867.7	1,074.8
	Technical	65.2	257.9	615.0	1,018.5	1,348.4
Food Preparation	Achievable - Low	1.2	7.2	23.5	44.2	58.7
	Achievable - High	3.8	18.5	51.9	90.3	115.8
	Economic	9.1	36.2	80.8	119.3	138.6
	Technical	9.1	36.2	80.8	119.3	138.6
Refrigeration	Achievable - Low	7.8	37.7	184.2	428.2	621.6
	Achievable - High	25.1	86.2	361.1	806.3	1,145.1
	Economic	59.2	146.4	457.5	964.6	1,341.5
	Technical	76.3	203.9	559.7	1,087.3	1,466.5
Interior Lighting	Achievable - Low	149.0	524.5	1,087.3	1,397.9	1,626.4
	Achievable - High	417.1	1,093.5	1,724.3	2,097.6	2,524.4
	Economic	721.1	1,560.9	2,057.1	2,430.8	2,871.0
	Technical	759.9	1,631.5	2,227.6	2,912.2	3,845.0
Exterior Lighting	Achievable - Low	30.3	168.5	362.5	419.7	457.0
	Achievable - High	84.7	359.5	527.4	563.5	636.3
	Economic	146.4	528.1	586.4	628.6	697.2
	Technical	146.9	529.3	589.8	638.5	715.5
Office Equipment	Achievable - Low	12.8	81.5	151.3	186.0	208.7
	Achievable - High	39.9	202.1	299.7	355.8	398.6
	Economic	68.8	311.9	371.7	418.4	468.5
	Technical	73.7	332.1	400.7	468.7	568.3
Miscellaneous	Achievable - Low	0.0	0.2	0.6	1.1	1.5
	Achievable - High	0.1	0.4	1.3	2.3	3.1
	Economic	0.3	1.0	2.3	3.6	4.3
	Technical	0.3	1.0	2.4	4.1	5.0
Total	**Achievable - Low**	**228**	**985**	**2,613**	**4,163**	**5,557**
	Achievable - High	**660**	**2,181**	**4,693**	**7,419**	**10,130**
	Economic	**1,244**	**3,475**	**6,106**	**9,145**	**12,142**
	Technical	**1,460**	**4,221**	**7,795**	**12,033**	**16,053**

Figure 6-9 Commercial Achievable Potential Savings by End Use in 2015 and 2030

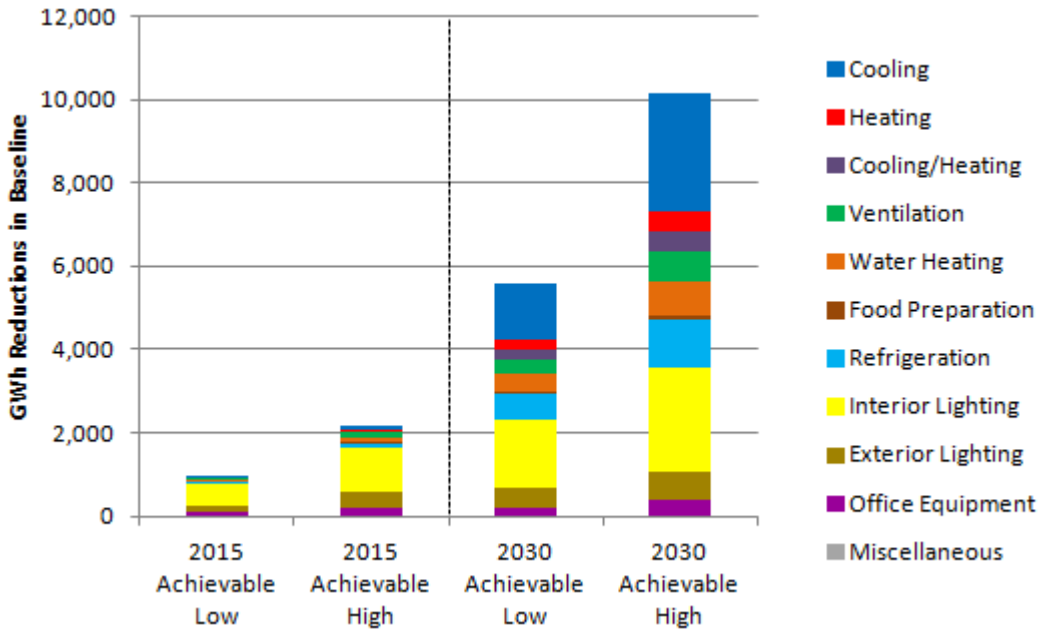


Table 6-11 and Table 6-12 present achievable potential savings for equipment measures and non-equipment measures, respectively, under the Achievable - Low case. The greatest savings in the near term (2015) come from:

- Replacement of interior lighting systems (279 GWh, 139 GWh, and 99 GWh respectively for screw-in, high bay, and linear fluorescent lighting systems)
- Installation of Energy Management Systems (155 GWh)
- HVAC equipment maintenance programs (155 GWh for AC maintenance and 36 GWh for heat pumps)
- Refrigerator decommissioning and recycling (134 GWh)
- Replacement of exterior lighting systems (97 GWh, 68 GWh, and 3 GWh respectively for screw-in, HID, and linear fluorescent lighting systems)

Together, these five categories of measures account for 1,166 MWh, roughly 62% of the Achievable - Low potential savings in the commercial sector in 2015. By 2030, non-equipment measures play a greater role in potential, led by energy management systems, refrigerator decommissioning, and roof-top equipment maintenance.

Table 6-11 Commercial Achievable - Low Savings for Equipment Measures (GWh)

End Use	Technology	2012	2015	2020	2025	2030
Cooling	Air-Cooled Chiller	1.1	6.0	24.2	52.3	77.9
	Other Cooling	-	2.9	22.3	45.4	65.4
	Roof Top AC	-	-	1.9	4.4	9.1
	Water-Cooled Chiller	2.5	13.6	55.0	118.3	176.5
Heating	Electric Heating	-	-	-	-	-
Cooling/Heating	Roof Top Heat Pump	0.4	3.2	10.7	20.8	34.4
Ventilation	Ventilation	10.0	55.3	176.0	295.8	347.5
Water Heating	Water Heating	6.4	42.1	141.1	261.2	375.4
Food Preparation	Dishwasher	0.3	2.0	6.7	12.7	16.9
	Fryer	0.2	1.3	4.2	7.8	10.4
	Hot Food Container	0.3	1.5	5.0	9.4	12.4
	Oven	0.4	2.3	7.6	14.2	19.0
Refrigeration	Glass Door Display	-	-	-	-	-
	Icemaker	0.0	0.3	1.0	2.0	2.5
	Open Display Case	-	1.6	12.2	23.9	36.4
	Reach-in Refrigerator	0.1	0.6	2.0	3.6	5.1
	Vending Machine	0.5	0.5	0.5	0.1	0.0
	Walk-in Refrigerator	1.0	6.4	21.9	39.3	57.1
Interior Lighting	High-Bay Fixtures	17.9	139.4	224.0	243.7	260.3
	Linear Fluorescent	23.1	99.3	298.3	443.6	502.9
	Screw-in	106.6	278.7	518.0	592.1	622.7
Exterior Lighting	HID	9.3	67.5	128.7	164.7	185.8
	Linear Fluorescent	0.8	3.4	8.9	15.1	16.7
	Screw-in	20.1	97.3	222.7	232.3	237.0
Office Equipment	Desktop Computer	5.9	40.5	71.9	86.9	95.0
	Laptop	0.9	6.2	11.1	13.5	14.9
	Monitor	0.2	1.2	2.1	2.6	2.9
	POS Terminal	-	-	-	-	-
	Printer/Copier/Fax	0.9	4.7	13.5	17.7	19.4
	Server	4.8	28.8	51.8	62.1	69.3
Miscellaneous	Miscellaneous	-	-	-	-	-
	Non-HVAC Motors	0.0	0.1	0.4	0.8	1.2
	Pool Heater	0.0	0.0	0.1	0.1	0.2
	Pool Pump	0.0	0.0	0.1	0.1	0.2
Subtotal	**Equipment**	**214**	**907**	**2,044**	**2,786**	**3,275**
Total	**Equipment and Non-Equipment Measures**	**560**	**1,882**	**6,825**	**14,301**	**22,444**

Table 6-12 Commercial Achievable - Low Savings for Non-equipment Measures (GWh)

Measure	2012	2015	2020	2025	2030
Air-Cooled Chiller - High Efficiency Fans	0.0	0.0	0.0	0.1	0.1
Chiller - Condenser Water Temperature Reset	0.4	1.4	6.2	20.7	46.0
Chiller - Economizer	5.5	16.0	77.6	187.3	225.1
Chiller - Thermal Energy Storage	-	-	-	-	-
Chiller - VSD	13.6	36.4	170.1	525.8	981.3
Display Case - LED Lighting	60.0	120.6	268.9	324.5	295.7
Energy Management System	62.7	155.3	710.4	2,290.0	4,672.6
Fans - Energy-Efficient Motors	0.2	0.4	1.6	5.4	11.1
Heat Pump - Maintenance	7.7	36.3	261.0	424.2	426.2
Hotel - Guest Room Controls	-	-	-	-	-
HVAC - Duct Repair and Sealing	15.8	48.9	248.1	688.3	1,027.6
Indoor Lighting - Daylighting Controls	2.5	4.2	12.4	36.9	102.2
Insulation - Ceiling	5.2	14.2	64.4	225.8	597.2
Insulation - Ducting	1.4	3.2	12.1	40.7	109.1
Insulation - Wall Cavity	16.1	42.0	187.2	649.6	1,685.8
Interior Fluorescent - Bi-Level Fixture w/Occupancy Sensor	0.6	1.4	5.1	18.8	51.6
Interior Fluorescent - Photocell-Controlled Dimming Ballasts	3.7	8.6	33.9	130.3	374.4
Interior Lighting - Fluorescent Delamp and Install Reflectors	8.6	18.5	71.5	238.5	599.7
Interior Lighting - LED Exit Lighting	6.5	24.6	143.5	225.3	211.9
Interior Lighting - Occupancy Sensors	3.3	6.1	21.5	71.4	173.6
Interior Lighting - Task Lighting	4.1	8.2	32.3	108.2	222.3
Interior Lighting - Time Clocks and Timers (lighting)	3.0	5.6	20.0	62.7	120.8
Lighting Retrocommissioning	3.4	6.8	25.8	83.5	198.5
Non-HVAC Motors - Variable Speed Control	0.0	0.0	0.1	0.5	0.7
Office Electronics - ENERGY STAR Power Supplies	0.5	1.2	6.2	22.2	48.1
Office Electronics - Plug Load Occupancy Sensors	0.7	1.4	6.4	25.4	72.8
Open Display Case - Night Covers	1.1	3.3	16.4	47.2	71.5
Pool Pump - Timer	0.0	0.0	0.0	0.0	0.0
Pumps - High-Efficiency Motors	-	-	-	-	-
Pumps - Variable Speed Control	-	-	-	-	-
Refrigerator - Anti-Sweat Heater	9.8	28.8	144.6	396.2	571.9
Refrigerator - Decommissioning and Recycling	47.1	134.4	645.6	1,731.4	2,552.1
Refrigerator - Door Gasket Replacement	0.8	2.8	12.0	34.6	55.7
Roofs - Cool Roof	3.1	7.9	34.1	114.1	287.7
RTU - Maintenance	32.8	155.2	1,116.2	1,837.1	1,929.6
Thermostat - Clock/Programmable	4.0	17.8	115.2	168.1	149.3

Table 6-12 Commercial Achievable - Low Savings for Non-equipment Measures (GWh) (continued)

Vending Machine - Controller	0.0	0.0	0.1	0.4	0.8
Ventilation - CO2 Controlled	0.0	0.1	0.2	0.6	1.8
Ventilation - Exhaust Hood Sensor Control	0.2	0.5	2.0	7.4	20.2
Ventilation - Variable Speed Control	-	-	-	-	-
Water Heating - Faucet Aerators and Low Flow Nozzles	1.3	6.0	39.7	61.1	57.4
Water Heating - Heat Trap	0.1	0.3	0.9	2.4	4.6
Water Heating - High Efficiency Circulation Pump	-	-	-	-	-
Water Heating - Hot Water Saver	1.2	3.2	13.6	32.7	42.8
Water Heating - Install Timer	0.1	0.3	0.9	2.4	4.7
Water Heating - Pipe Insulation	0.8	2.0	8.2	18.0	21.1
Water Heating - Solar Water Heating System	4.5	9.4	32.0	94.8	225.3
Water Heating - Tank Blanket	1.4	6.6	43.8	65.6	61.6
Water Heating - Thermostat Setback	2.8	7.8	35.9	89.2	122.8
Water-Cooled Chiller - Condenser Water Temperature Reset	3.2	8.1	35.6	106.8	205.8
Water-Cooled Chiller - Cooling Tower, High-Efficiency Fans	0.1	0.4	3.8	14.1	23.0
Windows - High Efficiency	6.2	18.6	93.7	283.8	505.0
Subtotal for Non-Equipment Measures	346	975	4,781	11,514	19,169
Total Equipment and Non-Equipment Measures	560	1,882	6,825	14,301	22,444

Commercial Potential by Market Segment

Table 6-13 shows potential estimates by segment in 2015. Retail has the largest savings potential in 2015 with a range of 159 GWh–345 GWh for large retail and 115 GWh–248 GWh for small retail. Together these two building types account for almost 28% of achievable low potential. Looking at the savings as a percentage of the segment's baseline use, warehouses have the greatest room for improvement, with Achievable – Low potential at 4.1%, followed by large and small miscellaneous.

Figure 6-10 summarizes the range of achievable potential for each segment. The Large Retail segment has the largest potential, followed by miscellaneous, small retail, large office, health and lodging.

Table 6-13 Commercial Potential by Market Segment, 2015

	Small Office	Restau-rant	Small Retail	Small Grocery	Ware-house	Small Misc.	Large Office	Large Retail
Baseline Forecast (GWh)	2,424	1,863	3,355	488	649	490	4,914	4,430
Energy Savings (GWh)								
Achievable - Low	52	59	115	9	27	19	100	159
Achievable - High	118	127	248	20	58	40	233	345
Economic Potential	191	198	383	33	88	62	381	526
Technical Potential	251	239	486	46	98	73	462	619
Energy Savings as % of Baseline								
Achievable - Low	2.1%	3.2%	3.4%	1.9%	4.1%	3.8%	2.0%	3.6%
Achievable - High	4.9%	6.8%	7.4%	4.2%	9.0%	8.2%	4.7%	7.8%
Economic Potential	7.9%	10.6%	11.4%	6.7%	13.6%	12.7%	7.8%	11.9%
Technical Potential	10.3%	12.8%	14.5%	9.3%	15.2%	14.8%	9.4%	14.0%
	Large Grocery	**Ref. Ware-house**	**School**	**College**	**Health**	**Lodging**	**Large Misc.**	**Grand Total**
Baseline Forecast (GWh)	3,403	657	2,647	2,106	4,426	2,507	3,227	37,587
Energy Savings (GWh)								
Achievable - Low	65	11	58	51	70	70	119	985
Achievable - High	145	24	133	114	162	155	258	2,181
Economic Potential	232	41	221	187	282	251	398	3,475
Technical Potential	309	46	275	234	351	274	459	4,221
Energy Savings as % of Baseline								
Achievable - Low	1.9%	1.6%	2.2%	2.4%	1.6%	2.8%	3.7%	2.6%
Achievable - High	4.3%	3.7%	5.0%	5.4%	3.7%	6.2%	8.0%	5.8%
Economic Potential	6.8%	6.3%	8.3%	8.9%	6.4%	10.0%	12.3%	9.2%
Technical Potential	9.1%	7.0%	10.4%	11.1%	7.9%	10.9%	14.2%	11.2%

Figure 6-10 Achievable Potential Savings in 2015 by Commercial Building Type

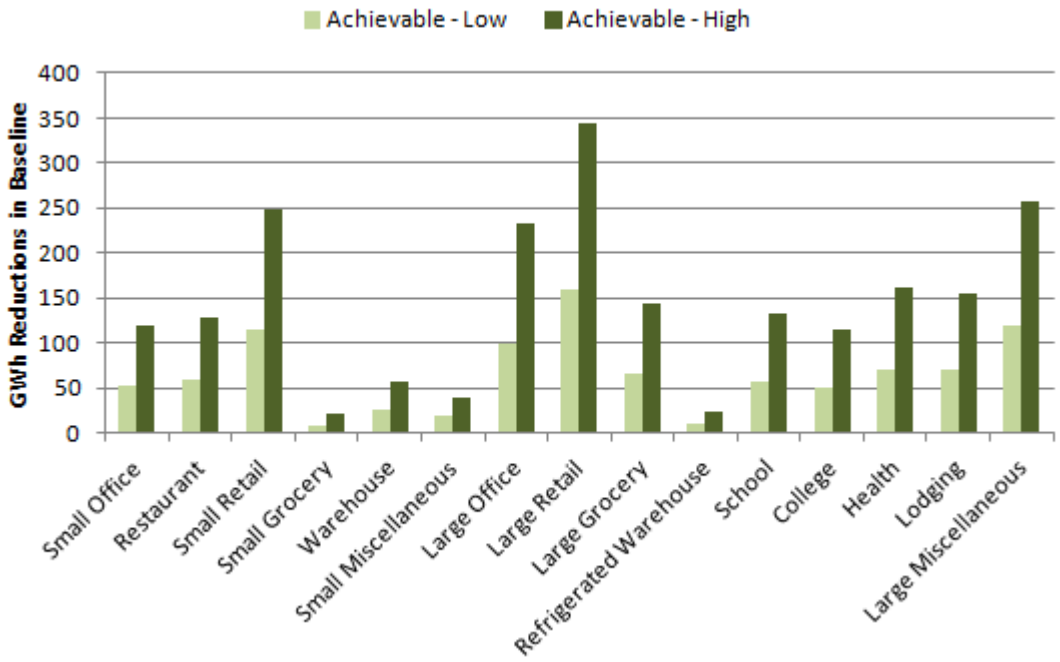


Table 6-14 and Table 6-15 present the achievable potential for 2015 by measure and building type. Lighting replacement and upgrade, particularly for screw-in lamps, is a key measure across all buildings. In the near term, lighting predominates, but other key measures for each building type are as follows:

- Retail: water heating and ventilation
- Offices: office equipment, ventilation, cooling equipment upgrades, and energy management systems
- Restaurants: water heating with HPWH, food preparation equipment, and refrigeration upgrades
- Grocery: refrigeration, particularly walk-in refrigeration, and water heating
- Warehouse: refrigeration equipment upgrades
- Schools: ventilation, office equipment, HPWH water heating equipment, and HVAC maintenance
- Colleges: ventilation, office equipment, and HPWH water heating equipment
- Health: ventilation, Energy management systems, variable speed drives on chillers, chiller upgrades, and office equipment
- Lodging: Heat pump and RTU equipment upgrades and maintenance, ventilation, and office equipment

For many building types, energy management systems become a significant source of energy potential over the longer term.

Table 6-14 Commercial Achievable Savings from Equipment Measures in 2015 by Building Type (GWh)

End Use	Technology	Small Office	Restau-rant	Small Retail	Small Grocery	Ware-house	Small Misc.	Large Office	Large Retail	Large Grocery	Refrig. Ware-house	School	College	Health	Lodging	Large Misc.
Cooling	Air-Cooled Chiller	0.0	0.0	0.0	0.0	-	0.2	0.1	2.2	0.4	0.1	0.2	0.1	2.4	0.0	0.2
	Other Cooling	0.1	0.4	0.2	0.0	0.0	0.0	0.5	0.1	-	0.0	-	-	0.7	0.9	0.1
	Roof Top AC	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Water-Cooled Chiller	0.0	0.0	0.0	0.0	-	0.1	3.2	0.6	0.3	0.1	0.8	1.5	2.8	0.6	3.6
Heating	Electric Heating	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Cool/ Heat	Roof Top Heat Pump	-	-	-	-	-	-	-	-	-	-	-	-	-	3.2	-
Ventilation	Ventilation	4.2	1.7	5.3	0.1	0.3	0.9	7.6	3.3	0.7	0.3	6.1	5.8	11.3	3.6	4.1
Water Heating	Water Heating	2.0	4.3	3.7	0.3	0.5	0.7	4.2	4.3	2.2	0.3	2.9	3.2	2.8	5.2	5.5
Food Preparation	Dishwasher	0.1	0.5	0.0	0.0	-	0.0	0.1	0.2	0.2	-	0.2	0.1	0.5	0.1	0.1
	Fryer	-	0.5	-	0.0	-	-	0.0	0.1	0.1	-	0.1	0.0	0.2	0.1	0.0
	Hot Food Container	-	0.4	0.0	0.0	-	-	0.1	0.2	0.2	-	0.1	0.1	0.4	0.1	0.1
	Oven	0.1	0.9	0.0	0.0	0.0	0.0	0.1	0.2	0.2	0.0	0.2	0.1	0.4	0.1	0.1
Refrigeration	Glass Door Display	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Icemaker	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Open Display Case	-	0.1	0.0	0.1	-	0.0	0.0	0.1	1.1	-	0.0	0.0	0.0	0.0	0.0
	Reach-in Refrigerator	0.0	0.1	0.0	0.0	-	0.0	0.0	0.1	0.1	-	0.1	0.0	0.0	0.0	0.0
	Vending Machine	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0
	Walk-in Refrigerator	-	0.7	-	0.2	-	-	-	0.3	2.1	2.5	0.1	0.0	0.1	0.2	0.1
Interior Lighting	High-Bay Fixtures	2.4	1.7	23.8	1.6	14.7	4.2	4.7	30.1	10.5	2.9	10.0	3.2	1.1	1.8	26.7
	Linear Fluorescent	6.6	1.8	11.7	1.0	2.1	1.5	12.4	14.8	6.7	0.4	12.9	4.8	9.1	4.1	9.5
	Screw-in	9.4	35.9	34.7	1.2	2.8	5.3	18.0	48.2	7.6	0.5	5.4	18.4	22.1	35.5	33.8
Exterior Lighting	HID	6.1	4.8	3.4	0.5	3.6	1.6	6.1	5.5	3.9	1.0	7.8	5.1	3.9	4.5	9.7
	Linear Fluorescent	0.2	0.0	0.0	0.0	0.0	0.4	0.1	0.0	0.1	0.0	0.0	0.0	0.0	0.0	2.5
	Screw-in	2.6	0.6	22.5	0.4	0.0	2.3	3.6	36.6	2.7	0.0	2.7	2.3	0.8	6.2	14.1
Office Equipment	Desktop Computer	5.0	0.3	1.1	0.0	0.4	0.3	21.8	1.8	0.4	0.1	2.2	2.1	2.6	0.5	1.7
	Laptop	0.8	0.0	0.1	0.0	0.1	0.0	3.4	0.3	0.1	0.0	0.2	0.3	0.4	0.1	0.3
	Monitor	0.1	0.0	0.0	0.0	0.0	0.0	0.6	0.1	0.0	0.0	0.1	0.1	0.1	0.0	0.1
	POS Terminal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Printer/Copier/Fax	1.0	0.0	0.1	0.0	0.0	0.0	1.5	0.2	0.0	0.0	0.6	0.3	0.5	0.0	0.3
	Server	5.8	0.7	2.6	0.1	1.0	0.6	4.2	4.2	0.5	0.2	3.4	1.6	1.5	0.5	2.0
Miscellaneous	Miscellaneous	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Non-HVAC Motors	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Pool Heater	-	-	-	-	-	0.0	-	-	-	-	0.0	0.0	0.0	0.0	0.0
	Pool Pump	-	-	-	-	-	0.0	-	-	-	-	0.0	0.0	0.0	0.0	0.0
Total for Equipment		46.5	55.8	109.4	5.8	25.7	18.0	92.3	153.4	40.2	8.4	56.1	49.2	63.8	67.4	114.5

Table 6-15 Commercial Achievable Savings from Non-Equipment Measures in 2015 by Building Type (GWh)

Measure	Small Office	Restau-rant	Small Retail	Small Grocery	Ware-house	Small Misc.	Large Office	Large Retail	Large Grocery	Refrig. Ware-house	School	College	Health	Lodging	Large Misc.
Air-Cooled Chiller - High Efficiency Fans	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Chiller - Condenser Water Temperature Reset	-	-	-	-	-	-	-	-	-	-	0.0	0.0	0.1	0.0	-
Chiller - Economizer	0.0	0.0	0.0	0.0	-	0.0	0.1	0.1	0.0	0.0	0.1	0.1	0.5	-	0.1
Chiller - Thermal Energy Storage	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Chiller - VSD	-	-	-	-	-	0.0	0.4	-	-	-	0.2	0.3	1.0	0.1	0.4
Display Case - LED Lighting	-	-	-	1.5	-	-	-	-	10.8	-	-	-	-	-	-
Energy Management System	1.3	0.2	-	0.1	0.3	0.2	2.5	-	0.4	0.0	-	-	1.2	0.8	1.4
Fans - Energy-Efficient Motors	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Heat Pump - Maintenance	0.3	0.2	0.6	0.0	0.1	0.0	0.4	0.2	0.1	0.0	0.2	0.3	0.5	0.3	0.2
Hotel - Guest Room Controls	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
HVAC - Duct Repair and Sealing	0.8	0.3	0.7	0.1	0.0	-	1.3	0.4	0.5	0.0	-	0.4	-	-	-
Indoor Lighting - Daylighting Controls	-	-	0.1	0.0	0.0	0.0	-	0.2	0.1	0.0	-	-	-	-	0.0
Insulation - Ceiling	0.1	0.1	0.2	0.0	0.0	0.0	0.1	0.2	0.2	0.0	0.0	0.0	0.3	0.0	0.0
Insulation - Ducting	-	-	-	-	-	-	-	-	-	-	-	-	0.0	-	-
Insulation - Wall Cavity	0.2	0.0	0.8	0.1	0.1	0.0	0.3	0.8	0.7	0.1	0.0	0.0	0.5	0.1	0.1
Interior Fluorescent - Bi-Level Fixture w/Occupancy Sensor	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Interior Fluorescent - Photocell-Controlled Dimming Ballasts	-	-	-	0.0	-	-	-	-	0.1	-	-	-	0.0	-	-
Interior Lighting - Fluorescent Delamp and Install Reflectors	0.3	-	-	0.0	-	-	0.4	-	0.2	-	-	-	0.1	-	0.2
Interior Lighting - LED Exit Lighting	0.2	0.1	0.4	0.0	0.1	0.1	0.4	0.5	0.2	0.0	0.4	0.2	0.2	0.2	0.4
Interior Lighting - Occupancy Sensors	0.1	-	-	-	-	-	0.1	-	-	-	-	-	-	-	-
Interior Lighting - Task Lighting	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Interior Lighting - Time Clocks and Timers (lighting)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Lighting Retrocommissioning	0.1	-	0.1	0.0	-	0.0	0.0	0.1	0.0	-	0.1	0.0	0.1	-	0.1
Non-HVAC Motors - Variable Speed Control	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Office Electronics - ENERGY STAR Power Supplies	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Office Electronics - Plug Load Occupancy Sensors	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Open Display Case - Night Covers	-	-	-	0.0	-	-	-	-	0.3	-	-	-	-	-	-

Measure	Small Office	Restau-rant	Small Retail	Small Grocery	Ware-house	Small Misc.	Large Office	Large Retail	Large Grocery	Refrig. Ware-house	School	College	Health	Lodging	Large Misc.
Pool Pump - Timer	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pumps - High-Efficiency Motors	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pumps - Variable Speed Control	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Refrigerator - Anti-Sweat Heater	-	-	-	0.3	-	-	-	-	2.4	-	-	-	-	-	-
Refrigerator - Decommissioning and Recycling	0.0	1.3	0.0	0.9	0.0	0.0	0.1	0.7	6.5	1.8	0.4	0.1	0.3	0.4	0.2
Refrigerator - Door Gasket Replacement	-	-	-	-	-	-	-	-	0.1	-	-	-	-	-	-
Roofs - Cool Roof	0.1	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.1	0.0	-	-	0.1	0.0	0.1
RTU - Maintenance	1.6	0.8	2.2	0.2	0.2	0.2	1.8	2.3	1.6	0.1	0.5	0.6	1.3	0.7	1.0
Thermostat - Clock/Programmable	0.1	-	0.1	0.0	0.1	0.0	0.1	0.2	0.2	0.0	-	0.1	0.1	0.1	0.1
Vending Machine - Controller	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ventilation - CO2 Controlled	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ventilation - Exhaust Hood Sensor Control	-	0.0	-	0.0	-	-	-	-	0.0	0.0	-	-	-	0.0	-
Ventilation - Variable Speed Control	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Water Heating - Faucet Aerators and Low Flow Nozzles	-	0.1	0.1	0.0	-	-	-	0.1	0.0	0.0	-	0.0	0.0	0.1	0.0
Water Heating - Heat Trap	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Water Heating - High Efficiency Circulation Pump	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Water Heating - Hot Water Saver	-	0.1	-	-	-	-	-	-	-	-	-	-	0.0	-	-
Water Heating - Install Timer	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Water Heating - Pipe Insulation	-	0.1	-	-	-	-	-	-	-	-	-	-	-	-	-
Water Heating - Solar Water Heating System	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Water Heating - Tank Blanket	0.0	0.2	0.1	0.0	-	-	-	0.2	0.1	0.0	-	-	-	-	-
Water Heating - Thermostat Setback	-	0.1	-	-	-	-	-	-	0.0	0.0	-	-	0.1	0.2	-
Water-Cooled Chiller - Condenser Water Temperature Reset	-	-	-	-	-	-	-	-	-	-	0.1	0.1	0.2	0.0	-
Water-Cooled Chiller - Cooling Tower, High-Efficiency Fans	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.0
Windows - High Efficiency	0.0	0.0	-	0.0	-	-	-	-	0.3	0.0	-	-	-	-	-
Total for Non-Equipment	**5.2**	**3.7**	**5.4**	**3.4**	**0.9**	**0.6**	**8.2**	**5.9**	**24.7**	**2.2**	**2.0**	**2.2**	**6.7**	**2.9**	**4.4**

Industrial Sector Potential

The industrial sector, at 44,311 GWh in 2009, accounts for almost one-third of total electricity sales. Chemical products, primary metals, paper products, and food products are the four largest industries throughout the Valley, accounting for 59% of total industrial sales in 2009. Because of their size, and in order to capture measures that are specific to these industries, we isolated them as separate segments.

Most of the equipment replacement opportunities are in the machine drive (motors) end use, but potential savings are diminishing 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 only available from upgrading to still more efficient levels. Furthermore, due to the site-specific nature of many industrial sector process energy efficiency opportunities, savings potential resulting from these customized approaches should be characterized individually. To understand these opportunities in more depth, it would be appropriate to carry out site-specific engineering assessments for each customer, though we would recommend that such assessments be limited to only the very largest customers.

Throughout the study period, Economic potential is about 80%–90% of Technical potential, indicating that most of the measures evaluated are cost-effective. In 2015, Achievable - Low potential is 826 GWh or 1.7% of the baseline industrial forecast. By 2030, it increases to 5,229 GWh, or 9.8% of the baseline forecast and 43% of economic potential. Table 6-16, Figure 6-11 and Figure 6-12 present the savings for the various types of potential considered in this study.

Table 6-16 Energy Efficiency Potential for the Industrial Sector

	2012	2015	2020	2025	2030
Baseline Forecast	46,394	48,173	50,777	52,364	53,412
Savings (GWh)					
Achievable - Low	199	826	2,134	3,604	5,229
Achievable - High	651	1,957	4,199	6,835	9,892
Economic	1,192	2,989	5,367	8,463	12,139
Technical	1,327	3,330	6,121	9,712	13,917
Savings (% of Baseline)					
Achievable - Low	0.4%	1.7%	4.2%	6.9%	9.8%
Achievable - High	1.4%	4.1%	8.3%	13.1%	18.5%
Economic	2.6%	6.2%	10.6%	16.2%	22.7%
Technical	2.9%	6.9%	12.1%	18.5%	26.1%
Savings (MW)					
Achievable - Low	58	244	616	1,012	1,424
Achievable - High	186	576	1,200	1,900	2,682
Economic	338	876	1,531	2,349	3,295
Technical	345	886	1,559	2,400	3,368
Savings (% of Baseline)					
Achievable - Low	0.5%	2.1%	5.0%	8.0%	11.2%
Achievable - High	1.7%	4.9%	9.8%	15.1%	21.1%
Economic	3.0%	7.5%	12.5%	18.6%	25.9%
Technical	3.1%	7.6%	12.7%	19.0%	26.5%

Figure 6-11 Industrial Energy Efficiency Potential Savings

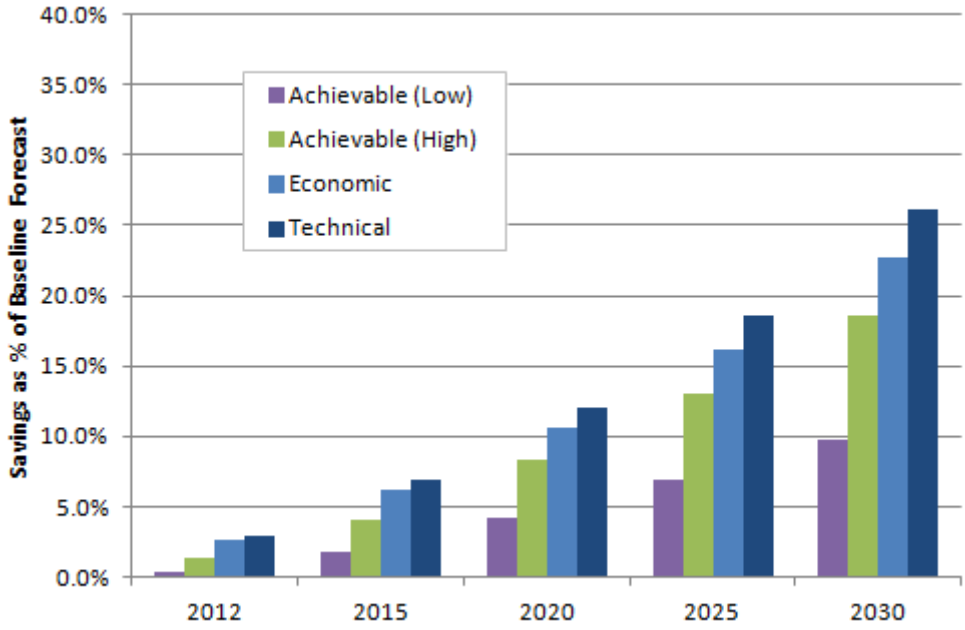
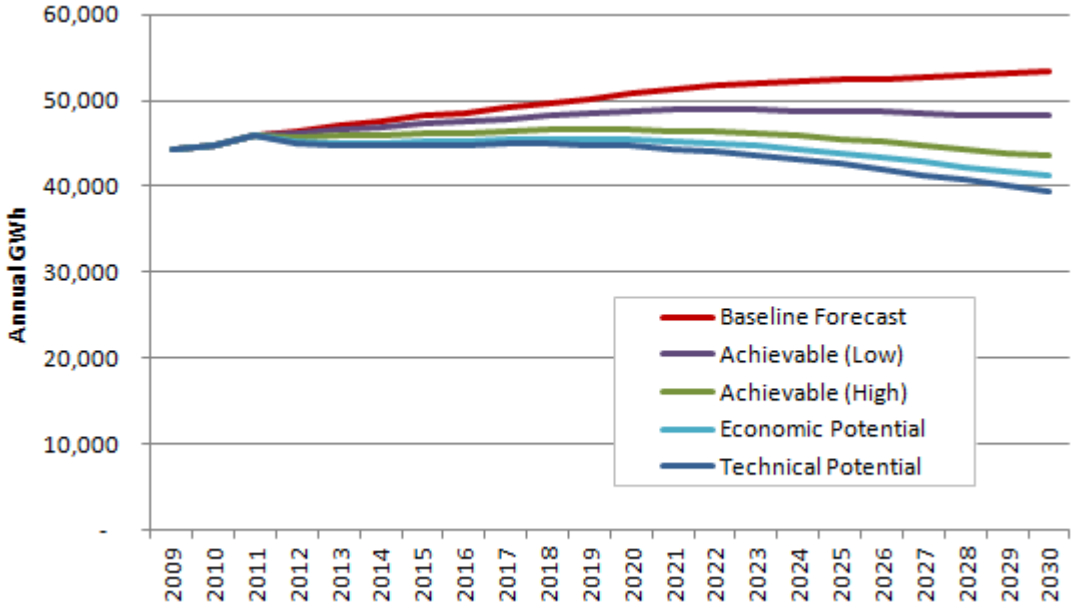


Figure 6-12 Industrial Energy Efficiency Potential Forecast



Industrial Potential by End Use

Table 6-17 presents the industrial savings by end use and type of potential. As mentioned above, machine drives offer the greatest opportunity for energy savings across the range of potential. Lighting has the next highest savings potential, particularly in the near term, but is ultimately dwarfed in comparison to the opportunities for machine drives.

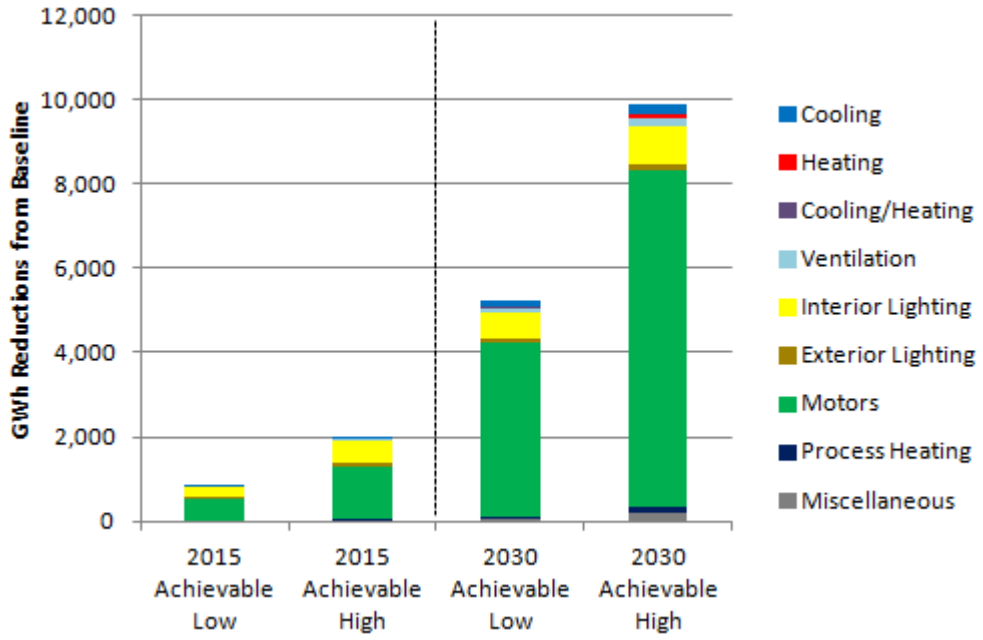
Table 6-17 Industrial Potential by End Use and Potential Type (GWh)

End Use	Case	2012	2015	2020	2025	2030
Cooling	Achievable - Low	2	7	32	69	126
	Achievable - High	6	16	65	141	255
	Economic Potential	15	27	79	167	298
	Technical Potential	73	196	434	711	1,024
Heating	Achievable - Low	0	2	7	17	33
	Achievable - High	1	4	14	34	63
	Economic Potential	3	6	17	39	74
	Technical Potential	27	48	118	255	458
Cooling/Heating	Achievable - Low	0	0	2	4	7
	Achievable - High	0	1	4	8	15
	Economic Potential	1	2	4	10	17
	Technical Potential	19	85	182	281	358
Ventilation	Achievable - Low	3	18	54	90	103
	Achievable - High	9	45	118	177	198
	Economic Potential	22	88	186	222	234
	Technical Potential	22	88	186	222	234
Interior Lighting	Achievable - Low	46	241	457	558	628
	Achievable - High	131	516	675	787	887
	Economic Potential	233	785	755	894	960
	Technical Potential	252	806	817	1,013	1,134
Exterior Lighting	Achievable - Low	4	33	65	86	96
	Achievable - High	13	73	105	128	139
	Economic Potential	22	116	125	147	152
	Technical Potential	24	118	129	156	168
Motors	Achievable - Low	140	516	1,481	2,709	4,117
	Achievable - High	474	1,270	3,119	5,363	8,006
	Economic Potential	848	1,886	4,022	6,634	9,823
	Technical Potential	863	1,910	4,077	6,724	9,960
Process Heating	Achievable - Low	1	4	14	31	57
	Achievable - High	6	13	39	83	152
	Economic Potential	13	23	57	123	223
	Technical Potential	13	23	57	123	223
Miscellaneous	Achievable - Low	0	0	0	0	0
	Achievable - High	0	0	0	0	0
	Economic Potential	0	0	0	0	0
	Technical Potential	0	0	0	0	0
Total	**Achievable - Low**	**197**	**820**	**2,113**	**3,565**	**5,167**
	Achievable - High	**641**	**1,937**	**4,138**	**6,722**	**9,713**
	Economic Potential	**1,158**	**2,932**	**5,245**	**8,237**	**11,781**
	Technical Potential	**1,293**	**3,274**	**5,999**	**9,485**	**13,559**

Figure 6-13 illustrates the range of achievable potential savings by end use in 2015 and 2030 for the industrial sector, reinforcing the dominance of the machine drive category. Beyond the replacement of motors and lighting, particularly high bay fixtures, with more efficient units, the specific measures that account for the largest savings in the industrial segment are:

- Integrated plant energy management — 45 MWh and 392 MWh of Achievable – Low potential in 2015 and 2030 respectively
- Fan and pump system measures, which include system optimization, energy management, and equipment upgrades — 135 GWh and 1,425 GWh of Achievable – Low potential in 2015 and 2030 respectively

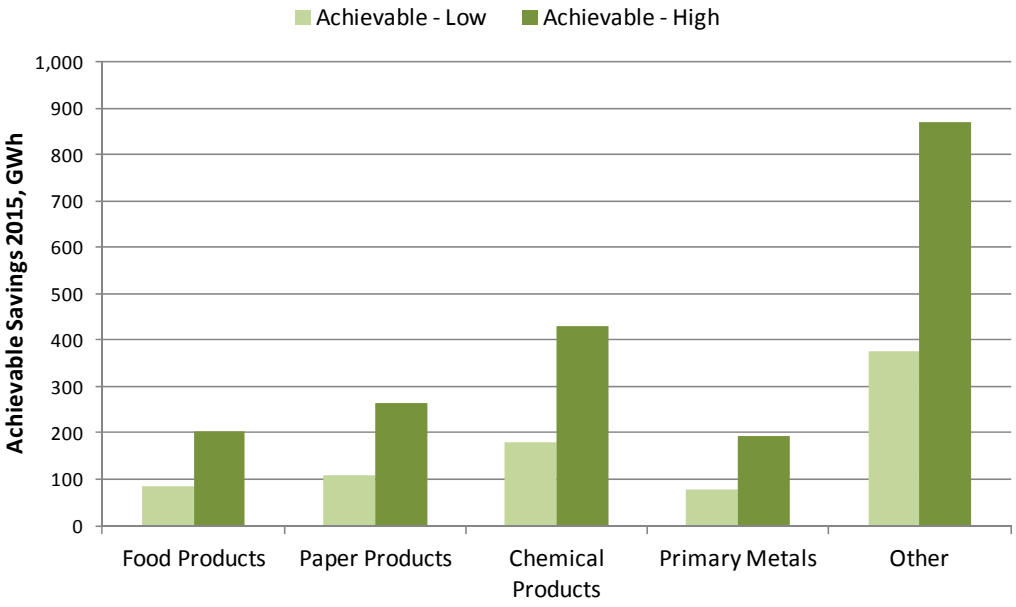
Figure 6-13 Industrial Achievable Potential Savings by End Use in 2015 and 2030



Industrial Potential by Market Segment

Figure 6-14 shows Achievable potential for the five industrial segments in 2015. Achievable - Low potential savings as a percentage of baseline usage range from a high of 2.4% for Paper Products to a low of 0.9% for Primary Metals. For the Other Industries segment, Achievable – Low potential in 2015 is 277 GWH, which is 2.1% of baseline energy use.

Figure 6-14 Achievable Potential Savings in 2015 by Industry Type



COST-EFFECTIVENESS ANALYSIS

Financial Impacts

An important result from the analysis is the financial impact of the achievable potentials, including utility program spending. Each energy efficiency measure has an incremental cost relative to the cost of doing nothing or choosing standard, baseline equipment. This incremental cost, also known as the measure cost, is born by the customer, the utility, or a combination of the two.

When a utility or program administrator is expending marketing or administrative dollars to facilitate the implementation of measures, this cost must also be considered. The sum of the measure cost and the program costs results in the total resource cost (TRC). An alternative cost metric is the utility cost (UC), which is the total of the program costs and only the utility incentive portion of the measure cost. The UC omits the customer-funded portion of the measure cost, and therefore gives an estimate of the dollars a utility will have to budget.

Program Cost Assumptions

The LoadMAP model returns values for measure incremental cost, but assumes nothing about incentive levels and therefore utility costs. Because program delivery costs can vary widely depending on delivery mechanism and incentive level, the following analysis of cost-effectiveness makes assumptions about what those costs will be for the Achievable- Low and Achievable – High potential cases. For planning purposes, utility administrative and marketing costs are commonly expressed as a percentage of incremental measure costs. The assumptions used for this analysis are shown in Table 7-1.

Table 7-1 Utility Program Cost Assumptions as % of Incremental Measure Cost

	Achievable (Low)	Achievable (High)
Incentive	50%	90%
Administration & Marketing	20%	30%
Total Program Cost	**70%**	**120%**

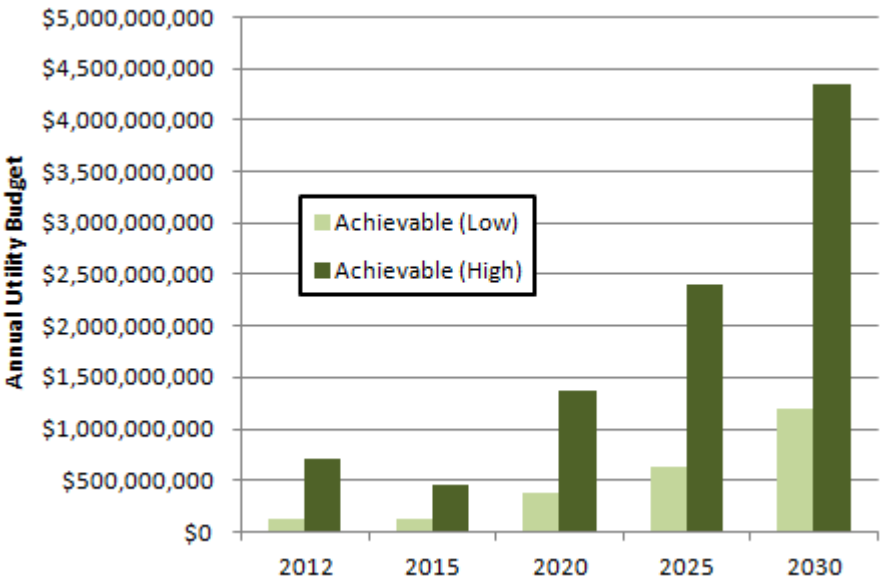
Note: The LoadMAP model currently includes a 10% administrative cost adder when running the economic screen, but higher values are applied for the analysis in this section.

With these assumptions, financial impacts can be developed to estimate the utility budget required to attain the achievable potentials. As shown in Table 7-2 and Figure 7-1, the resulting 2012 utility budgets can range from $129 million for the Achievable – Low portfolio up to $713 million for the Achievable – High portfolio. In 2030, the range of annual budgets is $1.2 and $4.4 billion. This aligns with the fact that some energy efficiency measures are more expensive than others, and lie along a supply curve of ascending cost for each incremental unit of energy saved. Simply put: to save more costs more.

Table 7-2 Financial Impacts of Achievable Potential ($2009)

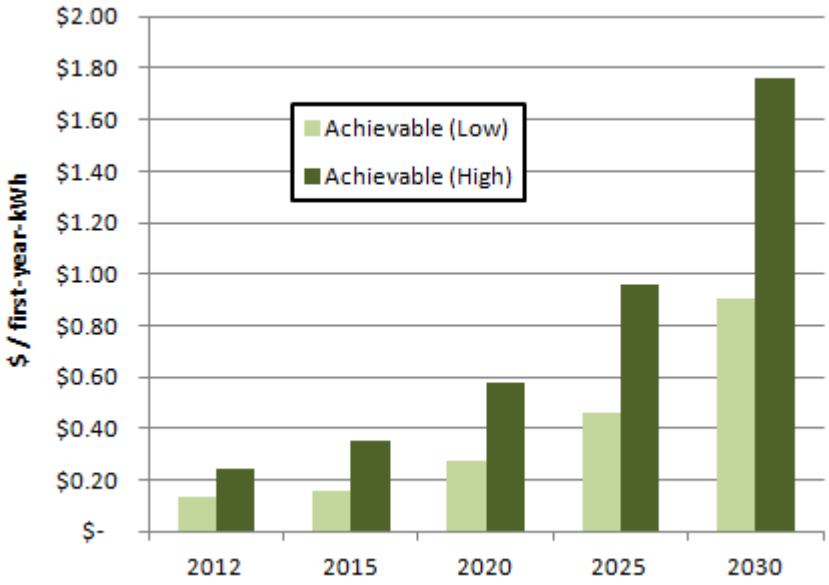
	2012	2015	2020	2025	2030
Achievable (Low)					
TRC Costs	$184,344,852	$189,291,145	$542,927,443	$904,868,221	$1,716,360,937
TRC $/first-year kWh	$0.23	$0.27	$0.47	$0.80	$1.55
Utility Costs	$129,041,397	$132,503,801	$380,049,210	$633,407,755	$1,201,452,656
Utility $/first-year kWh	$0.13	$0.16	$0.28	$0.46	$0.90
Achievable (High)					
TRC Costs	$594,354,770	$376,540,805	$1,139,916,783	$2,006,051,004	$3,629,694,758
TRC $/first-year kWh	$0.25	$0.35	$0.58	$0.96	$1.76
Utility Costs	$713,225,725	$451,848,966	$1,367,900,139	$2,407,261,205	$4,355,633,710
Utility $/first-year kWh	$0.23	$0.33	$0.53	$0.89	$1.63

Figure 7-1 Annual Utility Budget Estimates to Obtain Achievable Potential



A metric commonly used by utilities to track the efficacy of their programming efforts over time is dollars spent per first-year-kWh. The savings attained in that year are associated with a certain budget in that year, and benchmarked across time and against other utility programs. This is a preferred metric for program implementation staff who are interested in an immediate time slice. Table 7-2 and Figure 7-2 include cost per first-year kWh results for the two Achievable potential cases.

Figure 7-2 Utility Cost per First-Year kWh ($2009)



Another benchmark and indicator of program cost-effectiveness is the levelized cost of saved energy over the lifetime of EE measures. This metric is often preferred by long-term resource planners. The levelized cost is calculated as the net present value of the lifetime costs divided by the lifetime energy savings resulting from the program. Another way to look at it is to find the annual payment of amortizing the cost of a measure over its lifetime and dividing it by the annual kWh savings. The levelized costs for the range of achievable potentials are given in Table 7-3.

Table 7-3 Levelized Cost of Lifetime Energy Savings ($2009)

	Utility Cost $/kWh 2012-2032	TRC Cost $/kWh 2012-2032
Achievable (Low)	$0.040	$0.069
Achievable (High)	$0.071	$0.077

Cost-Effectiveness Tests

Obtaining financial impacts allows us to perform industry standard cost-effectiveness tests. Each test compares the benefits of the EE programs, defined as the lifetime avoided costs of saved energy and peak demand in a net present value format, with its own unique definition of costs. The cost definitions for the three tests most commonly used by utilities are described below.

- ***Total Resource Cost test (TRC).*** The total resource costs, as described above, are the incremental measure cost (both utility and customer portions) plus the program delivery costs; all in a net present value format.
- ***Utility Cost Test (UCT).*** The benefits of the UCT test are the same as those in the TRC test. The costs are the net present value of all program delivery costs and utility incentive costs.
- ***Rate Impact Measure test (RIM).*** The RIM costs are the same as the UCT, except for the addition of lost revenue. This 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 results for the three cost-effectiveness tests under the Achievable – Low and Achievable-High scenarios appear in Table 7-4:

Table 7-4 Cost-Effectiveness Results

Overall Cost-Effectiveness (2012–2032)	TRC	UCT	RIM
Achievable - Low			
NPV benefits	$11,420,752,312	$11,420,752,312	$11,420,752,312
NPV costs	$7,638,911,486	$4,456,031,700	$15,103,643,271
Sum	$3,781,840,826	$6,964,720,612	($3,682,890,958)
Ratio	1.50	2.56	0.76
Achievable - High			
NPV benefits	$21,923,758,227	$21,923,758,227	$21,923,758,227
NPV costs	$16,510,810,488	$15,240,748,142	$35,902,790,609
Sum	$5,412,947,739	$6,683,010,085	($13,979,032,382)
Ratio	1.33	1.44	0.61

PROGRAM RECOMMENDATIONS

The results of the EE assessment reveal that TVA has significant potential for energy efficiency resources over the next two decades. Our analysis has shown that TVA can realize an achievable range of reductions between 10.4% and 19.4% of the baseline forecast in 2030 with the measures represented in this report.

TVA's energy-efficiency programs are off to a strong start, with a comprehensive suite of programs currently moving from the planning phase to the implementation phase. Based on this study, Global provides the following recommendations to preserve and augment that momentum.

General Recommendations

- ***Coordinate distributor layer between TVA and end-user:*** As a wholesale provider for 155 power distributors, TVA's business landscape poses unique challenges for the administration of energy efficiency programs. Because of this arm's-length relationship with end users, TVA does not have the same level of information about customers as other utilities. TVA will need to coordinate closely with its power distributors. To facilitate better coordination, TVA should consider the hiring and training of dedicated personnel to serve as liaisons with the distributors.
- ***Maintain transparent stakeholder process:*** To date, TVA has been transparent and aboveboard with internal and external stakeholders. Continuing to involve stakeholders and cultivating a mutual understanding of continuous improvement is of paramount importance to the future success of programs. We recommend an open and transparent stakeholder process with regular touchpoints and workshops. Suggested workshop topics are: technical resource manual with deemed measure databases; evaluation, measurement, and verification protocols; emerging technologies; innovative program strategies; periodic reviews of program results; and sharing success stories from individual power distributors or customers.
- ***Create internal EE targets:*** TVA should continue to evolve and formulate its specific objectives regarding energy efficiency by creating targets and goals. Global recommends targets that fall within the range of achievable potentials identified in this study.
- ***Aggressively pursue lighting savings in the near-term:*** Lighting represents a bulk of the low-hanging fruit in the near term, with significant untapped potential in all sectors. Programs have not yet aggressively targeted lighting, beyond a limited CFL giveaway effort. Working upstream with trade allies and retailers will likely yield significant savings. In particular, as the EISA standards take effect, educational programs and coordination with retailers can help customers move beyond EISA-compliant lamps to more efficient CFL and LED technologies.
- ***Create targeted marketing messages:*** Energy prices in the Valley are cheaper than the national average. Correspondingly, the customer base does not have a long history of exposure to marketing and education regarding energy and sustainability issues like other jurisdictions around the nation. As a result, customers have not been strongly driven to consider energy efficiency measures, and awareness and adoption will be lower than national averages at first. Targeted marketing and education efforts should be developed with messages that speak to the customer base and cultivate shared attitudes.
- ***Expand knowledge of the customer base:*** TVA's pre-existing data regarding the customer base is minimal. Opportunities should be explored to expand this knowledge base. Not only will this information be valuable for program efforts, the results can be shared with distributors, many of whom are too small to conduct surveys on their own. Surveys should

collect data in all sectors on end use equipment saturations, customer attitudes, and measure penetration.

Residential Recommendations

- ***Pursue CFLs:*** Significant, cost-effective potential is available with CFLs, in spite of the forthcoming EISA standards that will reduce their per-unit savings compared to the new baseline. Also, TVA should focus strong attention on specialty CFL programs, as these bulbs are not addressed in the EISA standard.
- ***Focus on all-electric homes:*** The prominence of all-electric homes, roughly 50%, has many implications for program design. Audit programs with direct install measures are one mechanism for reaching these customers. New construction incentives can help to boost the penetration of heat pumps, heat pump water heaters (HPWH), and advanced construction designs.
- ***Pursue heat pump water heaters:*** Heat pump water heaters offer significant potential, but educational efforts, for trade allies as well as homeowners, will be required to achieve this potential. Consider bundling HPWH with the existing and established space conditioning heat pump program to take advantage of the gains the heat pump programs have made in acquainting trade allies and targeted participants with heat pump technology.

Commercial and Industrial Recommendations

- ***Pursue lighting savings:*** 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.
- ***Create customized, multi-year plans for large, complex customers***: For large enough customers, large success can be obtained with strategic energy management (SEM)[11] initiatives over longer time horizons. This means a larger tracking and time commitment, but many jurisdictions are finding this to be a more effective method than a "one and done" installation and rebate approach. These relationships involve personalized plans, identification of metrics, goal-setting, technical assistance, and attention from account executives.
- ***Focus program efforts on motor controls and system optimizations:*** Low-cost retrofits can have significant, low-cost energy impacts with minimal disruption (and often times improvement) of business processes.

[11] Sometimes called Continuous Energy Improvement (CEI).

COMPARISON OF PREVIOUS POTENTIAL STUDIES

Previous studies of energy efficiency potential for the Valley and for the southeast region have produced a range of results. As part of this potential assessment, TVA requested that Global develop a comparison of several key recent studies to better understand how the studies differ in their approaches and thus why their results differ as well. Table 9-1 presents an *at-a-glance* comparison of this study with other relevant studies of the southeast and the nation as a whole.

Table 9-1 Energy Efficiency Studies at a Glance

Source	Area	Year Released	Type of Potential	10-yr Savings[12] Estimate	20-yr Savings Estimate
This Study: Global TVA	**TVA**	**2011**	**Economic**	**13.9%** ***21.7 TWh***	**24.8%** ***44.8 TWh***
			Achievable (High)	**9.8%** ***15.3 TWh***	**19.8%** ***35.8 TWh***
			Achievable (Low)	**5.1%** ***8.0 TWh***	**10.6%** ***19.1 TWh***
EPRI National, South Region	Southern region	2009	Economic	12.2%	13.4%
			MAP	10.0%	11.1%
			RAP	4.4%	8.1%
EPRI-TVA	TVA	2010	Economic	10%	10%
			RAP	4.6%	6.9%
Meta-Review of South EE Studies-Georgia Tech	Southern region	2009	MAP	1.18% per year	
			RAP	0.88% per year	
EE in the South-Georgia Tech	Southern region	2010	Program potential	12%	16%
McKinsey Study	U.S.	2009	NPV-positive	23%	
EE in Appalachia-SEEA	Appalachian region	2009	Program potential	11%	24%
Powering the South-REPP	SERC and FRCC regions	2002	Clean Power Plan potential	13.5%	22.9%
TVA- PA Consulting	TVA	2008	Program potential	*11.7 TWh*	*19.5 TWh*
North Carolina study- ACEEE	North Carolina	2010	Medium program	14.9%	
			High program	20.4%	

[12] 10-year and 20-year savings are approximations. Because several studies start one or two years earlier or later, they do not fit in these categories exactly, but this simplification is made for comparison purposes.

The remainder of this section provides a more in-depth analysis of each of the studies and how they compare with the present study in terms of methodology, assumptions, approaches, estimated baselines, technical performance, adoption, and program/regulatory context.

Tennessee Valley Authority Energy Efficiency and Demand Response Potential Study — Global TVA (This Study)

We begin by briefly summarizing our own study in the same manner as we will summarize the comparison studies. The Global TVA study was conducted in 2011. It estimated EE and DR savings specifically for the TVA service territory. The base year for the study was 2009 and the forecast horizon was 2009 through 2030, with program activity beginning in 2012. The contractors for the study were Global Energy Partners and The Brattle Group.

Analysis approach: The study used a bottom-up analysis approach[13]. Analysis was performed at the sector, segment, end use, technology, and measure levels. TVA survey data, national surveys (RECS, CBECS and MECS), and previous Global studies provided the inputs to the base-year market characterization and end-use market profiles.

Baseline forecast: The study was grounded in the 2011 Annual Energy Outlook, but the forecast was developed independent of it for the TVA region specifically. It includes the effects of building codes and appliance standards in place in 2010, most notably the EISA lighting standard. The baseline does not include naturally occurring efficiency.

Levels of potential: Technical and economic potential were developed, as well as a range of achievable potentials: between Achievable – Low and Achievable High. Economic potential was assessed using the total resource cost (TRC) test. Achievable – High represents a theoretical upper bound of what could be achieved through utility programs. Achievable – Low represents a lower and more moderate estimate of achievable potential.

Study Findings: Table 9-2 and Figure 9-1 summarize the energy-efficiency savings for the different levels of potential relative to the baseline forecast. Table 9-3 summarizes the range of achievable potential by sector. The residential sector accounts for the largest portion of the savings, and the commercial and industrial have slightly lesser savings with similar magnitudes to each other.

[13] Global used its LoadMAP™ 3.0 analysis tool for this project.

Table 9-2 Summary of Energy Efficiency Potential – Global TVA

	2012	2015	2020	2025	2030
Baseline Forecast (GWh)	146,505	148,692	156,243	167,462	180,959
Energy Savings (Cumulative GWh)					
Achievable - Low	811	3,256	7,963	13,420	19,093
Achievable - High	2,417	7,494	15,337	25,215	35,781
Economic	4,481	12,418	21,658	33,091	44,821
Technical	5,349	15,347	27,545	42,822	57,244
Energy Savings (% of Baseline)					
Achievable - Low	0.6%	2.2%	5.1%	8.0%	10.6%
Achievable - High	1.7%	5.0%	9.8%	15.1%	19.8%
Economic	3.1%	8.4%	13.9%	19.8%	24.8%
Technical	3.7%	10.3%	17.6%	25.6%	31.6%

Figure 9-1 Summary of Achievable Potential Energy Savings – Global TVA

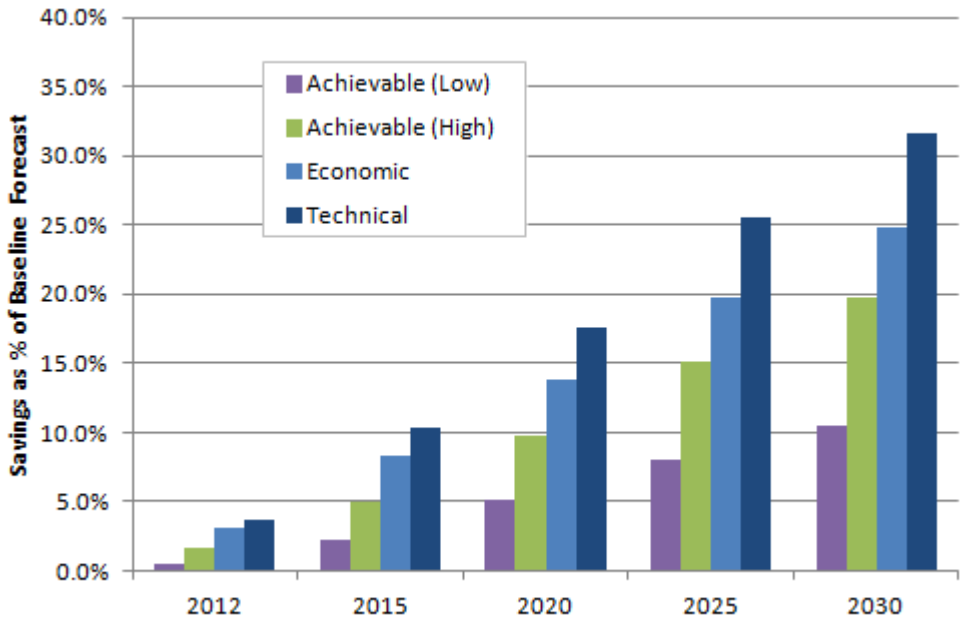


Table 9-3 Achievable Energy-efficiency Potential by Sector – Global TVA

	2012	2015	2020	2025	2030
Achievable - Low Savings (GWh)					
Residential	384	1,444	3,216	5,652	8,307
Commercial	228	985	2,613	4,163	5,557
Industrial	199	826	2,134	3,604	5,229
Total	**811**	**3,256**	**7,963**	**13,420**	**19,093**
Achievable - High Savings (GWh)					
Residential	1,107	3,356	6,445	10,961	15,759
Commercial	660	2,181	4,693	7,419	10,130
Industrial	651	1,957	4,199	6,835	9,892
Total	**2,417**	**7,494**	**15,337**	**25,215**	**35,781**

Assessment of Achievable Potential from Energy Efficiency and Demand Response Programs in the U.S. (2010–2030) — EPRI National, South Region

The EPRI National study was conducted in 2007–2008 and published in January 2009. It estimated EE and DR savings for the U.S. as a whole and for each of the four census regions. The base year for the study was 2008 and the forecast horizon was 2010 through 2030. The contractors for the study were Global Energy Partners, LLC and The Brattle Group.

Analysis approach: The study used a bottom-up analysis approach[14]. Analysis was performed at the sector level for each of the four census regions. The national surveys (RECS, CBECS and MECS) provided inputs to the base-year market characterization and end-use market profiles.

Baseline forecast: The study was grounded in the 2009 Annual Energy Outlook and this forecast was replicated in the modeling tool and was used as the baseline forecast. It included the effects of building codes and appliance standards in place in 2008, the most recent of which was the EISA lighting standard, as well as the effects of naturally occurring conservation.

Levels of potential: Four levels of potential were developed: technical potential, economic potential, maximum achievable potential (MAP), and realistic achievable potential (RAP). Economic potential was assessed using the participant test. MAP represents a theoretical upper bound of what could be achieved through utility programs. RAP represents a more moderate estimate of achievable potential.

Study Findings: The study findings for the South region, which is the region in the report that includes the TVA service territory, are summarized in Table 9-4 and Table 9-5.

Table 9-4 Savings Potential Levels – EPRI National, South Region

Potential Level	10-yr Cumulative Annual Energy Savings (% of baseline forecast)	20-yr Cumulative Annual Energy Savings (% of baseline forecast)
Technical	28.0%	31.2%
Economic	12.2%	13.4%
MAP	10.0%	11.1%
RAP	4.4%	8.1%

Table 9-5 Realistic Achievable Savings Potential by Sector – EPRI National, South Region

Sector	10-yr Cumulative Annual Energy Savings (% of baseline forecast)	20-yr Cumulative Annual Energy Savings (% of baseline forecast)
Residential	3.3%	7.1%
Commercial	5.3%	9.2%
Industrial	3.9%	7.2%
All Sectors RAP	4.4%	8.1%

Comparison to Global TVA Study: This study is reasonably comparable to the Global study, but shows lower potential. It employed a bottom-up modeling with a stock-accounting/turnover algorithm like the Global study. The baseline forecast was based on the AEO 2009 forecast (1.0% national annual growth) and also includes the effects of important codes and standards such as the EISA lighting standard; although it does not include some of the newest ones, such as the appliance standards of 2010. The study has regional specificity for the South, although it

[14] Global used its LoadMAP™ 1.0 analysis tool for this project.

is not singularly focused on the TVA service territory, unlike the Global study. A factor that tends to make potential estimates from the EPRI national study lower than the Global TVA study is the inclusion of naturally occurring efficiency in EPRI's baseline, which was not done in the Global study. Also, EPRI assumes that all the technology used in the study must be commercially available in the base year. This will limit the potential available in many forthcoming, cutting-edge technologies that are included in the Global study, such as advanced incandescent 3.0 in 2020 and SEER 21 air conditioners.

Assessment of Achievable Potential from Energy Efficiency and Demand Response Programs for the Tennessee Valley Authority (2010-2030) — EPRI TVA

For this study, completed in March 2010, EPRI began with the analysis framework used for the EPRI National Study and applied it to TVA by updating market data to the extent possible with TVA data. The base year for the study was 2006 and the forecast horizon was 2010 through 2030. The contractors for the study were EPRI and Energy Resource Economics, LLC.

Analysis approach: The study used a bottom-up analysis approach, much like the National Study. Potential estimates were developed at the TVA system level, by TVA district, by customer sector (residential, commercial and industrial), by end use, and by measure.

Baseline forecast: EPRI developed a baseline forecast using its stock-turnover model. It included the effects the EISA lighting standard.

Levels of potential: Four levels of potential were developed: technical potential, economic potential, maximum achievable potential (MAP) and realistic achievable potential (RAP). Economic potential was assessed using the participant test. MAP represents a theoretical upper bound of what could be achieved through utility programs. RAP represents a more moderate estimate of achievable potential.

Study Findings: The findings from the study are summarized in Table 9-6 and Table 9-7.

Table 9-6 Overall Savings Potential for RAP – EPRI TVA

Potential Level	10-yr Cumulative Annual Energy Savings % of baseline forecast	20-yr Cumulative Annual Energy Savings % of baseline forecast
Economic	10%	10%
RAP	4.6%	6.9%

Table 9-7 Savings Potential by Sector for RAP – EPRI TVA

RAP Estimates	Cumulative Savings in 10 Years		Cumulative Savings in 20 Years	
	GWh	% of baseline forecast	GWh	% of baseline forecast
Residential	2,424	3.7%	4,530	5.9%
Commercial	2,710	6.4%	2,650	6%
Industrial	2,549	4.1%	5,416	6.2%
ODL	214	9%	367	13%
Total	**7,895**	**4.6%**	**12,961**	**6.9%**

Comparison to Global TVA Study: This study is reasonably comparable to the Global study, but shows lower potential. It employed a bottom-up modeling approach with a stock-accounting/turnover algorithm like the Global study. The baseline was developed by EPRI and TVA, and includes the

effects of codes and standards such as the EISA lighting standard, although it does not include some of the newest ones, such as the appliance standards of 2010. The study has geographic specificity for TVA's territory. A factor that will tend to make the potential from the EPRI TVA study lower than the Global TVA study is the inclusion of naturally occurring efficiency in EPRI's baseline, which was not done in the Global study. Also, EPRI assumes that all the technology used in the study must be commercially available in the base year. This will limit the potential available in many forthcoming, cutting-edge technologies that are included in the Global study, such as advanced incandescent 3.0 in 2020 and SEER 21 air conditioners.

Meta-Review of Efficiency Potential Studies and Their Implications for the South — Georgia Tech Meta-Study

This study is a meta-review of 19 other potential studies focused in and around the Southern United States in the years prior to the report. Several of the studies covered in the Georgia Tech Meta-Study are also covered separately in this comparison: namely the EPRI National, SEEA, REPP, McKinsey, and North Carolina ACEEE studies. From these studies, the Georgia Tech Meta-Study collects more than 250 estimates of potential for different fuels, sectors, and potential types. The study was published by the Georgia Institute of Technology's School of Public Policy in August, 2009.

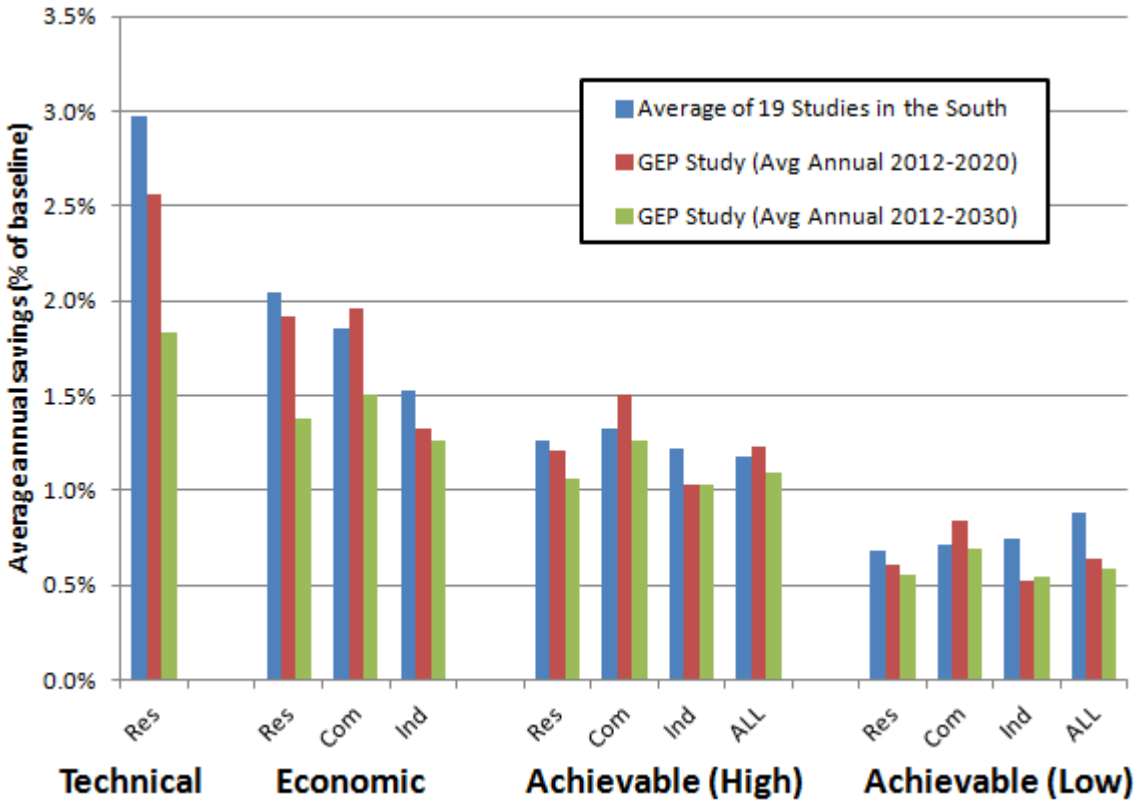
Analysis Approach: The study performs no analysis; rather is simply surveys and groups other studies' analyses. Potential estimates were developed over 2010 to 2030.

Study Findings: The findings for average annual electric savings from the meta-study are summarized in Table 9-8 below and compared with the relevant Global numbers in Figure 9-2. Because no time horizon is given by the meta study, the Global numbers are annualized for both 10 years and 20 years. Potential studies can be highly dependent on the length of years considered, as more low-hanging fruit is typically available in near-term analyses.

Table 9-8 Annual Savings Potential by Sector – Georgia Tech Meta-Study

Potential Type	Sector	Average Annual Savings from 19 Studies
Technical	Residential	2.97%
Economic	Residential	2.04%
Economic	Commercial	1.85%
Economic	Industrial	1.53%
Maximum Achievable	Residential	1.26%
Maximum Achievable	Commercial	1.33%
Maximum Achievable	Industrial	1.22%
Maximum Achievable	ALL	1.18%
Moderate Achievable	Residential	0.68%
Moderate Achievable	Commercial	0.71%
Moderate Achievable	Industrial	0.74%
Moderate Achievable	ALL	0.88%

Figure 9-2 Comparison of Georgia Tech Meta Study with Global Study



Comparison to Global TVA Study: All told, the meta-study aligns favorably with the results of the Global study, especially when considering the average savings in the first 10 years of the Global study. One can note that the MAP or Achievable – High metric is very similar between the studies, but Global shows a lower RAP or Achievable – Low metric; thus indicating that Global defines a wider range of potential than that defined by the average values of the meta-study.

Energy Efficiency in the South — Georgia Tech

This report presents energy efficiency savings potential for the south over the next 20 years for the residential, commercial, and industrial sectors. The study was published by the Southeast Energy Efficiency Alliance (SEEA) in April, 2010. The contractors for the study were Georgia Institute of Technology and Duke University.

Analysis Approach: The study employed a hybrid approach using both "bottom-up" and "top-down" modeling features. For the "bottom-up" approach, the study used a modified version of the National Energy Modeling System (NEMS) for its analysis. For the "top-down" approach, it used Global Insight's macroeconomic model. In addition to potential estimation, the study also estimated macroeconomic impacts and developed supply curves for a set of policy options. Cost-effectiveness assessment was based on the Total Resource Cost test. Potential estimates were developed over 2010 to 2030.

Baseline forecast: The baseline forecast of energy consumption for the South, its three Census Divisions, the 16 individual states, and the District of Columbia were derived from the updated Annual Energy Outlook 2009 reference projections. This Reference Scenario forecast takes into account the Economic Stimulus Package 2009.

Levels of potential: The study reported results for *program achievable potential*. It should be noted that these potential estimates include opportunities that are not typically bundled in energy efficiency studies, such as combined heat and power (CHP) and top-down policy options such as building code expansion. These factors will tend to produce higher potential relative to other studies that do not include them.

Study Findings: The findings from the study are summarized in the table below. Please note that the savings indicated are for total primary energy consumption.

Table 9-9 Savings Potential by Sector – Georgia Tech

Potential Estimates	Cumulative Savings in 10 Years (% of baseline forecast)	Cumulative Savings in 20 Years (% of baseline forecast)
Residential	9%	13%
Commercial	12%	18%
Industrial	11%	16%
Total	**12%**	**16%**

Comparison to Global TVA Study: The study baseline forecast is reasonably based on the AEO 2009 forecast, and the study has overall regional specificity, but comparisons with the Global study should be made mindfully. The first 10 years show higher achievable potential than the Global study, while the second 10 years are at the very upper end of the Global achievable range. The Georgia Tech study employs a hybrid bottom-up/top-down modeling approach that will have higher potential due to the inclusion of policy options like CHP and building codes. These effects are not included in Global's potential.

Unlocking Energy Efficiency in the U.S. Economy — McKinsey

This report was published by McKinsey & Company in July, 2009. It estimates the total energy savings potential for the United States over the 2008–2020 timeframe based on deploying a variety of energy efficiency measures in the residential, commercial, and industrial sectors. The study also identifies the barriers to achieving the potential and outlines strategies for overcoming these barriers.

Analysis approach: The study developed a set of business-as-usual choices for end-use technologies using EIA's modeling system and the Annual Energy Outlook 2008 as a foundation. In order to identify energy-saving opportunities, the study modeled deployment of 675 energy-saving measures and selected those that had a positive Net Present Value (NPV) over the lifetime of the equipment. Costs included equipment capital and installation costs, O&M costs, and direct energy costs.

Baseline forecast: The study was grounded in the 2008 Annual Energy Outlook and this forecast was replicated in the modeling tool and was used as the baseline forecast.

Levels of potential: The analysis developed a "NPV-positive" potential for energy efficiency, which selects end-use technologies with minimum positive NPV values over the equipment lifetime. Unlike traditional potential studies, it does not define technical and achievable levels of potential estimation. However, it estimates potential under alternative scenarios with variations in assumptions related to discount rates, energy retail prices, and carbon prices. As such, these results are most consistent with the economic potential estimated in traditional potential studies. That is, it does not consider customer, market, or regulatory barriers to achieving potential.

Study Findings: Overall, the study estimated 23% energy savings potential by 2020. Out of the total, the residential sector contribution is estimated at 35%, industrial sector contribution at 40%, and commercial sector contribution at 25%. It also presents an energy efficiency supply curve for 2020 using estimates of average cost for end-use energy savings and the potential associated with the various end uses.

Comparison to Global TVA Study: Comparisons between the McKinsey and Global study should be made mindfully. The first caveat is that McKinsey is considering all forms of energy usage, and not just electricity. The second caveat is that McKinsey uses its own version of "NPV-positive" potential

that is unique in the industry. The baseline forecast is based on AEO 2008 (1.1% national average annual growth). The forecast includes the EISA lighting standard, which is consistent with the Global study.

Energy Efficiency in Appalachia "How Much More is Available, at What Cost, and by When?" — SEEA

This report was published by the Southeast Energy Efficiency Alliance in March 2009. The contractors for the study were Georgia Institute of Technology and the American Council for an Energy Efficient Economy (ACEEE). The Appalachian Regional Commission (ARC) commissioned this study to assess long-term energy efficiency potential for the Appalachian region by introducing advanced energy efficiency standards for each energy end-use sector, and also to estimate the economic and environmental impacts of these standards.

Analysis approach: The study assumes a set of "transformative energy policies" in the Appalachian region, beginning in 2010, in order to assess the magnitude of cost-effective and achievable energy efficiency improvements in Appalachia. The policy portfolio modeled in the report includes a combination of Research, Development, and Demonstration (RD&D) and technology-deployment activities developed through a stakeholder approach. It estimates cost-effective energy-efficiency savings for four end-use sectors (residential, commercial, industrial, and transportation) using a set of policy bundles for each sector. It uses participant cost test and total resource cost test to assess cost-effectiveness under different carbon and energy price scenarios. The results of these policy analyses are then input into a dynamic input-output model to evaluate the macro-economic impacts of proposed policies. The study considers a 25-year time horizon from 2005-2030.

Baseline forecast: The study uses EIA's business-as-usual scenario in the 2008 Annual Energy Outlook as the baseline forecast.

Levels of potential: The study estimates program potential associated with cost-effective energy-efficiency improvements that would occur in response to specific policies such as subsidies and information dissemination.

Study Findings: Overall, the study estimated 11% energy savings potential by 2020 and 24% energy savings over baseline forecast in 2030. The commercial sector share at 42% accounts for the largest contribution in overall energy savings potential in 2030. Next, industrial sector share is estimated at 25%, followed by transportation at 18%, and residential at 15%. The study also estimates savings potential by fuel type. The electricity system is estimated to have a 68% share, followed by motor gasoline at 17%, and natural gas savings at 12%. Additionally, the study also estimates economic and job impacts associated with these energy savings.

Comparison to Global TVA Study: Comparisons with the Global study should be made mindfully. The SEEA study employs a high-level, top-down modeling approach, which is fundamentally different from the Global approach. Additionally, the SEEA energy savings include transportation and natural gas, as well as policy options like CHP and building codes. These effects are not included in Global's potential.

Powering the South: A Clean & Affordable Energy Plan for the Southern United States — REPP

This study was published in 2002. The report provides estimates of energy efficiency savings potential for the Southern region (SERC and FRCC) with recommendations on specific policy options to achieve those savings. In addition to energy efficiency, the report also recommends policy options for the region to advance the penetration of renewable energy. The base year for the study was 2000 and the forecast horizon was through 2020.

The contractors for the study were staff from the Renewable Energy Policy Project and Synapse Energy Economics.

Analysis approach: The PROSYM model[15] was used to simulate the power system in the south (including the SERC and FRCC regions) under two scenarios: Business as Usual and Clean Power Plan. The modeling was done at the state level. Analysis results are presented for Alabama, Florida, Georgia, North Carolina, South Carolina, and Tennessee. First the Business as Usual scenario was constructed based on the AEO 2001 forecast. Next, the Clean Power Plan scenario was analyzed. It included a set of energy efficiency measures and renewable resources.

Baseline forecast: The study was grounded in the 2001 Annual Energy Outlook (Business-as-Usual case).

Levels of potential: One level of potential was estimated in the Clean Power Plan, which assumed aggressive implementation of energy efficiency measures.

Study Findings: As part of the Clean Power Plan, the study recommended a set of policies to advance energy efficiency and renewable energy, and to curb pollution. It also provides a few specific recommendations for TVA, outside of these policies. Savings results, indicated in Table 9-10, are presented by sector.

Table 9-10 Savings Potential by State – REPP

Sector	Electricity Savings 2002–2010	Electricity Savings 2002–2020
Residential	13.5%	22.0%
Commercial	13.6%	22.9%
Industrial	14.5%	26.9%
Total	**13.5%**	**22.9%**

Comparison to Global TVA Study – Comparisons with the Global study should be made with a high degree of caution. This is an older study with outdated technology and cost assumptions. The baseline forecast is based on AEO 2001, which does not include the EISA lighting standard, as it was ratified six years after the release of the study. Additionally, the high-level, top-down modeling is very different from that employed by the Global study.

Tennessee Valley Authority: Energy Efficiency and Demand Response Plan 2008 — PA Consulting

This study was published in 2008. It estimated EE and DR program savings for TVA. The base year for the study was 2007 and the forecast horizon was 2009 to 2030.

Analysis approach: The study's goal was to determine the potential for demand response and energy efficiency programs that will reduce summer peak demand by 2012 at a cost equivalent or less than a supply-side option. It estimated monthly electricity use by sector and end use using a set of energy models. The energy usage was normalized using weather data. EE technologies and DR options were applied to the energy use to develop estimates of potential. The study also estimated levelized costs for each of the programs implemented through 2012. It identified the critical success factors and key challenges associated with achieving the savings. Along with potential estimation, the study also presented program designs for both EE and DR.

Baseline forecast: The baseline forecast was developed using TVA-provided data for its service territory. The base year for the study was 2007.

Levels of potential: The study estimated technical, economic, and program potential:

- Technical potential was developed by applying assumptions related to technically feasible energy efficiency improvements to every residential and non-residential building served by

[15] PROSYM is a chronological model that represents the operation of more than 1,200 individual generating units in the South to serve customer electricity demand on an hourly basis.

the TVA distributors. It also considered extensive application of site-based solar technologies. It did not include efficiency improvements for direct-serve customers and fuel-switching applications. Also, the technical potential estimation did not include the effect of any demand response options.

- Economic potential was developed by applying supply curves derived from a meta analysis of other studies. Otherwise, the study did not follow a detailed economic potential development approach.
- In addition to the economic and technical potential, the study estimated program potential in terms of summer and winter peak demand reductions, and annual energy savings. The study also provided total program costs along with per unit levelized program costs over 2009-2012.

Study Findings: The study estimated energy savings of nearly 12 TWh by 2020 and more than 19 TWh by 2030, as shown in Table 9-11.

Table 9-11 Savings Potential Summary – PA Consulting

Program Potential	Cumulative Savings 2009–2020	Cumulative Savings 2009–2030
Energy Savings (GWh)	11,688	19,473
Summer Peak Reduction (GW)	4.3	6.0
Winter Peak Reduction (GW)	4.1	7.9

Comparison to Global TVA Study: The PA Consulting plan specifically targets the TVA territory. The baseline was developed by TVA and PA Consulting. Comparisons with the Global study should be made mindfully, considering that PA Consulting developed potential estimates using a high-level, top-down approach in contrast to Global's bottom-up methodology. That said, the results and potentials are similar. The PA savings are in the middle of Global's achievable range for the first 10 years, and at the lower end for the second ten years.

North Carolina's Energy Future: Electricity, Water, and Transportation Efficiency — ACEEE

This study was published in 2010. It presents a portfolio of energy efficiency, water savings, and transportation efficiency policy options for the state of North Carolina that could potentially reduce the state's electricity needs by nearly a quarter and transportation fuel requirements by more than 10% by 2025. The contractors for this study were ACEEE, Potomac Resources, Navigant Consulting, ICF International, and Synapse Energy Economics.

Analysis approach: The analysis captures existing activities related to energy and water use efficiency improvements, and models a suite of expanded energy, water, and transportation efficiency policy options. The analysis draws on benchmarking experience from other states and stakeholder feedback from within the state. At the core of the policy options is the Energy Efficiency Resource Standard (EERS). Other policy options are built around EERS to help achieve a maximum level of savings. Cost-effectiveness assessment of the policy options is based on TRC and Participant Cost Tests. In addition to potential savings estimation, the study also estimates macroeconomic impacts associated with energy efficiency investments using a macroeconomic model. The timeframe of the study is from 2009 to 2025.

Baseline forecast: The base year for electricity sales in the state is 2008 and is grounded in *EIA's Electric Power Annual- 2007 State Data Tables*. The projections through 2025 are based on electricity-utility filed IRPs in 2009 for the state. The baseline forecast incorporates federal lighting and appliance standards enacted in 2007.

Levels of potential: The study presented results for two levels of potential associated with implementation of the policy packages for various sectors. There is a medium case scenario and high case scenario with the same set of policy options, but different program penetration rates and customer incentive levels.

Study Findings: Table 9-12 summarizes the key findings.

Table 9-12 Savings Potential Summary – ACEEE North Carolina

Scenario	Electricity savings by 2015	Electricity savings by 2020	Electricity savings by 2025
Medium case scenario	7,517 GWh (5.6%)	21,651 GWh (14.9%)	37,830 GWh (23.7%)
High case scenario	10,594 GWh (7.8%)	29,523 GWh (20.4%)	51,748 GWh (32.4%)

Comparison to Global TVA Study: Comparisons with the Global study should be made cautiously, considering that this study developed potential estimates using a high-level, top-down approach in contrast to Global's bottom-up methodology. Additionally, the content is specifically targeted for North Carolina, which has entirely different customer and usage characteristics. The baseline forecast is based on EIA's 2007 State Data Tables and data from North Carolina utility IRPs, and includes the effects of the EISA lighting standard. The ACEEE approach will tend to have considerably higher potential due to the inclusion of high-level policy options such as promotion of CHP, building codes, and electricity savings from water-saving initiatives.

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Global Energy Partners
An EnerNOC Company
500 Ygnacio Valley Road, Suite 450
Walnut Creek, CA 94596

P: 925.482.2000
F: 925.284.3147
E: gephq@gepllc.com

TENNESSEE VALLEY AUTHORITY POTENTIAL STUDY

VOLUME 2: ENERGY EFFICIENCY POTENTIAL STUDY

APPENDICES

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Global Energy Partners™
An EnerNOC Company

Global Energy Partners
An EnerNOC Company
500 Ygnacio Valley Road, Suite 450
Walnut Creek, CA 94596

P: 925.482.2000
F: 925.284.3147
E: gephq@gepllc.com

This report was prepared by

Global Energy Partners
An EnerNOC Company
500 Ygnacio Valley Blvd., Suite 450
Walnut Creek, CA 94596

Project Team:
I. Rohmund, Director
J. Borstein, Project Manager
D. Costenaro
A. Duer
D. Ghosh
K. Kolnowski
K. Marrin
F. Nguyen
A. Sanchez
S. Yoshida

Subcontractor*:*
The Brattle Group
353 Sacramento Street, Suite 1140
San Francisco, CA 94111

Dr. A. Faruqui
Dr. S. Sergici

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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 (2009). 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 electric technologies. (e.g., homes with electric space heating, commercial floor space with space cooling).
- ***UEC (unit energy consumption) or EUI (energy-use index)*** describes the amount of electricity consumed in 2009 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 use for the technology across all homes in 2009. It is computed as the product of the saturation and the UEC and is defined as kWh/household. 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 in 2009.
- ***Usage*** is the annual electricity use by a technology/end use in the segment. It is the product of the market size and intensity and is quantified in GWh.

This appendix presents the following residential market profiles:

- Residential market profiles by segment
- Commercial market profiles by building type
- Industrial market profiles

Table A-1 Single Family Market Profile, 2009

		Average Market Profiles				New Units			
End Use	**Technology**	**Saturation**	**UEC (kWh)**	**Intensity (kWh/HH)**	**Usage (GWh)**	**Saturation**	**UEC (kWh)**	**Intensity (kWh/HH)**	**Compared to Avg, UEC**
Cooling	Central AC	45.6%	4,878	2,223	6,550	51.1%	3,568	1,823	-26.9%
Cooling	Room AC	13.9%	1,778	247	727	2.8%	1,926	53	8.3%
Combined Heating/Cooling	Air-Source Heat Pump	36.1%	7,141	2,578	7,599	41.4%	5,574	2,308	-21.9%
Combined Heating/Cooling	Geothermal Heat Pump	0.8%	6,310	47	140	0.8%	5,037	38	-20.2%
Space Heating	Electric Resistance	1.6%	6,848	106	313	0.0%	5,866	-	-14.3%
Space Heating	Electric Furnace	9.2%	6,163	570	1,679	9.0%	5,280	475	-14.3%
Water Heating	Water Heater	68.6%	4,200	2,882	8,493	70.0%	3,815	2,670	-9.2%
Interior Lighting	Screw-in	100.0%	1,392	1,392	4,102	100.0%	1,366	1,366	-1.9%
Interior Lighting	Linear Fluorescent	100.0%	128	128	377	100.0%	122	122	-4.9%
Exterior Lighting	Screw-in	100.0%	325	325	959	100.0%	318	318	-2.2%
Appliances	Clothes Washer	96.3%	133	128	377	98.2%	56	55	-58.0%
Appliances	Clothes Dryer	92.4%	997	921	2,714	94.2%	685	645	-31.3%
Appliances	Dishwasher	73.1%	505	369	1,088	80.4%	196	158	-61.1%
Appliances	Refrigerator	99.9%	950	949	2,798	99.9%	539	538	-43.3%
Appliances	Freezer	55.3%	744	412	1,213	58.1%	429	249	-42.4%
Appliances	Second Refrigerator	31.2%	1,107	345	1,018	32.8%	605	198	-45.3%
Appliances	Stove	85.3%	570	487	1,434	85.3%	570	486	0.0%
Appliances	Microwave	97.1%	162	158	465	97.1%	162	158	0.0%
Electronics	Personal Computer	134.4%	328	441	1,299	147.9%	344	508	4.9%
Electronics	TV	267.0%	196	523	1,541	293.7%	175	514	-10.6%
Electronics	Printer/Fax/Copier	49.3%	50	25	73	49.3%	50	25	0.0%
Electronics	Set-top Boxes/DVR/Audio	304.0%	134	407	1,199	334.4%	134	447	0.0%
Electronics	Devices and Gadgets	100.0%	50	50	147	125.0%	50	63	0.0%
Miscellaneous	Pool Pump	16.5%	1,650	272	802	16.5%	1,616	266	-2.0%
Miscellaneous	Pool Heater	0.5%	6,281	32	95	0.5%	6,201	32	-1.3%
Miscellaneous	Hot Tub / Spa	8.5%	1,045	88	261	8.5%	1,013	86	-3.1%
Miscellaneous	Well Pump	5.0%	617	31	91	5.0%	576	29	-6.7%
Miscellaneous	Furnace Fan	50.1%	239	120	353	57.8%	236	137	-1.1%
Miscellaneous	Miscellaneous	100.0%	1,109	1,109	3,267	100.0%	1,330	1,330	20.0%
Total				**17,363**	**51,172**			**15,098**	

Table A-2 Multi Family Market Profile, 2009

		Average Market Profiles				New Units			
End Use	**Technology**	**Saturation**	**UEC (kWh)**	**Intensity (kWh/HH)**	**Usage (GWh)**	**Saturation**	**UEC (kWh)**	**Intensity (kWh/HH)**	**Compared to Avg, UEC**
Cooling	Central AC	70.4%	1,729	1,217	657	71.8%	1,249	897	-27.7%
Cooling	Room AC	9.4%	1,442	135	73	6.5%	1,446	95	0.3%
Combined Heating/Cooling	Air-Source Heat Pump	17.0%	2,688	458	247	17.0%	2,503	426	-6.9%
Combined Heating/Cooling	Geothermal Heat Pump	0.0%	2,376	-	-	0.0%	1,897	-	-20.2%
Space Heating	Electric Resistance	2.5%	2,227	56	30	2.0%	1,905	38	-14.5%
Space Heating	Electric Furnace	52.3%	2,264	1,184	639	53.0%	1,937	1,027	-14.5%
Water Heating	Water Heater	72.2%	1,972	1,424	769	72.2%	1,769	1,278	-10.3%
Interior Lighting	Screw-in	100.0%	583	583	315	100.0%	572	572	-1.9%
Interior Lighting	Linear Fluorescent	100.0%	44	44	24	100.0%	42	42	-4.9%
Exterior Lighting	Screw-in	100.0%	119	119	64	100.0%	116	116	-2.2%
Appliances	Clothes Washer	75.3%	107	81	44	79.0%	45	36	-58.0%
Appliances	Clothes Dryer	70.9%	798	565	305	74.4%	546	407	-31.5%
Appliances	Dishwasher	64.8%	404	262	141	71.3%	171	122	-57.8%
Appliances	Refrigerator	100.0%	760	760	410	100.0%	431	431	-43.3%
Appliances	Freezer	20.1%	596	120	65	20.1%	343	69	-42.4%
Appliances	Second Refrigerator	8.3%	885	74	40	8.3%	484	40	-45.3%
Appliances	Stove	91.0%	456	415	224	91.0%	456	415	0.0%
Appliances	Microwave	94.4%	130	123	66	94.4%	130	123	0.0%
Electronics	Personal Computer	93.5%	265	248	134	102.9%	278	286	4.9%
Electronics	TV	205.8%	158	325	176	226.3%	141	320	-10.6%
Electronics	Printer/Fax/Copier	34.3%	41	14	8	34.3%	41	14	0.0%
Electronics	Set-top Boxes/DVR/Audio	211.5%	108	229	124	232.7%	108	252	0.0%
Electronics	Devices and Gadgets	100.0%	51	51	27	120.0%	51	61	0.0%
Miscellaneous	Pool Pump	4.7%	1,515	71	38	4.7%	1,484	70	-2.0%
Miscellaneous	Pool Heater	1.4%	5,767	83	45	1.4%	5,605	81	-2.8%
Miscellaneous	Hot Tub / Spa	3.0%	960	29	16	3.0%	930	28	-3.1%
Miscellaneous	Well Pump	1.0%	562	6	3	1.0%	524	5	-6.7%
Miscellaneous	Furnace Fan	69.7%	65	45	24	81.0%	64	52	-1.1%
Miscellaneous	Miscellaneous	100.0%	870	870	470	100.0%	1,044	1,044	20.0%
Total				**9,588**	**5,178**			**8,344**	

Table A-3 Mobile Homes Market Profile, 2009

		Average Market Profiles				New Units			
End Use	**Technology**	**Saturation**	**UEC (kWh)**	**Intensity (kWh/HH)**	**Usage (GWh)**	**Saturation**	**UEC (kWh)**	**Intensity (kWh/HH)**	**Compared to Avg, UEC**
Cooling	Central AC	45.7%	4,892	2,237	828	56.0%	3,582	2,007	-26.8%
Cooling	Room AC	25.8%	2,840	731	271	5.2%	2,987	154	5.2%
Combined Heating/Cooling	Air-Source Heat Pump	27.3%	5,588	1,523	564	45.0%	4,113	1,851	-26.4%
Combined Heating/Cooling	Geothermal Heat Pump	0.4%	4,942	19	7	0.4%	3,730	14	-24.5%
Space Heating	Electric Resistance	2.8%	4,507	128	47	2.0%	3,847	77	-14.6%
Space Heating	Electric Furnace	41.0%	4,057	1,665	616	23.3%	3,462	806	-14.6%
Water Heating	Water Heater	94.7%	3,354	3,175	1,176	94.7%	3,029	2,867	-9.7%
Interior Lighting	Screw-in	100.0%	601	601	222	100.0%	590	590	-1.9%
Interior Lighting	Linear Fluorescent	100.0%	104	104	39	100.0%	99	99	-4.9%
Exterior Lighting	Screw-in	100.0%	217	217	80	100.0%	212	212	-2.2%
Appliances	Clothes Washer	94.0%	122	115	43	98.7%	51	51	-58.0%
Appliances	Clothes Dryer	93.1%	917	854	316	97.7%	630	616	-31.3%
Appliances	Dishwasher	47.4%	485	230	85	61.6%	205	126	-57.8%
Appliances	Refrigerator	100.0%	912	912	338	100.0%	517	517	-43.3%
Appliances	Freezer	51.0%	715	364	135	51.0%	411	210	-42.4%
Appliances	Second Refrigerator	9.2%	1,062	98	36	9.2%	581	53	-45.3%
Appliances	Stove	85.2%	547	466	173	85.2%	547	466	0.0%
Appliances	Microwave	94.6%	156	147	55	94.6%	156	147	0.0%
Electronics	Personal Computer	85.2%	302	257	95	93.7%	316	296	4.9%
Electronics	TV	216.3%	180	390	144	238.0%	161	383	-10.6%
Electronics	Printer/Fax/Copier	31.2%	46	14	5	31.2%	46	14	0.0%
Electronics	Set-top Boxes/DVR/Audio	192.6%	123	237	88	211.9%	123	261	0.0%
Electronics	Devices and Gadgets	100.0%	58	58	21	120.0%	58	69	0.0%
Miscellaneous	Pool Pump	7.3%	1,725	125	46	7.3%	1,690	123	-2.0%
Miscellaneous	Pool Heater	0.4%	6,567	25	9	0.4%	6,436	24	-2.0%
Miscellaneous	Hot Tub / Spa	1.8%	1,093	20	7	1.8%	1,059	19	-3.1%
Miscellaneous	Well Pump	10.0%	519	52	19	10.0%	484	48	-6.7%
Miscellaneous	Furnace Fan	53.1%	181	96	36	66.2%	179	118	-1.1%
Miscellaneous	Miscellaneous	100.0%	1,060	1,060	392	100.0%	1,272	1,272	20.0%
Total				**15,918**	**5,895**			**13,491**	

Table A-4 Commercial, College Segment Market Profile, 2009

		Average Market Profiles				New Units			
End Use	**Technology**	**Saturation**	**EUI (kWh/ sqft)**	**Intensity (kWh/ sqft)**	**Usage (GWh)**	**Saturation**	**EUI (kWh/ sqft)**	**Intensity (kWh/ sqft)**	**Compared to Avg, UEC**
Cooling	Air-Cooled Chiller	2.9%	10.02	0.29	40.8	3.4%	7.05	0.24	-29.6%
Cooling	Water-Cooled Chiller	13.7%	10.01	1.37	194.4	16.4%	8.37	1.37	-16.4%
Cooling	Roof Top AC	34.0%	6.23	2.12	301.2	40.8%	4.89	2.00	-21.5%
Cooling	Other Cooling	15.9%	5.37	0.85	121.2	19.1%	4.97	0.95	-7.5%
Heating	Electric Heating	32.5%	4.83	1.57	223.1	32.5%	4.61	1.50	-4.5%
Cooling/Heating	Roof Top Heat Pump	10.2%	9.75	0.99	141.2	12.2%	8.46	1.04	-13.2%
Ventilation	Ventilation	100.0%	1.44	1.44	204.9	100.0%	1.39	1.39	-3.5%
Water Heating	Water Heating	38.1%	1.96	0.75	105.9	38.1%	1.92	0.73	-2.0%
Interior Lighting	Screw-in	100.0%	1.61	1.61	228.3	100.0%	1.28	1.28	-20.7%
Interior Lighting	High-Bay Fixtures	100.0%	0.29	0.29	41.8	100.0%	0.12	0.12	-58.1%
Interior Lighting	Linear Fluorescent	100.0%	2.05	2.05	290.7	100.0%	1.86	1.86	-9.0%
Exterior Lighting	Screw-in	100.0%	0.12	0.12	17.1	100.0%	0.12	0.12	-2.7%
Exterior Lighting	HID	100.0%	0.60	0.60	84.7	100.0%	0.50	0.50	-16.7%
Exterior Lighting	Linear Fluorescent	100.0%	0.00	0.00	0.1	100.0%	0.00	0.00	-14.6%
Refrigeration	Walk-in Refrigerator	26.6%	0.17	0.05	6.6	34.6%	0.08	0.03	-56.2%
Refrigeration	Reach-in Refrigerator	26.6%	0.05	0.01	2.0	34.6%	0.03	0.01	-42.8%
Refrigeration	Glass Door Display	26.6%	0.11	0.03	4.2	34.6%	0.11	0.04	-5.8%
Refrigeration	Open Display Case	26.6%	0.05	0.01	1.9	34.6%	0.05	0.02	-5.8%
Refrigeration	Icemaker	26.6%	0.06	0.02	2.3	34.6%	0.06	0.02	-7.4%
Refrigeration	Vending Machine	26.6%	0.06	0.01	2.1	34.6%	0.04	0.01	-35.6%
Food Preparation	Oven	11.8%	0.25	0.03	4.3	17.7%	0.25	0.04	-1.1%
Food Preparation	Fryer	11.8%	0.38	0.04	6.4	17.7%	0.38	0.07	-0.5%
Food Preparation	Dishwasher	11.8%	0.58	0.07	9.8	17.7%	0.44	0.08	-23.8%
Food Preparation	Hot Food Container	11.8%	0.17	0.02	2.8	17.7%	0.10	0.02	-39.1%
Office Equipment	Desktop Computer	100.0%	0.36	0.36	51.0	125.0%	0.37	0.46	3.3%
Office Equipment	Laptop	100.0%	0.06	0.06	7.9	125.0%	0.06	0.07	3.3%
Office Equipment	Server	100.0%	0.17	0.17	24.1	125.0%	0.17	0.21	-0.5%
Office Equipment	Monitor	100.0%	0.07	0.07	9.4	125.0%	0.06	0.08	-2.6%
Office Equipment	Printer/Copier/Fax	100.0%	0.06	0.06	8.1	125.0%	0.07	0.08	18.7%
Office Equipment	POS Terminal	20.8%	0.06	0.01	1.7	22.9%	0.05	0.01	-12.8%
Miscellaneous	Non-HVAC Motors	88.8%	0.02	0.02	2.3	97.7%	0.02	0.02	0.0%
Miscellaneous	Pool Pump	4.9%	0.00	0.00	0.0	5.8%	0.00	0.00	0.0%
Miscellaneous	Pool Heater	1.2%	0.01	0.00	0.0	1.5%	0.01	0.00	0.0%
Miscellaneous	Miscellaneous	100.0%	0.40	0.40	56.8	100.0%	0.52	0.52	30.0%
Total				**15.48**	**2,199.2**			**14.89**	

Table A-5 Commercial, School Segment Market Profile, 2009

		Average Market Profiles				New Units			
End Use	**Technology**	**Saturation**	**EUI (kWh/ sqft)**	**Intensity (kWh/ sqft)**	**Usage (GWh)**	**Saturation**	**EUI (kWh/ sqft)**	**Intensity (kWh/ sqft)**	**Compared to Avg, UEC**
Cooling	Air-Cooled Chiller	6.7%	5.19	0.35	100.5	8.7%	3.65	0.32	-29.6%
Cooling	Water-Cooled Chiller	6.7%	5.18	0.34	100.4	8.7%	4.33	0.37	-16.4%
Cooling	Roof Top AC	27.4%	3.23	0.88	257.2	35.6%	2.53	0.90	-21.5%
Cooling	Other Cooling	12.8%	2.78	0.36	103.5	16.6%	2.57	0.43	-7.5%
Heating	Electric Heating	26.2%	2.70	0.71	206.1	26.2%	2.58	0.68	-4.5%
Cooling/Heating	Roof Top Heat Pump	8.2%	5.19	0.43	124.1	10.7%	4.50	0.48	-13.2%
Ventilation	Ventilation	100.0%	0.74	0.74	214.9	100.0%	0.71	0.71	-3.5%
Water Heating	Water Heating	32.9%	1.02	0.34	98.0	32.9%	1.00	0.33	-2.0%
Interior Lighting	Screw-in	100.0%	0.29	0.29	85.7	100.0%	0.23	0.23	-21.5%
Interior Lighting	High-Bay Fixtures	100.0%	0.45	0.45	129.6	100.0%	0.18	0.18	-58.6%
Interior Lighting	Linear Fluorescent	100.0%	2.71	2.71	789.2	100.0%	2.44	2.44	-9.9%
Exterior Lighting	Screw-in	100.0%	0.07	0.07	19.7	100.0%	0.07	0.07	-2.7%
Exterior Lighting	HID	100.0%	0.44	0.44	127.9	100.0%	0.37	0.37	-16.7%
Exterior Lighting	Linear Fluorescent	100.0%	0.00	0.00	0.2	100.0%	0.00	0.00	-14.6%
Refrigeration	Walk-in Refrigerator	65.7%	0.19	0.12	36.0	78.8%	0.08	0.06	-56.2%
Refrigeration	Reach-in Refrigerator	65.7%	0.06	0.04	11.1	78.8%	0.03	0.03	-42.8%
Refrigeration	Glass Door Display	65.7%	0.12	0.08	23.2	78.8%	0.11	0.09	-5.8%
Refrigeration	Open Display Case	65.7%	0.05	0.04	10.5	78.8%	0.05	0.04	-5.8%
Refrigeration	Icemaker	65.7%	0.07	0.04	12.7	78.8%	0.06	0.05	-7.4%
Refrigeration	Vending Machine	65.7%	0.06	0.04	11.4	78.8%	0.04	0.03	-35.6%
Food Preparation	Oven	29.8%	0.14	0.04	12.0	44.7%	0.14	0.06	-1.1%
Food Preparation	Fryer	29.8%	0.21	0.06	17.9	44.7%	0.20	0.09	-0.5%
Food Preparation	Dishwasher	29.8%	0.32	0.09	27.5	44.7%	0.24	0.11	-23.8%
Food Preparation	Hot Food Container	29.8%	0.09	0.03	7.9	44.7%	0.06	0.02	-39.1%
Office Equipment	Desktop Computer	100.0%	0.18	0.18	52.6	125.0%	0.19	0.23	3.3%
Office Equipment	Laptop	100.0%	0.02	0.02	5.4	125.0%	0.02	0.02	3.3%
Office Equipment	Server	100.0%	0.17	0.17	49.8	125.0%	0.17	0.21	-0.5%
Office Equipment	Monitor	100.0%	0.03	0.03	9.8	125.0%	0.03	0.04	-2.6%
Office Equipment	Printer/Copier/Fax	100.0%	0.06	0.06	16.8	125.0%	0.07	0.09	18.7%
Office Equipment	POS Terminal	4.2%	0.02	0.00	0.3	4.6%	0.02	0.00	-12.8%
Miscellaneous	Non-HVAC Motors	43.7%	0.02	0.01	2.3	45.8%	0.02	0.01	0.0%
Miscellaneous	Pool Pump	1.2%	0.00	0.00	0.0	1.5%	0.00	0.00	0.0%
Miscellaneous	Pool Heater	0.3%	0.00	0.00	0.0	0.4%	0.00	0.00	0.0%
Miscellaneous	Miscellaneous	100.0%	0.23	0.23	66.3	100.0%	0.30	0.30	30.0%
Total				**9.38**	**2,730.6**			**8.99**	

Table A-6 Commercial, Large Grocery Segment Market Profile, 2009

		Average Market Profiles				New Units			
End Use	**Technology**	**Saturation**	**EUI (kWh/ sqft)**	**Intensity (kWh/ sqft)**	**Usage (GWh)**	**Saturation**	**EUI (kWh/ sqft)**	**Intensity (kWh/ sqft)**	**Compared to Avg, UEC**
Cooling	Air-Cooled Chiller	3.2%	12.59	0.41	29.0	3.2%	12.31	0.40	-2.3%
Cooling	Water-Cooled Chiller	3.2%	10.72	0.35	24.7	3.2%	9.94	0.32	-7.2%
Cooling	Roof Top AC	84.5%	10.78	9.11	652.0	84.5%	7.01	5.92	-35.0%
Cooling	Other Cooling	0.0%	9.29	-	-	0.0%	8.57	-	-7.7%
Heating	Electric Heating	54.4%	2.98	1.62	115.9	54.4%	3.16	1.72	6.2%
Cooling/Heating	Roof Top Heat Pump	3.8%	11.89	0.45	32.2	3.8%	11.08	0.42	-6.7%
Ventilation	Ventilation	100.0%	2.13	2.13	152.2	100.0%	2.05	2.05	-3.6%
Water Heating	Water Heating	46.0%	2.21	1.02	72.9	46.0%	2.17	1.00	-2.0%
Interior Lighting	Screw-in	100.0%	1.23	1.23	87.7	100.0%	1.06	1.06	-13.4%
Interior Lighting	High-Bay Fixtures	100.0%	1.84	1.84	131.5	100.0%	0.83	0.83	-55.0%
Interior Lighting	Linear Fluorescent	100.0%	5.57	5.57	399.0	100.0%	5.30	5.30	-5.0%
Exterior Lighting	Screw-in	100.0%	0.26	0.26	18.7	100.0%	0.25	0.25	-3.0%
Exterior Lighting	HID	100.0%	0.90	0.90	64.8	100.0%	0.75	0.75	-16.7%
Exterior Lighting	Linear Fluorescent	100.0%	0.04	0.04	2.6	100.0%	0.03	0.03	-17.9%
Refrigeration	Walk-in Refrigerator	98.9%	6.54	6.46	462.6	100.0%	4.01	4.01	-38.7%
Refrigeration	Reach-in Refrigerator	98.9%	0.29	0.28	20.4	100.0%	0.20	0.20	-30.8%
Refrigeration	Glass Door Display	98.9%	12.05	11.92	853.2	100.0%	14.19	14.19	17.7%
Refrigeration	Open Display Case	98.9%	5.44	5.38	385.2	100.0%	6.41	6.41	17.7%
Refrigeration	Icemaker	98.9%	0.17	0.16	11.7	100.0%	0.15	0.15	-7.4%
Refrigeration	Vending Machine	98.9%	0.30	0.29	20.9	100.0%	0.26	0.26	-12.8%
Food Preparation	Oven	31.4%	0.62	0.19	13.8	47.1%	0.61	0.29	-1.1%
Food Preparation	Fryer	31.4%	0.92	0.29	20.6	47.1%	0.91	0.43	-0.5%
Food Preparation	Dishwasher	31.4%	1.41	0.44	31.7	47.1%	1.08	0.51	-23.8%
Food Preparation	Hot Food Container	31.4%	0.40	0.13	9.1	47.1%	0.25	0.12	-39.1%
Office Equipment	Desktop Computer	100.0%	0.14	0.14	10.3	120.0%	0.15	0.18	3.3%
Office Equipment	Laptop	100.0%	0.02	0.02	1.6	125.0%	0.02	0.03	3.3%
Office Equipment	Server	100.0%	0.10	0.10	7.3	125.0%	0.10	0.13	-0.5%
Office Equipment	Monitor	100.0%	0.03	0.03	1.9	125.0%	0.03	0.03	-2.6%
Office Equipment	Printer/Copier/Fax	100.0%	0.01	0.01	1.0	125.0%	0.02	0.02	18.7%
Office Equipment	POS Terminal	100.0%	0.07	0.07	5.0	120.0%	0.06	0.07	-12.8%
Miscellaneous	Non-HVAC Motors	34.6%	0.12	0.04	2.9	38.1%	0.12	0.04	0.0%
Miscellaneous	Pool Pump	0.0%	-	-	-	0.0%	-	-	0.0%
Miscellaneous	Pool Heater	0.0%	-	-	-	0.0%	-	-	0.0%
Miscellaneous	Miscellaneous	100.0%	0.74	0.74	52.7	100.0%	0.96	0.96	30.0%
Total				**51.63**	**3,695.0**			**48.06**	

Table A-7 Commercial, Small Grocery Segment Market Profile, 2009

		Average Market Profiles				New Units			
End Use	**Technology**	**Saturation**	**EUI (kWh/ sqft)**	**Intensity (kWh/ sqft)**	**Usage (GWh)**	**Saturation**	**EUI (kWh/ sqft)**	**Intensity (kWh/ sqft)**	**Compared to Avg, UEC**
Cooling	Air-Cooled Chiller	0.2%	11.78	0.03	0.3	0.2%	11.51	0.02	-2.3%
Cooling	Water-Cooled Chiller	0.1%	10.02	0.01	0.1	0.1%	9.30	0.01	-7.2%
Cooling	Roof Top AC	61.0%	10.08	6.15	74.2	61.0%	6.55	4.00	-35.0%
Cooling	Other Cooling	20.1%	8.69	1.74	21.0	20.1%	8.02	1.61	-7.7%
Heating	Electric Heating	44.9%	2.93	1.31	15.8	44.9%	3.11	1.40	6.2%
Cooling/Heating	Roof Top Heat Pump	13.4%	11.19	1.49	18.0	13.4%	10.43	1.39	-6.7%
Ventilation	Ventilation	100.0%	1.91	1.91	23.1	100.0%	1.85	1.85	-3.6%
Water Heating	Water Heating	46.0%	1.77	0.81	9.8	46.0%	1.74	0.80	-2.0%
Interior Lighting	Screw-in	100.0%	1.10	1.10	13.3	100.0%	0.99	0.99	-9.8%
Interior Lighting	High-Bay Fixtures	100.0%	1.65	1.65	19.9	100.0%	0.74	0.74	-55.4%
Interior Lighting	Linear Fluorescent	100.0%	5.02	5.02	60.5	100.0%	4.73	4.73	-5.6%
Exterior Lighting	Screw-in	100.0%	0.21	0.21	2.5	100.0%	0.20	0.20	-3.0%
Exterior Lighting	HID	100.0%	0.72	0.72	8.7	100.0%	0.60	0.60	-16.7%
Exterior Lighting	Linear Fluorescent	100.0%	0.03	0.03	0.4	100.0%	0.02	0.02	-17.9%
Refrigeration	Walk-in Refrigerator	98.9%	3.79	3.74	45.1	100.0%	2.32	2.32	-38.7%
Refrigeration	Reach-in Refrigerator	98.9%	0.58	0.58	7.0	100.0%	0.40	0.40	-30.8%
Refrigeration	Glass Door Display	98.9%	9.77	9.67	116.5	100.0%	11.50	11.50	17.7%
Refrigeration	Open Display Case	98.9%	4.41	4.36	52.6	100.0%	5.19	5.19	17.7%
Refrigeration	Icemaker	98.9%	0.67	0.66	8.0	100.0%	0.62	0.62	-7.4%
Refrigeration	Vending Machine	98.9%	0.60	0.59	7.1	100.0%	0.52	0.52	-12.8%
Food Preparation	Oven	31.4%	0.49	0.15	1.9	47.1%	0.49	0.23	-1.1%
Food Preparation	Fryer	31.4%	0.73	0.23	2.8	47.1%	0.73	0.34	-0.5%
Food Preparation	Dishwasher	31.4%	1.13	0.35	4.3	47.1%	0.86	0.41	-23.8%
Food Preparation	Hot Food Container	31.4%	0.32	0.10	1.2	47.1%	0.20	0.09	-39.1%
Office Equipment	Desktop Computer	100.0%	0.10	0.10	1.2	110.0%	0.10	0.11	3.3%
Office Equipment	Laptop	100.0%	0.01	0.01	0.1	110.0%	0.01	0.01	3.3%
Office Equipment	Server	100.0%	0.14	0.14	1.7	110.0%	0.14	0.16	-0.5%
Office Equipment	Monitor	100.0%	0.02	0.02	0.2	110.0%	0.02	0.02	-2.6%
Office Equipment	Printer/Copier/Fax	100.0%	0.01	0.01	0.1	110.0%	0.01	0.01	18.7%
Office Equipment	POS Terminal	100.0%	0.02	0.02	0.2	120.0%	0.02	0.02	-12.8%
Miscellaneous	Non-HVAC Motors	34.6%	0.27	0.09	1.1	36.4%	0.27	0.10	0.0%
Miscellaneous	Pool Pump	0.0%	-	-	-	0.0%	-	-	0.0%
Miscellaneous	Pool Heater	0.0%	-	-	-	0.0%	-	-	0.0%
Miscellaneous	Miscellaneous	100.0%	0.53	0.53	6.4	100.0%	0.63	0.63	20.0%
Total				**43.57**	**525.4**			**41.07**	

Table A-8 Commercial, Health Segment Market Profile, 2009

		Average Market Profiles				New Units			
End Use	**Technology**	**Saturation**	**EUI (kWh/ sqft)**	**Intensity (kWh/ sqft)**	**Usage (GWh)**	**Saturation**	**EUI (kWh/ sqft)**	**Intensity (kWh/ sqft)**	**Compared to Avg, UEC**
Cooling	Air-Cooled Chiller	14.0%	17.95	2.52	342.3	14.0%	14.15	1.98	-21.2%
Cooling	Water-Cooled Chiller	14.0%	17.41	2.44	332.1	14.0%	14.46	2.03	-17.0%
Cooling	Roof Top AC	44.1%	10.37	4.57	622.6	44.1%	9.26	4.08	-10.7%
Cooling	Other Cooling	12.8%	8.94	1.14	155.2	12.8%	8.25	1.05	-7.7%
Heating	Electric Heating	33.1%	5.80	1.92	261.2	33.1%	5.16	1.71	-11.1%
Cooling/Heating	Roof Top Heat Pump	11.5%	14.68	1.69	229.6	11.5%	14.02	1.61	-4.5%
Ventilation	Ventilation	100.0%	4.00	4.00	544.0	100.0%	3.13	3.13	-21.7%
Water Heating	Water Heating	18.7%	3.30	0.62	84.2	18.7%	3.24	0.61	-2.0%
Interior Lighting	Screw-in	100.0%	1.58	1.58	214.4	100.0%	1.21	1.21	-23.1%
Interior Lighting	High-Bay Fixtures	100.0%	0.10	0.10	14.0	100.0%	0.04	0.04	-60.7%
Interior Lighting	Linear Fluorescent	100.0%	4.01	4.01	546.1	100.0%	3.35	3.35	-16.4%
Exterior Lighting	Screw-in	100.0%	0.04	0.04	4.8	100.0%	0.03	0.03	-2.6%
Exterior Lighting	HID	100.0%	0.45	0.45	61.6	100.0%	0.38	0.38	-16.7%
Exterior Lighting	Linear Fluorescent	100.0%	0.00	0.00	0.1	100.0%	0.00	0.00	-14.0%
Refrigeration	Walk-in Refrigerator	86.4%	0.27	0.23	31.3	95.0%	0.12	0.11	-56.2%
Refrigeration	Reach-in Refrigerator	86.4%	0.04	0.04	4.8	95.0%	0.02	0.02	-46.8%
Refrigeration	Glass Door Display	86.4%	0.17	0.15	20.2	95.0%	0.16	0.15	-5.8%
Refrigeration	Open Display Case	86.4%	0.08	0.07	9.1	95.0%	0.07	0.07	-5.8%
Refrigeration	Icemaker	86.4%	0.09	0.08	11.1	95.0%	0.09	0.08	-7.4%
Refrigeration	Vending Machine	86.4%	0.08	0.07	9.9	103.7%	0.05	0.06	-35.6%
Food Preparation	Oven	35.1%	0.63	0.22	30.1	49.1%	0.62	0.31	-1.1%
Food Preparation	Fryer	35.1%	0.94	0.33	44.8	49.1%	0.93	0.46	-0.5%
Food Preparation	Dishwasher	35.1%	1.44	0.51	69.0	49.1%	1.10	0.54	-23.8%
Food Preparation	Hot Food Container	35.1%	0.41	0.14	19.7	49.1%	0.25	0.12	-39.1%
Office Equipment	Desktop Computer	100.0%	0.44	0.44	60.2	125.0%	0.46	0.57	3.3%
Office Equipment	Laptop	100.0%	0.07	0.07	9.3	125.0%	0.07	0.09	3.3%
Office Equipment	Server	100.0%	0.16	0.16	21.3	125.0%	0.16	0.19	-0.5%
Office Equipment	Monitor	100.0%	0.08	0.08	11.1	125.0%	0.08	0.10	-2.6%
Office Equipment	Printer/Copier/Fax	100.0%	0.11	0.11	14.4	125.0%	0.13	0.16	18.7%
Office Equipment	POS Terminal	5.5%	0.11	0.01	0.8	6.9%	0.09	0.01	-12.8%
Miscellaneous	Non-HVAC Motors	74.1%	0.23	0.17	23.3	88.9%	0.23	0.21	0.0%
Miscellaneous	Pool Pump	0.9%	0.01	0.00	0.0	1.2%	0.01	0.00	0.0%
Miscellaneous	Pool Heater	0.2%	0.02	0.00	0.0	0.3%	0.02	0.00	0.0%
Miscellaneous	Miscellaneous	100.0%	3.83	3.83	521.1	100.0%	5.36	5.36	40.0%
Total				**31.77**	**4,323.9**			**29.82**	

Table A-9 Commercial, Lodging Segment Market Profile, 2009

		Average Market Profiles				New Units			
End Use	**Technology**	**Saturation**	**EUI (kWh/ sqft)**	**Intensity (kWh/ sqft)**	**Usage (GWh)**	**Saturation**	**EUI (kWh/ sqft)**	**Intensity (kWh/ sqft)**	**Compared to Avg, UEC**
Cooling	Air-Cooled Chiller	0.9%	5.00	0.05	6.6	0.9%	4.52	0.04	-9.6%
Cooling	Water-Cooled Chiller	16.2%	3.40	0.55	79.3	16.2%	3.08	0.50	-9.5%
Cooling	Roof Top AC	37.8%	7.19	2.72	392.4	37.8%	6.27	2.37	-12.7%
Cooling	Other Cooling	28.1%	6.19	1.74	251.1	28.1%	5.71	1.60	-7.7%
Heating	Electric Heating	59.3%	2.13	1.26	181.9	59.3%	1.89	1.12	-11.1%
Cooling/Heating	Roof Top Heat Pump	14.3%	8.85	1.26	182.4	14.3%	7.41	1.06	-16.3%
Ventilation	Ventilation	100.0%	1.47	1.47	212.7	100.0%	1.19	1.19	-19.2%
Water Heating	Water Heating	24.1%	4.95	1.20	172.6	24.1%	4.85	1.17	-2.0%
Interior Lighting	Screw-in	100.0%	4.03	4.03	581.8	100.0%	3.62	3.62	-10.3%
Interior Lighting	High-Bay Fixtures	100.0%	0.13	0.13	18.5	100.0%	0.07	0.07	-48.3%
Interior Lighting	Linear Fluorescent	100.0%	1.55	1.55	224.3	100.0%	1.56	1.56	0.8%
Exterior Lighting	Screw-in	100.0%	0.26	0.26	37.9	100.0%	0.26	0.26	-2.0%
Exterior Lighting	HID	100.0%	0.51	0.51	73.7	100.0%	0.42	0.42	-16.7%
Exterior Lighting	Linear Fluorescent	100.0%	0.00	0.00	0.2	100.0%	0.00	0.00	-14.0%
Refrigeration	Walk-in Refrigerator	58.9%	0.48	0.28	41.0	70.7%	0.21	0.15	-56.2%
Refrigeration	Reach-in Refrigerator	58.9%	0.07	0.04	6.3	70.7%	0.04	0.03	-46.8%
Refrigeration	Glass Door Display	58.9%	0.31	0.18	26.4	70.7%	0.29	0.21	-5.8%
Refrigeration	Open Display Case	58.9%	0.14	0.08	11.9	70.7%	0.13	0.09	-5.8%
Refrigeration	Icemaker	58.9%	0.09	0.05	7.3	70.7%	0.08	0.06	-7.4%
Refrigeration	Vending Machine	58.9%	0.15	0.09	12.9	70.7%	0.10	0.07	-35.6%
Food Preparation	Oven	18.8%	0.34	0.06	9.4	26.3%	0.34	0.09	-1.1%
Food Preparation	Fryer	18.8%	0.51	0.10	13.9	26.3%	0.51	0.13	-0.5%
Food Preparation	Dishwasher	18.8%	0.79	0.15	21.4	26.3%	0.60	0.16	-23.8%
Food Preparation	Hot Food Container	18.8%	0.23	0.04	6.1	26.3%	0.14	0.04	-39.1%
Office Equipment	Desktop Computer	100.0%	0.08	0.08	11.4	125.0%	0.08	0.10	3.3%
Office Equipment	Laptop	100.0%	0.01	0.01	1.8	125.0%	0.01	0.02	3.3%
Office Equipment	Server	100.0%	0.06	0.06	8.1	125.0%	0.06	0.07	-0.5%
Office Equipment	Monitor	100.0%	0.01	0.01	2.1	125.0%	0.01	0.02	-2.6%
Office Equipment	Printer/Copier/Fax	100.0%	0.01	0.01	1.1	125.0%	0.01	0.01	18.7%
Office Equipment	POS Terminal	100.0%	0.01	0.01	1.1	125.0%	0.01	0.01	-12.8%
Miscellaneous	Non-HVAC Motors	91.3%	0.03	0.02	3.4	100.4%	0.03	0.03	0.0%
Miscellaneous	Pool Pump	39.5%	0.01	0.01	0.7	51.3%	0.01	0.01	0.0%
Miscellaneous	Pool Heater	9.9%	0.03	0.00	0.4	12.8%	0.03	0.00	0.0%
Miscellaneous	Miscellaneous	100.0%	1.08	1.08	156.5	125.0%	1.41	1.76	30.0%
Total				**19.10**	**2,758.5**			**18.02**	

Table A-10 Commercial, Large Miscellaneous Segment Market Profile, 2009

		Average Market Profiles				New Units			
End Use	**Technology**	**Saturation**	**EUI (kWh/ sqft)**	**Intensity (kWh/ sqft)**	**Usage (GWh)**	**Saturation**	**EUI (kWh/ sqft)**	**Intensity (kWh/ sqft)**	**Compared to Avg, UEC**
Cooling	Air-Cooled Chiller	1.1%	6.53	0.07	18.2	1.4%	5.85	0.08	-10.3%
Cooling	Water-Cooled Chiller	19.7%	5.55	1.10	276.1	25.6%	5.09	1.31	-8.3%
Cooling	Roof Top AC	34.6%	5.59	1.93	486.7	44.9%	4.15	1.86	-25.7%
Cooling	Other Cooling	4.9%	4.81	0.24	59.9	6.4%	4.44	0.29	-7.7%
Heating	Electric Heating	19.5%	2.65	0.52	130.1	19.5%	2.34	0.46	-11.4%
Cooling/Heating	Roof Top Heat Pump	7.3%	8.37	0.61	154.1	9.5%	7.30	0.69	-12.8%
Ventilation	Ventilation	100.0%	0.86	0.86	216.1	100.0%	0.59	0.59	-30.9%
Water Heating	Water Heating	40.6%	1.62	0.66	165.7	40.6%	1.59	0.64	-2.0%
Interior Lighting	Screw-in	100.0%	0.81	0.81	205.5	100.0%	0.74	0.74	-9.7%
Interior Lighting	High-Bay Fixtures	100.0%	1.31	1.31	330.9	100.0%	0.59	0.59	-54.8%
Interior Lighting	Linear Fluorescent	100.0%	2.13	2.13	537.5	100.0%	2.01	2.01	-5.9%
Exterior Lighting	Screw-in	100.0%	0.29	0.29	73.2	100.0%	0.29	0.29	-1.5%
Exterior Lighting	HID	100.0%	0.61	0.61	154.2	100.0%	0.51	0.51	-16.7%
Exterior Lighting	Linear Fluorescent	100.0%	0.33	0.33	82.8	100.0%	0.31	0.31	-6.2%
Refrigeration	Walk-in Refrigerator	21.6%	0.38	0.08	20.8	23.8%	0.17	0.04	-56.3%
Refrigeration	Reach-in Refrigerator	21.6%	0.06	0.01	3.2	23.8%	0.03	0.01	-46.8%
Refrigeration	Glass Door Display	21.6%	0.25	0.05	13.4	23.8%	0.23	0.06	-5.8%
Refrigeration	Open Display Case	21.6%	0.11	0.02	6.1	23.8%	0.10	0.02	-5.8%
Refrigeration	Icemaker	21.6%	0.07	0.01	3.7	25.9%	0.06	0.02	-7.4%
Refrigeration	Vending Machine	21.6%	0.12	0.03	6.6	25.9%	0.08	0.02	-35.6%
Food Preparation	Oven	9.1%	0.18	0.02	4.1	10.9%	0.18	0.02	-1.1%
Food Preparation	Fryer	9.1%	0.27	0.02	6.1	10.9%	0.27	0.03	-0.5%
Food Preparation	Dishwasher	9.1%	0.41	0.04	9.5	10.9%	0.31	0.03	-23.8%
Food Preparation	Hot Food Container	9.1%	0.12	0.01	2.7	10.9%	0.07	0.01	-39.1%
Office Equipment	Desktop Computer	100.0%	0.16	0.16	39.5	120.0%	0.16	0.19	3.3%
Office Equipment	Laptop	100.0%	0.02	0.02	6.1	120.0%	0.03	0.03	3.3%
Office Equipment	Server	100.0%	0.11	0.11	28.1	120.0%	0.11	0.13	-0.5%
Office Equipment	Monitor	100.0%	0.03	0.03	7.3	120.0%	0.03	0.03	-2.6%
Office Equipment	Printer/Copier/Fax	100.0%	0.03	0.03	7.6	120.0%	0.04	0.04	18.7%
Office Equipment	POS Terminal	30.5%	0.06	0.02	4.6	36.6%	0.05	0.02	-12.8%
Miscellaneous	Non-HVAC Motors	59.9%	0.06	0.04	9.4	65.9%	0.06	0.04	0.0%
Miscellaneous	Pool Pump	4.3%	0.00	0.00	0.0	4.9%	0.00	0.00	0.0%
Miscellaneous	Pool Heater	1.1%	0.00	0.00	0.0	1.2%	0.00	0.00	0.0%
Miscellaneous	Miscellaneous	100.0%	0.84	0.84	211.5	100.0%	1.09	1.09	30.0%
Total				**13.02**	**3,281.2**			**12.20**	

Table A-11 Commercial, Small Miscellaneous Segment Market Profile, 2009

		Average Market Profiles				New Units			
End Use	**Technology**	**Saturation**	**EUI (kWh/ sqft)**	**Intensity (kWh/ sqft)**	**Usage (GWh)**	**Saturation**	**EUI (kWh/ sqft)**	**Intensity (kWh/ sqft)**	**Compared to Avg, UEC**
Cooling	Air-Cooled Chiller	5.4%	4.12	0.22	10.6	7.0%	3.55	0.25	-13.9%
Cooling	Water-Cooled Chiller	1.7%	3.96	0.07	3.2	2.2%	3.94	0.09	-0.7%
Cooling	Roof Top AC	36.9%	4.38	1.62	77.6	48.0%	3.26	1.56	-25.7%
Cooling	Other Cooling	15.8%	4.06	0.64	30.9	20.6%	3.75	0.77	-7.7%
Heating	Electric Heating	18.9%	1.89	0.36	17.2	18.9%	1.68	0.32	-11.4%
Cooling/Heating	Roof Top Heat Pump	7.9%	6.04	0.48	22.8	10.2%	5.27	0.54	-12.8%
Ventilation	Ventilation	100.0%	0.59	0.59	28.4	100.0%	0.48	0.48	-18.3%
Water Heating	Water Heating	40.6%	1.12	0.45	21.8	40.6%	1.09	0.44	-2.0%
Interior Lighting	Screw-in	100.0%	0.63	0.63	30.3	100.0%	0.61	0.61	-2.6%
Interior Lighting	High-Bay Fixtures	100.0%	1.02	1.02	48.8	100.0%	0.50	0.50	-51.3%
Interior Lighting	Linear Fluorescent	100.0%	1.65	1.65	79.3	100.0%	1.68	1.68	1.5%
Exterior Lighting	Screw-in	100.0%	0.24	0.24	11.8	100.0%	0.24	0.24	-2.4%
Exterior Lighting	HID	100.0%	0.52	0.52	24.8	100.0%	0.43	0.43	-16.7%
Exterior Lighting	Linear Fluorescent	100.0%	0.28	0.28	13.3	100.0%	0.26	0.26	-6.2%
Refrigeration	Walk-in Refrigerator	21.6%	-	-	-	23.8%	-	-	0.0%
Refrigeration	Reach-in Refrigerator	21.6%	0.07	0.02	0.7	23.8%	0.04	0.01	-46.8%
Refrigeration	Glass Door Display	21.6%	0.30	0.06	3.1	23.8%	0.28	0.07	-5.8%
Refrigeration	Open Display Case	21.6%	0.13	0.03	1.4	23.8%	0.13	0.03	-5.8%
Refrigeration	Icemaker	21.6%	0.08	0.02	0.8	25.9%	0.08	0.02	-7.4%
Refrigeration	Vending Machine	21.6%	0.07	0.02	0.7	25.9%	0.05	0.01	-35.6%
Food Preparation	Oven	9.1%	0.22	0.02	1.0	10.9%	0.22	0.02	-1.1%
Food Preparation	Fryer	9.1%	-	-	-	10.9%	-	-	0.0%
Food Preparation	Dishwasher	9.1%	0.50	0.05	2.2	10.9%	0.38	0.04	-23.8%
Food Preparation	Hot Food Container	9.1%	-	-	-	10.9%	-	-	0.0%
Office Equipment	Desktop Computer	100.0%	0.12	0.12	5.8	120.0%	0.13	0.15	3.3%
Office Equipment	Laptop	100.0%	0.02	0.02	0.7	120.0%	0.02	0.02	3.3%
Office Equipment	Server	100.0%	0.17	0.17	8.3	120.0%	0.17	0.21	-0.5%
Office Equipment	Monitor	100.0%	0.02	0.02	1.1	120.0%	0.02	0.03	-2.6%
Office Equipment	Printer/Copier/Fax	100.0%	0.02	0.02	1.1	120.0%	0.03	0.03	18.7%
Office Equipment	POS Terminal	30.5%	0.05	0.01	0.7	36.6%	0.04	0.01	-12.8%
Miscellaneous	Non-HVAC Motors	59.9%	0.09	0.05	2.6	62.9%	0.09	0.06	0.0%
Miscellaneous	Pool Pump	4.3%	0.01	0.00	0.0	4.9%	0.01	0.00	0.0%
Miscellaneous	Pool Heater	1.1%	0.02	0.00	0.0	1.2%	0.02	0.00	0.0%
Miscellaneous	Miscellaneous	100.0%	0.71	0.71	34.0	100.0%	0.92	0.92	30.0%
Total				**10.10**	**484.9**			**9.79**	

Table A-12 Commercial, Large Office Segment Market Profile, 2009

		Average Market Profiles				New Units			
End Use	**Technology**	**Saturation**	**EUI (kWh/ sqft)**	**Intensity (kWh/ sqft)**	**Usage (GWh)**	**Saturation**	**EUI (kWh/ sqft)**	**Intensity (kWh/ sqft)**	**Compared to Avg, UEC**
Cooling	Air-Cooled Chiller	1.4%	7.10	0.10	23.0	1.4%	5.80	0.08	-18.2%
Cooling	Water-Cooled Chiller	24.2%	6.88	1.66	397.0	24.2%	6.01	1.45	-12.6%
Cooling	Roof Top AC	52.1%	7.45	3.88	927.3	52.1%	5.44	2.84	-27.0%
Cooling	Other Cooling	8.0%	6.42	0.51	122.4	8.0%	5.93	0.47	-7.7%
Heating	Electric Heating	57.1%	2.36	1.35	321.7	57.1%	2.13	1.22	-9.7%
Cooling/Heating	Roof Top Heat Pump	12.3%	9.67	1.19	284.5	12.3%	8.36	1.03	-13.5%
Ventilation	Ventilation	100.0%	2.82	2.82	673.9	100.0%	1.87	1.87	-33.7%
Water Heating	Water Heating	68.8%	0.94	0.65	154.0	68.8%	0.92	0.63	-2.0%
Interior Lighting	Screw-in	100.0%	0.78	0.78	185.3	100.0%	0.59	0.59	-23.8%
Interior Lighting	High-Bay Fixtures	100.0%	0.25	0.25	60.7	100.0%	0.11	0.11	-58.5%
Interior Lighting	Linear Fluorescent	100.0%	3.53	3.53	841.9	100.0%	3.09	3.09	-12.5%
Exterior Lighting	Screw-in	100.0%	0.12	0.12	27.7	100.0%	0.11	0.11	-2.7%
Exterior Lighting	HID	100.0%	0.44	0.44	105.8	100.0%	0.37	0.37	-16.7%
Exterior Lighting	Linear Fluorescent	100.0%	0.02	0.02	5.3	100.0%	0.02	0.02	-22.3%
Refrigeration	Walk-in Refrigerator	44.9%	-	-	-	49.4%	-	-	0.0%
Refrigeration	Reach-in Refrigerator	44.9%	0.05	0.02	5.0	49.4%	0.02	0.01	-46.8%
Refrigeration	Glass Door Display	44.9%	0.20	0.09	21.0	49.4%	0.18	0.09	-5.8%
Refrigeration	Open Display Case	44.9%	0.09	0.04	9.5	49.4%	0.08	0.04	-5.8%
Refrigeration	Icemaker	44.9%	0.05	0.02	5.8	49.4%	0.05	0.02	-7.4%
Refrigeration	Vending Machine	44.9%	0.10	0.04	10.3	53.9%	0.06	0.03	-35.6%
Food Preparation	Oven	25.3%	0.12	0.03	7.0	30.3%	0.11	0.03	-1.1%
Food Preparation	Fryer	25.3%	0.17	0.04	10.4	30.3%	0.17	0.05	-0.5%
Food Preparation	Dishwasher	25.3%	0.27	0.07	16.0	30.3%	0.20	0.06	-23.8%
Food Preparation	Hot Food Container	25.3%	0.08	0.02	4.6	30.3%	0.05	0.01	-39.1%
Office Equipment	Desktop Computer	100.0%	2.33	2.33	555.5	125.0%	2.40	3.00	3.3%
Office Equipment	Laptop	100.0%	0.36	0.36	85.8	125.0%	0.37	0.46	3.3%
Office Equipment	Server	100.0%	0.28	0.28	65.7	125.0%	0.27	0.34	-0.5%
Office Equipment	Monitor	100.0%	0.43	0.43	102.9	125.0%	0.42	0.52	-2.6%
Office Equipment	Printer/Copier/Fax	100.0%	0.19	0.19	44.3	125.0%	0.22	0.28	18.7%
Office Equipment	POS Terminal	12.7%	0.01	0.00	0.5	13.9%	0.01	0.00	-12.8%
Miscellaneous	Non-HVAC Motors	89.6%	0.12	0.11	26.2	98.5%	0.12	0.12	0.0%
Miscellaneous	Pool Pump	0.0%	-	-	-	0.0%	-	-	0.0%
Miscellaneous	Pool Heater	0.0%	-	-	-	0.0%	-	-	0.0%
Miscellaneous	Miscellaneous	100.0%	0.94	0.94	223.5	100.0%	1.22	1.22	30.0%
Total				**22.30**	**5,324.4**			**20.19**	

Table A-13 Commercial, Small Office Segment Market Profile, 2009

		Average Market Profiles				New Units			
End Use	**Technology**	**Saturation**	**EUI (kWh/ sqft)**	**Intensity (kWh/ sqft)**	**Usage (GWh)**	**Saturation**	**EUI (kWh/ sqft)**	**Intensity (kWh/ sqft)**	**Compared to Avg, UEC**
Cooling	Air-Cooled Chiller	0.2%	7.36	0.01	1.9	0.2%	7.52	0.01	2.1%
Cooling	Water-Cooled Chiller	0.1%	7.08	0.01	0.9	0.1%	6.33	0.01	-10.7%
Cooling	Roof Top AC	62.8%	7.82	4.91	653.4	62.8%	5.91	3.71	-24.5%
Cooling	Other Cooling	20.7%	7.25	1.50	199.3	20.7%	6.69	1.38	-7.7%
Heating	Electric Heating	48.7%	2.77	1.35	179.7	48.7%	2.46	1.20	-11.4%
Cooling/Heating	Roof Top Heat Pump	13.7%	10.26	1.41	187.7	13.7%	8.21	1.13	-20.0%
Ventilation	Ventilation	100.0%	1.09	1.09	145.3	100.0%	0.89	0.89	-18.3%
Water Heating	Water Heating	68.3%	0.81	0.55	73.5	68.3%	0.79	0.54	-2.0%
Interior Lighting	Screw-in	100.0%	0.72	0.72	95.1	100.0%	0.55	0.55	-23.4%
Interior Lighting	High-Bay Fixtures	100.0%	0.23	0.23	31.1	100.0%	0.10	0.10	-58.2%
Interior Lighting	Linear Fluorescent	100.0%	3.25	3.25	432.0	100.0%	2.86	2.86	-12.1%
Exterior Lighting	Screw-in	100.0%	0.15	0.15	20.0	100.0%	0.15	0.15	-2.7%
Exterior Lighting	HID	100.0%	0.78	0.78	104.0	100.0%	0.65	0.65	-16.7%
Exterior Lighting	Linear Fluorescent	100.0%	0.06	0.06	8.3	100.0%	0.05	0.05	-22.3%
Refrigeration	Walk-in Refrigerator	5.1%	-	-	-	5.6%	-	-	0.0%
Refrigeration	Reach-in Refrigerator	5.1%	0.18	0.01	1.2	6.6%	0.10	0.01	-46.8%
Refrigeration	Glass Door Display	5.1%	-	-	-	6.6%	-	-	0.0%
Refrigeration	Open Display Case	5.1%	-	-	-	6.6%	-	-	0.0%
Refrigeration	Icemaker	5.1%	0.21	0.01	1.4	6.6%	0.19	0.01	-7.4%
Refrigeration	Vending Machine	5.1%	0.19	0.01	1.3	6.6%	0.12	0.01	-35.4%
Food Preparation	Oven	2.1%	0.31	0.01	0.8	3.1%	0.30	0.01	-1.1%
Food Preparation	Fryer	2.1%	-	-	-	2.5%	-	-	0.0%
Food Preparation	Dishwasher	2.1%	0.70	0.01	1.9	3.1%	0.53	0.02	-23.8%
Food Preparation	Hot Food Container	2.1%	-	-	-	2.5%	-	-	0.0%
Office Equipment	Desktop Computer	100.0%	0.96	0.96	127.1	125.0%	0.99	1.23	3.3%
Office Equipment	Laptop	100.0%	0.15	0.15	19.6	125.0%	0.15	0.19	3.3%
Office Equipment	Server	100.0%	0.68	0.68	90.2	125.0%	0.67	0.84	-0.5%
Office Equipment	Monitor	100.0%	0.18	0.18	23.5	125.0%	0.17	0.22	-2.6%
Office Equipment	Printer/Copier/Fax	100.0%	0.23	0.23	30.4	125.0%	0.27	0.34	18.7%
Office Equipment	POS Terminal	20.5%	0.09	0.02	2.5	22.5%	0.08	0.02	-12.8%
Miscellaneous	Non-HVAC Motors	22.0%	0.19	0.04	5.7	23.1%	0.19	0.04	0.0%
Miscellaneous	Pool Pump	0.0%	-	-	-	0.0%	-	-	0.0%
Miscellaneous	Pool Heater	0.0%	-	-	-	0.0%	-	-	0.0%
Miscellaneous	Miscellaneous	100.0%	0.94	0.94	124.9	100.0%	1.22	1.22	30.0%
Total				**19.27**	**2,562.8**			**17.38**	

Table A-14 Commercial, Restaurant Segment Market Profile, 2009

		Average Market Profiles				New Units			
End Use	**Technology**	**Saturation**	**EUI (kWh/ sqft)**	**Intensity (kWh/ sqft)**	**Usage (GWh)**	**Saturation**	**EUI (kWh/ sqft)**	**Intensity (kWh/ sqft)**	**Compared to Avg, UEC**
Cooling	Air-Cooled Chiller	0.2%	18.41	0.03	1.0	0.2%	17.58	0.03	-4.5%
Cooling	Water-Cooled Chiller	0.1%	18.40	0.02	0.9	0.1%	17.64	0.02	-4.2%
Cooling	Roof Top AC	61.2%	14.90	9.12	335.0	61.2%	9.97	6.10	-33.1%
Cooling	Other Cooling	20.2%	13.81	2.78	102.2	20.2%	12.74	2.57	-7.7%
Heating	Electric Heating	30.9%	4.18	1.29	47.5	30.9%	3.41	1.06	-18.3%
Cooling/Heating	Roof Top Heat Pump	13.4%	17.67	2.37	87.0	13.4%	15.67	2.10	-11.3%
Ventilation	Ventilation	100.0%	3.29	3.29	120.8	100.0%	2.51	2.51	-23.7%
Water Heating	Water Heating	33.2%	11.60	3.85	141.6	33.2%	11.36	3.78	-2.1%
Interior Lighting	Screw-in	100.0%	5.17	5.17	189.9	100.0%	4.88	4.88	-5.7%
Interior Lighting	High-Bay Fixtures	100.0%	0.47	0.47	17.2	100.0%	0.24	0.24	-48.6%
Interior Lighting	Linear Fluorescent	100.0%	2.70	2.70	99.0	100.0%	2.62	2.62	-2.9%
Exterior Lighting	Screw-in	100.0%	0.21	0.21	7.7	100.0%	0.20	0.20	-6.3%
Exterior Lighting	HID	100.0%	2.17	2.17	79.6	100.0%	1.80	1.80	-16.7%
Exterior Lighting	Linear Fluorescent	100.0%	0.01	0.01	0.3	100.0%	0.01	0.01	18.1%
Refrigeration	Walk-in Refrigerator	97.3%	4.51	4.39	161.2	100.0%	1.97	1.97	-56.3%
Refrigeration	Reach-in Refrigerator	97.3%	0.69	0.68	24.8	100.0%	0.37	0.37	-46.2%
Refrigeration	Glass Door Display	97.3%	2.91	2.83	104.0	100.0%	2.74	2.74	-5.8%
Refrigeration	Open Display Case	97.3%	1.31	1.28	47.0	100.0%	1.24	1.24	-5.8%
Refrigeration	Icemaker	97.3%	0.80	0.78	28.6	100.0%	0.74	0.74	-7.4%
Refrigeration	Vending Machine	97.3%	0.71	0.69	25.5	100.0%	0.62	0.62	-12.8%
Food Preparation	Oven	36.1%	5.25	1.90	69.6	43.3%	5.20	2.25	-1.1%
Food Preparation	Fryer	36.1%	7.82	2.82	103.6	43.3%	7.78	3.37	-0.5%
Food Preparation	Dishwasher	36.1%	6.02	2.17	79.7	43.3%	4.59	1.98	-23.8%
Food Preparation	Hot Food Container	36.1%	1.72	0.62	22.8	43.3%	1.05	0.45	-39.1%
Office Equipment	Desktop Computer	100.0%	0.19	0.19	7.2	110.0%	0.20	0.22	3.3%
Office Equipment	Laptop	100.0%	0.02	0.02	0.9	110.0%	0.02	0.03	3.3%
Office Equipment	Server	100.0%	0.28	0.28	10.1	110.0%	0.27	0.30	-0.5%
Office Equipment	Monitor	100.0%	0.04	0.04	1.3	110.0%	0.04	0.04	-2.6%
Office Equipment	Printer/Copier/Fax	100.0%	0.04	0.04	1.4	110.0%	0.04	0.05	18.7%
Office Equipment	POS Terminal	100.0%	0.07	0.07	2.7	120.0%	0.07	0.08	-12.8%
Miscellaneous	Non-HVAC Motors	20.0%	0.81	0.16	6.0	21.0%	0.81	0.17	0.0%
Miscellaneous	Pool Pump	0.0%	-	-	-	0.0%	-	-	0.0%
Miscellaneous	Pool Heater	0.0%	-	-	-	0.0%	-	-	0.0%
Miscellaneous	Miscellaneous	100.0%	1.13	1.13	41.4	100.0%	1.47	1.47	30.0%
Total				**53.56**	**1,967.4**			**46.00**	

Table A-15 Commercial, Large Retail Segment Market Profile, 2009

		Average Market Profiles				New Units			
End Use	**Technology**	**Saturation**	**EUI (kWh/ sqft)**	**Intensity (kWh/ sqft)**	**Usage (GWh)**	**Saturation**	**EUI (kWh/ sqft)**	**Intensity (kWh/ sqft)**	**Compared to Avg, UEC**
Cooling	Air-Cooled Chiller	7.9%	6.72	0.53	155.1	8.7%	6.57	0.57	-2.3%
Cooling	Water-Cooled Chiller	2.4%	5.72	0.14	40.8	2.7%	5.31	0.14	-7.2%
Cooling	Roof Top AC	66.7%	5.75	3.84	1,124.2	73.3%	4.33	3.18	-24.7%
Cooling	Other Cooling	5.6%	4.96	0.28	81.6	6.2%	4.57	0.28	-7.7%
Heating	Electric Heating	51.6%	2.33	1.20	352.3	51.6%	2.00	1.03	-14.3%
Cooling/Heating	Roof Top Heat Pump	4.7%	8.21	0.38	112.8	5.2%	6.69	0.35	-18.5%
Ventilation	Ventilation	100.0%	0.97	0.97	285.6	100.0%	0.73	0.73	-25.1%
Water Heating	Water Heating	61.8%	0.78	0.48	141.5	61.8%	0.76	0.47	-2.9%
Interior Lighting	Screw-in	100.0%	1.00	1.00	293.6	100.0%	0.90	0.90	-10.1%
Interior Lighting	High-Bay Fixtures	100.0%	1.29	1.29	378.8	100.0%	0.58	0.58	-55.4%
Interior Lighting	Linear Fluorescent	100.0%	2.98	2.98	872.9	100.0%	2.81	2.81	-5.5%
Exterior Lighting	Screw-in	100.0%	0.55	0.55	160.4	100.0%	0.54	0.54	-0.5%
Exterior Lighting	HID	100.0%	0.31	0.31	89.6	100.0%	0.25	0.25	-16.7%
Exterior Lighting	Linear Fluorescent	100.0%	0.01	0.01	1.7	100.0%	0.00	0.00	-15.1%
Refrigeration	Walk-in Refrigerator	52.4%	0.45	0.24	69.0	68.1%	0.20	0.13	-56.3%
Refrigeration	Reach-in Refrigerator	52.4%	0.07	0.04	10.6	68.1%	0.04	0.03	-46.0%
Refrigeration	Glass Door Display	52.4%	0.29	0.15	44.5	68.1%	0.27	0.19	-5.8%
Refrigeration	Open Display Case	52.4%	0.13	0.07	20.1	68.1%	0.12	0.08	-5.8%
Refrigeration	Icemaker	52.4%	0.16	0.08	24.5	68.1%	0.15	0.10	-7.4%
Refrigeration	Vending Machine	52.4%	0.14	0.07	21.8	68.1%	0.09	0.06	-35.4%
Food Preparation	Oven	22.8%	0.19	0.04	12.6	27.3%	0.19	0.05	-1.1%
Food Preparation	Fryer	22.8%	0.28	0.06	18.8	27.3%	0.28	0.08	-0.5%
Food Preparation	Dishwasher	22.8%	0.43	0.10	28.9	27.3%	0.33	0.09	-23.8%
Food Preparation	Hot Food Container	22.8%	0.12	0.03	8.3	27.3%	0.08	0.02	-39.1%
Office Equipment	Desktop Computer	100.0%	0.15	0.15	44.2	120.0%	0.16	0.19	3.3%
Office Equipment	Laptop	100.0%	0.02	0.02	6.8	120.0%	0.02	0.03	3.3%
Office Equipment	Server	100.0%	0.21	0.21	62.8	120.0%	0.21	0.26	-0.5%
Office Equipment	Monitor	100.0%	0.03	0.03	8.2	120.0%	0.03	0.03	-2.6%
Office Equipment	Printer/Copier/Fax	100.0%	0.01	0.01	4.2	120.0%	0.02	0.02	18.7%
Office Equipment	POS Terminal	100.0%	0.06	0.06	17.0	120.0%	0.05	0.06	-12.8%
Miscellaneous	Non-HVAC Motors	40.2%	0.06	0.03	7.5	42.2%	0.06	0.03	0.0%
Miscellaneous	Pool Pump	0.0%	-	-	-	0.0%	-	-	0.0%
Miscellaneous	Pool Heater	0.0%	-	-	-	0.0%	-	-	0.0%
Miscellaneous	Miscellaneous	100.0%	0.60	0.60	176.7	100.0%	0.78	0.78	30.0%
Total				**15.96**	**4,677.5**			**14.07**	

Table A-16 Commercial, Small Retail Segment Market Profile, 2009

		Average Market Profiles				New Units			
End Use	**Technology**	**Saturation**	**EUI (kWh/ sqft)**	**Intensity (kWh/ sqft)**	**Usage (GWh)**	**Saturation**	**EUI (kWh/ sqft)**	**Intensity (kWh/ sqft)**	**Compared to Avg, UEC**
Cooling	Air-Cooled Chiller	0.2%	5.53	0.01	2.8	0.2%	5.41	0.01	-2.3%
Cooling	Water-Cooled Chiller	0.1%	5.32	0.00	0.8	0.1%	4.94	0.00	-7.2%
Cooling	Roof Top AC	62.8%	5.88	3.69	832.2	62.8%	4.66	2.93	-20.7%
Cooling	Other Cooling	20.7%	5.45	1.13	253.9	20.7%	5.03	1.04	-7.7%
Heating	Electric Heating	48.7%	2.41	1.17	264.4	48.7%	2.14	1.04	-11.0%
Cooling/Heating	Roof Top Heat Pump	13.7%	7.99	1.10	247.5	13.7%	7.62	1.05	-4.6%
Ventilation	Ventilation	100.0%	0.97	0.97	219.5	100.0%	0.72	0.72	-25.7%
Water Heating	Water Heating	68.3%	0.78	0.53	120.2	68.3%	0.76	0.52	-2.9%
Interior Lighting	Screw-in	100.0%	1.00	1.00	225.7	100.0%	0.94	0.94	-6.4%
Interior Lighting	High-Bay Fixtures	100.0%	1.29	1.29	291.2	100.0%	0.60	0.60	-53.6%
Interior Lighting	Linear Fluorescent	100.0%	2.98	2.98	671.1	100.0%	2.93	2.93	-1.5%
Exterior Lighting	Screw-in	100.0%	0.44	0.44	98.7	100.0%	0.44	0.44	-0.5%
Exterior Lighting	HID	100.0%	0.24	0.24	55.1	100.0%	0.20	0.20	-16.7%
Exterior Lighting	Linear Fluorescent	100.0%	0.00	0.00	1.1	100.0%	0.00	0.00	-15.1%
Refrigeration	Walk-in Refrigerator	5.1%	-	-	-	6.6%	-	-	0.0%
Refrigeration	Reach-in Refrigerator	5.1%	0.11	0.01	1.2	6.6%	0.06	0.00	-46.0%
Refrigeration	Glass Door Display	5.1%	0.45	0.02	5.2	6.6%	0.42	0.03	-5.8%
Refrigeration	Open Display Case	5.1%	0.20	0.01	2.3	6.6%	0.19	0.01	-5.8%
Refrigeration	Icemaker	5.1%	0.12	0.01	1.4	6.6%	0.11	0.01	-7.4%
Refrigeration	Vending Machine	5.1%	0.11	0.01	1.3	6.6%	0.07	0.00	-35.4%
Food Preparation	Oven	2.1%	0.21	0.00	1.0	2.5%	0.21	0.01	-1.1%
Food Preparation	Fryer	2.1%	-	-	-	2.5%	-	-	0.0%
Food Preparation	Dishwasher	2.1%	0.48	0.01	2.2	2.5%	0.36	0.01	-23.8%
Food Preparation	Hot Food Container	2.1%	0.14	0.00	0.6	2.5%	0.08	0.00	-39.1%
Office Equipment	Desktop Computer	100.0%	0.12	0.12	27.5	110.0%	0.13	0.14	3.3%
Office Equipment	Laptop	100.0%	0.02	0.02	3.4	110.0%	0.02	0.02	3.3%
Office Equipment	Server	100.0%	0.17	0.17	39.0	110.0%	0.17	0.19	-0.5%
Office Equipment	Monitor	100.0%	0.02	0.02	5.1	110.0%	0.02	0.02	-2.6%
Office Equipment	Printer/Copier/Fax	100.0%	0.01	0.01	2.6	110.0%	0.01	0.02	18.7%
Office Equipment	POS Terminal	100.0%	0.05	0.05	10.6	120.0%	0.04	0.05	-12.8%
Miscellaneous	Non-HVAC Motors	22.0%	0.25	0.05	12.3	23.1%	0.25	0.06	0.0%
Miscellaneous	Pool Pump	0.0%	-	-	-	0.0%	-	-	0.0%
Miscellaneous	Pool Heater	0.0%	-	-	-	0.0%	-	-	0.0%
Miscellaneous	Miscellaneous	100.0%	0.45	0.45	101.0	100.0%	0.58	0.58	30.0%
Total				**15.54**	**3,500.8**			**13.58**	

Table A-17 Commercial, Warehouse Segment Market Profile, 2009

		Average Market Profiles				New Units			
End Use	**Technology**	**Saturation**	**EUI (kWh/ sqft)**	**Intensity (kWh/ sqft)**	**Usage (GWh)**	**Saturation**	**EUI (kWh/ sqft)**	**Intensity (kWh/ sqft)**	**Compared to Avg, UEC**
Cooling	Air-Cooled Chiller	0.0%	4.43	-	-	0.0%	3.89	-	-12.3%
Cooling	Water-Cooled Chiller	0.0%	3.83	-	-	0.0%	3.35	-	-12.4%
Cooling	Roof Top AC	17.6%	3.73	0.65	86.8	17.6%	2.88	0.51	-22.6%
Cooling	Other Cooling	4.0%	3.45	0.14	18.3	4.0%	3.19	0.13	-7.7%
Heating	Electric Heating	9.3%	3.82	0.35	47.0	9.3%	3.39	0.31	-11.1%
Cooling/Heating	Roof Top Heat Pump	2.7%	7.38	0.20	26.7	2.7%	5.97	0.16	-19.0%
Ventilation	Ventilation	100.0%	0.22	0.22	29.6	100.0%	0.17	0.17	-23.1%
Water Heating	Water Heating	52.1%	0.22	0.12	15.5	52.1%	0.22	0.11	-2.0%
Interior Lighting	Screw-in	100.0%	0.12	0.12	16.3	100.0%	0.13	0.13	5.2%
Interior Lighting	High-Bay Fixtures	100.0%	1.41	1.41	186.7	100.0%	0.69	0.69	-51.0%
Interior Lighting	Linear Fluorescent	100.0%	0.93	0.93	123.1	100.0%	1.00	1.00	7.3%
Exterior Lighting	Screw-in	100.0%	0.00	0.00	0.1	100.0%	0.00	0.00	-2.8%
Exterior Lighting	HID	100.0%	0.46	0.46	61.1	100.0%	0.38	0.38	-16.7%
Exterior Lighting	Linear Fluorescent	100.0%	0.00	0.00	0.0	100.0%	0.00	0.00	-15.6%
Refrigeration	Walk-in Refrigerator	10.1%	-	-	-	11.1%	-	-	0.0%
Refrigeration	Reach-in Refrigerator	10.1%	-	-	-	11.1%	-	-	0.0%
Refrigeration	Glass Door Display	10.1%	-	-	-	11.1%	-	-	0.0%
Refrigeration	Open Display Case	10.1%	-	-	-	11.1%	-	-	0.0%
Refrigeration	Icemaker	10.1%	0.53	0.05	7.0	12.1%	0.49	0.06	-7.4%
Refrigeration	Vending Machine	10.1%	0.47	0.05	6.3	12.1%	0.30	0.04	-35.4%
Food Preparation	Oven	0.9%	0.19	0.00	0.2	1.0%	0.18	0.00	-1.1%
Food Preparation	Fryer	0.9%	-	-	-	1.0%	-	-	0.0%
Food Preparation	Dishwasher	0.9%	-	-	-	1.0%	-	-	0.0%
Food Preparation	Hot Food Container	0.9%	-	-	-	1.0%	-	-	0.0%
Office Equipment	Desktop Computer	100.0%	0.08	0.08	11.2	110.0%	0.09	0.10	3.3%
Office Equipment	Laptop	100.0%	0.01	0.01	1.4	110.0%	0.01	0.01	3.3%
Office Equipment	Server	100.0%	0.12	0.12	15.9	110.0%	0.12	0.13	-0.5%
Office Equipment	Monitor	100.0%	0.02	0.02	2.1	110.0%	0.02	0.02	-2.6%
Office Equipment	Printer/Copier/Fax	100.0%	0.01	0.01	1.1	110.0%	0.01	0.01	18.7%
Office Equipment	POS Terminal	1.9%	0.02	0.00	0.0	2.3%	0.01	0.00	-12.8%
Miscellaneous	Non-HVAC Motors	49.9%	0.06	0.03	4.3	59.8%	0.06	0.04	0.0%
Miscellaneous	Pool Pump	0.0%	-	-	-	0.0%	-	-	0.0%
Miscellaneous	Pool Heater	0.0%	-	-	-	0.0%	-	-	0.0%
Miscellaneous	Miscellaneous	100.0%	0.40	0.40	53.4	100.0%	0.48	0.48	20.0%
Total				**5.39**	**714.2**			**4.49**	

Table A-18 Commercial, Refrigerated Warehouse Segment Market Profile, 2009

		Average Market Profiles				New Units			
End Use	**Technology**	**Saturation**	**EUI (kWh/ sqft)**	**Intensity (kWh/ sqft)**	**Usage (GWh)**	**Saturation**	**EUI (kWh/ sqft)**	**Intensity (kWh/ sqft)**	**Compared to Avg, UEC**
Cooling	Air-Cooled Chiller	8.5%	4.33	0.37	12.5	8.5%	3.80	0.32	-12.3%
Cooling	Water-Cooled Chiller	4.6%	3.74	0.17	5.8	4.6%	3.28	0.15	-12.4%
Cooling	Roof Top AC	26.6%	3.64	0.97	33.0	26.6%	2.82	0.75	-22.6%
Cooling	Other Cooling	4.1%	3.37	0.14	4.7	4.1%	3.11	0.13	-7.7%
Heating	Electric Heating	2.9%	3.63	0.11	3.6	2.9%	3.22	0.09	-11.1%
Cooling/Heating	Roof Top Heat Pump	6.3%	7.11	0.45	15.2	6.3%	5.76	0.36	-19.0%
Ventilation	Ventilation	100.0%	0.82	0.82	27.7	100.0%	0.63	0.63	-23.1%
Water Heating	Water Heating	62.5%	0.46	0.29	9.9	62.5%	0.46	0.28	-2.0%
Interior Lighting	Screw-in	100.0%	0.09	0.09	3.2	100.0%	0.10	0.10	5.7%
Interior Lighting	High-Bay Fixtures	100.0%	1.07	1.07	36.4	100.0%	0.53	0.53	-50.8%
Interior Lighting	Linear Fluorescent	100.0%	0.71	0.71	24.0	100.0%	0.76	0.76	7.8%
Exterior Lighting	Screw-in	100.0%	0.00	0.00	0.0	100.0%	0.00	0.00	-2.8%
Exterior Lighting	HID	100.0%	0.51	0.51	17.4	100.0%	0.43	0.43	-16.7%
Exterior Lighting	Linear Fluorescent	100.0%	0.00	0.00	0.0	100.0%	0.00	0.00	-15.6%
Refrigeration	Walk-in Refrigerator	91.7%	18.96	17.38	591.3	100.0%	9.95	9.95	-47.5%
Refrigeration	Reach-in Refrigerator	91.7%	-	-	-	100.0%	-	-	0.0%
Refrigeration	Glass Door Display	91.7%	-	-	-	100.0%	-	-	0.0%
Refrigeration	Open Display Case	91.7%	-	-	-	100.0%	-	-	0.0%
Refrigeration	Icemaker	91.7%	0.06	0.05	1.7	100.0%	0.05	0.05	-7.4%
Refrigeration	Vending Machine	91.7%	0.05	0.05	1.6	100.0%	0.03	0.03	-35.4%
Food Preparation	Oven	25.0%	0.39	0.10	3.3	27.5%	0.38	0.11	-1.1%
Food Preparation	Fryer	25.0%	-	-	-	27.5%	-	-	0.0%
Food Preparation	Dishwasher	25.0%	-	-	-	27.5%	-	-	0.0%
Food Preparation	Hot Food Container	25.0%	-	-	-	27.5%	-	-	0.0%
Office Equipment	Desktop Computer	100.0%	0.06	0.06	2.1	110.0%	0.06	0.07	3.3%
Office Equipment	Laptop	100.0%	0.01	0.01	0.3	110.0%	0.01	0.01	3.3%
Office Equipment	Server	100.0%	0.09	0.09	3.0	110.0%	0.09	0.10	-0.5%
Office Equipment	Monitor	100.0%	0.01	0.01	0.4	110.0%	0.01	0.01	-2.6%
Office Equipment	Printer/Copier/Fax	100.0%	0.01	0.01	0.2	110.0%	0.01	0.01	18.7%
Office Equipment	POS Terminal	1.9%	0.01	0.00	0.0	2.3%	0.01	0.00	-12.8%
Miscellaneous	Non-HVAC Motors	49.9%	0.06	0.03	1.1	59.8%	0.06	0.04	0.0%
Miscellaneous	Pool Pump	0.0%	-	-	-	0.0%	-	-	0.0%
Miscellaneous	Pool Heater	0.0%	-	-	-	0.0%	-	-	0.0%
Miscellaneous	Miscellaneous	100.0%	0.50	0.50	17.0	100.0%	0.60	0.60	20.0%
Total				**23.97**	**815.5**			**15.51**	

Table A-19 Industrial, Food Products Segment Market Profile, 2009

		Average Market Profiles				New Units			
End Use	**Technology**	**Saturation**	**EUI (kWh)**	**Intensity (kWh/ employee)**	**Usage (GWh)**	**Saturation**	**EUI (kWh)**	**Intensity (kWh/ employee)**	**Compared to Avg, UEC**
Cooling	Roof top AC	17.6%	11,610	2,040	132	17.6%	7,967	1,400	-31.4%
Cooling	Other Cooling	4.0%	10,760	431	28	4.0%	13,027	522	21.1%
Heating	Electric Heating	9.3%	11,898	1,104	71	9.3%	9,654	896	-18.9%
Cooling/Heating	Roof top Heat Pump	2.7%	22,986	627	41	2.7%	15,654	427	-31.9%
Ventilation	Ventilation	100.0%	697	697	45	100.0%	338	338	-51.5%
Interior Lighting	Screw-in	100.0%	331	331	21	100.0%	322	322	-2.9%
Interior Lighting	High-Bay Fixtures	100.0%	2,387	2,387	154	100.0%	1,517	1,517	-36.4%
Interior Lighting	Linear Fluorescent	100.0%	544	544	35	100.0%	414	414	-23.8%
Exterior Lighting	Screw-in	100.0%	1	1	0	100.0%	1	1	-2.2%
Exterior Lighting	HID	100.0%	611	611	39	100.0%	509	509	-16.7%
Exterior Lighting	Linear Fluorescent	100.0%	0	0	0	100.0%	0	0	-15.6%
Motors	1-5 HP	50.4%	8,481	4,278	276	50.4%	9,197	4,639	8.4%
Motors	6-20 HP	18.7%	35,058	6,551	423	18.7%	38,580	7,210	10.0%
Motors	21-50 HP	5.5%	126,241	6,952	449	5.5%	136,213	7,502	7.9%
Motors	51-100 HP	2.1%	280,238	5,972	386	2.1%	310,829	6,624	10.9%
Motors	101-200 HP	1.1%	600,938	6,908	446	1.1%	658,180	7,566	9.5%
Motors	201-500 HP	0.7%	892,208	6,061	392	0.7%	973,725	6,615	9.1%
Motors	501-1000 HP	0.2%	2,707,845	6,551	423	0.2%	2,707,845	6,551	0.0%
Motors	1000+ HP	0.0%	5,352,487	1,292	83	0.0%	5,352,487	1,292	0.0%
Process Heating	Process Heating	100.0%	1,927	1,927	124	100.0%	1,927	1,927	0.0%
Miscellaneous	Miscellaneous	100.0%	4,678	4,678	302	100.0%	4,678	4,678	0.0%
Total				**59,945**	**3,873**			**60,950**	

Table A-20 Industrial, Paper Products Segment Market Profile, 2009

		Average Market Profiles				New Units			
End Use	**Technology**	**Saturation**	**EUI (kWh)**	**Intensity (kWh/ employee)**	**Usage (GWh)**	**Saturation**	**EUI (kWh)**	**Intensity (kWh/ employee)**	**Compared to Avg, UEC**
Cooling	Roof top AC	17.6%	30,615	5,379	125	17.6%	21,010	3,691	-31.4%
Cooling	Other Cooling	4.0%	28,373	1,137	26	4.0%	34,350	1,376	21.1%
Heating	Electric Heating	9.3%	31,376	2,911	68	9.3%	25,458	2,362	-18.9%
Cooling/Heating	Roof top Heat Pump	2.7%	60,614	1,655	38	2.7%	41,279	1,127	-31.9%
Ventilation	Ventilation	100.0%	1,837	1,837	43	100.0%	891	891	-51.5%
Interior Lighting	Screw-in	100.0%	626	626	15	100.0%	608	608	-2.9%
Interior Lighting	High-Bay Fixtures	100.0%	4,506	4,506	105	100.0%	2,865	2,865	-36.4%
Interior Lighting	Linear Fluorescent	100.0%	1,026	1,026	24	100.0%	782	782	-23.8%
Exterior Lighting	Screw-in	100.0%	3	3	0	100.0%	3	3	-2.2%
Exterior Lighting	HID	100.0%	1,153	1,153	27	100.0%	961	961	-16.7%
Exterior Lighting	Linear Fluorescent	100.0%	0	0	0	100.0%	0	0	-15.6%
Motors	1-5 HP	39.9%	7,660	3,060	71	39.9%	8,306	3,318	8.4%
Motors	6-20 HP	20.4%	35,593	7,248	168	20.4%	39,169	7,976	10.0%
Motors	21-50 HP	11.7%	121,502	14,173	329	11.7%	131,100	15,293	7.9%
Motors	51-100 HP	7.2%	295,873	21,420	497	7.2%	328,170	23,759	10.9%
Motors	101-200 HP	3.0%	685,925	20,454	475	3.0%	751,262	22,402	9.5%
Motors	201-500 HP	2.2%	1,450,865	31,567	733	2.2%	1,583,424	34,451	9.1%
Motors	501-1000 HP	1.0%	3,231,342	33,178	770	1.0%	3,231,342	33,178	0.0%
Motors	1000+ HP	0.5%	6,155,205	29,795	692	0.5%	6,155,205	29,795	0.0%
Process Heating	Process Heating	100.0%	5,071	5,071	118	100.0%	5,071	5,071	0.0%
Miscellaneous	Miscellaneous	100.0%	6,547	6,547	152	100.0%	6,547	6,547	0.0%
Total				**192,744**	**4,475**			**196,454**	

Table A-21 Industrial, Chemical Products Segment Market Profile, 2009

Average Market Profiles						New Units			
End Use	**Technology**	**Saturation**	**EUI (kWh)**	**Intensity (kWh/ employee)**	**Usage (GWh)**	**Saturation**	**EUI (kWh)**	**Intensity (kWh/ employee)**	**Compared to Avg, UEC**
Cooling	Roof top AC	17.6%	45,983	8,079	283	17.6%	31,556	5,544	-31.4%
Cooling	Other Cooling	4.0%	42,616	1,708	60	4.0%	51,594	2,067	21.1%
Heating	Electric Heating	9.3%	47,126	4,372	153	9.3%	38,237	3,547	-18.9%
Cooling/Heating	Roof top Heat Pump	2.7%	91,041	2,485	87	2.7%	62,001	1,692	-31.9%
Ventilation	Ventilation	100.0%	2,759	2,759	97	100.0%	1,338	1,338	-51.5%
Interior Lighting	Screw-in	100.0%	922	922	32	100.0%	896	896	-2.9%
Interior Lighting	High-Bay Fixtures	100.0%	6,640	6,640	233	100.0%	4,222	4,222	-36.4%
Interior Lighting	Linear Fluorescent	100.0%	1,512	1,512	53	100.0%	1,152	1,152	-23.8%
Exterior Lighting	Screw-in	100.0%	4	4	0	100.0%	4	4	-2.2%
Exterior Lighting	HID	100.0%	1,700	1,700	60	100.0%	1,416	1,416	-16.7%
Exterior Lighting	Linear Fluorescent	100.0%	0	0	0	100.0%	0	0	-15.6%
Motors	1-5 HP	36.0%	7,582	2,732	96	36.0%	8,222	2,962	8.4%
Motors	6-20 HP	29.9%	36,553	10,927	383	29.9%	40,226	12,024	10.0%
Motors	21-50 HP	14.8%	104,702	15,536	544	14.8%	112,973	16,763	7.9%
Motors	51-100 HP	6.4%	248,998	15,878	556	6.4%	276,178	17,611	10.9%
Motors	101-200 HP	4.2%	584,981	24,414	855	4.2%	640,702	26,740	9.5%
Motors	201-500 HP	2.4%	1,305,242	30,902	1,083	2.4%	1,424,496	33,725	9.1%
Motors	501-1000 HP	0.7%	3,235,584	23,390	819	0.7%	3,235,584	23,390	0.0%
Motors	1000+ HP	0.8%	5,533,625	46,950	1,645	0.8%	5,533,625	46,950	0.0%
Process Heating	Process Heating	100.0%	10,336	10,336	362	100.0%	10,336	10,336	0.0%
Miscellaneous	Miscellaneous	100.0%	47,929	47,929	1,679	100.0%	47,929	47,929	0.0%
Total				**259,173**	**9,080**			**260,309**	

Table A-22 Industrial, Primary Metals Segment Market Profile, 2009

		Average Market Profiles				New Units			
End Use	**Technology**	**Saturation**	**EUI (kWh)**	**Intensity (kWh/ employee)**	**Usage (GWh)**	**Saturation**	**EUI (kWh)**	**Intensity (kWh/ employee)**	**Compared to Avg, UEC**
Cooling	Roof top AC	17.6%	54,520	9,579	151	17.6%	37,415	6,574	-31.4%
Cooling	Other Cooling	4.0%	50,528	2,025	32	4.0%	61,174	2,451	21.1%
Heating	Electric Heating	9.3%	55,876	5,184	82	9.3%	45,337	4,206	-18.9%
Cooling/Heating	Roof top Heat Pump	2.7%	107,945	2,947	47	2.7%	73,513	2,007	-31.9%
Ventilation	Ventilation	100.0%	3,271	3,271	52	100.0%	1,587	1,587	-51.5%
Interior Lighting	Screw-in	100.0%	1,062	1,062	17	100.0%	1,032	1,032	-2.9%
Interior Lighting	High-Bay Fixtures	100.0%	7,650	7,650	121	100.0%	4,864	4,864	-36.4%
Interior Lighting	Linear Fluorescent	100.0%	1,742	1,742	28	100.0%	1,327	1,327	-23.8%
Exterior Lighting	Screw-in	100.0%	5	5	0	100.0%	5	5	-2.2%
Exterior Lighting	HID	100.0%	1,958	1,958	31	100.0%	1,631	1,631	-16.7%
Exterior Lighting	Linear Fluorescent	100.0%	1	1	0	100.0%	0	0	-15.6%
Motors	1-5 HP	62.4%	9,080	5,664	90	62.4%	9,846	6,142	8.4%
Motors	6-20 HP	29.0%	34,421	9,986	158	29.0%	37,879	10,989	10.0%
Motors	21-50 HP	12.3%	116,477	14,309	226	12.3%	125,678	15,439	7.9%
Motors	51-100 HP	4.6%	318,230	14,756	233	4.6%	352,967	16,366	10.9%
Motors	101-200 HP	2.3%	819,645	18,482	292	2.3%	897,719	20,242	9.5%
Motors	201-500 HP	1.8%	1,601,809	28,915	457	1.8%	1,748,159	31,557	9.1%
Motors	501-1000 HP	0.8%	3,736,468	29,511	467	0.8%	3,736,468	29,511	0.0%
Motors	1000+ HP	0.5%	5,782,350	27,276	431	0.5%	5,782,350	27,276	0.0%
Process Heating	Process Heating	100.0%	163,171	163,171	2,580	100.0%	163,171	163,171	0.0%
Miscellaneous	Miscellaneous	100.0%	197,223	197,223	3,119	100.0%	197,223	197,223	0.0%
	Total			**544,714**	**8,614**			**543,599**	

Table A-23 Industrial, Other Industrial Segment Market Profile, 2009

		Average Market Profiles				New Units			
End Use	**Technology**	**Saturation**	**EUI (kWh)**	**Intensity (kWh/ employee)**	**Usage (GWh)**	**Saturation**	**EUI (kWh)**	**Intensity (kWh/ employee)**	**Compared to Avg, UEC**
Cooling	Roof top AC	17.6%	27,679	4,863	1,619	17.6%	18,995	3,337	-31.4%
Cooling	Other Cooling	4.0%	25,652	1,028	342	4.0%	31,056	1,244	21.1%
Heating	Electric Heating	9.3%	28,367	2,632	876	9.3%	23,016	2,135	-18.9%
Cooling/Heating	Roof top Heat Pump	2.7%	54,801	1,496	498	2.7%	37,321	1,019	-31.9%
Ventilation	Ventilation	100.0%	1,661	1,661	553	100.0%	805	805	-51.5%
Interior Lighting	Screw-in	100.0%	673	673	224	100.0%	654	654	-2.9%
Interior Lighting	High-Bay Fixtures	100.0%	4,848	4,848	1,614	100.0%	3,083	3,083	-36.4%
Interior Lighting	Linear Fluorescent	100.0%	1,104	1,104	368	100.0%	841	841	-23.8%
Exterior Lighting	Screw-in	100.0%	3	3	1	100.0%	3	3	-2.2%
Exterior Lighting	HID	100.0%	1,241	1,241	413	100.0%	1,034	1,034	-16.7%
Exterior Lighting	Linear Fluorescent	100.0%	0	0	0	100.0%	0	0	-15.6%
Motors	1-5 HP	23.6%	10,660	2,516	838	23.6%	11,559	2,728	8.4%
Motors	6-20 HP	8.8%	56,949	5,008	1,667	8.8%	62,670	5,511	10.0%
Motors	21-50 HP	2.5%	190,665	4,790	1,595	2.5%	205,726	5,169	7.9%
Motors	51-100 HP	0.8%	506,054	4,113	1,369	0.8%	561,294	4,562	10.9%
Motors	101-200 HP	0.4%	1,046,018	4,089	1,361	0.4%	1,145,655	4,478	9.5%
Motors	201-500 HP	0.1%	2,734,799	2,274	757	0.1%	2,984,664	2,482	9.1%
Motors	501-1000 HP	0.0%	8,852,104	1,282	427	0.0%	8,852,104	1,282	0.0%
Motors	1000+ HP	0.0%	4,703,156	121	40	0.0%	4,703,156	121	0.0%
Process Heating	Process Heating	100.0%	5,191	5,191	1,728	100.0%	5,191	5,191	0.0%
Miscellaneous	Miscellaneous	100.0%	5,935	5,935	1,976	100.0%	5,935	5,935	0.0%
Total				**54,869**	**18,268**			**51,616**	

RESIDENTIAL ENERGY-EFFICIENCY EQUIPMENT AND MEASURE DATA

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

Table B-1 provides brief descriptions for all equipment and other measures that were assessed for potential.

Table B-2 through Table B-7 list the detailed unit-level data for the equipment measures for each of the housing type segments — Single Family, Multi Family, and Mobile Homes — and for existing and new construction, respectively. Savings are in kWh/yr/household, and incremental costs are in $/household ($/HH), unless noted otherwise. The BC ratio shown in the tables are for the first year of the forecast (2012), however the B/C ratio is calculated within LoadMAP for each year of the forecast. The B/C ratio in the tables is zero if the measure represents the baseline technology or if the technology is not available in 2012.

End Use	Technology	Efficiency Definition	Savings (kWh/ HH/yr)	Incremental Cost ($/HH)	Lifetime (yrs)	BC Ratio
Cooling	Central AC	SEER 13	-	$0	15	-
Cooling	Central AC	SEER 14 (Energy Star)	309	$337	15	0.51
Cooling	Central AC	SEER 15 (CEE Tier 2)	413	$843	15	0.27
Cooling	Central AC	SEER 16 (CEE Tier 3)	500	$885	15	0.31
Cooling	Central AC	Ductless Minisplit	575	$2,972	15	0.11
Cooling	Central AC	SEER 21	787	$2,867	15	0.15
Cooling	Room AC	EER 9.8	-	$0	10	-
Cooling	Room AC	EER 10.8 (Energy Star)	289	$213	10	0.50
Cooling	Room AC	EER 11.0	340	$272	10	0.46
Cooling	Room AC	EER 12.0	571	$1,396	10	0.15
Combined Heat/Cool	Air-Source Heat Pump	SEER 13	-	$0	15	-
Combined Heat/Cool	Air-Source Heat Pump	SEER 14 (Energy Star)	311	$247	15	1.26
Combined Heat/Cool	Air-Source Heat Pump	SEER 15 (CEE Tier 2)	455	$385	15	1.18
Combined Heat/Cool	Air-Source Heat Pump	SEER 16 (CEE Tier 3)	791	$647	15	1.23
Combined Heat/Cool	Air-Source Heat Pump	Ductless Minisplit	989	$1,942	15	0.51
Combined Heat/Cool	Geothermal Heat Pump	EER 14.1	-	$0	16	-
Combined Heat/Cool	Geothermal Heat Pump	EER 16	352	$245	16	1.52
Combined Heat/Cool	Geothermal Heat Pump	EER 18	576	$654	16	0.93
Combined Heat/Cool	Geothermal Heat Pump	EER 30	1,838	$1,472	16	1.32
Space Heating	Electric Resistance	Standard	-	$0	20	-
Space Heating	Electric Furnace	Standard	-	$0	15	-
Water Heating	Water Heater	EF 0.9	-	$0	15	-
Water Heating	Water Heater	EF 0.95	186	$100	15	1.17
Water Heating	Water Heater	EF 2.3 (HP)	1,882	$1,714	15	0.70
Water Heating	Water Heater	Solar	1,911	$3,600	15	0.33
Interior Lighting	Screw-in	Incandescent	-	$0	3	-
Interior Lighting	Screw-in	Infrared Halogen	120	$91	4	-
Interior Lighting	Screw-in	Infrared Halogen (2020)	438	$91	4	-

End Use	Technology	Efficiency Definition	Savings (kWh/ HH/yr)	Incremental Cost ($/HH)	Lifetime (yrs)	BC Ratio
Interior Lighting	Screw-in	CFL	497	$56	6	2.21
Interior Lighting	Screw-in	LED	546	$1,166	15	0.30
Interior Lighting	Linear Fluorescent	T12	-	$0	10	-
Interior Lighting	Linear Fluorescent	T8	9	-$3	10	1.00
Interior Lighting	Linear Fluorescent	Super T8	27	$26	10	0.43
Interior Lighting	Linear Fluorescent	T5	27	$45	10	0.25
Interior Lighting	Linear Fluorescent	LED	30	$388	20	0.06
Exterior Lighting	Screw-in	Incandescent	-	$0	3	-
Exterior Lighting	Screw-in	Infrared Halogen	24	$23	4	-
Exterior Lighting	Screw-in	Infrared Halogen (2020)	150	$23	4	-
Exterior Lighting	Screw-in	CFL	171	$15	6	2.89
Exterior Lighting	Screw-in	LED	193	$299	15	0.41
Appliances	Clothes Washer	Standard (1.26)	-	$0	10	-
Appliances	Clothes Washer	Energy Star (1.72)	50	$75	10	0.27
Appliances	Clothes Washer	AHAM (MEF 1.72)	50	$75	10	-
Appliances	Clothes Washer	Energy Star (MEF 2.0)	54	$115	10	-
Appliances	Clothes Washer	AHAM (MEF 2.0)	54	$115	10	-
Appliances	Clothes Washer	Compact (MEF 2.79)	60	$225	10	0.11
Appliances	Clothes Dryer	Baseline	-	$0	13	-
Appliances	Clothes Dryer	High Efficiency	42	$100	13	0.22
Appliances	Clothes Dryer	Baseline (2015+)	44	$75	13	-
Appliances	Clothes Dryer	High Efficiency (2015+)	75	$175	13	-
Appliances	Dishwasher	Standard (EF 0.46)	-	$0	9	-
Appliances	Dishwasher	Standard (EF 0.63)	75	$0	9	-
Appliances	Dishwasher	Energy Star (EF 0.69)	116	$5	9	2.93
Appliances	Dishwasher	Energy Star (EF 0.73)	128	$80	9	-
Appliances	Dishwasher	AHAM (EF 0.73)	128	$80	9	-
Appliances	Dishwasher	Ultra Efficient (EF 1.1)	185	$255	9	0.15
Appliances	Refrigerator	Standard	-	$0	13	-
Appliances	Refrigerator	Energy Star	112	$25	13	2.26
Appliances	Refrigerator	High Efficiency	131	$425	13	0.15
Appliances	Refrigerator	AHAM (2014)	139	$218	13	-
Appliances	Refrigerator	High Efficiency (2014)	166	$695	13	-
Appliances	Freezer	Standard	-	$0	11	-
Appliances	Freezer	Energy Star	71	$50	11	0.59
Appliances	Freezer	High Efficiency	103	$198	11	0.22
Appliances	Freezer	AHAM (2014)	104	$198	11	-
Appliances	Freezer	High Efficiency (2014)	130	$352	11	-
Appliances	Second Refrigerator	Standard	-	$0	13	-
Appliances	Second Refrigerator	Energy Star	52	$25	13	1.05
Appliances	Second Refrigerator	High Efficiency	73	$425	13	0.09
Appliances	Second Refrigerator	AHAM (2014)	110	$218	13	-
Appliances	Second Refrigerator	High Efficiency (2014)	142	$695	13	-
Appliances	Stove	Baseline	-	$0	13	-
Appliances	Stove	Convection	2	$121	13	0.01
Appliances	Stove	Halogen Burner	5	$580	13	0.00
Appliances	Stove	Induction	29	$898	13	0.02
Appliances	Microwave	Standard	-	$0	9	-
Electronics	Personal Computer	Standard	-	$0	5	-
Electronics	Personal Computer	Energy Star	124	$0	5	2,235.28
Electronics	TV	Standard	-	$0	11	-
Electronics	TV	Energy Star (3.1)	57	$0	11	-
Electronics	TV	Energy Star (4.1)	92	$0	11	1,988.92
Electronics	TV	Energy Star (5.1)	104	$0	11	-
Electronics	Printer/Fax/Copier	Standard	-	$0	5	-
Electronics	Printer/Fax/Copier	Energy Star	14	$0	5	255.49
Electronics	Set-top Boxes/DVR/Audio	Standard	-	$0	5	-

End Use	Technology	Efficiency Definition	Savings (kWh/ HH/yr)	Incremental Cost ($/HH)	Lifetime (yrs)	BC Ratio
Electronics	Set-top Boxes/DVR/Audio	Energy Star (2009)	45	$0	5	810.25
Electronics	Set-top Boxes/DVR/Audio	Energy Star (2011)	60	$0	5	-
Electronics	Devices and Gadgets	Standard	-	$0	5	-
Miscellaneous	Pool Pump	Standard	-	$0	15	-
Miscellaneous	Pool Pump	High Efficiency	173	-$250	15	1.00
Miscellaneous	Pool Pump	Two-Speed	690	-$1,000	15	1.00
Miscellaneous	Pool Heater	Electric Resistance	-	$0	15	-
Miscellaneous	Pool Heater	Heat Pump (COP = 5.0)	5,253	-$5,025	15	1.00
Miscellaneous	Pool Heater	Solar	6,239	-$5,967	15	1.00
Miscellaneous	Hot Tub / Spa	Standard	-	$0	15	-
Miscellaneous	Hot Tub / Spa	Efficient Pumps	164	-$375	15	1.00
Miscellaneous	Hot Tub / Spa	Improved Controls and Pumps	219	-$500	15	1.00
Miscellaneous	Well Pump	Baseline (40% EF)	-	$0	10	-
Miscellaneous	Well Pump	High Efficiency (60% EF)	173	-$197	10	1.00
Miscellaneous	Furnace Fan	Standard	-	$0	18	-
Miscellaneous	Furnace Fan	ECM	31	-$47	18	1.00
Miscellaneous	Miscellaneous	Miscellaneous	-	$0	5	-

Table B-8 through Table B-13 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 percentage of the end-use loads. Base saturation indicates the percentage of homes in which the measure is already installed. Applicability/Feasibility is the product of two factors 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 forecast although the B/C ratio is calculated within LoadMAP for each year of the forecast. The B/C ratio is zero if the measure represents the baseline technology or if the measure is not available in 2012.

Table B-1 Residential Energy-Efficiency Equipment/Measure Descriptions

End-Use	Equipment/ Measure	Description
Cooling	Central Air Conditioner — (CAC)	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 Air Conditioner – ENERGY STAR or better	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	Central Air Conditioner 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 performance, requiring the AC unit to use more energy for the same cooling load.
Cooling	Attic Fan	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.
Cooling	Ceiling Fan	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.
Cooling	Whole-House Fan	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.
Cooling	Dehumidifier	By reducing humidity within the home, dehumidifiers improve comfort and allow raising the air conditioning set point. ENERGY STAR rated units are available.

End-Use	Equipment/ Measure	Description
Combined Heating / Cooling	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.
Combined Heating / Cooling	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.
Combined Heating / Cooling	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.
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. 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)	Ducting, Repair and Sealing	An ideal duct system would be free of leaks. Leakage in unsealed ducts varies considerably because of differences in fabricating machinery used, 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. This analysis assumes that over time air loss from ducts has doubled, and conducting repair and sealing of the ducts will restore leakage from ducts to the original baseline level.

End-Use	Equipment/ Measure	Description
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 — 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.
HVAC (all)	Insulation — Foundation Insulation — Wall Cavity 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. Foundation, insulation, wall cavity insulation, and wall sheathing are modeled for new construction / major retrofits only.
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)	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 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.
Cooling	Windows — Reflective Film	Reflective films applied to the window interior help reduce solar gain into the space and thus lower cooling energy use.

End-Use	Equipment/ Measure	Description
Cooling	Roof — High Reflectivity	The color and material of a building structure surface determine the amount of solar radiation absorbed by that surface and subsequently transferred into a building. This is called solar absorptance. Using a roofing material with low solar absorptance or painting the roof a light color reduces the cooling load. This analysis assumes that implementing high reflectivity roofs will decrease the roof's absorptance of solar radiation by 45%.
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.
Water Heating	Water Heater - Electric, High Efficiency (includes Heat Pump 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. Solar thermal water heating systems are also modeled. Electric instantaneous water heaters are available, but are excluded from this study due to potentially high instantaneous demand concerns.
Water Heating	Water Heating, Solar	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	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.

End-Use	Equipment/ Measure	Description
Water Heating	Pipe Insulation	Insulating hot water pipes decreases energy losses from piping that distributes hot water throughout the building. I also results in quicker delivery of hot water and may allow lower the hot water set point, which saves energy. The most common insulation materials for this purpose are polyethylene and neoprene.
Water Heating	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	Tank Blanket	Insulating hot water tanks decreases standby energy losses from the tank. Pre-fitted insulating blankets are readily available.
Water Heating	Thermostat Setback / 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	Hot Water Saver	A hot water saver is a plumbing device that attaches to the showerhead and that pauses the flow of water until the water is hot enough for use. The water is re-started by the flip of a switch.
Water Heating	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.
Interior Lighting / Exterior Lighting	Infrared Halogen Lamps	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.
Interior Lighting / Exterior Lighting	Compact Fluorescent Lamps	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. The 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.
Interior Lighting / Exterior Lighting	LED Lighting (Screw-in and linear)	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.

End-Use	Equipment/ Measure	Description
Interior Lighting	Fluorescent, T8, Super T8, and T5 Lamps and Electronic Ballasts	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”.
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	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	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	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	Clothes Washer, ENERGY STAR or better	ENERGY STAR labeled 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.
Appliances	Clothes Dryer – Electric, High Efficiency	An energy-efficient clothes dryer has a moisture-sensing device to 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, ENERGY STAR or better	ENERGY STAR labeled 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	Refrigerator/Freezer, ENERGY STAR or better	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.

End-Use	Equipment/ Measure	Description
Appliances	Refrigerator/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	Refrigerator/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.
Appliances	Range and Oven – Electric, High Efficiency	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.
Electronics	Personal Computers, ENERGY STAR or better	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	Printers/Faxes/Copiers, ENERGY STAR or better	Improved power management can significantly reduce the annual energy consumption of printers and peripherals in both standby and normal operation. ENERGY STAR and Climate Savers labeled products provide increasing level of energy efficiency.
Electronics	Color TVs and Home Electronics (including set-top boxes and DVRs), ENERGY STAR or better	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	Reduce Standby Wattage	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	Furnace Fans, Electronically Commutating Motor	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.

End-Use	Equipment/ Measure	Description
Miscellaneous	Pool/Hot Tub/Spa Pump	High-efficiency motors and two-speed pumps provide improved energy efficiency for this load.
Miscellaneous	Pool/Spa Pump Timer	A pool/spa pump timer allows the pump to turn off automatically, eliminating the wasted energy associated with unnecessary pumping.
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.
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
Cooling / Space Heating / Interior Lighting	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 / Space Heating / Interior Lighting	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. Typically, designs specify the building orientation, building shell, building mechanical 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, daylighting strategies, and shading strategies, This measure is modeled for new vintage only.
Cooling / Space Heating / Interior Lighting	ENERGY STAR Homes	This measure entails the use of the efficient measures outlined above as well as the design approaches described in advanced construction designs, but with specific requirements that adhere to the ENERGY STAR standard and measurement system. This measure is modeled for new vintage only.
Cooling / Space Heating / Interior Lighting	Energy-Efficient Manufactured Homes	This measure entails the use of the efficient measures outlined above as well as the design approaches described in advanced construction designs, but with specific application toward manufactured homes. This measure is modeled for new vintage only.

Table B-2 Energy-Efficiency Equipment Data—Single Family, Existing Vintage

End Use	Technology	Efficiency Definition	Savings (kWh/ HH/yr)	Incremental Cost ($/HH)	Lifetime (yrs)	BC Ratio
Cooling	Central AC	SEER 13	-	$0	15	-
Cooling	Central AC	SEER 14 (Energy Star)	315	$414	15	0.42
Cooling	Central AC	SEER 15 (CEE Tier 2)	436	$1,035	15	0.23
Cooling	Central AC	SEER 16 (CEE Tier 3)	537	$1,087	15	0.28
Cooling	Central AC	Ductless Minisplit	623	$3,650	15	0.10
Cooling	Central AC	SEER 21	871	$3,520	15	0.14
Cooling	Room AC	EER 9.8	-	$0	10	-
Cooling	Room AC	EER 10.8 (Energy Star)	151	$87	10	0.65
Cooling	Room AC	EER 11.0	178	$111	10	0.60
Cooling	Room AC	EER 12.0	299	$568	10	0.20
Combined Heat/Cool	Air-Source Heat Pump	SEER 13	-	$0	15	-
Combined Heat/Cool	Air-Source Heat Pump	SEER 14 (Energy Star)	534	$383	15	1.39
Combined Heat/Cool	Air-Source Heat Pump	SEER 15 (CEE Tier 2)	782	$599	15	1.30
Combined Heat/Cool	Air-Source Heat Pump	SEER 16 (CEE Tier 3)	1,360	$1,006	15	1.35
Combined Heat/Cool	Air-Source Heat Pump	Ductless Minisplit	1,700	$3,017	15	0.56
Combined Heat/Cool	Geothermal Heat Pump	EER 14.1	-	$0	16	-
Combined Heat/Cool	Geothermal Heat Pump	EER 16	739	$379	16	2.05
Combined Heat/Cool	Geothermal Heat Pump	EER 18	1,172	$1,011	16	1.22
Combined Heat/Cool	Geothermal Heat Pump	EER 30	3,227	$2,275	16	1.49
Space Heating	Electric Resistance	Standard	-	$0	20	-
Space Heating	Electric Furnace	Standard	-	$0	15	-
Water Heating	Water Heater	EF 0.9	-	$0	15	-
Water Heating	Water Heater	EF 0.95	233	$100	15	1.51
Water Heating	Water Heater	EF 2.3 (HP)	2,358	$1,714	15	0.91
Water Heating	Water Heater	Solar	2,393	$3,600	15	0.43
Interior Lighting	Screw-in	Incandescent	-	$0	3	-
Interior Lighting	Screw-in	Infrared Halogen	271	$192	4	-
Interior Lighting	Screw-in	Infrared Halogen (2020)	988	$192	4	-
Interior Lighting	Screw-in	CFL	1,120	$118	6	2.37
Interior Lighting	Screw-in	LED	1,231	$2,460	15	0.32
Interior Lighting	Linear Fluorescent	T12	-	$0	10	-
Interior Lighting	Linear Fluorescent	T8	11	-$4	10	1.00
Interior Lighting	Linear Fluorescent	Super T8	33	$29	10	0.47
Interior Lighting	Linear Fluorescent	T5	34	$50	10	0.28
Interior Lighting	Linear Fluorescent	LED	36	$433	20	0.07
Exterior Lighting	Screw-in	Incandescent	-	$0	3	-
Exterior Lighting	Screw-in	Infrared Halogen	35	$33	4	-
Exterior Lighting	Screw-in	Infrared Halogen (2020)	219	$33	4	-
Exterior Lighting	Screw-in	CFL	250	$21	6	2.95
Exterior Lighting	Screw-in	LED	281	$428	15	0.42
Appliances	Clothes Washer	Standard (1.26)	-	$0	10	-
Appliances	Clothes Washer	Energy Star (1.72)	54	$75	10	0.29
Appliances	Clothes Washer	AHAM (MEF 1.72)	54	$75	10	-
Appliances	Clothes Washer	Energy Star (MEF 2.0)	58	$115	10	-
Appliances	Clothes Washer	AHAM (MEF 2.0)	58	$115	10	-
Appliances	Clothes Washer	Compact (MEF 2.79)	65	$225	10	0.12
Appliances	Clothes Dryer	Baseline	-	$0	13	-
Appliances	Clothes Dryer	High Efficiency	46	$100	13	0.24
Appliances	Clothes Dryer	Baseline (2015+)	48	$75	13	-
Appliances	Clothes Dryer	High Efficiency (2015+)	82	$175	13	-
Appliances	Dishwasher	Standard (EF 0.46)	-	$0	9	-
Appliances	Dishwasher	Standard (EF 0.63)	79	$0	9	-
Appliances	Dishwasher	Energy Star (EF 0.69)	121	$5	9	3.05
Appliances	Dishwasher	Energy Star (EF 0.73)	134	$80	9	-

End Use	Technology	Efficiency Definition	Savings (kWh/ HH/yr)	Incremental Cost ($/HH)	Lifetime (yrs)	BC Ratio
Appliances	Dishwasher	AHAM (EF 0.73)	134	$80	9	-
Appliances	Dishwasher	Ultra Efficient (EF 1.1)	193	$255	9	0.16
Appliances	Refrigerator	Standard	-	$0	13	-
Appliances	Refrigerator	Energy Star	117	$25	13	2.35
Appliances	Refrigerator	High Efficiency	136	$425	13	0.16
Appliances	Refrigerator	AHAM (2014)	145	$218	13	-
Appliances	Refrigerator	High Efficiency (2014)	173	$695	13	-
Appliances	Freezer	Standard	-	$0	11	-
Appliances	Freezer	Energy Star	74	$50	11	0.62
Appliances	Freezer	High Efficiency	108	$198	11	0.23
Appliances	Freezer	AHAM (2014)	109	$198	11	-
Appliances	Freezer	High Efficiency (2014)	136	$352	11	-
Appliances	Second Refrigerator	Standard	-	$0	13	-
Appliances	Second Refrigerator	Energy Star	54	$25	13	1.09
Appliances	Second Refrigerator	High Efficiency	76	$425	13	0.09
Appliances	Second Refrigerator	AHAM (2014)	115	$218	13	-
Appliances	Second Refrigerator	High Efficiency (2014)	148	$695	13	-
Appliances	Stove	Baseline	-	$0	13	-
Appliances	Stove	Convection	2	$121	13	0.01
Appliances	Stove	Halogen Burner	5	$580	13	0.00
Appliances	Stove	Induction	30	$898	13	0.02
Appliances	Microwave	Standard	-	$0	9	-
Electronics	Personal Computer	Standard	-	$0	5	-
Electronics	Personal Computer	Energy Star	135	$0	5	2,306.20
Electronics	TV	Standard	-	$0	11	-
Electronics	TV	Energy Star (3.1)	62	$0	11	-
Electronics	TV	Energy Star (4.1)	100	$0	11	2,074.75
Electronics	TV	Energy Star (5.1)	113	$0	11	-
Electronics	Printer/Fax/Copier	Standard	-	$0	5	-
Electronics	Printer/Fax/Copier	Energy Star	15	$0	5	263.60
Electronics	Set-top Boxes/DVR/Audio	Standard	-	$0	5	-
Electronics	Set-top Boxes/DVR/Audio	Energy Star (2009)	49	$0	5	835.96
Electronics	Set-top Boxes/DVR/Audio	Energy Star (2011)	65	$0	5	-
Electronics	Devices and Gadgets	Standard	-	$0	5	-
Miscellaneous	Pool Pump	Standard	-	$0	15	-
Miscellaneous	Pool Pump	High Efficiency	165	-$250	15	1.00
Miscellaneous	Pool Pump	Two-Speed	660	-$1,000	15	1.00
Miscellaneous	Pool Heater	Electric Resistance	-	$0	15	-
Miscellaneous	Pool Heater	Heat Pump (COP = 5.0)	5,025	-$5,025	15	1.00
Miscellaneous	Pool Heater	Solar	5,967	-$5,967	15	1.00
Miscellaneous	Hot Tub / Spa	Standard	-	$0	15	-
Miscellaneous	Hot Tub / Spa	Efficient Pumps	157	-$375	15	1.00
Miscellaneous	Hot Tub / Spa	Improved Controls and Pumps	209	-$500	15	1.00
Miscellaneous	Well Pump	Baseline (40% EF)	-	$0	10	-
Miscellaneous	Well Pump	High Efficiency (60% EF)	206	-$197	10	1.00
Miscellaneous	Furnace Fan	Standard	-	$0	18	-
Miscellaneous	Furnace Fan	ECM	41	-$47	18	1.00
Miscellaneous	Miscellaneous	Miscellaneous	-	$0	5	-

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

End Use	Technology	Efficiency Definition	Savings (kWh/ HH/yr)	Incremental Cost ($/HH)	Lifetime (yrs)	BC Ratio
Cooling	Central AC	SEER 13	-	$0	15	-
Cooling	Central AC	SEER 14 (Energy Star)	117	$163	15	0.40
Cooling	Central AC	SEER 15 (CEE Tier 2)	226	$408	15	0.31
Cooling	Central AC	SEER 16 (CEE Tier 3)	318	$428	15	0.41
Cooling	Central AC	Ductless Minisplit	396	$1,437	15	0.15
Cooling	Central AC	SEER 21	619	$1,386	15	0.25
Cooling	Room AC	EER 9.8	-	$0	10	-
Cooling	Room AC	EER 10.8 (Energy Star)	123	$53	10	0.86
Cooling	Room AC	EER 11.0	144	$68	10	0.79
Cooling	Room AC	EER 12.0	243	$349	10	0.26
Combined Heat/Cool	Air-Source Heat Pump	SEER 13	-	$0	15	-
Combined Heat/Cool	Air-Source Heat Pump	SEER 14 (Energy Star)	201	$116	15	2.11
Combined Heat/Cool	Air-Source Heat Pump	SEER 15 (CEE Tier 2)	294	$182	15	1.98
Combined Heat/Cool	Air-Source Heat Pump	SEER 16 (CEE Tier 3)	512	$305	15	2.04
Combined Heat/Cool	Air-Source Heat Pump	Ductless Minisplit	640	$915	15	0.85
Combined Heat/Cool	Geothermal Heat Pump	EER 14.1	-	$0	16	-
Combined Heat/Cool	Geothermal Heat Pump	EER 16	278	$143	16	2.50
Combined Heat/Cool	Geothermal Heat Pump	EER 18	441	$381	16	1.49
Combined Heat/Cool	Geothermal Heat Pump	EER 30	1,215	$857	16	1.82
Space Heating	Electric Resistance	Standard	-	$0	20	-
Space Heating	Electric Furnace	Standard	-	$0	15	-
Water Heating	Water Heater	EF 0.9	-	$0	15	-
Water Heating	Water Heater	EF 0.95	109	$100	15	0.70
Water Heating	Water Heater	EF 2.3 (HP)	1,107	$1,714	15	0.42
Water Heating	Water Heater	Solar	1,124	$3,600	15	0.20
Interior Lighting	Screw-in	Incandescent	-	$0	3	-
Interior Lighting	Screw-in	Infrared Halogen	113	$82	4	-
Interior Lighting	Screw-in	Infrared Halogen (2020)	414	$82	4	-
Interior Lighting	Screw-in	CFL	469	$50	6	2.33
Interior Lighting	Screw-in	LED	516	$1,048	15	0.32
Interior Lighting	Linear Fluorescent	T12	-	$0	10	-
Interior Lighting	Linear Fluorescent	T8	4	-$1	10	1.00
Interior Lighting	Linear Fluorescent	Super T8	11	$10	10	0.46
Interior Lighting	Linear Fluorescent	T5	12	$18	10	0.27
Interior Lighting	Linear Fluorescent	LED	12	$152	20	0.07
Exterior Lighting	Screw-in	Incandescent	-	$0	3	-
Exterior Lighting	Screw-in	Infrared Halogen	13	$13	4	-
Exterior Lighting	Screw-in	Infrared Halogen (2020)	80	$13	4	-
Exterior Lighting	Screw-in	CFL	91	$8	6	2.82
Exterior Lighting	Screw-in	LED	103	$164	15	0.40
Appliances	Clothes Washer	Standard (1.26)	-	$0	10	-
Appliances	Clothes Washer	Energy Star (1.72)	44	$75	10	0.24
Appliances	Clothes Washer	AHAM (MEF 1.72)	44	$75	10	-
Appliances	Clothes Washer	Energy Star (MEF 2.0)	47	$115	10	-
Appliances	Clothes Washer	AHAM (MEF 2.0)	47	$115	10	-
Appliances	Clothes Washer	Compact (MEF 2.79)	53	$225	10	0.10
Appliances	Clothes Dryer	Baseline	-	$0	13	-
Appliances	Clothes Dryer	High Efficiency	37	$100	13	0.19
Appliances	Clothes Dryer	Baseline (2015+)	38	$75	13	-
Appliances	Clothes Dryer	High Efficiency (2015+)	65	$175	13	-
Appliances	Dishwasher	Standard (EF 0.46)	-	$0	9	-
Appliances	Dishwasher	Standard (EF 0.63)	63	$0	9	-
Appliances	Dishwasher	Energy Star (EF 0.69)	97	$5	9	2.44
Appliances	Dishwasher	Energy Star (EF 0.73)	107	$80	9	-

End Use	Technology	Efficiency Definition	Savings (kWh/ HH/yr)	Incremental Cost ($/HH)	Lifetime (yrs)	BC Ratio
Appliances	Dishwasher	AHAM (EF 0.73)	107	$80	9	-
Appliances	Dishwasher	Ultra Efficient (EF 1.1)	154	$255	9	0.13
Appliances	Refrigerator	Standard	-	$0	13	-
Appliances	Refrigerator	Energy Star	93	$25	13	1.88
Appliances	Refrigerator	High Efficiency	109	$425	13	0.13
Appliances	Refrigerator	AHAM (2014)	116	$218	13	-
Appliances	Refrigerator	High Efficiency (2014)	138	$695	13	-
Appliances	Freezer	Standard	-	$0	11	-
Appliances	Freezer	Energy Star	59	$50	11	0.50
Appliances	Freezer	High Efficiency	86	$198	11	0.18
Appliances	Freezer	AHAM (2014)	87	$198	11	-
Appliances	Freezer	High Efficiency (2014)	108	$352	11	-
Appliances	Second Refrigerator	Standard	-	$0	13	-
Appliances	Second Refrigerator	Energy Star	43	$25	13	0.87
Appliances	Second Refrigerator	High Efficiency	61	$425	13	0.07
Appliances	Second Refrigerator	AHAM (2014)	92	$218	13	-
Appliances	Second Refrigerator	High Efficiency (2014)	118	$695	13	-
Appliances	Stove	Baseline	-	$0	13	-
Appliances	Stove	Convection	1	$121	13	0.01
Appliances	Stove	Halogen Burner	4	$580	13	0.00
Appliances	Stove	Induction	24	$898	13	0.01
Appliances	Microwave	Standard	-	$0	9	-
Electronics	Personal Computer	Standard	-	$0	5	-
Electronics	Personal Computer	Energy Star	109	$0	5	1,850.75
Electronics	TV	Standard	-	$0	11	-
Electronics	TV	Energy Star (3.1)	50	$0	11	-
Electronics	TV	Energy Star (4.1)	81	$0	11	1,667.47
Electronics	TV	Energy Star (5.1)	91	$0	11	-
Electronics	Printer/Fax/Copier	Standard	-	$0	5	-
Electronics	Printer/Fax/Copier	Energy Star	12	$0	5	211.54
Electronics	Set-top Boxes/DVR/Audio	Standard	-	$0	5	-
Electronics	Set-top Boxes/DVR/Audio	Energy Star (2009)	39	$0	5	670.86
Electronics	Set-top Boxes/DVR/Audio	Energy Star (2011)	53	$0	5	-
Electronics	Devices and Gadgets	Standard	-	$0	5	-
Miscellaneous	Pool Pump	Standard	-	$0	15	-
Miscellaneous	Pool Pump	High Efficiency	152	-$250	15	1.00
Miscellaneous	Pool Pump	Two-Speed	606	-$1,000	15	1.00
Miscellaneous	Pool Heater	Electric Resistance	-	$0	15	-
Miscellaneous	Pool Heater	Heat Pump (COP = 5.0)	4,614	-$5,025	15	1.00
Miscellaneous	Pool Heater	Solar	5,479	-$5,967	15	1.00
Miscellaneous	Hot Tub / Spa	Standard	-	$0	15	-
Miscellaneous	Hot Tub / Spa	Efficient Pumps	144	-$375	15	1.00
Miscellaneous	Hot Tub / Spa	Improved Controls and Pumps	192	-$500	15	1.00
Miscellaneous	Well Pump	Baseline (40% EF)	-	$0	10	-
Miscellaneous	Well Pump	High Efficiency (60% EF)	187	-$197	10	1.00
Miscellaneous	Furnace Fan	Standard	-	$0	18	-
Miscellaneous	Furnace Fan	ECM	11	-$47	18	1.00
Miscellaneous	Miscellaneous	Miscellaneous	-	$0	5	-

Table B-4 Energy-Efficiency Equipment Data—Mobile Homes, Existing Vintage

End Use	Technology	Efficiency Definition	Savings (kWh/ HH/yr)	Incremental Cost ($/HH)	Lifetime (yrs)	BC Ratio
Cooling	Central AC	SEER 13	-	$0	15	-
Cooling	Central AC	SEER 14 (Energy Star)	117	$163	15	0.40
Cooling	Central AC	SEER 15 (CEE Tier 2)	226	$408	15	0.31
Cooling	Central AC	SEER 16 (CEE Tier 3)	318	$428	15	0.41
Cooling	Central AC	Ductless Minisplit	396	$1,437	15	0.15
Cooling	Central AC	SEER 21	619	$1,386	15	0.25
Cooling	Room AC	EER 9.8	-	$0	10	-
Cooling	Room AC	EER 10.8 (Energy Star)	123	$53	10	0.86
Cooling	Room AC	EER 11.0	144	$68	10	0.79
Cooling	Room AC	EER 12.0	243	$349	10	0.26
Combined Heat/Cool	Air-Source Heat Pump	SEER 13	-	$0	15	-
Combined Heat/Cool	Air-Source Heat Pump	SEER 14 (Energy Star)	201	$116	15	2.11
Combined Heat/Cool	Air-Source Heat Pump	SEER 15 (CEE Tier 2)	294	$182	15	1.98
Combined Heat/Cool	Air-Source Heat Pump	SEER 16 (CEE Tier 3)	512	$305	15	2.04
Combined Heat/Cool	Air-Source Heat Pump	Ductless Minisplit	640	$915	15	0.85
Combined Heat/Cool	Geothermal Heat Pump	EER 14.1	-	$0	16	-
Combined Heat/Cool	Geothermal Heat Pump	EER 16	278	$143	16	2.50
Combined Heat/Cool	Geothermal Heat Pump	EER 18	441	$381	16	1.49
Combined Heat/Cool	Geothermal Heat Pump	EER 30	1,215	$857	16	1.82
Space Heating	Electric Resistance	Standard	-	$0	20	-
Space Heating	Electric Furnace	Standard	-	$0	15	-
Water Heating	Water Heater	EF 0.9	-	$0	15	-
Water Heating	Water Heater	EF 0.95	109	$100	15	0.70
Water Heating	Water Heater	EF 2.3 (HP)	1,107	$1,714	15	0.42
Water Heating	Water Heater	Solar	1,124	$3,600	15	0.20
Interior Lighting	Screw-in	Incandescent	-	$0	3	-
Interior Lighting	Screw-in	Infrared Halogen	113	$82	4	-
Interior Lighting	Screw-in	Infrared Halogen (2020)	414	$82	4	-
Interior Lighting	Screw-in	CFL	469	$50	6	2.33
Interior Lighting	Screw-in	LED	516	$1,048	15	0.32
Interior Lighting	Linear Fluorescent	T12	-	$0	10	-
Interior Lighting	Linear Fluorescent	T8	4	-$1	10	1.00
Interior Lighting	Linear Fluorescent	Super T8	11	$10	10	0.46
Interior Lighting	Linear Fluorescent	T5	12	$18	10	0.27
Interior Lighting	Linear Fluorescent	LED	12	$152	20	0.07
Exterior Lighting	Screw-in	Incandescent	-	$0	3	-
Exterior Lighting	Screw-in	Infrared Halogen	13	$13	4	-
Exterior Lighting	Screw-in	Infrared Halogen (2020)	80	$13	4	-
Exterior Lighting	Screw-in	CFL	91	$8	6	2.82
Exterior Lighting	Screw-in	LED	103	$164	15	0.40
Appliances	Clothes Washer	Standard (1.26)	-	$0	10	-
Appliances	Clothes Washer	Energy Star (1.72)	44	$75	10	0.24
Appliances	Clothes Washer	AHAM (MEF 1.72)	44	$75	10	-
Appliances	Clothes Washer	Energy Star (MEF 2.0)	47	$115	10	-
Appliances	Clothes Washer	AHAM (MEF 2.0)	47	$115	10	-
Appliances	Clothes Washer	Compact (MEF 2.79)	53	$225	10	0.10
Appliances	Clothes Dryer	Baseline	-	$0	13	-
Appliances	Clothes Dryer	High Efficiency	37	$100	13	0.19
Appliances	Clothes Dryer	Baseline (2015+)	38	$75	13	-
Appliances	Clothes Dryer	High Efficiency (2015+)	65	$175	13	-
Appliances	Dishwasher	Standard (EF 0.46)	-	$0	9	-
Appliances	Dishwasher	Standard (EF 0.63)	63	$0	9	-
Appliances	Dishwasher	Energy Star (EF 0.69)	97	$5	9	2.44
Appliances	Dishwasher	Energy Star (EF 0.73)	107	$80	9	-

End Use	Technology	Efficiency Definition	Savings (kWh/ HH/yr)	Incremental Cost ($/HH)	Lifetime (yrs)	BC Ratio
Appliances	Dishwasher	AHAM (EF 0.73)	107	$80	9	-
Appliances	Dishwasher	Ultra Efficient (EF 1.1)	154	$255	9	0.13
Appliances	Refrigerator	Standard	-	$0	13	-
Appliances	Refrigerator	Energy Star	93	$25	13	1.88
Appliances	Refrigerator	High Efficiency	109	$425	13	0.13
Appliances	Refrigerator	AHAM (2014)	116	$218	13	-
Appliances	Refrigerator	High Efficiency (2014)	138	$695	13	-
Appliances	Freezer	Standard	-	$0	11	-
Appliances	Freezer	Energy Star	59	$50	11	0.50
Appliances	Freezer	High Efficiency	86	$198	11	0.18
Appliances	Freezer	AHAM (2014)	87	$198	11	-
Appliances	Freezer	High Efficiency (2014)	108	$352	11	-
Appliances	Second Refrigerator	Standard	-	$0	13	-
Appliances	Second Refrigerator	Energy Star	43	$25	13	0.87
Appliances	Second Refrigerator	High Efficiency	61	$425	13	0.07
Appliances	Second Refrigerator	AHAM (2014)	92	$218	13	-
Appliances	Second Refrigerator	High Efficiency (2014)	118	$695	13	-
Appliances	Stove	Baseline	-	$0	13	-
Appliances	Stove	Convection	1	$121	13	0.01
Appliances	Stove	Halogen Burner	4	$580	13	0.00
Appliances	Stove	Induction	24	$898	13	0.01
Appliances	Microwave	Standard	-	$0	9	-
Electronics	Personal Computer	Standard	-	$0	5	-
Electronics	Personal Computer	Energy Star	109	$0	5	1,850.75
Electronics	TV	Standard	-	$0	11	-
Electronics	TV	Energy Star (3.1)	50	$0	11	-
Electronics	TV	Energy Star (4.1)	81	$0	11	1,667.47
Electronics	TV	Energy Star (5.1)	91	$0	11	-
Electronics	Printer/Fax/Copier	Standard	-	$0	5	-
Electronics	Printer/Fax/Copier	Energy Star	12	$0	5	211.54
Electronics	Set-top Boxes/DVR/Audio	Standard	-	$0	5	-
Electronics	Set-top Boxes/DVR/Audio	Energy Star (2009)	39	$0	5	670.86
Electronics	Set-top Boxes/DVR/Audio	Energy Star (2011)	53	$0	5	-
Electronics	Devices and Gadgets	Standard	-	$0	5	-
Miscellaneous	Pool Pump	Standard	-	$0	15	-
Miscellaneous	Pool Pump	High Efficiency	152	-$250	15	1.00
Miscellaneous	Pool Pump	Two-Speed	606	-$1,000	15	1.00
Miscellaneous	Pool Heater	Electric Resistance	-	$0	15	-
Miscellaneous	Pool Heater	Heat Pump (COP = 5.0)	4,614	-$5,025	15	1.00
Miscellaneous	Pool Heater	Solar	5,479	-$5,967	15	1.00
Miscellaneous	Hot Tub / Spa	Standard	-	$0	15	-
Miscellaneous	Hot Tub / Spa	Efficient Pumps	144	-$375	15	1.00
Miscellaneous	Hot Tub / Spa	Improved Controls and Pumps	192	-$500	15	1.00
Miscellaneous	Well Pump	Baseline (40% EF)	-	$0	10	-
Miscellaneous	Well Pump	High Efficiency (60% EF)	187	-$197	10	1.00
Miscellaneous	Furnace Fan	Standard	-	$0	18	-
Miscellaneous	Furnace Fan	ECM	11	-$47	18	1.00
Miscellaneous	Miscellaneous	Miscellaneous	-	$0	5	-

Table B-5 Energy-Efficiency Equipment Data—Single Family, New Vintage

End Use	Technology	Efficiency Definition	Savings (kWh/ HH/yr)	Incremental Cost ($/HH)	Lifetime (yrs)	BC Ratio
Cooling	Central AC	SEER 13	-	$0	15	-
Cooling	Central AC	SEER 14 (Energy Star)	298	$345	15	0.48
Cooling	Central AC	SEER 15 (CEE Tier 2)	403	$862	15	0.26
Cooling	Central AC	SEER 16 (CEE Tier 3)	491	$905	15	0.30
Cooling	Central AC	Ductless Minisplit	566	$3,038	15	0.10
Cooling	Central AC	SEER 21	780	$2,931	15	0.15
Cooling	Room AC	EER 9.8	-	$0	10	-
Cooling	Room AC	EER 10.8 (Energy Star)	186	$130	10	0.53
Cooling	Room AC	EER 11.0	219	$166	10	0.49
Cooling	Room AC	EER 12.0	368	$852	10	0.16
Combined Heat/Cool	Air-Source Heat Pump	SEER 13	-	$0	15	-
Combined Heat/Cool	Air-Source Heat Pump	SEER 14 (Energy Star)	417	$327	15	1.27
Combined Heat/Cool	Air-Source Heat Pump	SEER 15 (CEE Tier 2)	611	$511	15	1.19
Combined Heat/Cool	Air-Source Heat Pump	SEER 16 (CEE Tier 3)	1,063	$858	15	1.23
Combined Heat/Cool	Air-Source Heat Pump	Ductless Minisplit	1,329	$2,574	15	0.51
Combined Heat/Cool	Geothermal Heat Pump	EER 14.1	-	$0	16	-
Combined Heat/Cool	Geothermal Heat Pump	EER 16	525	$324	16	1.71
Combined Heat/Cool	Geothermal Heat Pump	EER 18	873	$863	16	1.06
Combined Heat/Cool	Geothermal Heat Pump	EER 30	2,540	$1,941	16	1.38
Space Heating	Electric Resistance	Standard	-	$0	20	-
Space Heating	Electric Furnace	Standard	-	$0	15	-
Water Heating	Water Heater	EF 0.9	-	$0	15	-
Water Heating	Water Heater	EF 0.95	233	$100	15	1.51
Water Heating	Water Heater	EF 2.3 (HP)	2,358	$1,714	15	0.91
Water Heating	Water Heater	Solar	2,393	$3,600	15	0.43
Interior Lighting	Screw-in	Incandescent	-	$0	3	-
Interior Lighting	Screw-in	Infrared Halogen	278	$192	4	-
Interior Lighting	Screw-in	Infrared Halogen (2020)	1,015	$192	4	-
Interior Lighting	Screw-in	CFL	1,150	$118	6	2.43
Interior Lighting	Screw-in	LED	1,264	$2,460	15	0.33
Interior Lighting	Linear Fluorescent	T12	-	$0	10	-
Interior Lighting	Linear Fluorescent	T8	11	-$4	10	1.00
Interior Lighting	Linear Fluorescent	Super T8	33	$29	10	0.47
Interior Lighting	Linear Fluorescent	T5	34	$50	10	0.28
Interior Lighting	Linear Fluorescent	LED	36	$433	20	0.07
Exterior Lighting	Screw-in	Incandescent	-	$0	3	-
Exterior Lighting	Screw-in	Infrared Halogen	36	$33	4	-
Exterior Lighting	Screw-in	Infrared Halogen (2020)	225	$33	4	-
Exterior Lighting	Screw-in	CFL	256	$21	6	3.03
Exterior Lighting	Screw-in	LED	289	$428	15	0.43
Appliances	Clothes Washer	Standard (1.26)	-	$0	10	-
Appliances	Clothes Washer	Energy Star (1.72)	54	$75	10	0.29
Appliances	Clothes Washer	AHAM (MEF 1.72)	54	$75	10	-
Appliances	Clothes Washer	Energy Star (MEF 2.0)	58	$115	10	-
Appliances	Clothes Washer	AHAM (MEF 2.0)	58	$115	10	-
Appliances	Clothes Washer	Compact (MEF 2.79)	65	$225	10	0.12
Appliances	Clothes Dryer	Baseline	-	$0	13	-
Appliances	Clothes Dryer	High Efficiency	46	$100	13	0.24
Appliances	Clothes Dryer	Baseline (2015+)	48	$75	13	-
Appliances	Clothes Dryer	High Efficiency (2015+)	82	$175	13	-
Appliances	Dishwasher	Standard (EF 0.46)	-	$0	9	-
Appliances	Dishwasher	Standard (EF 0.63)	79	$0	9	-
Appliances	Dishwasher	Energy Star (EF 0.69)	121	$5	9	3.05
Appliances	Dishwasher	Energy Star (EF 0.73)	134	$80	9	-

End Use	Technology	Efficiency Definition	Savings (kWh/ HH/yr)	Incremental Cost ($/HH)	Lifetime (yrs)	BC Ratio
Appliances	Dishwasher	AHAM (EF 0.73)	134	$80	9	-
Appliances	Dishwasher	Ultra Efficient (EF 1.1)	193	$255	9	0.16
Appliances	Refrigerator	Standard	-	$0	13	-
Appliances	Refrigerator	Energy Star	117	$25	13	2.35
Appliances	Refrigerator	High Efficiency	136	$425	13	0.16
Appliances	Refrigerator	AHAM (2014)	145	$218	13	-
Appliances	Refrigerator	High Efficiency (2014)	173	$695	13	-
Appliances	Freezer	Standard	-	$0	11	-
Appliances	Freezer	Energy Star	74	$50	11	0.62
Appliances	Freezer	High Efficiency	108	$198	11	0.23
Appliances	Freezer	AHAM (2014)	109	$198	11	-
Appliances	Freezer	High Efficiency (2014)	136	$352	11	-
Appliances	Second Refrigerator	Standard	-	$0	13	-
Appliances	Second Refrigerator	Energy Star	54	$25	13	1.09
Appliances	Second Refrigerator	High Efficiency	76	$425	13	0.09
Appliances	Second Refrigerator	AHAM (2014)	115	$218	13	-
Appliances	Second Refrigerator	High Efficiency (2014)	148	$695	13	-
Appliances	Stove	Baseline	-	$0	13	-
Appliances	Stove	Convection	2	$121	13	0.01
Appliances	Stove	Halogen Burner	5	$580	13	0.00
Appliances	Stove	Induction	30	$898	13	0.02
Appliances	Microwave	Standard	-	$0	9	-
Electronics	Personal Computer	Standard	-	$0	5	-
Electronics	Personal Computer	Energy Star	135	$0	5	2,306.20
Electronics	TV	Standard	-	$0	11	-
Electronics	TV	Energy Star (3.1)	62	$0	11	-
Electronics	TV	Energy Star (4.1)	100	$0	11	2,074.75
Electronics	TV	Energy Star (5.1)	113	$0	11	-
Electronics	Printer/Fax/Copier	Standard	-	$0	5	-
Electronics	Printer/Fax/Copier	Energy Star	15	$0	5	263.60
Electronics	Set-top Boxes/DVR/Audio	Standard	-	$0	5	-
Electronics	Set-top Boxes/DVR/Audio	Energy Star (2009)	49	$0	5	835.96
Electronics	Set-top Boxes/DVR/Audio	Energy Star (2011)	65	$0	5	-
Electronics	Devices and Gadgets	Standard	-	$0	5	-
Miscellaneous	Pool Pump	Standard	-	$0	15	-
Miscellaneous	Pool Pump	High Efficiency	165	-$250	15	1.00
Miscellaneous	Pool Pump	Two-Speed	660	-$1,000	15	1.00
Miscellaneous	Pool Heater	Electric Resistance	-	$0	15	-
Miscellaneous	Pool Heater	Heat Pump (COP = 5.0)	5,025	-$5,025	15	1.00
Miscellaneous	Pool Heater	Solar	5,967	-$5,967	15	1.00
Miscellaneous	Hot Tub / Spa	Standard	-	$0	15	-
Miscellaneous	Hot Tub / Spa	Efficient Pumps	157	-$375	15	1.00
Miscellaneous	Hot Tub / Spa	Improved Controls and Pumps	209	-$500	15	1.00
Miscellaneous	Well Pump	Baseline (40% EF)	-	$0	10	-
Miscellaneous	Well Pump	High Efficiency (60% EF)	206	-$197	10	1.00
Miscellaneous	Furnace Fan	Standard	-	$0	18	-
Miscellaneous	Furnace Fan	ECM	41	-$47	18	1.00
Miscellaneous	Miscellaneous	Miscellaneous	-	$0	5	-

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

End Use	Technology	Efficiency Definition	Savings (kWh/ HH/yr)	Incremental Cost ($/HH)	Lifetime (yrs)	BC Ratio
Cooling	Central AC	SEER 13	-	$0	15	-
Cooling	Central AC	SEER 14 (Energy Star)	112	$173	15	0.36
Cooling	Central AC	SEER 15 (CEE Tier 2)	218	$433	15	0.28
Cooling	Central AC	SEER 16 (CEE Tier 3)	307	$455	15	0.38
Cooling	Central AC	Ductless Minisplit	383	$1,527	15	0.14
Cooling	Central AC	SEER 21	600	$1,473	15	0.23
Cooling	Room AC	EER 9.8	-	$0	10	-
Cooling	Room AC	EER 10.8 (Energy Star)	140	$74	10	0.70
Cooling	Room AC	EER 11.0	164	$94	10	0.65
Cooling	Room AC	EER 12.0	276	$484	10	0.21
Combined Heat/Cool	Air-Source Heat Pump	SEER 13	-	$0	15	-
Combined Heat/Cool	Air-Source Heat Pump	SEER 14 (Energy Star)	191	$121	15	1.93
Combined Heat/Cool	Air-Source Heat Pump	SEER 15 (CEE Tier 2)	280	$189	15	1.81
Combined Heat/Cool	Air-Source Heat Pump	SEER 16 (CEE Tier 3)	488	$317	15	1.87
Combined Heat/Cool	Air-Source Heat Pump	Ductless Minisplit	610	$951	15	0.78
Combined Heat/Cool	Geothermal Heat Pump	EER 14.1	-	$0	16	-
Combined Heat/Cool	Geothermal Heat Pump	EER 16	198	$122	16	2.08
Combined Heat/Cool	Geothermal Heat Pump	EER 18	329	$325	16	1.30
Combined Heat/Cool	Geothermal Heat Pump	EER 30	957	$731	16	1.68
Space Heating	Electric Resistance	Standard	-	$0	20	-
Space Heating	Electric Furnace	Standard	-	$0	15	-
Water Heating	Water Heater	EF 0.9	-	$0	15	-
Water Heating	Water Heater	EF 0.95	109	$100	15	0.70
Water Heating	Water Heater	EF 2.3 (HP)	1,107	$1,714	15	0.42
Water Heating	Water Heater	Solar	1,124	$3,600	15	0.20
Interior Lighting	Screw-in	Incandescent	-	$0	3	-
Interior Lighting	Screw-in	Infrared Halogen	116	$82	4	-
Interior Lighting	Screw-in	Infrared Halogen (2020)	425	$82	4	-
Interior Lighting	Screw-in	CFL	482	$50	6	2.39
Interior Lighting	Screw-in	LED	530	$1,048	15	0.32
Interior Lighting	Linear Fluorescent	T12	-	$0	10	-
Interior Lighting	Linear Fluorescent	T8	4	-$1	10	1.00
Interior Lighting	Linear Fluorescent	Super T8	11	$10	10	0.46
Interior Lighting	Linear Fluorescent	T5	12	$18	10	0.27
Interior Lighting	Linear Fluorescent	LED	12	$152	20	0.07
Exterior Lighting	Screw-in	Incandescent	-	$0	3	-
Exterior Lighting	Screw-in	Infrared Halogen	13	$13	4	-
Exterior Lighting	Screw-in	Infrared Halogen (2020)	82	$13	4	-
Exterior Lighting	Screw-in	CFL	94	$8	6	2.89
Exterior Lighting	Screw-in	LED	105	$164	15	0.41
Appliances	Clothes Washer	Standard (1.26)	-	$0	10	-
Appliances	Clothes Washer	Energy Star (1.72)	44	$75	10	0.24
Appliances	Clothes Washer	AHAM (MEF 1.72)	44	$75	10	-
Appliances	Clothes Washer	Energy Star (MEF 2.0)	47	$115	10	-
Appliances	Clothes Washer	AHAM (MEF 2.0)	47	$115	10	-
Appliances	Clothes Washer	Compact (MEF 2.79)	53	$225	10	0.10
Appliances	Clothes Dryer	Baseline	-	$0	13	-
Appliances	Clothes Dryer	High Efficiency	37	$100	13	0.19
Appliances	Clothes Dryer	Baseline (2015+)	38	$75	13	-
Appliances	Clothes Dryer	High Efficiency (2015+)	65	$175	13	-
Appliances	Dishwasher	Standard (EF 0.46)	-	$0	9	-
Appliances	Dishwasher	Standard (EF 0.63)	63	$0	9	-
Appliances	Dishwasher	Energy Star (EF 0.69)	97	$5	9	2.44
Appliances	Dishwasher	Energy Star (EF 0.73)	107	$80	9	-

End Use	Technology	Efficiency Definition	Savings (kWh/ HH/yr)	Incremental Cost ($/HH)	Lifetime (yrs)	BC Ratio
Appliances	Dishwasher	AHAM (EF 0.73)	107	$80	9	-
Appliances	Dishwasher	Ultra Efficient (EF 1.1)	154	$255	9	0.13
Appliances	Refrigerator	Standard	-	$0	13	-
Appliances	Refrigerator	Energy Star	93	$25	13	1.88
Appliances	Refrigerator	High Efficiency	109	$425	13	0.13
Appliances	Refrigerator	AHAM (2014)	116	$218	13	-
Appliances	Refrigerator	High Efficiency (2014)	138	$695	13	-
Appliances	Freezer	Standard	-	$0	11	-
Appliances	Freezer	Energy Star	59	$50	11	0.50
Appliances	Freezer	High Efficiency	86	$198	11	0.18
Appliances	Freezer	AHAM (2014)	87	$198	11	-
Appliances	Freezer	High Efficiency (2014)	108	$352	11	-
Appliances	Second Refrigerator	Standard	-	$0	13	-
Appliances	Second Refrigerator	Energy Star	43	$25	13	0.87
Appliances	Second Refrigerator	High Efficiency	61	$425	13	0.07
Appliances	Second Refrigerator	AHAM (2014)	92	$218	13	-
Appliances	Second Refrigerator	High Efficiency (2014)	118	$695	13	-
Appliances	Stove	Baseline	-	$0	13	-
Appliances	Stove	Convection	1	$121	13	0.01
Appliances	Stove	Halogen Burner	4	$580	13	0.00
Appliances	Stove	Induction	24	$898	13	0.01
Appliances	Microwave	Standard	-	$0	9	-
Electronics	Personal Computer	Standard	-	$0	5	-
Electronics	Personal Computer	Energy Star	109	$0	5	1,850.75
Electronics	TV	Standard	-	$0	11	-
Electronics	TV	Energy Star (3.1)	50	$0	11	-
Electronics	TV	Energy Star (4.1)	81	$0	11	1,667.47
Electronics	TV	Energy Star (5.1)	91	$0	11	-
Electronics	Printer/Fax/Copier	Standard	-	$0	5	-
Electronics	Printer/Fax/Copier	Energy Star	12	$0	5	211.54
Electronics	Set-top Boxes/DVR/Audio	Standard	-	$0	5	-
Electronics	Set-top Boxes/DVR/Audio	Energy Star (2009)	39	$0	5	670.86
Electronics	Set-top Boxes/DVR/Audio	Energy Star (2011)	53	$0	5	-
Electronics	Devices and Gadgets	Standard	-	$0	5	-
Miscellaneous	Pool Pump	Standard	-	$0	15	-
Miscellaneous	Pool Pump	High Efficiency	152	-$250	15	1.00
Miscellaneous	Pool Pump	Two-Speed	606	-$1,000	15	1.00
Miscellaneous	Pool Heater	Electric Resistance	-	$0	15	-
Miscellaneous	Pool Heater	Heat Pump (COP = 5.0)	4,614	-$5,025	15	1.00
Miscellaneous	Pool Heater	Solar	5,479	-$5,967	15	1.00
Miscellaneous	Hot Tub / Spa	Standard	-	$0	15	-
Miscellaneous	Hot Tub / Spa	Efficient Pumps	144	-$375	15	1.00
Miscellaneous	Hot Tub / Spa	Improved Controls and Pumps	192	-$500	15	1.00
Miscellaneous	Well Pump	Baseline (40% EF)	-	$0	10	-
Miscellaneous	Well Pump	High Efficiency (60% EF)	187	-$197	10	1.00
Miscellaneous	Furnace Fan	Standard	-	$0	18	-
Miscellaneous	Furnace Fan	ECM	11	-$47	18	1.00
Miscellaneous	Miscellaneous	Miscellaneous	-	$0	5	-

Table B-7 Energy-Efficiency Equipment Data—Mobile Homes, New Vintage

End Use	Technology	Efficiency Definition	Savings (kWh/ HH/yr)	Incremental Cost ($/HH)	Lifetime (yrs)	BC Ratio
Cooling	Central AC	SEER 13	-	$0	15	-
Cooling	Central AC	SEER 14 (Energy Star)	309	$337	15	0.51
Cooling	Central AC	SEER 15 (CEE Tier 2)	413	$843	15	0.27
Cooling	Central AC	SEER 16 (CEE Tier 3)	500	$885	15	0.31
Cooling	Central AC	Ductless Minisplit	575	$2,972	15	0.11
Cooling	Central AC	SEER 21	787	$2,867	15	0.15
Cooling	Room AC	EER 9.8	-	$0	10	-
Cooling	Room AC	EER 10.8 (Energy Star)	289	$213	10	0.50
Cooling	Room AC	EER 11.0	340	$272	10	0.46
Cooling	Room AC	EER 12.0	571	$1,396	10	0.15
Combined Heat/Cool	Air-Source Heat Pump	SEER 13	-	$0	15	-
Combined Heat/Cool	Air-Source Heat Pump	SEER 14 (Energy Star)	311	$247	15	1.26
Combined Heat/Cool	Air-Source Heat Pump	SEER 15 (CEE Tier 2)	455	$385	15	1.18
Combined Heat/Cool	Air-Source Heat Pump	SEER 16 (CEE Tier 3)	791	$647	15	1.23
Combined Heat/Cool	Air-Source Heat Pump	Ductless Minisplit	989	$1,942	15	0.51
Combined Heat/Cool	Geothermal Heat Pump	EER 14.1	-	$0	16	-
Combined Heat/Cool	Geothermal Heat Pump	EER 16	352	$245	16	1.52
Combined Heat/Cool	Geothermal Heat Pump	EER 18	576	$654	16	0.93
Combined Heat/Cool	Geothermal Heat Pump	EER 30	1,838	$1,472	16	1.32
Space Heating	Electric Resistance	Standard	-	$0	20	-
Space Heating	Electric Furnace	Standard	-	$0	15	-
Water Heating	Water Heater	EF 0.9	-	$0	15	-
Water Heating	Water Heater	EF 0.95	186	$100	15	1.17
Water Heating	Water Heater	EF 2.3 (HP)	1,882	$1,714	15	0.70
Water Heating	Water Heater	Solar	1,911	$3,600	15	0.33
Interior Lighting	Screw-in	Incandescent	-	$0	3	-
Interior Lighting	Screw-in	Infrared Halogen	120	$91	4	-
Interior Lighting	Screw-in	Infrared Halogen (2020)	438	$91	4	-
Interior Lighting	Screw-in	CFL	497	$56	6	2.21
Interior Lighting	Screw-in	LED	546	$1,166	15	0.30
Interior Lighting	Linear Fluorescent	T12	-	$0	10	-
Interior Lighting	Linear Fluorescent	T8	9	-$3	10	1.00
Interior Lighting	Linear Fluorescent	Super T8	27	$26	10	0.43
Interior Lighting	Linear Fluorescent	T5	27	$45	10	0.25
Interior Lighting	Linear Fluorescent	LED	30	$388	20	0.06
Exterior Lighting	Screw-in	Incandescent	-	$0	3	-
Exterior Lighting	Screw-in	Infrared Halogen	24	$23	4	-
Exterior Lighting	Screw-in	Infrared Halogen (2020)	150	$23	4	-
Exterior Lighting	Screw-in	CFL	171	$15	6	2.89
Exterior Lighting	Screw-in	LED	193	$299	15	0.41
Appliances	Clothes Washer	Standard (1.26)	-	$0	10	-
Appliances	Clothes Washer	Energy Star (1.72)	50	$75	10	0.27
Appliances	Clothes Washer	AHAM (MEF 1.72)	50	$75	10	-
Appliances	Clothes Washer	Energy Star (MEF 2.0)	54	$115	10	-
Appliances	Clothes Washer	AHAM (MEF 2.0)	54	$115	10	-
Appliances	Clothes Washer	Compact (MEF 2.79)	60	$225	10	0.11
Appliances	Clothes Dryer	Baseline	-	$0	13	-
Appliances	Clothes Dryer	High Efficiency	42	$100	13	0.22
Appliances	Clothes Dryer	Baseline (2015+)	44	$75	13	-
Appliances	Clothes Dryer	High Efficiency (2015+)	75	$175	13	-
Appliances	Dishwasher	Standard (EF 0.46)	-	$0	9	-
Appliances	Dishwasher	Standard (EF 0.63)	75	$0	9	-
Appliances	Dishwasher	Energy Star (EF 0.69)	116	$5	9	2.93
Appliances	Dishwasher	Energy Star (EF 0.73)	128	$80	9	-

End Use	Technology	Efficiency Definition	Savings (kWh/ HH/yr)	Incremental Cost ($/HH)	Lifetime (yrs)	BC Ratio
Appliances	Dishwasher	AHAM (EF 0.73)	128	$80	9	-
Appliances	Dishwasher	Ultra Efficient (EF 1.1)	185	$255	9	0.15
Appliances	Refrigerator	Standard	-	$0	13	-
Appliances	Refrigerator	Energy Star	112	$25	13	2.26
Appliances	Refrigerator	High Efficiency	131	$425	13	0.15
Appliances	Refrigerator	AHAM (2014)	139	$218	13	-
Appliances	Refrigerator	High Efficiency (2014)	166	$695	13	-
Appliances	Freezer	Standard	-	$0	11	-
Appliances	Freezer	Energy Star	71	$50	11	0.59
Appliances	Freezer	High Efficiency	103	$198	11	0.22
Appliances	Freezer	AHAM (2014)	104	$198	11	-
Appliances	Freezer	High Efficiency (2014)	130	$352	11	-
Appliances	Second Refrigerator	Standard	-	$0	13	-
Appliances	Second Refrigerator	Energy Star	52	$25	13	1.05
Appliances	Second Refrigerator	High Efficiency	73	$425	13	0.09
Appliances	Second Refrigerator	AHAM (2014)	110	$218	13	-
Appliances	Second Refrigerator	High Efficiency (2014)	142	$695	13	-
Appliances	Stove	Baseline	-	$0	13	-
Appliances	Stove	Convection	2	$121	13	0.01
Appliances	Stove	Halogen Burner	5	$580	13	0.00
Appliances	Stove	Induction	29	$898	13	0.02
Appliances	Microwave	Standard	-	$0	9	-
Electronics	Personal Computer	Standard	-	$0	5	-
Electronics	Personal Computer	Energy Star	124	$0	5	2,235.28
Electronics	TV	Standard	-	$0	11	-
Electronics	TV	Energy Star (3.1)	57	$0	11	-
Electronics	TV	Energy Star (4.1)	92	$0	11	1,988.92
Electronics	TV	Energy Star (5.1)	104	$0	11	-
Electronics	Printer/Fax/Copier	Standard	-	$0	5	-
Electronics	Printer/Fax/Copier	Energy Star	14	$0	5	255.49
Electronics	Set-top Boxes/DVR/Audio	Standard	-	$0	5	-
Electronics	Set-top Boxes/DVR/Audio	Energy Star (2009)	45	$0	5	810.25
Electronics	Set-top Boxes/DVR/Audio	Energy Star (2011)	60	$0	5	-
Electronics	Devices and Gadgets	Standard	-	$0	5	-
Miscellaneous	Pool Pump	Standard	-	$0	15	-
Miscellaneous	Pool Pump	High Efficiency	173	-$250	15	1.00
Miscellaneous	Pool Pump	Two-Speed	690	-$1,000	15	1.00
Miscellaneous	Pool Heater	Electric Resistance	-	$0	15	-
Miscellaneous	Pool Heater	Heat Pump (COP = 5.0)	5,253	-$5,025	15	1.00
Miscellaneous	Pool Heater	Solar	6,239	-$5,967	15	1.00
Miscellaneous	Hot Tub / Spa	Standard	-	$0	15	-
Miscellaneous	Hot Tub / Spa	Efficient Pumps	164	-$375	15	1.00
Miscellaneous	Hot Tub / Spa	Improved Controls and Pumps	219	-$500	15	1.00
Miscellaneous	Well Pump	Baseline (40% EF)	-	$0	10	-
Miscellaneous	Well Pump	High Efficiency (60% EF)	173	-$197	10	1.00
Miscellaneous	Furnace Fan	Standard	-	$0	18	-
Miscellaneous	Furnace Fan	ECM	31	-$47	18	1.00
Miscellaneous	Miscellaneous	Miscellaneous	-	$0	5	-

Table B-8 Energy-Efficiency Non-Equipment Measure Data—Single Family, Existing Vintage

Measure	End Use	Energy Savings	Demand Savings	Base Satura-tion	Appl./ Feas.	Cost ($/ install)	Life-time (yrs)	BC Ratio
Central AC - Maintenance	Cooling	10%	0%	15%	100%	$125	4	0.38
Attic Fan - Installation	Cooling	1%	0%	12%	23%	$141	18	0.08
Attic Fan - Photovoltaic	Cooling	1%	0%	13%	45%	$350	19	0.04
Ceiling Fan - Installation	Cooling	11%	0%	56%	75%	$120	15	1.71
Whole-House Fan - Installation	Cooling	7%	0%	4%	19%	$250	20	0.44
Dehumidifier	Cooling	9%	0%	4%	8%	$300	12	0.34
Central Heat Pump - Maintenance	Combined Heat/Cool	9%	9%	15%	90%	$125	4	1.65
Central Heat Pump - Maintenance	Combined Heat/Cool	9%	9%	15%	90%	$125	4	1.65
Insulation - Ducting	Cooling	3%	0%	15%	75%	$500	18	0.40
Insulation - Ducting	Combined Heat/Cool	4%	4%	15%	75%	$500	18	0.40
Insulation - Ducting	Space Heating	4%	4%	15%	75%	$500	18	0.40
Ducting - Repair and Sealing	Cooling	14%	0%	12%	50%	$144	18	7.01
Ducting - Repair and Sealing	Combined Heat/Cool	14%	13%	12%	50%	$144	18	7.01
Ducting - Repair and Sealing	Space Heating	14%	13%	12%	50%	$144	18	7.01
Insulation - Infiltration Control	Cooling	10%	0%	46%	90%	$266	11	1.42
Insulation - Infiltration Control	Combined Heat/Cool	10%	7%	46%	90%	$266	11	1.42
Insulation - Infiltration Control	Space Heating	10%	7%	46%	90%	$266	11	1.42
Insulation - Ceiling	Cooling	10%	0%	16%	38%	$141	20	4.44
Insulation - Ceiling	Combined Heat/Cool	10%	11%	16%	38%	$141	20	4.44
Insulation - Ceiling	Space Heating	10%	11%	16%	38%	$141	20	4.44
Doors - Storm and Thermal	Cooling	1%	0%	38%	75%	$320	12	0.34
Doors - Storm and Thermal	Combined Heat/Cool	2%	3%	38%	75%	$320	12	0.34
Doors - Storm and Thermal	Space Heating	3%	3%	38%	75%	$320	12	0.34
Windows - ENERGY STAR	Cooling	18%	0%	24%	90%	$210	20	1.38
Windows - Install reflective film	Cooling	24%	0%	5%	45%	$895	10	0.28
Roofs - High Reflectivity	Cooling	7%	0%	5%	10%	$1,550	15	0.06
Thermostat - Clock/Programmable	Cooling	7%	0%	46%	56%	$73	12	7.24
Thermostat - Clock/Programmable	Combined Heat/Cool	10%	12%	46%	56%	$73	12	7.24
Thermostat - Clock/Programmable	Space Heating	12%	12%	46%	56%	$73	12	7.24
Water Heater - Faucet Aerators	Water Heating	3%	2%	12%	90%	$13	12	3.84
Water Heater - Pipe Insulation	Water Heating	7%	1%	42%	38%	$180	15	0.77
Water Heater - Low-Flow Showerheads	Water Heating	7%	1%	27%	75%	$38	10	2.81
Water Heater - Tank Blanket/Insulation	Water Heating	5%	9%	19%	75%	$24	13	5.29
Water Heater - Thermostat Setback	Water Heating	9%	9%	5%	75%	$40	5	2.27
Water Heater - Timer	Water Heating	5%	5%	17%	40%	$194	10	0.47
Water Heater - Hot Water Saver	Water Heating	9%	9%	0%	50%	$35	5	2.60
Interior Lighting - Occupancy Sensor	Interior Lighting	35%	35%	4%	5%	$750	15	0.30
Exterior Lighting - Photovoltaic - Installation	Exterior Lighting	16%	16%	10%	45%	$2,975	15	0.04
Exterior Lighting - Photosensor Control	Exterior Lighting	6%	6%	26%	45%	$90	8	0.30
Exterior Lighting - Timeclock Installation	Exterior Lighting	10%	10%	10%	45%	$108	8	0.43
Refrigerator - Remove Second Unit	Appliances	100%	100%	0%	100%	$75	5	2.36
Refrigerator - Maintenance	Appliances	5%	5%	37%	100%	$50	4	0.13
Freezer - Remove Second Unit	Appliances	100%	100%	0%	38%	$75	5	1.49
Freezer - Maintenance	Appliances	5%	5%	0%	100%	$50	4	0.09
Home Electronics - Reduce Standby Wattage	Electronics	10%	10%	5%	90%	$20	8	2.20
Pool - Pump Timer	Miscellaneous	11%	0%	25%	90%	$160	15	1.00
Spa - Pump Timer	Miscellaneous	11%	11%	25%	90%	$160	15	1.10
Home Energy Management System	Cooling	5%	0%	0%	38%	$300	20	1.62
Home Energy Management System	Combined Heat/Cool	5%	5%	0%	38%	$300	20	1.62
Home Energy Management System	Space Heating	5%	5%	0%	38%	$300	20	1.62
Home Energy Management System	Interior Lighting	20%	20%	0%	38%	$300	20	1.62

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

Measure	End Use	Energy Savings	Demand Savings	Base Satura-tion	Appl./ Feas.	Cost ($/ install)	Life-time (yrs)	BC Ratio
Central AC - Maintenance	Cooling	10%	0%	15%	100%	$100	4	0.20
Attic Fan - Installation	Cooling	0%	0%	1%	23%	$141	18	-
Attic Fan - Photovoltaic	Cooling	0%	0%	2%	11%	$350	19	-
Ceiling Fan - Installation	Cooling	20%	0%	56%	75%	$120	15	1.12
Whole-House Fan - Installation	Cooling	0%	0%	4%	19%	$125	20	-
Dehumidifier	Cooling	9%	0%	2%	3%	$200	12	0.23
Central Heat Pump - Maintenance	Combined Heat/Cool	9%	9%	15%	90%	$100	4	0.82
Central Heat Pump - Maintenance	Combined Heat/Cool	9%	9%	15%	90%	$100	4	0.82
Insulation - Ducting	Cooling	2%	0%	13%	75%	$375	18	0.13
Insulation - Ducting	Combined Heat/Cool	3%	4%	13%	75%	$375	18	0.13
Insulation - Ducting	Space Heating	4%	4%	13%	75%	$375	18	0.13
Ducting - Repair and Sealing	Cooling	12%	0%	12%	50%	$144	18	1.43
Ducting - Repair and Sealing	Combined Heat/Cool	12%	13%	12%	50%	$144	18	1.43
Ducting - Repair and Sealing	Space Heating	12%	13%	12%	50%	$144	18	1.43
Insulation - Infiltration Control	Cooling	13%	0%	19%	90%	$266	11	0.51
Insulation - Infiltration Control	Combined Heat/Cool	13%	8%	19%	90%	$266	11	0.51
Insulation - Infiltration Control	Space Heating	13%	8%	19%	90%	$266	11	0.51
Insulation - Ceiling	Cooling	5%	0%	11%	19%	$88	20	1.03
Insulation - Ceiling	Combined Heat/Cool	5%	5%	11%	19%	$88	20	1.03
Insulation - Ceiling	Space Heating	5%	5%	11%	19%	$88	20	1.03
Doors - Storm and Thermal	Cooling	1%	0%	17%	75%	$320	12	0.09
Doors - Storm and Thermal	Combined Heat/Cool	2%	3%	17%	75%	$320	12	0.09
Doors - Storm and Thermal	Space Heating	3%	3%	17%	75%	$320	12	0.09
Windows - ENERGY STAR	Cooling	32%	0%	13%	90%	$44	20	5.05
Windows - Install reflective film	Cooling	18%	0%	5%	45%	$186	10	0.43
Roofs - High Reflectivity	Cooling	6%	0%	3%	10%	$1,550	15	0.02
Thermostat - Clock/Programmable	Cooling	7%	0%	27%	68%	$73	12	3.56
Thermostat - Clock/Programmable	Combined Heat/Cool	14%	23%	27%	68%	$73	12	3.56
Thermostat - Clock/Programmable	Space Heating	23%	23%	27%	68%	$73	12	3.56
Water Heater - Faucet Aerators	Water Heating	6%	4%	8%	90%	$13	12	3.81
Water Heater - Pipe Insulation	Water Heating	15%	3%	42%	38%	$180	15	0.77
Water Heater - Low-Flow Showerheads	Water Heating	8%	2%	17%	75%	$19	10	2.79
Water Heater - Tank Blanket/Insulation	Water Heating	5%	9%	19%	75%	$24	13	2.39
Water Heater - Thermostat Setback	Water Heating	9%	9%	5%	75%	$40	5	1.02
Water Heater - Timer	Water Heating	5%	5%	5%	40%	$194	10	0.21
Water Heater - Hot Water Saver	Water Heating	9%	9%	0%	50%	$35	5	1.17
Interior Lighting - Occupancy Sensor	Interior Lighting	35%	35%	1%	5%	$256	15	0.66
Exterior Lighting - Photovoltaic - Installation	Exterior Lighting	22%	22%	10%	45%	$2,975	15	0.04
Exterior Lighting - Photosensor Control	Exterior Lighting	8%	8%	11%	45%	$90	8	0.30
Exterior Lighting - Timeclock Installation	Exterior Lighting	10%	10%	6%	45%	$108	8	0.32
Refrigerator - Remove Second Unit	Appliances	100%	100%	0%	100%	$75	5	2.12
Refrigerator - Maintenance	Appliances	5%	5%	27%	100%	$50	4	0.10
Freezer - Remove Second Unit	Appliances	100%	100%	0%	38%	$75	5	1.17
Freezer - Maintenance	Appliances	5%	5%	0%	100%	$50	4	0.07
Home Electronics - Reduce Standby Wattage	Electronics	10%	10%	5%	90%	$20	8	1.78
Pool - Pump Timer	Miscellaneous	11%	0%	25%	90%	$16	15	8.21
Spa - Pump Timer	Miscellaneous	11%	11%	25%	90%	$16	15	8.99
Home Energy Management System	Cooling	13%	0%	0%	13%	$300	20	1.14
Home Energy Management System	Combined Heat/Cool	13%	13%	0%	13%	$300	20	1.14
Home Energy Management System	Space Heating	13%	13%	0%	13%	$300	20	1.14

Home Energy Management System	Interior Lighting	20%	20%	0%	13%	$300	20	1.14

Table B-10 Energy-Efficiency Non-Equipment Measure Data—Mobile Homes, Existing Vintage

Measure	End Use	Energy Savings	Demand Savings	Base Satura-tion	Appl./ Feas.	Cost ($/ install)	Life-time (yrs)	BC Ratio
Central AC - Maintenance	Cooling	10%	0%	15%	100%	$100	4	0.48
Attic Fan - Installation	Cooling	0%	0%	12%	23%	$141	18	0.07
Attic Fan - Photovoltaic	Cooling	0%	0%	13%	45%	$350	19	0.03
Ceiling Fan - Installation	Cooling	10%	0%	56%	75%	$120	15	1.46
Whole-House Fan - Installation	Cooling	7%	0%	4%	19%	$125	20	0.87
Dehumidifier	Cooling	9%	0%	4%	8%	$300	12	0.35
Central Heat Pump - Maintenance	Combined Heat/Cool	9%	9%	15%	90%	$100	4	1.87
Central Heat Pump - Maintenance	Combined Heat/Cool	9%	9%	15%	90%	$100	4	1.87
Insulation - Ducting	Cooling	3%	0%	15%	75%	$395	18	0.44
Insulation - Ducting	Combined Heat/Cool	4%	4%	15%	75%	$395	18	0.44
Insulation - Ducting	Space Heating	4%	4%	15%	75%	$395	18	0.44
Ducting - Repair and Sealing	Cooling	14%	0%	12%	50%	$144	18	5.80
Ducting - Repair and Sealing	Combined Heat/Cool	14%	13%	12%	50%	$144	18	5.80
Ducting - Repair and Sealing	Space Heating	14%	13%	12%	50%	$144	18	5.80
Insulation - Infiltration Control	Cooling	9%	0%	19%	90%	$266	11	1.15
Insulation - Infiltration Control	Combined Heat/Cool	9%	9%	19%	90%	$266	11	1.15
Insulation - Infiltration Control	Space Heating	9%	9%	19%	90%	$266	11	1.15
Insulation - Ceiling	Cooling	15%	0%	12%	38%	$123	20	5.76
Insulation - Ceiling	Combined Heat/Cool	15%	13%	12%	38%	$123	20	5.76
Insulation - Ceiling	Space Heating	15%	13%	12%	38%	$123	20	5.76
Doors - Storm and Thermal	Cooling	2%	0%	38%	75%	$320	12	0.33
Doors - Storm and Thermal	Combined Heat/Cool	3%	3%	38%	75%	$320	12	0.33
Doors - Storm and Thermal	Space Heating	3%	3%	38%	75%	$320	12	0.33
Windows - ENERGY STAR	Cooling	13%	0%	13%	90%	$185	20	1.13
Windows - Install reflective film	Cooling	27%	0%	5%	45%	$788	10	0.36
Roofs - High Reflectivity	Cooling	7%	0%	5%	10%	$1,550	15	0.06
Thermostat - Clock/Programmable	Cooling	7%	0%	46%	56%	$73	12	5.48
Thermostat - Clock/Programmable	Combined Heat/Cool	9%	11%	46%	56%	$73	12	5.48
Thermostat - Clock/Programmable	Space Heating	11%	11%	46%	56%	$73	12	5.48
Water Heater - Faucet Aerators	Water Heating	3%	2%	12%	90%	$13	12	3.83
Water Heater - Pipe Insulation	Water Heating	9%	2%	42%	38%	$180	15	0.77
Water Heater - Low-Flow Showerheads	Water Heating	4%	1%	27%	75%	$19	10	2.71
Water Heater - Tank Blanket/Insulation	Water Heating	5%	9%	19%	75%	$24	13	3.99
Water Heater - Thermostat Setback	Water Heating	9%	9%	5%	75%	$40	5	1.73
Water Heater - Timer	Water Heating	5%	5%	17%	40%	$194	10	0.36
Water Heater - Hot Water Saver	Water Heating	9%	9%	0%	50%	$35	5	1.97
Interior Lighting - Occupancy Sensor	Interior Lighting	35%	35%	4%	5%	$256	15	0.65
Exterior Lighting - Photovoltaic - Installation	Exterior Lighting	22%	22%	10%	45%	$2,975	15	0.04
Exterior Lighting - Photosensor Control	Exterior Lighting	8%	8%	26%	45%	$90	8	0.30
Exterior Lighting - Timeclock Installation	Exterior Lighting	10%	10%	10%	45%	$108	8	0.32
Refrigerator - Remove Second Unit	Appliances	100%	100%	0%	100%	$75	5	2.43
Refrigerator - Maintenance	Appliances	5%	5%	35%	100%	$50	4	0.13
Freezer - Remove Second Unit	Appliances	100%	100%	0%	38%	$75	5	1.46
Freezer - Maintenance	Appliances	5%	5%	0%	100%	$50	4	0.09
Home Electronics - Reduce Standby Wattage	Electronics	10%	10%	5%	90%	$20	8	2.31
Pool - Pump Timer	Miscellaneous	13%	0%	25%	90%	$160	15	1.00
Spa - Pump Timer	Miscellaneous	13%	13%	25%	90%	$160	15	1.14
Home Energy Management System	Cooling	7%	0%	0%	38%	$300	20	1.58
Home Energy Management System	Combined Heat/Cool	7%	7%	0%	38%	$300	20	1.58

Home Energy Management System	Space Heating	7%	7%	0%	38%	$300	20	1.58
Home Energy Management System	Interior Lighting	20%	20%	0%	38%	$300	20	1.58

Table B-11 Energy-Efficiency Non-Equipment Measure Data—Single Family, New Vintage

Measure	End Use	Energy Savings	Demand Savings	Base Satura-tion	Appl./ Feas.	Cost ($/ install)	Life-time (yrs)	BC Ratio
Central AC - Maintenance	Cooling	8%	0%	15%	100%	$125	4	0.36
Attic Fan - Installation	Cooling	1%	0%	4%	23%	$41	18	0.28
Attic Fan - Photovoltaic	Cooling	1%	0%	4%	11%	$200	19	0.06
Ceiling Fan - Installation	Cooling	12%	0%	57%	75%	$80	15	2.74
Whole-House Fan - Installation	Cooling	7%	0%	4%	19%	$250	20	0.44
Dehumidifier	Cooling	9%	0%	3%	3%	$300	12	0.36
Central Heat Pump - Maintenance	Combined Heat/Cool	6%	6%	15%	90%	$125	4	1.20
Central Heat Pump - Maintenance	Combined Heat/Cool	6%	6%	15%	90%	$125	4	1.20
Insulation - Ducting	Cooling	3%	0%	50%	75%	$250	18	0.67
Insulation - Ducting	Combined Heat/Cool	4%	5%	50%	75%	$250	18	0.67
Insulation - Ducting	Space Heating	5%	5%	50%	75%	$250	18	0.67
Ducting - Repair and Sealing	Cooling	11%	0%	12%	50%	$144	18	4.95
Ducting - Repair and Sealing	Combined Heat/Cool	9%	8%	12%	50%	$144	18	4.95
Ducting - Repair and Sealing	Space Heating	8%	8%	12%	50%	$144	18	4.95
Insulation - Infiltration Control	Cooling	10%	0%	46%	90%	$266	11	1.01
Insulation - Infiltration Control	Combined Heat/Cool	10%	7%	46%	90%	$266	11	1.01
Insulation - Infiltration Control	Space Heating	10%	7%	46%	90%	$266	11	1.01
Insulation - Ceiling	Cooling	10%	0%	16%	48%	$141	20	3.14
Insulation - Ceiling	Combined Heat/Cool	10%	11%	16%	48%	$141	20	3.14
Insulation - Ceiling	Space Heating	10%	11%	16%	48%	$141	20	3.14
Insulation - Foundation	Cooling	0%	0%	20%	90%	$358	20	0.02
Insulation - Foundation	Combined Heat/Cool	0%	0%	20%	90%	$358	20	0.02
Insulation - Foundation	Space Heating	0%	0%	20%	90%	$358	20	0.02
Insulation - Wall Cavity	Cooling	8%	0%	13%	90%	$412	20	0.71
Insulation - Wall Cavity	Combined Heat/Cool	8%	5%	13%	90%	$412	20	0.71
Insulation - Wall Cavity	Space Heating	8%	5%	13%	90%	$412	20	0.71
Insulation - Wall Sheathing	Cooling	1%	0%	20%	90%	$618	20	0.32
Insulation - Wall Sheathing	Combined Heat/Cool	4%	7%	20%	90%	$618	20	0.32
Insulation - Wall Sheathing	Space Heating	7%	7%	20%	90%	$618	20	0.32
Doors - Storm and Thermal	Cooling	1%	0%	13%	75%	$180	12	0.48
Doors - Storm and Thermal	Combined Heat/Cool	2%	4%	13%	75%	$180	12	0.48
Doors - Storm and Thermal	Space Heating	4%	4%	13%	75%	$180	12	0.48
Windows - ENERGY STAR	Cooling	18%	0%	24%	90%	$194	20	1.62
Windows - Install reflective film	Cooling	25%	0%	2%	45%	$578	10	0.44
Roofs - High Reflectivity	Cooling	6%	0%	5%	90%	$517	15	0.15
Thermostat - Clock/Programmable	Cooling	7%	0%	57%	75%	$73	12	3.73
Thermostat - Clock/Programmable	Combined Heat/Cool	8%	9%	57%	75%	$73	12	3.73
Thermostat - Clock/Programmable	Space Heating	9%	9%	57%	75%	$73	12	3.73
Water Heater - Faucet Aerators	Water Heating	3%	2%	3%	90%	$7	12	7.19
Water Heater - Pipe Insulation	Water Heating	7%	2%	42%	41%	$50	15	2.94
Water Heater - Low-Flow Showerheads	Water Heating	7%	1%	12%	75%	$48	10	2.20
Water Heater - Tank Blanket/Insulation	Water Heating	5%	9%	8%	25%	$24	13	5.25
Water Heater - Thermostat Setback	Water Heating	9%	9%	5%	75%	$40	5	2.23
Water Heater - Timer	Water Heating	5%	5%	5%	40%	$194	10	0.46
Water Heater - Hot Water Saver	Water Heating	9%	9%	0%	50%	$35	5	2.60
Water Heater - Drainwater Heat Recovery	Water Heating	15%	15%	1%	90%	$899	15	0.39
Interior Lighting - Occupancy Sensor	Interior Lighting	35%	35%	3%	9%	$500	15	0.57
Exterior Lighting - Photovoltaic - Installation	Exterior Lighting	14%	14%	10%	45%	$2,975	15	0.04
Exterior Lighting - Photosensor Control	Exterior Lighting	5%	5%	19%	45%	$90	8	0.32

Measure	End Use	Energy Savings	Demand Savings	Base Satura-tion	Appl./ Feas.	Cost ($/ install)	Life-time (yrs)	BC Ratio
Exterior Lighting - Timeclock Installation	Exterior Lighting	10%	10%	16%	45%	$108	8	0.54
Refrigerator - Remove Second Unit	Appliances	100%	100%	0%	100%	$75	5	3.15
Refrigerator - Maintenance	Appliances	5%	5%	24%	100%	$50	4	0.16
Freezer - Remove Second Unit	Appliances	100%	100%	0%	38%	$75	5	2.05
Freezer - Maintenance	Appliances	5%	5%	0%	100%	$50	4	0.12
Home Electronics - Reduce Standby Wattage	Electronics	10%	10%	5%	90%	$20	8	2.17
Pool - Pump Timer	Miscellaneous	9%	0%	25%	90%	$160	15	1.01
Spa - Pump Timer	Miscellaneous	9%	9%	25%	90%	$160	15	1.10
Advanced New Construction Design	Cooling	40%	0%	2%	45%	$4,500	18	0.40
Advanced New Construction Design	Combined Heat/Cool	40%	40%	2%	45%	$4,500	18	0.40
Advanced New Construction Design	Space Heating	40%	40%	2%	45%	$4,500	18	0.40
Advanced New Construction Design	Interior Lighting	20%	20%	2%	45%	$4,500	18	0.40
ENERGY STAR Homes	Cooling	20%	0%	14%	75%	$5,000	18	0.20
ENERGY STAR Homes	Combined Heat/Cool	20%	20%	14%	75%	$5,000	18	0.20
ENERGY STAR Homes	Space Heating	20%	20%	14%	75%	$5,000	18	0.20
ENERGY STAR Homes	Interior Lighting	20%	20%	14%	75%	$5,000	18	0.20
Home Energy Management System	Cooling	6%	0%	0%	68%	$250	20	1.80
Home Energy Management System	Combined Heat/Cool	6%	6%	0%	68%	$250	20	1.80
Home Energy Management System	Space Heating	6%	6%	0%	68%	$250	20	1.80
Home Energy Management System	Interior Lighting	20%	20%	0%	68%	$250	20	1.80

Table B-12 Energy-Efficiency Non-Equipment Measure Data—Multi Family, New Vintage

Measure	End Use	Energy Savings	Demand Savings	Base Satura-tion	Appl./ Feas.	Cost ($/ install)	Life-time (yrs)	BC Ratio
Central AC - Maintenance	Cooling	9%	0%	15%	100%	$100	4	0.22
Attic Fan - Installation	Cooling	0%	0%	15%	23%	$41	18	-
Attic Fan - Photovoltaic	Cooling	0%	0%	5%	11%	$200	19	-
Ceiling Fan - Installation	Cooling	21%	0%	33%	75%	$80	15	2.07
Whole-House Fan - Installation	Cooling	0%	0%	4%	19%	$125	20	-
Dehumidifier	Cooling	9%	0%	1%	3%	$300	12	0.22
Central Heat Pump - Maintenance	Combined Heat/Cool	8%	8%	15%	90%	$100	4	0.68
Central Heat Pump - Maintenance	Combined Heat/Cool	8%	8%	15%	90%	$100	4	0.68
Insulation - Ducting	Cooling	2%	0%	50%	75%	$200	18	0.21
Insulation - Ducting	Combined Heat/Cool	3%	5%	50%	75%	$200	18	0.21
Insulation - Ducting	Space Heating	5%	5%	50%	75%	$200	18	0.21
Ducting - Repair and Sealing	Cooling	11%	0%	12%	50%	$144	18	1.18
Ducting - Repair and Sealing	Combined Heat/Cool	10%	7%	12%	50%	$144	18	1.18
Ducting - Repair and Sealing	Space Heating	7%	7%	12%	50%	$144	18	1.18
Insulation - Infiltration Control	Cooling	13%	0%	19%	90%	$266	11	0.43
Insulation - Infiltration Control	Combined Heat/Cool	13%	8%	19%	90%	$266	11	0.43
Insulation - Infiltration Control	Space Heating	13%	8%	19%	90%	$266	11	0.43
Insulation - Ceiling	Cooling	5%	0%	13%	48%	$88	20	0.86
Insulation - Ceiling	Combined Heat/Cool	5%	5%	13%	48%	$88	20	0.86
Insulation - Ceiling	Space Heating	5%	5%	13%	48%	$88	20	0.86
Insulation - Foundation	Cooling	0%	0%	4%	90%	$38	20	-
Insulation - Foundation	Combined Heat/Cool	0%	0%	4%	90%	$38	20	-
Insulation - Foundation	Space Heating	0%	0%	4%	90%	$38	20	-
Insulation - Wall Cavity	Cooling	3%	0%	17%	90%	$44	20	0.92
Insulation - Wall Cavity	Combined Heat/Cool	3%	2%	17%	90%	$44	20	0.92
Insulation - Wall Cavity	Space Heating	3%	2%	17%	90%	$44	20	0.92
Insulation - Wall Sheathing	Cooling	1%	0%	4%	90%	$66	20	1.23
Insulation - Wall Sheathing	Combined Heat/Cool	4%	11%	4%	90%	$66	20	1.23
Insulation - Wall Sheathing	Space Heating	11%	11%	4%	90%	$66	20	1.23
Doors - Storm and Thermal	Cooling	1%	0%	19%	75%	$180	12	0.13
Doors - Storm and Thermal	Combined Heat/Cool	2%	4%	19%	75%	$180	12	0.13
Doors - Storm and Thermal	Space Heating	4%	4%	19%	75%	$180	12	0.13
Windows - ENERGY STAR	Cooling	32%	0%	13%	90%	$73	20	3.91
Windows - Install reflective film	Cooling	25%	0%	2%	45%	$219	10	0.56
Roofs - High Reflectivity	Cooling	4%	0%	0%	90%	$517	15	0.05
Thermostat - Clock/Programmable	Cooling	7%	0%	19%	25%	$73	12	2.59
Thermostat - Clock/Programmable	Combined Heat/Cool	13%	25%	19%	25%	$73	12	2.59
Thermostat - Clock/Programmable	Space Heating	25%	25%	19%	25%	$73	12	2.59
Water Heater - Faucet Aerators	Water Heating	6%	4%	4%	90%	$7	12	7.24
Water Heater - Pipe Insulation	Water Heating	16%	4%	42%	41%	$50	15	2.96
Water Heater - Low-Flow Showerheads	Water Heating	8%	2%	19%	75%	$24	10	2.22
Water Heater - Tank Blanket/Insulation	Water Heating	5%	9%	8%	25%	$24	13	2.41
Water Heater - Thermostat Setback	Water Heating	9%	9%	5%	75%	$40	5	1.03
Water Heater - Timer	Water Heating	5%	5%	5%	40%	$194	10	0.21
Water Heater - Hot Water Saver	Water Heating	9%	9%	0%	50%	$35	5	1.19
Water Heater - Drainwater Heat Recovery	Water Heating	15%	15%	1%	90%	$899	15	0.18
Interior Lighting - Occupancy Sensor	Interior Lighting	35%	35%	1%	9%	$256	15	0.82
Exterior Lighting - Photovoltaic - Installation	Exterior Lighting	19%	19%	10%	45%	$2,975	15	0.04
Exterior Lighting - Photosensor Control	Exterior Lighting	7%	7%	0%	45%	$90	8	0.32
Exterior Lighting - Timeclock Installation	Exterior Lighting	10%	10%	11%	45%	$108	8	0.40
Refrigerator - Remove Second Unit	Appliances	100%	100%	0%	100%	$75	5	2.52
Refrigerator - Maintenance	Appliances	5%	5%	9%	100%	$50	4	0.13

Measure	End Use	Energy Savings	Demand Savings	Base Satura-tion	Appl./ Feas.	Cost ($/ install)	Life-time (yrs)	BC Ratio
Freezer - Remove Second Unit	Appliances	100%	100%	0%	38%	$75	5	1.64
Freezer - Maintenance	Appliances	5%	5%	9%	100%	$50	4	0.10
Home Electronics - Reduce Standby Wattage	Electronics	10%	10%	5%	90%	$20	8	1.77
Pool - Pump Timer	Miscellaneous	9%	0%	25%	90%	$16	15	8.15
Spa - Pump Timer	Miscellaneous	9%	9%	25%	90%	$16	15	8.79
Advanced New Construction Design	Cooling	40%	0%	2%	45%	$2,500	18	0.27
Advanced New Construction Design	Combined Heat/Cool	40%	40%	2%	45%	$2,500	18	0.27
Advanced New Construction Design	Space Heating	40%	40%	2%	45%	$2,500	18	0.27
Advanced New Construction Design	Interior Lighting	20%	20%	2%	45%	$2,500	18	0.27
ENERGY STAR Homes	Cooling	20%	0%	14%	75%	$5,000	18	0.08
ENERGY STAR Homes	Combined Heat/Cool	20%	20%	14%	75%	$5,000	18	0.08
ENERGY STAR Homes	Space Heating	20%	20%	14%	75%	$5,000	18	0.08
ENERGY STAR Homes	Interior Lighting	20%	20%	14%	75%	$5,000	18	0.08
Home Energy Management System	Cooling	12%	0%	0%	68%	$250	20	1.25
Home Energy Management System	Combined Heat/Cool	12%	12%	0%	68%	$250	20	1.25
Home Energy Management System	Space Heating	12%	12%	0%	68%	$250	20	1.25
Home Energy Management System	Interior Lighting	20%	20%	0%	68%	$250	20	1.25

Table B-13 Energy-Efficiency Non-Equipment Measure Data—Mobile Homes, New Vintage

Measure	End Use	Energy Savings	Demand Savings	Base Satura-tion	Appl./ Feas.	Cost ($/ install)	Life-time (yrs)	BC Ratio
Central AC - Maintenance	Cooling	7%	0%	15%	100%	$100	4	0.40
Attic Fan - Installation	Cooling	1%	0%	4%	23%	$41	18	0.23
Attic Fan - Photovoltaic	Cooling	1%	0%	4%	11%	$200	19	0.05
Ceiling Fan - Installation	Cooling	11%	0%	57%	75%	$80	15	2.06
Whole-House Fan - Installation	Cooling	7%	0%	4%	19%	$125	20	0.77
Dehumidifier	Cooling	9%	0%	3%	3%	$300	12	0.37
Central Heat Pump - Maintenance	Combined Heat/Cool	6%	6%	15%	90%	$100	4	1.24
Central Heat Pump - Maintenance	Combined Heat/Cool	6%	6%	15%	90%	$100	4	1.24
Insulation - Ducting	Cooling	3%	0%	50%	75%	$250	18	0.55
Insulation - Ducting	Combined Heat/Cool	4%	5%	50%	75%	$250	18	0.55
Insulation - Ducting	Space Heating	5%	5%	50%	75%	$250	18	0.55
Ducting - Repair and Sealing	Cooling	10%	0%	12%	50%	$144	18	3.82
Ducting - Repair and Sealing	Combined Heat/Cool	9%	7%	12%	50%	$144	18	3.82
Ducting - Repair and Sealing	Space Heating	7%	7%	12%	50%	$144	18	3.82
Insulation - Infiltration Control	Cooling	9%	0%	19%	90%	$266	11	0.75
Insulation - Infiltration Control	Combined Heat/Cool	9%	9%	19%	90%	$266	11	0.75
Insulation - Infiltration Control	Space Heating	9%	9%	19%	90%	$266	11	0.75
Insulation - Ceiling	Cooling	15%	0%	17%	48%	$123	20	3.81
Insulation - Ceiling	Combined Heat/Cool	15%	13%	17%	48%	$123	20	3.81
Insulation - Ceiling	Space Heating	15%	13%	17%	48%	$123	20	3.81
Insulation - Foundation	Cooling	12%	0%	20%	90%	$251	20	1.42
Insulation - Foundation	Combined Heat/Cool	12%	7%	20%	90%	$251	20	1.42
Insulation - Foundation	Space Heating	12%	7%	20%	90%	$251	20	1.42
Insulation - Wall Cavity	Cooling	11%	0%	0%	90%	$289	20	1.15
Insulation - Wall Cavity	Combined Heat/Cool	11%	8%	0%	90%	$289	20	1.15
Insulation - Wall Cavity	Space Heating	11%	8%	0%	90%	$289	20	1.15
Insulation - Wall Sheathing	Cooling	1%	0%	20%	90%	$433	20	0.43
Insulation - Wall Sheathing	Combined Heat/Cool	5%	9%	20%	90%	$433	20	0.43
Insulation - Wall Sheathing	Space Heating	9%	9%	20%	90%	$433	20	0.43
Doors - Storm and Thermal	Cooling	2%	0%	13%	75%	$180	12	0.49
Doors - Storm and Thermal	Combined Heat/Cool	3%	5%	13%	75%	$180	12	0.49
Doors - Storm and Thermal	Space Heating	5%	5%	13%	75%	$180	12	0.49
Windows - ENERGY STAR	Cooling	13%	0%	13%	90%	$193	20	1.06
Windows - Install reflective film	Cooling	29%	0%	2%	45%	$576	10	0.45
Roofs - High Reflectivity	Cooling	6%	0%	5%	90%	$517	15	0.14
Thermostat - Clock/Programmable	Cooling	6%	0%	57%	75%	$73	12	2.75
Thermostat - Clock/Programmable	Combined Heat/Cool	7%	9%	57%	75%	$73	12	2.75
Thermostat - Clock/Programmable	Space Heating	9%	9%	57%	75%	$73	12	2.75
Water Heater - Faucet Aerators	Water Heating	3%	2%	3%	90%	$7	12	7.23
Water Heater - Pipe Insulation	Water Heating	9%	2%	42%	41%	$50	15	2.96
Water Heater - Low-Flow Showerheads	Water Heating	4%	1%	12%	75%	$24	10	2.14
Water Heater - Tank Blanket/Insulation	Water Heating	5%	9%	8%	25%	$24	13	3.99
Water Heater - Thermostat Setback	Water Heating	9%	9%	5%	75%	$40	5	1.71
Water Heater - Timer	Water Heating	5%	5%	5%	40%	$194	10	0.36
Water Heater - Hot Water Saver	Water Heating	9%	9%	0%	50%	$35	5	1.98
Water Heater - Drainwater Heat Recovery	Water Heating	15%	15%	1%	90%	$899	15	0.30
Interior Lighting - Occupancy Sensor	Interior Lighting	35%	35%	3%	9%	$256	15	0.82
Exterior Lighting - Photovoltaic - Installation	Exterior Lighting	19%	19%	10%	45%	$2,975	15	0.04
Exterior Lighting - Photosensor Control	Exterior Lighting	7%	7%	19%	45%	$90	8	0.32
Exterior Lighting - Timeclock Installation	Exterior Lighting	10%	10%	16%	45%	$108	8	0.40
Refrigerator - Remove Second Unit	Appliances	100%	100%	0%	100%	$75	5	3.03
Refrigerator - Maintenance	Appliances	5%	5%	0%	100%	$50	4	0.16

Measure	End Use	Energy Savings	Demand Savings	Base Satura-tion	Appl./ Feas.	Cost ($/ install)	Life-time (yrs)	BC Ratio
Freezer - Remove Second Unit	Appliances	100%	100%	0%	38%	$75	5	1.98
Freezer - Maintenance	Appliances	5%	5%	0%	100%	$50	4	0.12
Home Electronics - Reduce Standby Wattage	Electronics	10%	10%	5%	90%	$20	8	2.31
Pool - Pump Timer	Miscellaneous	12%	0%	25%	90%	$160	15	1.01
Spa - Pump Timer	Miscellaneous	12%	12%	25%	90%	$160	15	1.14
Advanced New Construction Design	Cooling	40%	0%	2%	45%	$2,500	18	0.56
Advanced New Construction Design	Combined Heat/Cool	40%	40%	2%	45%	$2,500	18	0.56
Advanced New Construction Design	Space Heating	40%	40%	2%	45%	$2,500	18	0.56
Advanced New Construction Design	Interior Lighting	20%	20%	2%	45%	$2,500	18	0.56
ENERGY STAR Homes	Cooling	20%	0%	14%	75%	$5,000	18	0.15
ENERGY STAR Homes	Combined Heat/Cool	20%	20%	14%	75%	$5,000	18	0.15
ENERGY STAR Homes	Space Heating	20%	20%	14%	75%	$5,000	18	0.15
ENERGY STAR Homes	Interior Lighting	20%	20%	14%	75%	$5,000	18	0.15
Energy Efficient Manufactured Home	Cooling	20%	0%	15%	75%	$3,500	18	0.22
Energy Efficient Manufactured Home	Combined Heat/Cool	20%	20%	15%	75%	$3,500	18	0.22
Energy Efficient Manufactured Home	Space Heating	20%	20%	15%	75%	$3,500	18	0.22
Energy Efficient Manufactured Home	Interior Lighting	20%	20%	15%	75%	$3,500	18	0.22
Home Energy Management System	Cooling	8%	0%	0%	68%	$250	20	1.67
Home Energy Management System	Combined Heat/Cool	8%	8%	0%	68%	$250	20	1.67
Home Energy Management System	Space Heating	8%	8%	0%	68%	$250	20	1.67
Home Energy Management System	Interior Lighting	20%	20%	0%	68%	$250	20	1.67

COMMERCIAL ENERGY-EFFICIENCY EQUIPMENT AND MEASURE DATA

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

Table C-1 provides brief narrative descriptions for all measures

Table C-2 through Table C-31 lists the detailed unit-level data (including economic screen results) for commercial equipment measures in existing and new buildings.

Table C-32 through Table C-61 lists the detailed unit-level data (including economic screen results) for commercial non-equipment measures in existing and new construction.

Table C-1 Commercial Energy-Efficiency Equipment/Measure Descriptions

End-Use	Equipment/ Measure	Commercial Measures Descriptions
Cooling	Chiller - Air-cooled, High-efficiency	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	Chiller - Water-cooled, High-efficiency	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	Air Conditioner - Packaged, High-efficiency (including ductless mini-split)	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	Cooling Other, High Efficiency	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).
Combined Heating / Cooling	Heat Pump - Air-Source, High-efficiency (including ductless mini-split)	For heat pumps, units with increasing EER and COP levels are evaluated, as well as a ductless mini-split system.
Cooling	Chiller, Variable Speed Drive	Variable speed drives, which reduce chiller energy use under part load, are modeled for both air-cooled and water-cooled chillers.
Cooling	Chiller, Condenser Water Temperature 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, High-Efficiency Fans	For air-cooled chillers, high-efficiency cooling fans utilize variable frequency drives that improve fan performance by adjusting fan speed and rotation as conditions change.

End-Use	Equipment/ Measure	Commercial Measures Descriptions
Cooling	Water-Cooled Chiller, Cooling Tower, High-Efficiency Fans	For water-cooled chillers, high-efficiency cooling tower fans utilize variable frequency drives in the cooling tower design. VFDs improve fan performance by adjusting fan speed and rotation as conditions change.
Cooling	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.
Cooling	Chiller, Economizer, Installation	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	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.
Combined Heating / Cooling	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%.
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%.
Ventilation	Variable Air - Volume Systems	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.
Ventilation	Ventilation - Variable Speed Control	Variable speed controls adjust ventilation fans for part-load conditions to reduce energy use. This can be accomplished by using electronically commutated motors (ECM's).
Ventilation	Ventilation - CO2 Controlled	Carbon dioxide (CO2) levels indicate the level of occupancy in a space. This measure uses sensors to monitor CO2 levels and controls on the air handling system to adjust the amount of outside air accordingly. Ventilation rates are thereby controlled based on occupancy, rather than a fixed rate, thus saving HVAC energy use.
Ventilation	Ventilation - Exhaust Hood Sensor Control	Improved exhaust hoods involve installing variable-speed controls on commercial kitchen hoods. These controls provide ventilation based on actual cooking loads. When grills, broilers, stoves, fryers or other kitchen appliances are not being used, the controls automatically sense the reduced load and decrease the fan speed accordingly. This results in lower energy consumption because the system is only running as needed rather than at 100% capacity at all times.

End-Use	Equipment/ Measure	Commercial Measures Descriptions
Ventilation	Fans, Energy-Efficient Motors	High-efficiency motors are essentially interchangeable with standard motors, but differences in construction make them more efficient. Energy-efficient motors achieve their improved efficiency by reducing the losses that occur in the conversion of electrical energy to mechanical energy. This analysis assumes that the efficiency of supply fans is increased by 5% due to installing energy-efficient motors.
HVAC	Pumps, High-Efficiency Motors	High-efficiency motors are essentially interchangeable with standard motors, but differences in construction make them more efficient. Energy-efficient motors achieve their improved efficiency by reducing the losses that occur in the conversion of electrical energy to mechanical energy. This analysis assumes that the efficiency of supply fans is increased by 5% due to installing energy-efficient motors.
HVAC	Pumps, Variable Speed Control	The part-load efficiency of chilled water / hot water loop pumps can be improved substantially by varying the speed of the motor drive according to the building demand for heating or cooling. This measure also reduces piping losses. However, pump speeds can generally only be reduced to a minimum specified rate, because chillers, boilers, and control valves may require a minimum flow rate to operate. Two major types of variable speed drives are mechanical and electronic. An additional benefit of variable-speed drives 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 drives are installed.
HVAC	Ducting, Insulation	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	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. This analysis assumes that the baseline air loss from ducts has doubled, and conducting repair and sealing of the ducts will restore leakage from ducts to the original baseline level.
HVAC	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.

End-Use	Equipment/ Measure	Commercial Measures Descriptions
HVAC	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	Roofs, Cool Roof	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	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, Lighting	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	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.

End-Use	Equipment/ Measure	Commercial Measures Descriptions
Interior Lighting	Screw-in: Halogen, CFL, Cold Cathode, LED	This measure evaluates higher-efficiency alternatives for screw-in interior lamps including halogen, CFL, Cold Cathode, 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.
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	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	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	Time Clocks and Timers (lighting)	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	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.

End-Use	Equipment/ Measure	Commercial Measures Descriptions
Interior Lighting	Interior Fluorescent - Bi-Level Fixture w/Occupancy Sensor	Bi-level fixtures with occupancy sensors detect when a space is unoccupied and reduce light output to a lower level.
Interior Lighting	Indoor Lighting - Daylighting Controls	Daylighting controls use a photosensor to detect ambient light and turn off interior lights accordingly.
Exterior Lighting	Screw-in: Halogen, CFL, Cold Cathode, LED	This measure evaluates higher-efficiency alternatives for screw-in exterior lamps including halogen, CFL, Cold Cathode, and LED.
Exterior Lighting	High Intensity Discharge (HID)	Alternatives modeled include mercury vapor, metal halides, T5 high output, high pressure sodium, and low pressure sodium.
Exterior Lighting	Linear Fluorescent	For linear fluorescent fixtures, alternatives include T12, T8, Super T8, T5, and LED.
Interior and Exterior Lighting	Lighting Retrocommissioning	Lighting retrocommissioning projects in existing commercial buildings do not require an event such as a tenant turnover, a major renovation, or an update to electrical circuits to drive its adoption. Rather, a decision-maker can decide at any time to perform a comprehensive audit of a facility's lighting systems, followed by an upgrade of equipment (lamps, ballasts, fixtures, reflectors), controls (occupancy sensors, daylighting controls, and central automation).
Water Heating	Water Heater - Electric, High-Efficiency and Heat Pump Water Heaters	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.
Water Heating	Faucet Aerators and 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 Heating	Pipe - Hot Water, 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 Heating, Tank Blanket	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.
Water Heating	Water Heating, Hot Water Saver	A hot water saver is a plumbing device that attaches to the showerhead and that pauses the flow of water until the water is hot enough for use. The water is re-started by the flip of a switch.

End-Use	Equipment/ Measure	Commercial Measures Descriptions
Water Heating	Pump - Hot Water Circulation, High-Efficiency	A high efficiency circulation pump uses an electronically commutated motor (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 Heating, Solar Water Heating System	Solar water heating systems can be used in commercial buildings that have an appropriate flat or 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 Heating, Heat Trap	Heat traps are valves that only allow water to flow one way in a pipe. They typically operate by means of a ball that sinks or floats depending on flow conditions to open and close the tap. They are placed on pipes running into water heaters to prevent unwanted hot-water flow out of the tank and unwanted cold-water flow into the tank.
Water Heating	Water Heating, Install Timer	This measure uses a timer to adjust the water heater setpoint lower or completely disable the unit at times of low usage, typically when the building is unoccupied.
Water Heating	Water Heating, Thermostat Setback	This measure uses a thermostat to adjust the water heater setpoint lower.
Refrigeration	Refrigerator - Walk-In, High-Efficiency	Standard compressors typically operate at approximately 65% efficiency. High-efficiency models are available that can improve compressor efficiency by 15%.
Refrigeration	Refrigerator - Reach-In, High-Efficiency	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.
Refrigeration	Refrigerator - Glass Door Display, High-Efficiency	These refrigerators can be designed to perform at higher efficiency through a combination of compressor equipment upgrades, default temperature settings, and defrost patterns.
Refrigeration	Refrigerator - Open Display Case, High-Efficiency	These refrigerators can be designed to perform at higher efficiency through a combination of compressor equipment upgrades, default temperature settings, and defrost patterns.
Refrigeration	Icemaker, High Efficiency	By optimizing the timing of ice production and the type of output to the specific application, icemakers are assumed to deliver electricity savings.
Refrigeration	Refrigerator Decommissioning and Recycling	Early retirement, removal, and recycling or older, little used refrigerators and freezers removes the energy use of these inefficient, aging units.

End-Use	Equipment/ Measure	Commercial Measures Descriptions
Refrigeration	Controls, 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	Door Gasket, Replacement	This measure involves replacing aging door gaskets that no longer adequately seal reach-in refrigerators or glass door display cases.
Refrigeration	Night Covers	Night covers can be used on open refrigeration cases when a facility is closed or few customers are in the store.
Refrigeration	High-Efficiency Display Case LED Lighting	High-efficiency LED display case lighting not only reduces direct lighting energy use, but also reduce internal heat gains to the case from lights that must be removed by the refrigeration system.
Refrigeration	Vending Machine, High Efficiency	High-efficiency vending machines incorporate more efficient compressors and lighting.
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 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.
Food Prep	Cooking Equipment, High Efficiency	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.
Office Equipment	Office Electronics - Desktop and Laptop Computers, ENERGY STAR	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. The ClimateSavers Initiative, made up of leading computer processor manufacturers, has stated a goal of reducing power consumption in active mode by 50% by integrating innovative power management into the chip design process.
Office Equipment	Office Electronics - Monitor, ENERGY STAR	ENERGY STAR labeled monitors automatically power down to 15 watts or less when not in use.
Office Equipment	Office Electronics - Server, ENERGY STAR	In addition to the "sleep" mode a reductions and the efficient processors being designed by members of the ClimateSavers Initiative, servers have additional energy-saving opportunities through "virtualization" and other architecture solutions that involve optimal matching of computation tasks to hardware requirements

End-Use	Equipment/ Measure	Commercial Measures Descriptions
Office Equipment	Office Electronics - Copier/Printer, ENERGY STAR	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, reducing a copier's annual electricity costs by over 60%. High-speed copiers that include a duplexing unit that is set to automatically make double-sided copies can reduce paper costs and help to save trees.
Office Equipment	Office Electronics - 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.
Office Equipment	Office Electronics - 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.
Office Equipment	Office Electronics - Power Supply, ENERGY STAR	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.
HVAC, Interior Lighting	Hotel Guestroom Controls (occupancy)	Hotel guestrooms can be fitted with occupancy controls that turn off energy-using equipment when the guest is not using the room. The occupancy controls comes in several forms, but this analysis assumes the simplest kind, which is a simple switch near the room's entry where the guest can deposit their room key or card. If the key or card is present, then lights, TV, and air conditioning can receive power and operate. When the guest leaves and takes the key, all equipment shuts off.
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	Non-HVAC Motors, Variable Speed Control	The part-load efficiency of motor 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.
Miscellaneous	Pool, Efficient Pool Pumps	High-efficiency motors and two-speed pumps provide improved energy efficiency for this load.
Miscellaneous	Pool, Heat Pump or Solar Heating System	This measure replaces an electric resistance pool heater with a heat pump or 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.

Table C-2 Energy-Efficiency Equipment Data—College, Existing Vintage

End Use	Technology	Efficiency Definition	Savings (kWh/ sqft/yr)	Incremental Cost ($/sqft)	Lifetime (yrs)	BC Ratio
Cooling	Air-Cooled Chiller	1.5 kw/ton, COP 2.3	-	$0.00	20	-
Cooling	Air-Cooled Chiller	1.3 kw/ton, COP 2.7	1.42	$1.74	20	0.53
Cooling	Air-Cooled Chiller	1.26 kw/ton, COP 2.8	1.71	$2.26	20	0.48
Cooling	Air-Cooled Chiller	1.0 kw/ton, COP 3.5	3.55	$2.78	20	0.82
Cooling	Air-Cooled Chiller	0.97 kw/ton, COP 3.6	3.77	$3.30	20	0.73
Cooling	Water-Cooled Chiller	0.75 kw/ton, COP 4.7	-	$0.00	20	-
Cooling	Water-Cooled Chiller	0.60 kw/ton, COP 5.9	2.04	$0.65	20	2.03
Cooling	Water-Cooled Chiller	0.58 kw/ton, COP 6.1	2.32	$1.29	20	1.15
Cooling	Water-Cooled Chiller	0.55 kw/Ton, COP 6.4	2.73	$1.55	20	1.13
Cooling	Water-Cooled Chiller	0.51 kw/ton, COP 6.9	3.27	$2.41	20	0.87
Cooling	Water-Cooled Chiller	0.50 kw/Ton, COP 7.0	3.41	$2.67	20	0.82
Cooling	Water-Cooled Chiller	0.48 kw/ton, COP 7.3	3.68	$2.93	20	0.81
Cooling	Roof Top AC	EER 9.2	-	$0.00	16	-
Cooling	Roof Top AC	EER 10.1	0.57	$1.10	16	0.28
Cooling	Roof Top AC	EER 11.2	1.15	$2.12	16	0.29
Cooling	Roof Top AC	EER 12.0	1.50	$4.08	16	0.20
Cooling	Roof Top AC	Ductless Minisplit	2.05	$13.38	16	0.08
Cooling	Other Cooling	EER 9.8	-	$0.00	14	-
Cooling	Other Cooling	EER 10.0	0.12	$1.08	14	0.05
Cooling	Other Cooling	EER 10.2	0.24	$1.28	14	0.09
Cooling	Other Cooling	EER 10.4	0.35	$1.48	14	0.11
Cooling	Other Cooling	EER 10.6	0.46	$1.67	14	0.13
Cooling	Other Cooling	EER 10.8	0.56	$1.87	14	0.14
Cooling	Other Cooling	EER 12.0	1.12	$9.64	14	0.06
Heating	Electric Heating	Standard	-	$0.00	25	-
Cooling/Heating	Roof Top Heat Pump	EER 9.3	-	$0.00	16	-
Cooling/Heating	Roof Top Heat Pump	EER 10.3	0.84	$0.95	16	0.51
Cooling/Heating	Roof Top Heat Pump	EER 11.0	1.34	$1.36	16	0.57
Cooling/Heating	Roof Top Heat Pump	EER 11.7	1.78	$3.49	16	0.29
Cooling/Heating	Roof Top Heat Pump	EER 12.0	1.95	$4.55	16	0.25
Cooling/Heating	Roof Top Heat Pump	Ductless Minisplit	2.98	$8.72	16	0.20
Cooling/Heating	Roof Top Heat Pump	Geothermal	5.17	$15.08	16	0.20
Ventilation	Ventilation	Constant Volume	-	$0.00	10	-
Ventilation	Ventilation	Constant Volume with ECM	0.17	$0.35	10	0.20
Ventilation	Ventilation	Variable Air Volume	0.58	-$0.14	10	1.00
Ventilation	Ventilation	Variable Air Volume with ECM	0.72	$0.21	10	1.39
Water Heating	Water Heating	EF .97	-	$0.00	15	-
Water Heating	Water Heating	EF .98	0.02	$0.03	15	0.38
Water Heating	Water Heating	EF 2.3	1.12	$0.09	15	7.53
Interior Lighting	Screw-in	Incandescent	-	$0.00	2	-
Interior Lighting	Screw-in	90W Halogen PAR-38	0.44	$0.03	3	1.98
Interior Lighting	Screw-in	70W HIR PAR-38	0.67	$0.04	3	2.20
Interior Lighting	Screw-in	CFL	1.25	$0.02	6	16.24
Interior Lighting	Screw-in	LED	1.36	$0.56	12	1.20
Interior Lighting	High-Bay Fixtures	Metal Halides	-	$0.00	3	-
Interior Lighting	High-Bay Fixtures	LED	0.12	$0.10	15	0.82
Interior Lighting	High-Bay Fixtures	T8	0.12	$0.00	10	1.00
Interior Lighting	High-Bay Fixtures	High Pressure Sodium	0.13	$0.00	6	1.00
Interior Lighting	High-Bay Fixtures	T5	0.16	$0.00	10	1.00
Interior Lighting	Linear Fluorescent	T12	-	$0.00	10	-
Interior Lighting	Linear Fluorescent	LED	0.53	$2.32	15	0.14
Interior Lighting	Linear Fluorescent	T8	0.55	$0.00	10	241.12
Interior Lighting	Linear Fluorescent	Super T8	0.76	$0.02	10	20.48
Exterior Lighting	Screw-in	Incandescent	-	$0.00	2	-

End Use	Technology	Efficiency Definition	Savings (kWh/ sqft/yr)	Incremental Cost ($/sqft)	Lifetime (yrs)	BC Ratio
Exterior Lighting	Screw-in	90W Halogen PAR-38	0.04	$0.00	3	2.25
Exterior Lighting	Screw-in	70W HIR PAR-38	0.06	$0.00	3	2.49
Exterior Lighting	Screw-in	CFL	0.11	$0.00	6	18.88
Exterior Lighting	Screw-in	LED	0.12	$0.03	12	1.46
Exterior Lighting	HID	Metal Halides	-	$0.00	3	-
Exterior Lighting	HID	LED	0.15	$0.50	15	0.16
Exterior Lighting	HID	T8	0.15	$0.00	10	1.00
Exterior Lighting	HID	High Pressure Sodium	0.24	$0.00	6	1.00
Exterior Lighting	HID	T5	0.25	$0.00	10	1.00
Exterior Lighting	Linear Fluorescent	T12	-	$0.00	10	-
Exterior Lighting	Linear Fluorescent	LED	0.00	$0.00	15	0.13
Exterior Lighting	Linear Fluorescent	T8	0.00	$0.00	10	227.85
Exterior Lighting	Linear Fluorescent	Super T8	0.00	$0.00	10	19.35
Exterior Lighting	Linear Fluorescent	T5	0.00	$0.00	10	13.92
Refrigeration	Walk-in Refrigerator	14600 kWh/yr	-	$0.00	18	-
Refrigeration	Walk-in Refrigerator	10800 kWh/yr	0.03	$0.01	18	1.71
Refrigeration	Walk-in Refrigerator	10000 kWh/yr	0.03	$0.01	18	1.64
Refrigeration	Walk-in Refrigerator	9000 kWh/yr	0.04	$0.02	18	1.11
Refrigeration	Reach-in Refrigerator	3100 kWh/yr	-	$0.00	18	-
Refrigeration	Reach-in Refrigerator	2500 kWh/yr	0.01	$0.01	18	1.01
Refrigeration	Reach-in Refrigerator	2400 kWh/yr	0.01	$0.01	18	1.05
Refrigeration	Reach-in Refrigerator	1500 kWh/yr	0.02	$0.01	18	2.16
Refrigeration	Glass Door Display	15500 kWh/yr	-	$0.00	18	-
Refrigeration	Glass Door Display	14480 kWh/yr	0.01	$0.00	18	3.28
Refrigeration	Glass Door Display	11700 kWh/yr	0.03	$0.01	18	1.25
Refrigeration	Glass Door Display	8400 kWh/yr	0.05	$0.00	18	-
Refrigeration	Glass Door Display	6800 kWh/yr	0.06	$0.01	18	-
Refrigeration	Open Display Case	7000 kWh/yr	-	$0.00	18	-
Refrigeration	Open Display Case	6535 kWh/yr	0.00	$0.00	18	3.31
Refrigeration	Open Display Case	5350 kWh/yr	0.01	$0.00	18	-
Refrigeration	Open Display Case	5300 kWh/yr	0.01	$0.01	18	1.22
Refrigeration	Open Display Case	4350 kWh/yr	0.02	$0.01	18	-
Refrigeration	Icemaker	7.0 kWh/100 lbs	-	$0.00	12	-
Refrigeration	Icemaker	6.3 kWh/100 lbs	0.01	$0.00	12	1.10
Refrigeration	Icemaker	6.0 kWh/100 lbs	0.01	$0.00	12	1.04
Refrigeration	Icemaker	5.5 kWh/100 lbs	0.01	$0.02	12	0.42
Refrigeration	Vending Machine	3400 kWh/year	-	$0.00	10	-
Refrigeration	Vending Machine	2400 kWh/year	0.01	$0.00	10	4.03
Refrigeration	Vending Machine	1700 kWh/year	0.02	$0.00	10	2.28
Food Preparation	Oven	Standard	-	$0.00	12	-
Food Preparation	Oven	Energy Star	0.04	$0.00	12	94,572.93
Food Preparation	Fryer	Standard	-	$0.00	12	-
Food Preparation	Fryer	Energy Star	0.02	$0.01	12	2.28
Food Preparation	Dishwasher	Standard	-	$0.00	12	-
Food Preparation	Dishwasher	Energy Star	0.19	$0.01	12	10.90
Food Preparation	Hot Food Container	Standard	-	$0.00	12	-
Food Preparation	Hot Food Container	Energy Star	0.13	$0.03	12	2.22
Office Equipment	Desktop Computer	Standard	-	$0.00	4	-
Office Equipment	Desktop Computer	Energy Star	0.15	$0.00	4	2,018.52
Office Equipment	Laptop	Standard	-	$0.00	4	-
Office Equipment	Laptop	Energy Star	0.02	$0.00	4	622.25
Office Equipment	Server	Standard	-	$0.00	3	-
Office Equipment	Server	Energy Star	0.05	$0.00	3	7,120.99
Office Equipment	Monitor	Standard	-	$0.00	4	-
Office Equipment	Monitor	Energy Star	0.02	$0.00	4	227.65
Office Equipment	Printer/Copier/Fax	Standard	-	$0.00	6	-
Office Equipment	Printer/Copier/Fax	Energy Star	0.03	$0.00	6	2,122.59

End Use	Technology	Efficiency Definition	Savings (kWh/ sqft/yr)	Incremental Cost ($/sqft)	Lifetime (yrs)	BC Ratio
Office Equipment	POS Terminal	Standard	-	$0.00	4	-
Office Equipment	POS Terminal	Efficient	0.03	$0.02	4	0.27
Miscellaneous	Non-HVAC Motors	Standard (EPAct)	-	$0.00	15	-
Miscellaneous	Non-HVAC Motors	Standard (EPAct 2015)	0.00	$0.00	15	-
Miscellaneous	Non-HVAC Motors	High Efficiency	0.00	$0.00	15	5.55
Miscellaneous	Non-HVAC Motors	High Efficiency (2015)	0.00	$0.00	15	-
Miscellaneous	Non-HVAC Motors	Premium (NEMA)	0.00	$0.00	15	5.55
Miscellaneous	Non-HVAC Motors	Premium (NEMA 2015)	0.00	$0.00	15	-
Miscellaneous	Pool Pump	Standard	-	$0.00	15	-
Miscellaneous	Pool Pump	High Efficiency	0.00	$0.00	15	1.84
Miscellaneous	Pool Pump	Two-Speed	0.00	$0.00	15	1.08
Miscellaneous	Pool Heater	Standard	-	$0.00	15	-
Miscellaneous	Pool Heater	Heat Pump	0.01	$0.01	15	0.94
Miscellaneous	Pool Heater	Solar	0.01	$0.01	15	0.94
Miscellaneous	Miscellaneous	Standard	-	$0.00	5	-

Table C-3 Energy-Efficiency Equipment Data—School, Existing Vintage

End Use	Technology	Efficiency Definition	Savings (kWh/ sqft/yr)	Incremental Cost ($/sqft)	Lifetime (yrs)	BC Ratio
Cooling	Air-Cooled Chiller	1.5 kw/ton, COP 2.3	-	$0.00	20	-
Cooling	Air-Cooled Chiller	1.3 kw/ton, COP 2.7	0.74	$0.90	20	0.53
Cooling	Air-Cooled Chiller	1.26 kw/ton, COP 2.8	0.88	$1.17	20	0.48
Cooling	Air-Cooled Chiller	1.0 kw/ton, COP 3.5	1.84	$1.44	20	0.82
Cooling	Air-Cooled Chiller	0.97 kw/ton, COP 3.6	1.95	$1.71	20	0.73
Cooling	Water-Cooled Chiller	0.75 kw/ton, COP 4.7	-	$0.00	20	-
Cooling	Water-Cooled Chiller	0.60 kw/ton, COP 5.9	1.06	$0.33	20	2.03
Cooling	Water-Cooled Chiller	0.58 kw/ton, COP 6.1	1.20	$0.67	20	1.15
Cooling	Water-Cooled Chiller	0.55 kw/Ton, COP 6.4	1.41	$0.80	20	1.13
Cooling	Water-Cooled Chiller	0.51 kw/ton, COP 6.9	1.69	$1.25	20	0.87
Cooling	Water-Cooled Chiller	0.50 kw/Ton, COP 7.0	1.76	$1.38	20	0.82
Cooling	Water-Cooled Chiller	0.48 kw/ton, COP 7.3	1.91	$1.52	20	0.81
Cooling	Roof Top AC	EER 9.2	-	$0.00	16	-
Cooling	Roof Top AC	EER 10.1	0.30	$0.57	16	0.28
Cooling	Roof Top AC	EER 11.2	0.59	$1.10	16	0.29
Cooling	Roof Top AC	EER 12.0	0.78	$2.11	16	0.20
Cooling	Roof Top AC	Ductless Minisplit	1.06	$6.93	16	0.08
Cooling	Other Cooling	EER 9.8	-	$0.00	14	-
Cooling	Other Cooling	EER 10.0	0.06	$0.56	14	0.05
Cooling	Other Cooling	EER 10.2	0.12	$0.66	14	0.09
Cooling	Other Cooling	EER 10.4	0.18	$0.76	14	0.11
Cooling	Other Cooling	EER 10.6	0.24	$0.87	14	0.13
Cooling	Other Cooling	EER 10.8	0.29	$0.97	14	0.14
Cooling	Other Cooling	EER 12.0	0.58	$4.99	14	0.06
Heating	Electric Heating	Standard	-	$0.00	25	-
Cooling/Heating	Roof Top Heat Pump	EER 9.3	-	$0.00	16	-
Cooling/Heating	Roof Top Heat Pump	EER 10.3	0.45	$0.50	16	0.56
Cooling/Heating	Roof Top Heat Pump	EER 11.0	0.71	$0.72	16	0.63
Cooling/Heating	Roof Top Heat Pump	EER 11.7	0.95	$1.86	16	0.32
Cooling/Heating	Roof Top Heat Pump	EER 12.0	1.04	$2.42	16	0.27
Cooling/Heating	Roof Top Heat Pump	Ductless Minisplit	1.58	$4.64	16	0.22
Cooling/Heating	Roof Top Heat Pump	Geothermal	2.75	$8.03	16	0.22
Ventilation	Ventilation	Constant Volume	-	$0.00	10	-
Ventilation	Ventilation	Constant Volume with ECM	0.09	$0.18	10	0.20
Ventilation	Ventilation	Variable Air Volume	0.30	-$0.07	10	1.00
Ventilation	Ventilation	Variable Air Volume with ECM	0.37	$0.11	10	1.39
Water Heating	Water Heating	EF .97	-	$0.00	15	-
Water Heating	Water Heating	EF .98	0.01	$0.02	15	0.40
Water Heating	Water Heating	EF 2.3	0.58	$0.05	15	7.81
Interior Lighting	Screw-in	Incandescent	-	$0.00	2	-
Interior Lighting	Screw-in	90W Halogen PAR-38	0.08	$0.02	3	0.44
Interior Lighting	Screw-in	70W HIR PAR-38	0.12	$0.03	3	0.49
Interior Lighting	Screw-in	CFL	0.23	$0.02	6	3.56
Interior Lighting	Screw-in	LED	0.25	$0.53	12	0.26
Interior Lighting	High-Bay Fixtures	Metal Halides	-	$0.00	3	-
Interior Lighting	High-Bay Fixtures	LED	0.18	$0.22	15	0.63
Interior Lighting	High-Bay Fixtures	T8	0.19	-$0.01	10	1.00
Interior Lighting	High-Bay Fixtures	High Pressure Sodium	0.20	$0.00	6	1.00
Interior Lighting	High-Bay Fixtures	T5	0.24	$0.00	10	1.00
Interior Lighting	Linear Fluorescent	T12	-	$0.00	10	-
Interior Lighting	Linear Fluorescent	LED	0.70	$1.77	15	0.26
Interior Lighting	Linear Fluorescent	T8	0.73	$0.00	10	460.51
Interior Lighting	Linear Fluorescent	Super T8	1.01	$0.01	10	39.11
Exterior Lighting	Screw-in	Incandescent	-	$0.00	2	-
Exterior Lighting	Screw-in	90W Halogen PAR-38	0.02	$0.00	3	2.25

End Use	Technology	Efficiency Definition	Savings (kWh/ sqft/yr)	Incremental Cost ($/sqft)	Lifetime (yrs)	BC Ratio
Exterior Lighting	Screw-in	70W HIR PAR-38	0.03	$0.00	3	2.49
Exterior Lighting	Screw-in	CFL	0.06	$0.00	6	18.88
Exterior Lighting	Screw-in	LED	0.07	$0.02	12	1.46
Exterior Lighting	HID	Metal Halides	-	$0.00	3	-
Exterior Lighting	HID	LED	0.11	$0.37	15	0.16
Exterior Lighting	HID	T8	0.11	$0.00	10	1.00
Exterior Lighting	HID	High Pressure Sodium	0.17	$0.00	6	1.00
Exterior Lighting	HID	T5	0.18	$0.00	10	1.00
Exterior Lighting	Linear Fluorescent	T12	-	$0.00	10	-
Exterior Lighting	Linear Fluorescent	LED	0.00	$0.00	15	0.13
Exterior Lighting	Linear Fluorescent	T8	0.00	$0.00	10	227.85
Exterior Lighting	Linear Fluorescent	Super T8	0.00	$0.00	10	19.35
Exterior Lighting	Linear Fluorescent	T5	0.00	$0.00	10	13.92
Refrigeration	Walk-in Refrigerator	14600 kWh/yr	-	$0.00	18	-
Refrigeration	Walk-in Refrigerator	10800 kWh/yr	0.03	$0.01	18	1.72
Refrigeration	Walk-in Refrigerator	10000 kWh/yr	0.04	$0.01	18	1.65
Refrigeration	Walk-in Refrigerator	9000 kWh/yr	0.04	$0.03	18	1.12
Refrigeration	Reach-in Refrigerator	3100 kWh/yr	-	$0.00	18	-
Refrigeration	Reach-in Refrigerator	2500 kWh/yr	0.01	$0.01	18	1.02
Refrigeration	Reach-in Refrigerator	2400 kWh/yr	0.01	$0.01	18	1.06
Refrigeration	Reach-in Refrigerator	1500 kWh/yr	0.02	$0.01	18	2.18
Refrigeration	Glass Door Display	15500 kWh/yr	-	$0.00	18	-
Refrigeration	Glass Door Display	14480 kWh/yr	0.01	$0.00	18	3.31
Refrigeration	Glass Door Display	11700 kWh/yr	0.03	$0.02	18	1.26
Refrigeration	Glass Door Display	8400 kWh/yr	0.05	$0.00	18	-
Refrigeration	Glass Door Display	6800 kWh/yr	0.07	$0.02	18	-
Refrigeration	Open Display Case	7000 kWh/yr	-	$0.00	18	-
Refrigeration	Open Display Case	6535 kWh/yr	0.00	$0.00	18	3.33
Refrigeration	Open Display Case	5350 kWh/yr	0.01	$0.00	18	-
Refrigeration	Open Display Case	5300 kWh/yr	0.01	$0.01	18	1.23
Refrigeration	Open Display Case	4350 kWh/yr	0.02	$0.01	18	-
Refrigeration	Icemaker	7.0 kWh/100 lbs	-	$0.00	12	-
Refrigeration	Icemaker	6.3 kWh/100 lbs	0.01	$0.00	12	1.11
Refrigeration	Icemaker	6.0 kWh/100 lbs	0.01	$0.00	12	1.05
Refrigeration	Icemaker	5.5 kWh/100 lbs	0.01	$0.02	12	0.42
Refrigeration	Vending Machine	3400 kWh/year	-	$0.00	10	-
Refrigeration	Vending Machine	2400 kWh/year	0.02	$0.00	10	4.06
Refrigeration	Vending Machine	1700 kWh/year	0.03	$0.00	10	2.30
Food Preparation	Oven	Standard	-	$0.00	12	-
Food Preparation	Oven	Energy Star	0.02	$0.00	12	110,574.77
Food Preparation	Fryer	Standard	-	$0.00	12	-
Food Preparation	Fryer	Energy Star	0.01	$0.00	12	2.67
Food Preparation	Dishwasher	Standard	-	$0.00	12	-
Food Preparation	Dishwasher	Energy Star	0.11	$0.00	12	12.75
Food Preparation	Hot Food Container	Standard	-	$0.00	12	-
Food Preparation	Hot Food Container	Energy Star	0.07	$0.02	12	2.60
Office Equipment	Desktop Computer	Standard	-	$0.00	4	-
Office Equipment	Desktop Computer	Energy Star	0.07	$0.00	4	2,208.46
Office Equipment	Laptop	Standard	-	$0.00	4	-
Office Equipment	Laptop	Energy Star	0.01	$0.00	4	680.80
Office Equipment	Server	Standard	-	$0.00	3	-
Office Equipment	Server	Energy Star	0.05	$0.00	3	7,804.08
Office Equipment	Monitor	Standard	-	$0.00	4	-
Office Equipment	Monitor	Energy Star	0.01	$0.00	4	249.07
Office Equipment	Printer/Copier/Fax	Standard	-	$0.00	6	-
Office Equipment	Printer/Copier/Fax	Energy Star	0.03	$0.00	6	2,306.86

End Use	Technology	Efficiency Definition	Savings (kWh/ sqft/yr)	Incremental Cost ($/sqft)	Lifetime (yrs)	BC Ratio
Office Equipment	POS Terminal	Standard	-	$0.00	4	-
Office Equipment	POS Terminal	Efficient	0.01	$0.01	4	0.29
Miscellaneous	Non-HVAC Motors	Standard (EPAct)	-	$0.00	15	-
Miscellaneous	Non-HVAC Motors	Standard (EPAct 2015)	0.00	$0.00	15	-
Miscellaneous	Non-HVAC Motors	High Efficiency	0.00	$0.00	15	6.01
Miscellaneous	Non-HVAC Motors	High Efficiency (2015)	0.00	$0.00	15	-
Miscellaneous	Non-HVAC Motors	Premium (NEMA)	0.00	$0.00	15	6.01
Miscellaneous	Non-HVAC Motors	Premium (NEMA 2015)	0.00	$0.00	15	-
Miscellaneous	Pool Pump	Standard	-	$0.00	15	-
Miscellaneous	Pool Pump	High Efficiency	0.00	$0.00	15	2.00
Miscellaneous	Pool Pump	Two-Speed	0.00	$0.00	15	1.17
Miscellaneous	Pool Heater	Standard	-	$0.00	15	-
Miscellaneous	Pool Heater	Heat Pump	0.00	$0.00	15	1.02
Miscellaneous	Pool Heater	Solar	0.00	$0.00	15	1.01
Miscellaneous	Miscellaneous	Standard	-	$0.00	5	-

Table C-4 Energy-Efficiency Equipment Data—Large Grocery, Existing Vintage

End Use	Technology	Efficiency Definition	Savings (kWh/ sqft/yr)	Incremental Cost ($/sqft)	Lifetime (yrs)	BC Ratio
Cooling	Air-Cooled Chiller	1.5 kw/ton, COP 2.3	-	$0.00	20	-
Cooling	Air-Cooled Chiller	1.3 kw/ton, COP 2.7	1.79	$0.52	20	2.21
Cooling	Air-Cooled Chiller	1.26 kw/ton, COP 2.8	2.14	$0.68	20	2.04
Cooling	Air-Cooled Chiller	1.0 kw/ton, COP 3.5	4.47	$0.83	20	3.45
Cooling	Air-Cooled Chiller	0.97 kw/ton, COP 3.6	4.73	$0.99	20	3.08
Cooling	Water-Cooled Chiller	0.75 kw/ton, COP 4.7	-	$0.00	20	-
Cooling	Water-Cooled Chiller	0.60 kw/ton, COP 5.9	2.18	$0.20	20	7.15
Cooling	Water-Cooled Chiller	0.58 kw/ton, COP 6.1	2.47	$0.39	20	4.05
Cooling	Water-Cooled Chiller	0.55 kw/Ton, COP 6.4	2.91	$0.47	20	3.98
Cooling	Water-Cooled Chiller	0.51 kw/ton, COP 6.9	3.49	$0.73	20	3.07
Cooling	Water-Cooled Chiller	0.50 kw/Ton, COP 7.0	3.64	$0.81	20	2.89
Cooling	Water-Cooled Chiller	0.48 kw/ton, COP 7.3	3.93	$0.89	20	2.85
Cooling	Roof Top AC	EER 9.2	-	$0.00	16	-
Cooling	Roof Top AC	EER 10.1	0.93	$3.86	16	0.13
Cooling	Roof Top AC	EER 11.2	1.85	$7.42	16	0.13
Cooling	Roof Top AC	EER 12.0	2.42	$14.25	16	0.09
Cooling	Roof Top AC	Ductless Minisplit	3.36	$46.76	16	0.04
Cooling	Other Cooling	EER 9.8	-	$0.00	14	-
Cooling	Other Cooling	EER 10.0	0.21	$0.36	14	0.28
Cooling	Other Cooling	EER 10.2	0.41	$0.43	14	0.46
Cooling	Other Cooling	EER 10.4	0.61	$0.49	14	0.59
Cooling	Other Cooling	EER 10.6	0.80	$0.56	14	0.68
Cooling	Other Cooling	EER 10.8	0.98	$0.63	14	0.74
Cooling	Other Cooling	EER 12.0	1.93	$3.22	14	0.29
Heating	Electric Heating	Standard	-	$0.00	25	-
Cooling/Heating	Roof Top Heat Pump	EER 9.3	-	$0.00	16	-
Cooling/Heating	Roof Top Heat Pump	EER 10.3	1.06	$0.64	16	0.99
Cooling/Heating	Roof Top Heat Pump	EER 11.0	1.70	$0.92	16	1.10
Cooling/Heating	Roof Top Heat Pump	EER 11.7	2.25	$2.35	16	0.57
Cooling/Heating	Roof Top Heat Pump	EER 12.0	2.47	$3.07	16	0.48
Cooling/Heating	Roof Top Heat Pump	Ductless Minisplit	3.77	$5.87	16	0.38
Cooling/Heating	Roof Top Heat Pump	Geothermal	5.91	$10.15	16	0.35
Ventilation	Ventilation	Constant Volume	-	$0.00	10	-
Ventilation	Ventilation	Constant Volume with ECM	0.21	$0.51	10	0.16
Ventilation	Ventilation	Variable Air Volume	0.21	-$0.21	10	1.00
Ventilation	Ventilation	Variable Air Volume with ECM	0.49	$0.30	10	0.64
Water Heating	Water Heating	EF .97	-	$0.00	15	-
Water Heating	Water Heating	EF .98	0.02	$0.02	15	0.69
Water Heating	Water Heating	EF 2.3	1.27	$0.06	15	13.74
Interior Lighting	Screw-in	Incandescent	-	$0.00	2	-
Interior Lighting	Screw-in	90W Halogen PAR-38	0.36	$0.03	3	1.39
Interior Lighting	Screw-in	70W HIR PAR-38	0.55	$0.04	3	1.55
Interior Lighting	Screw-in	CFL	1.03	$0.02	6	11.42
Interior Lighting	Screw-in	LED	1.11	$0.66	12	0.85
Interior Lighting	High-Bay Fixtures	Metal Halides	-	$0.00	3	-
Interior Lighting	High-Bay Fixtures	LED	0.77	$0.03	15	16.81
Interior Lighting	High-Bay Fixtures	T8	0.78	$0.00	10	1.00
Interior Lighting	High-Bay Fixtures	High Pressure Sodium	0.83	$0.00	6	1.00
Interior Lighting	High-Bay Fixtures	T5	1.00	$0.00	10	1.00
Interior Lighting	Linear Fluorescent	T12	-	$0.00	10	-
Interior Lighting	Linear Fluorescent	LED	1.43	$2.91	15	0.30
Interior Lighting	Linear Fluorescent	T8	1.49	$0.00	10	519.78
Interior Lighting	Linear Fluorescent	Super T8	2.06	$0.02	10	44.15
Exterior Lighting	Screw-in	Incandescent	-	$0.00	2	-

End Use	Technology	Efficiency Definition	Savings (kWh/ sqft/yr)	Incremental Cost ($/sqft)	Lifetime (yrs)	BC Ratio
Exterior Lighting	Screw-in	90W Halogen PAR-38	0.09	$0.00	3	2.22
Exterior Lighting	Screw-in	70W HIR PAR-38	0.13	$0.01	3	2.46
Exterior Lighting	Screw-in	CFL	0.25	$0.00	6	18.65
Exterior Lighting	Screw-in	LED	0.27	$0.08	12	1.44
Exterior Lighting	HID	Metal Halides	-	$0.00	3	-
Exterior Lighting	HID	LED	0.22	$0.75	15	0.16
Exterior Lighting	HID	T8	0.23	-$0.01	10	1.00
Exterior Lighting	HID	High Pressure Sodium	0.36	$0.00	6	1.00
Exterior Lighting	HID	T5	0.37	$0.00	10	1.00
Exterior Lighting	Linear Fluorescent	T12	-	$0.00	10	-
Exterior Lighting	Linear Fluorescent	LED	0.01	$0.03	15	0.13
Exterior Lighting	Linear Fluorescent	T8	0.01	$0.00	10	227.85
Exterior Lighting	Linear Fluorescent	Super T8	0.01	$0.00	10	19.35
Exterior Lighting	Linear Fluorescent	T5	0.01	$0.00	10	13.92
Refrigeration	Walk-in Refrigerator	14600 kWh/yr	-	$0.00	18	-
Refrigeration	Walk-in Refrigerator	10800 kWh/yr	1.01	$0.40	18	1.71
Refrigeration	Walk-in Refrigerator	10000 kWh/yr	1.22	$0.50	18	1.63
Refrigeration	Walk-in Refrigerator	9000 kWh/yr	1.48	$0.90	18	1.11
Refrigeration	Reach-in Refrigerator	3100 kWh/yr	-	$0.00	18	-
Refrigeration	Reach-in Refrigerator	2500 kWh/yr	0.05	$0.03	18	1.01
Refrigeration	Reach-in Refrigerator	2400 kWh/yr	0.05	$0.03	18	1.05
Refrigeration	Reach-in Refrigerator	1500 kWh/yr	0.12	$0.04	18	2.16
Refrigeration	Glass Door Display	15500 kWh/yr	-	$0.00	18	-
Refrigeration	Glass Door Display	14480 kWh/yr	0.77	$0.16	18	3.27
Refrigeration	Glass Door Display	11700 kWh/yr	2.88	$1.56	18	1.24
Refrigeration	Glass Door Display	8400 kWh/yr	5.37	$0.16	18	-
Refrigeration	Glass Door Display	6800 kWh/yr	6.58	$1.56	18	-
Refrigeration	Open Display Case	7000 kWh/yr	-	$0.00	18	-
Refrigeration	Open Display Case	6535 kWh/yr	0.35	$0.07	18	3.30
Refrigeration	Open Display Case	5350 kWh/yr	1.25	$0.07	18	-
Refrigeration	Open Display Case	5300 kWh/yr	1.29	$0.71	18	1.22
Refrigeration	Open Display Case	4350 kWh/yr	2.01	$0.71	18	-
Refrigeration	Icemaker	7.0 kWh/100 lbs	-	$0.00	12	-
Refrigeration	Icemaker	6.3 kWh/100 lbs	0.02	$0.01	12	1.10
Refrigeration	Icemaker	6.0 kWh/100 lbs	0.02	$0.01	12	1.03
Refrigeration	Icemaker	5.5 kWh/100 lbs	0.04	$0.04	12	0.42
Refrigeration	Vending Machine	3400 kWh/year	-	$0.00	10	-
Refrigeration	Vending Machine	2400 kWh/year	0.08	$0.01	10	4.01
Refrigeration	Vending Machine	1700 kWh/year	0.13	$0.02	10	2.27
Food Preparation	Oven	Standard	-	$0.00	12	-
Food Preparation	Oven	Energy Star	0.09	$0.00	12	96,282.52
Food Preparation	Fryer	Standard	-	$0.00	12	-
Food Preparation	Fryer	Energy Star	0.06	$0.01	12	2.32
Food Preparation	Dishwasher	Standard	-	$0.00	12	-
Food Preparation	Dishwasher	Energy Star	0.47	$0.02	12	11.10
Food Preparation	Hot Food Container	Standard	-	$0.00	12	-
Food Preparation	Hot Food Container	Energy Star	0.32	$0.07	12	2.26
Office Equipment	Desktop Computer	Standard	-	$0.00	4	-
Office Equipment	Desktop Computer	Energy Star	0.06	$0.00	4	2,010.93
Office Equipment	Laptop	Standard	-	$0.00	4	-
Office Equipment	Laptop	Energy Star	0.01	$0.00	4	619.91
Office Equipment	Server	Standard	-	$0.00	3	-
Office Equipment	Server	Energy Star	0.03	$0.00	3	7,093.69
Office Equipment	Monitor	Standard	-	$0.00	4	-
Office Equipment	Monitor	Energy Star	0.01	$0.00	4	226.80
Office Equipment	Printer/Copier/Fax	Standard	-	$0.00	6	-
Office Equipment	Printer/Copier/Fax	Energy Star	0.01	$0.00	6	2,115.22

End Use	Technology	Efficiency Definition	Savings (kWh/ sqft/yr)	Incremental Cost ($/sqft)	Lifetime (yrs)	BC Ratio
Office Equipment	POS Terminal	Standard	-	$0.00	4	-
Office Equipment	POS Terminal	Efficient	0.04	$0.02	4	0.27
Miscellaneous	Non-HVAC Motors	Standard (EPAct)	-	$0.00	15	-
Miscellaneous	Non-HVAC Motors	Standard (EPAct 2015)	0.00	$0.00	15	-
Miscellaneous	Non-HVAC Motors	High Efficiency	0.00	$0.00	15	5.43
Miscellaneous	Non-HVAC Motors	High Efficiency (2015)	0.00	$0.00	15	-
Miscellaneous	Non-HVAC Motors	Premium (NEMA)	0.00	$0.00	15	5.43
Miscellaneous	Non-HVAC Motors	Premium (NEMA 2015)	0.00	$0.00	15	-
Miscellaneous	Pool Pump	Standard	-	$0.00	15	-
Miscellaneous	Pool Pump	High Efficiency	-	$0.00	15	1.00
Miscellaneous	Pool Pump	Two-Speed	-	$0.00	15	1.00
Miscellaneous	Pool Heater	Standard	-	$0.00	15	-
Miscellaneous	Pool Heater	Heat Pump	-	$0.00	15	1.00
Miscellaneous	Pool Heater	Solar	-	$0.00	15	1.00
Miscellaneous	Miscellaneous	Standard	-	$0.00	5	-

Table C-5 Energy-Efficiency Equipment Data—Small Grocery, Existing Vintage

End Use	Technology	Efficiency Definition	Savings (kWh/ sqft/yr)	Incremental Cost ($/sqft)	Lifetime (yrs)	BC Ratio
Cooling	Air-Cooled Chiller	1.5 kw/ton, COP 2.3	-	$0.00	20	-
Cooling	Air-Cooled Chiller	1.3 kw/ton, COP 2.7	1.67	$0.49	20	2.21
Cooling	Air-Cooled Chiller	1.26 kw/ton, COP 2.8	2.01	$0.63	20	2.04
Cooling	Air-Cooled Chiller	1.0 kw/ton, COP 3.5	4.18	$0.78	20	3.45
Cooling	Air-Cooled Chiller	0.97 kw/ton, COP 3.6	4.43	$0.92	20	3.08
Cooling	Water-Cooled Chiller	0.75 kw/ton, COP 4.7	-	$0.00	20	-
Cooling	Water-Cooled Chiller	0.60 kw/ton, COP 5.9	2.04	$0.18	20	7.15
Cooling	Water-Cooled Chiller	0.58 kw/ton, COP 6.1	2.31	$0.37	20	4.05
Cooling	Water-Cooled Chiller	0.55 kw/Ton, COP 6.4	2.72	$0.44	20	3.98
Cooling	Water-Cooled Chiller	0.51 kw/ton, COP 6.9	3.27	$0.68	20	3.07
Cooling	Water-Cooled Chiller	0.50 kw/Ton, COP 7.0	3.40	$0.76	20	2.89
Cooling	Water-Cooled Chiller	0.48 kw/ton, COP 7.3	3.68	$0.83	20	2.85
Cooling	Roof Top AC	EER 9.2	-	$0.00	16	-
Cooling	Roof Top AC	EER 10.1	0.87	$3.61	16	0.13
Cooling	Roof Top AC	EER 11.2	1.73	$6.94	16	0.13
Cooling	Roof Top AC	EER 12.0	2.27	$13.33	16	0.09
Cooling	Roof Top AC	Ductless Minisplit	3.15	$43.74	16	0.04
Cooling	Other Cooling	EER 9.8	-	$0.00	14	-
Cooling	Other Cooling	EER 10.0	0.20	$0.34	14	0.28
Cooling	Other Cooling	EER 10.2	0.39	$0.40	14	0.46
Cooling	Other Cooling	EER 10.4	0.57	$0.46	14	0.59
Cooling	Other Cooling	EER 10.6	0.74	$0.52	14	0.68
Cooling	Other Cooling	EER 10.8	0.91	$0.58	14	0.74
Cooling	Other Cooling	EER 12.0	1.81	$3.01	14	0.29
Heating	Electric Heating	Standard	-	$0.00	25	-
Cooling/Heating	Roof Top Heat Pump	EER 9.3	-	$0.00	16	-
Cooling/Heating	Roof Top Heat Pump	EER 10.3	1.00	$0.60	16	0.99
Cooling/Heating	Roof Top Heat Pump	EER 11.0	1.60	$0.86	16	1.10
Cooling/Heating	Roof Top Heat Pump	EER 11.7	2.12	$2.21	16	0.57
Cooling/Heating	Roof Top Heat Pump	EER 12.0	2.33	$2.89	16	0.48
Cooling/Heating	Roof Top Heat Pump	Ductless Minisplit	3.55	$5.53	16	0.38
Cooling/Heating	Roof Top Heat Pump	Geothermal	5.56	$9.56	16	0.35
Ventilation	Ventilation	Constant Volume	-	$0.00	10	-
Ventilation	Ventilation	Constant Volume with ECM	0.19	$0.46	10	0.16
Ventilation	Ventilation	Variable Air Volume	0.19	-$0.19	10	1.00
Ventilation	Ventilation	Variable Air Volume with ECM	0.44	$0.27	10	0.64
Water Heating	Water Heating	EF .97	-	$0.00	15	-
Water Heating	Water Heating	EF .98	0.02	$0.02	15	0.69
Water Heating	Water Heating	EF 2.3	1.01	$0.04	15	13.74
Interior Lighting	Screw-in	Incandescent	-	$0.00	2	-
Interior Lighting	Screw-in	90W Halogen PAR-38	0.32	$0.03	3	1.39
Interior Lighting	Screw-in	70W HIR PAR-38	0.49	$0.04	3	1.55
Interior Lighting	Screw-in	CFL	0.93	$0.02	6	11.42
Interior Lighting	Screw-in	LED	1.00	$0.59	12	0.85
Interior Lighting	High-Bay Fixtures	Metal Halides	-	$0.00	3	-
Interior Lighting	High-Bay Fixtures	LED	0.69	$0.03	15	16.81
Interior Lighting	High-Bay Fixtures	T8	0.70	$0.00	10	1.00
Interior Lighting	High-Bay Fixtures	High Pressure Sodium	0.75	$0.00	6	1.00
Interior Lighting	High-Bay Fixtures	T5	0.90	$0.00	10	1.00
Interior Lighting	Linear Fluorescent	T12	-	$0.00	10	-
Interior Lighting	Linear Fluorescent	LED	1.28	$2.62	15	0.30
Interior Lighting	Linear Fluorescent	T8	1.34	$0.00	10	519.78
Interior Lighting	Linear Fluorescent	Super T8	1.85	$0.02	10	44.15
Exterior Lighting	Screw-in	Incandescent	-	$0.00	2	-
Exterior Lighting	Screw-in	90W Halogen PAR-38	0.07	$0.00	3	2.22

End Use	Technology	Efficiency Definition	Savings (kWh/ sqft/yr)	Incremental Cost ($/sqft)	Lifetime (yrs)	BC Ratio
Exterior Lighting	Screw-in	70W HIR PAR-38	0.11	$0.00	3	2.46
Exterior Lighting	Screw-in	CFL	0.20	$0.00	6	18.65
Exterior Lighting	Screw-in	LED	0.22	$0.06	12	1.44
Exterior Lighting	HID	Metal Halides	-	$0.00	3	-
Exterior Lighting	HID	LED	0.18	$0.60	15	0.16
Exterior Lighting	HID	T8	0.18	$0.00	10	1.00
Exterior Lighting	HID	High Pressure Sodium	0.29	$0.00	6	1.00
Exterior Lighting	HID	T5	0.30	$0.00	10	1.00
Exterior Lighting	Linear Fluorescent	T12	-	$0.00	10	-
Exterior Lighting	Linear Fluorescent	LED	0.01	$0.03	15	0.13
Exterior Lighting	Linear Fluorescent	T8	0.01	$0.00	10	227.85
Exterior Lighting	Linear Fluorescent	Super T8	0.01	$0.00	10	19.35
Exterior Lighting	Linear Fluorescent	T5	0.01	$0.00	10	13.92
Refrigeration	Walk-in Refrigerator	14600 kWh/yr	-	$0.00	18	-
Refrigeration	Walk-in Refrigerator	10800 kWh/yr	0.58	$0.23	18	1.71
Refrigeration	Walk-in Refrigerator	10000 kWh/yr	0.71	$0.29	18	1.63
Refrigeration	Walk-in Refrigerator	9000 kWh/yr	0.86	$0.52	18	1.11
Refrigeration	Reach-in Refrigerator	3100 kWh/yr	-	$0.00	18	-
Refrigeration	Reach-in Refrigerator	2500 kWh/yr	0.09	$0.06	18	1.01
Refrigeration	Reach-in Refrigerator	2400 kWh/yr	0.11	$0.07	18	1.05
Refrigeration	Reach-in Refrigerator	1500 kWh/yr	0.25	$0.08	18	2.16
Refrigeration	Glass Door Display	15500 kWh/yr	-	$0.00	18	-
Refrigeration	Glass Door Display	14480 kWh/yr	0.63	$0.13	18	3.27
Refrigeration	Glass Door Display	11700 kWh/yr	2.33	$1.26	18	1.24
Refrigeration	Glass Door Display	8400 kWh/yr	4.36	$0.13	18	-
Refrigeration	Glass Door Display	6800 kWh/yr	5.34	$1.26	18	-
Refrigeration	Open Display Case	7000 kWh/yr	-	$0.00	18	-
Refrigeration	Open Display Case	6535 kWh/yr	0.29	$0.06	18	3.30
Refrigeration	Open Display Case	5350 kWh/yr	1.01	$0.06	18	-
Refrigeration	Open Display Case	5300 kWh/yr	1.04	$0.58	18	1.22
Refrigeration	Open Display Case	4350 kWh/yr	1.63	$0.58	18	-
Refrigeration	Icemaker	7.0 kWh/100 lbs	-	$0.00	12	-
Refrigeration	Icemaker	6.3 kWh/100 lbs	0.07	$0.03	12	1.10
Refrigeration	Icemaker	6.0 kWh/100 lbs	0.10	$0.05	12	1.03
Refrigeration	Icemaker	5.5 kWh/100 lbs	0.15	$0.17	12	0.42
Refrigeration	Vending Machine	3400 kWh/year	-	$0.00	10	-
Refrigeration	Vending Machine	2400 kWh/year	0.15	$0.02	10	4.01
Refrigeration	Vending Machine	1700 kWh/year	0.26	$0.05	10	2.27
Food Preparation	Oven	Standard	-	$0.00	12	-
Food Preparation	Oven	Energy Star	0.08	$0.00	12	96,282.52
Food Preparation	Fryer	Standard	-	$0.00	12	-
Food Preparation	Fryer	Energy Star	0.05	$0.01	12	2.32
Food Preparation	Dishwasher	Standard	-	$0.00	12	-
Food Preparation	Dishwasher	Energy Star	0.38	$0.02	12	11.10
Food Preparation	Hot Food Container	Standard	-	$0.00	12	-
Food Preparation	Hot Food Container	Energy Star	0.25	$0.06	12	2.26
Office Equipment	Desktop Computer	Standard	-	$0.00	4	-
Office Equipment	Desktop Computer	Energy Star	0.04	$0.00	4	2,010.93
Office Equipment	Laptop	Standard	-	$0.00	4	-
Office Equipment	Laptop	Energy Star	0.01	$0.00	4	619.91
Office Equipment	Server	Standard	-	$0.00	3	-
Office Equipment	Server	Energy Star	0.04	$0.00	3	7,093.69
Office Equipment	Monitor	Standard	-	$0.00	4	-
Office Equipment	Monitor	Energy Star	0.00	$0.00	4	226.80
Office Equipment	Printer/Copier/Fax	Standard	-	$0.00	6	-
Office Equipment	Printer/Copier/Fax	Energy Star	0.01	$0.00	6	2,115.22

End Use	Technology	Efficiency Definition	Savings (kWh/ sqft/yr)	Incremental Cost ($/sqft)	Lifetime (yrs)	BC Ratio
Office Equipment	POS Terminal	Standard	-	$0.00	4	-
Office Equipment	POS Terminal	Efficient	0.01	$0.01	4	0.27
Miscellaneous	Non-HVAC Motors	Standard (EPAct)	-	$0.00	15	-
Miscellaneous	Non-HVAC Motors	Standard (EPAct 2015)	0.00	$0.00	15	-
Miscellaneous	Non-HVAC Motors	High Efficiency	0.00	$0.00	15	5.43
Miscellaneous	Non-HVAC Motors	High Efficiency (2015)	0.01	$0.00	15	-
Miscellaneous	Non-HVAC Motors	Premium (NEMA)	0.01	$0.00	15	5.43
Miscellaneous	Non-HVAC Motors	Premium (NEMA 2015)	0.01	$0.00	15	-
Miscellaneous	Pool Pump	Standard	-	$0.00	15	-
Miscellaneous	Pool Pump	High Efficiency	-	$0.00	15	1.00
Miscellaneous	Pool Pump	Two-Speed	-	$0.00	15	1.00
Miscellaneous	Pool Heater	Standard	-	$0.00	15	-
Miscellaneous	Pool Heater	Heat Pump	-	$0.00	15	1.00
Miscellaneous	Pool Heater	Solar	-	$0.00	15	1.00
Miscellaneous	Miscellaneous	Standard	-	$0.00	5	-

Table C-6 Energy-Efficiency Equipment Data—Health, Existing Vintage

End Use	Technology	Efficiency Definition	Savings (kWh/ sqft/yr)	Incremental Cost ($/sqft)	Lifetime (yrs)	BC Ratio
Cooling	Air-Cooled Chiller	1.5 kw/ton, COP 2.3	-	$0.00	20	-
Cooling	Air-Cooled Chiller	1.3 kw/ton, COP 2.7	2.55	$1.02	20	1.86
Cooling	Air-Cooled Chiller	1.26 kw/ton, COP 2.8	3.05	$1.32	20	1.71
Cooling	Air-Cooled Chiller	1.0 kw/ton, COP 3.5	6.36	$1.63	20	2.90
Cooling	Air-Cooled Chiller	0.97 kw/ton, COP 3.6	6.75	$1.93	20	2.59
Cooling	Water-Cooled Chiller	0.75 kw/ton, COP 4.7	-	$0.00	20	-
Cooling	Water-Cooled Chiller	0.60 kw/ton, COP 5.9	3.54	$0.38	20	6.88
Cooling	Water-Cooled Chiller	0.58 kw/ton, COP 6.1	4.01	$0.76	20	3.90
Cooling	Water-Cooled Chiller	0.55 kw/Ton, COP 6.4	4.72	$0.92	20	3.82
Cooling	Water-Cooled Chiller	0.51 kw/ton, COP 6.9	5.67	$1.43	20	2.95
Cooling	Water-Cooled Chiller	0.50 kw/Ton, COP 7.0	5.91	$1.58	20	2.78
Cooling	Water-Cooled Chiller	0.48 kw/ton, COP 7.3	6.38	$1.73	20	2.74
Cooling	Roof Top AC	EER 9.2	-	$0.00	16	-
Cooling	Roof Top AC	EER 10.1	0.95	$0.37	16	1.62
Cooling	Roof Top AC	EER 11.2	1.91	$0.71	16	1.69
Cooling	Roof Top AC	EER 12.0	2.49	$1.36	16	1.15
Cooling	Roof Top AC	Ductless Minisplit	3.59	$4.45	16	0.50
Cooling	Other Cooling	EER 9.8	-	$0.00	14	-
Cooling	Other Cooling	EER 10.0	0.20	$0.35	14	0.33
Cooling	Other Cooling	EER 10.2	0.40	$0.41	14	0.54
Cooling	Other Cooling	EER 10.4	0.59	$0.47	14	0.69
Cooling	Other Cooling	EER 10.6	0.77	$0.54	14	0.79
Cooling	Other Cooling	EER 10.8	0.94	$0.60	14	0.87
Cooling	Other Cooling	EER 12.0	1.86	$3.10	14	0.33
Heating	Electric Heating	Standard	-	$0.00	25	-
Cooling/Heating	Roof Top Heat Pump	EER 9.3	-	$0.00	16	-
Cooling/Heating	Roof Top Heat Pump	EER 10.3	1.45	$0.46	16	1.80
Cooling/Heating	Roof Top Heat Pump	EER 11.0	2.31	$0.66	16	2.00
Cooling/Heating	Roof Top Heat Pump	EER 11.7	3.06	$1.68	16	1.03
Cooling/Heating	Roof Top Heat Pump	EER 12.0	3.36	$2.19	16	0.87
Cooling/Heating	Roof Top Heat Pump	Ductless Minisplit	5.12	$4.20	16	0.69
Cooling/Heating	Roof Top Heat Pump	Geothermal	8.53	$7.26	16	0.67
Ventilation	Ventilation	Constant Volume	-	$0.00	10	-
Ventilation	Ventilation	Constant Volume with ECM	0.38	$0.39	10	0.40
Ventilation	Ventilation	Variable Air Volume	0.98	-$0.16	10	1.00
Ventilation	Ventilation	Variable Air Volume with ECM	1.36	$0.23	10	2.36
Water Heating	Water Heating	EF .97	-	$0.00	15	-
Water Heating	Water Heating	EF .98	0.03	$0.02	15	1.07
Water Heating	Water Heating	EF 2.3	1.89	$0.05	15	21.02
Interior Lighting	Screw-in	Incandescent	-	$0.00	2	-
Interior Lighting	Screw-in	90W Halogen PAR-38	0.42	$0.01	3	4.08
Interior Lighting	Screw-in	70W HIR PAR-38	0.64	$0.02	3	4.52
Interior Lighting	Screw-in	CFL	1.19	$0.01	6	33.43
Interior Lighting	Screw-in	LED	1.29	$0.26	12	2.49
Interior Lighting	High-Bay Fixtures	Metal Halides	-	$0.00	3	-
Interior Lighting	High-Bay Fixtures	LED	0.04	$0.01	15	2.22
Interior Lighting	High-Bay Fixtures	T8	0.04	$0.00	10	1.00
Interior Lighting	High-Bay Fixtures	High Pressure Sodium	0.04	$0.00	6	1.00
Interior Lighting	High-Bay Fixtures	T5	0.05	$0.00	10	1.00
Interior Lighting	Linear Fluorescent	T12	-	$0.00	10	-
Interior Lighting	Linear Fluorescent	LED	0.98	$1.52	15	0.38
Interior Lighting	Linear Fluorescent	T8	1.01	$0.00	10	670.64
Interior Lighting	Linear Fluorescent	Super T8	1.41	$0.01	10	56.96
Exterior Lighting	Screw-in	Incandescent	-	$0.00	2	-

End Use	Technology	Efficiency Definition	Savings (kWh/ sqft/yr)	Incremental Cost ($/sqft)	Lifetime (yrs)	BC Ratio
Exterior Lighting	Screw-in	90W Halogen PAR-38	0.01	$0.00	3	2.39
Exterior Lighting	Screw-in	70W HIR PAR-38	0.02	$0.00	3	2.65
Exterior Lighting	Screw-in	CFL	0.03	$0.00	6	20.10
Exterior Lighting	Screw-in	LED	0.03	$0.01	12	1.55
Exterior Lighting	HID	Metal Halides	-	$0.00	3	-
Exterior Lighting	HID	LED	0.11	$0.38	15	0.16
Exterior Lighting	HID	T8	0.12	$0.00	10	1.00
Exterior Lighting	HID	High Pressure Sodium	0.18	$0.00	6	1.00
Exterior Lighting	HID	T5	0.19	$0.00	10	1.00
Exterior Lighting	Linear Fluorescent	T12	-	$0.00	10	-
Exterior Lighting	Linear Fluorescent	LED	0.00	$0.00	15	0.13
Exterior Lighting	Linear Fluorescent	T8	0.00	$0.00	10	227.85
Exterior Lighting	Linear Fluorescent	Super T8	0.00	$0.00	10	19.35
Exterior Lighting	Linear Fluorescent	T5	0.00	$0.00	10	13.92
Refrigeration	Walk-in Refrigerator	14600 kWh/yr	-	$0.00	18	-
Refrigeration	Walk-in Refrigerator	10800 kWh/yr	0.04	$0.02	18	1.72
Refrigeration	Walk-in Refrigerator	10000 kWh/yr	0.05	$0.02	18	1.64
Refrigeration	Walk-in Refrigerator	9000 kWh/yr	0.06	$0.04	18	1.12
Refrigeration	Reach-in Refrigerator	3100 kWh/yr	-	$0.00	18	-
Refrigeration	Reach-in Refrigerator	2500 kWh/yr	0.01	$0.00	18	1.02
Refrigeration	Reach-in Refrigerator	2400 kWh/yr	0.01	$0.00	18	1.06
Refrigeration	Reach-in Refrigerator	1500 kWh/yr	0.02	$0.01	18	2.17
Refrigeration	Glass Door Display	15500 kWh/yr	-	$0.00	18	-
Refrigeration	Glass Door Display	14480 kWh/yr	0.01	$0.00	18	3.29
Refrigeration	Glass Door Display	11700 kWh/yr	0.04	$0.02	18	1.25
Refrigeration	Glass Door Display	8400 kWh/yr	0.08	$0.00	18	-
Refrigeration	Glass Door Display	6800 kWh/yr	0.09	$0.02	18	-
Refrigeration	Open Display Case	7000 kWh/yr	-	$0.00	18	-
Refrigeration	Open Display Case	6535 kWh/yr	0.01	$0.00	18	3.32
Refrigeration	Open Display Case	5350 kWh/yr	0.02	$0.00	18	-
Refrigeration	Open Display Case	5300 kWh/yr	0.02	$0.01	18	1.23
Refrigeration	Open Display Case	4350 kWh/yr	0.03	$0.01	18	-
Refrigeration	Icemaker	7.0 kWh/100 lbs	-	$0.00	12	-
Refrigeration	Icemaker	6.3 kWh/100 lbs	0.01	$0.00	12	1.11
Refrigeration	Icemaker	6.0 kWh/100 lbs	0.01	$0.01	12	1.04
Refrigeration	Icemaker	5.5 kWh/100 lbs	0.02	$0.02	12	0.42
Refrigeration	Vending Machine	3400 kWh/year	-	$0.00	10	-
Refrigeration	Vending Machine	2400 kWh/year	0.02	$0.00	10	4.05
Refrigeration	Vending Machine	1700 kWh/year	0.04	$0.01	10	2.29
Food Preparation	Oven	Standard	-	$0.00	12	-
Food Preparation	Oven	Energy Star	0.10	$0.00	12	93,022.83
Food Preparation	Fryer	Standard	-	$0.00	12	-
Food Preparation	Fryer	Energy Star	0.06	$0.01	12	2.24
Food Preparation	Dishwasher	Standard	-	$0.00	12	-
Food Preparation	Dishwasher	Energy Star	0.48	$0.02	12	10.72
Food Preparation	Hot Food Container	Standard	-	$0.00	12	-
Food Preparation	Hot Food Container	Energy Star	0.33	$0.07	12	2.19
Office Equipment	Desktop Computer	Standard	-	$0.00	4	-
Office Equipment	Desktop Computer	Energy Star	0.18	$0.00	4	2,032.04
Office Equipment	Laptop	Standard	-	$0.00	4	-
Office Equipment	Laptop	Energy Star	0.03	$0.00	4	626.42
Office Equipment	Server	Standard	-	$0.00	3	-
Office Equipment	Server	Energy Star	0.04	$0.00	3	7,169.59
Office Equipment	Monitor	Standard	-	$0.00	4	-
Office Equipment	Monitor	Energy Star	0.02	$0.00	4	229.18
Office Equipment	Printer/Copier/Fax	Standard	-	$0.00	6	-
Office Equipment	Printer/Copier/Fax	Energy Star	0.06	$0.00	6	2,135.70

End Use	Technology	Efficiency Definition	Savings (kWh/ sqft/yr)	Incremental Cost ($/sqft)	Lifetime (yrs)	BC Ratio
Office Equipment	POS Terminal	Standard	-	$0.00	4	-
Office Equipment	POS Terminal	Efficient	0.06	$0.03	4	0.27
Miscellaneous	Non-HVAC Motors	Standard (EPAct)	-	$0.00	15	-
Miscellaneous	Non-HVAC Motors	Standard (EPAct 2015)	0.00	$0.00	15	-
Miscellaneous	Non-HVAC Motors	High Efficiency	0.00	$0.00	15	5.47
Miscellaneous	Non-HVAC Motors	High Efficiency (2015)	0.00	$0.00	15	-
Miscellaneous	Non-HVAC Motors	Premium (NEMA)	0.01	$0.00	15	5.47
Miscellaneous	Non-HVAC Motors	Premium (NEMA 2015)	0.01	$0.00	15	-
Miscellaneous	Pool Pump	Standard	-	$0.00	15	-
Miscellaneous	Pool Pump	High Efficiency	0.00	$0.00	15	1.81
Miscellaneous	Pool Pump	Two-Speed	0.00	$0.00	15	1.07
Miscellaneous	Pool Heater	Standard	-	$0.00	15	-
Miscellaneous	Pool Heater	Heat Pump	0.02	$0.01	15	0.93
Miscellaneous	Pool Heater	Solar	0.02	$0.02	15	0.92
Miscellaneous	Miscellaneous	Standard	-	$0.00	5	-

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

End Use	Technology	Efficiency Definition	Savings (kWh/ sqft/yr)	Incremental Cost ($/sqft)	Lifetime (yrs)	BC Ratio
Cooling	Air-Cooled Chiller	1.5 kw/ton, COP 2.3	-	$0.00	20	-
Cooling	Air-Cooled Chiller	1.3 kw/ton, COP 2.7	0.71	$0.21	20	2.43
Cooling	Air-Cooled Chiller	1.26 kw/ton, COP 2.8	0.85	$0.27	20	2.24
Cooling	Air-Cooled Chiller	1.0 kw/ton, COP 3.5	1.77	$0.33	20	3.79
Cooling	Air-Cooled Chiller	0.97 kw/ton, COP 3.6	1.88	$0.40	20	3.39
Cooling	Water-Cooled Chiller	0.75 kw/ton, COP 4.7	-	$0.00	20	-
Cooling	Water-Cooled Chiller	0.60 kw/ton, COP 5.9	0.66	$0.06	20	7.90
Cooling	Water-Cooled Chiller	0.58 kw/ton, COP 6.1	0.75	$0.12	20	4.48
Cooling	Water-Cooled Chiller	0.55 kw/Ton, COP 6.4	0.89	$0.14	20	4.39
Cooling	Water-Cooled Chiller	0.51 kw/ton, COP 6.9	1.06	$0.22	20	3.39
Cooling	Water-Cooled Chiller	0.50 kw/Ton, COP 7.0	1.11	$0.25	20	3.19
Cooling	Water-Cooled Chiller	0.48 kw/ton, COP 7.3	1.20	$0.27	20	3.14
Cooling	Roof Top AC	EER 9.2	-	$0.00	16	-
Cooling	Roof Top AC	EER 10.1	0.23	$0.08	16	1.67
Cooling	Roof Top AC	EER 11.2	0.46	$0.16	16	1.74
Cooling	Roof Top AC	EER 12.0	0.60	$0.30	16	1.18
Cooling	Roof Top AC	Ductless Minisplit	0.92	$0.99	16	0.55
Cooling	Other Cooling	EER 9.8	-	$0.00	14	-
Cooling	Other Cooling	EER 10.0	0.14	$0.24	14	0.31
Cooling	Other Cooling	EER 10.2	0.28	$0.28	14	0.52
Cooling	Other Cooling	EER 10.4	0.41	$0.33	14	0.66
Cooling	Other Cooling	EER 10.6	0.53	$0.37	14	0.76
Cooling	Other Cooling	EER 10.8	0.65	$0.42	14	0.84
Cooling	Other Cooling	EER 12.0	1.29	$2.15	14	0.32
Heating	Electric Heating	Standard	-	$0.00	25	-
Cooling/Heating	Roof Top Heat Pump	EER 9.3	-	$0.00	16	-
Cooling/Heating	Roof Top Heat Pump	EER 10.3	0.34	$0.11	16	1.70
Cooling/Heating	Roof Top Heat Pump	EER 11.0	0.54	$0.16	16	1.88
Cooling/Heating	Roof Top Heat Pump	EER 11.7	0.71	$0.40	16	0.97
Cooling/Heating	Roof Top Heat Pump	EER 12.0	0.78	$0.52	16	0.82
Cooling/Heating	Roof Top Heat Pump	Ductless Minisplit	1.19	$1.00	16	0.65
Cooling/Heating	Roof Top Heat Pump	Geothermal	3.92	$1.73	16	1.23
Ventilation	Ventilation	Constant Volume	-	$0.00	10	-
Ventilation	Ventilation	Constant Volume with ECM	0.14	$0.17	10	0.34
Ventilation	Ventilation	Variable Air Volume	0.28	-$0.07	10	1.00
Ventilation	Ventilation	Variable Air Volume with ECM	0.44	$0.10	10	1.75
Water Heating	Water Heating	EF .97	-	$0.00	15	-
Water Heating	Water Heating	EF .98	0.05	$0.08	15	0.38
Water Heating	Water Heating	EF 2.3	2.84	$0.23	15	7.54
Interior Lighting	Screw-in	Incandescent	-	$0.00	2	-
Interior Lighting	Screw-in	90W Halogen PAR-38	1.51	$0.05	3	3.43
Interior Lighting	Screw-in	70W HIR PAR-38	2.32	$0.07	3	3.81
Interior Lighting	Screw-in	CFL	4.35	$0.04	6	28.18
Interior Lighting	Screw-in	LED	4.71	$1.10	12	2.10
Interior Lighting	High-Bay Fixtures	Metal Halides	-	$0.00	3	-
Interior Lighting	High-Bay Fixtures	LED	0.06	$0.03	15	1.57
Interior Lighting	High-Bay Fixtures	T8	0.07	$0.00	10	1.00
Interior Lighting	High-Bay Fixtures	High Pressure Sodium	0.07	$0.00	6	1.00
Interior Lighting	High-Bay Fixtures	T5	0.08	$0.00	10	1.00
Interior Lighting	Linear Fluorescent	T12	-	$0.00	10	-
Interior Lighting	Linear Fluorescent	LED	0.44	$0.25	15	1.06
Interior Lighting	Linear Fluorescent	T8	0.46	$0.00	10	1,863.74
Interior Lighting	Linear Fluorescent	Super T8	0.64	$0.00	10	158.30
Exterior Lighting	Screw-in	Incandescent	-	$0.00	2	-
Exterior Lighting	Screw-in	90W Halogen PAR-38	0.08	$0.00	3	2.39

End Use	Technology	Efficiency Definition	Savings (kWh/ sqft/yr)	Incremental Cost ($/sqft)	Lifetime (yrs)	BC Ratio
Exterior Lighting	Screw-in	70W HIR PAR-38	0.12	$0.00	3	2.66
Exterior Lighting	Screw-in	CFL	0.23	$0.00	6	20.11
Exterior Lighting	Screw-in	LED	0.25	$0.07	12	1.55
Exterior Lighting	HID	Metal Halides	-	$0.00	3	-
Exterior Lighting	HID	LED	0.12	$0.43	15	0.16
Exterior Lighting	HID	T8	0.13	$0.00	10	1.00
Exterior Lighting	HID	High Pressure Sodium	0.20	$0.00	6	1.00
Exterior Lighting	HID	T5	0.21	$0.00	10	1.00
Exterior Lighting	Linear Fluorescent	T12	-	$0.00	10	-
Exterior Lighting	Linear Fluorescent	LED	0.00	$0.00	15	0.13
Exterior Lighting	Linear Fluorescent	T8	0.00	$0.00	10	227.85
Exterior Lighting	Linear Fluorescent	Super T8	0.00	$0.00	10	19.35
Exterior Lighting	Linear Fluorescent	T5	0.00	$0.00	10	13.92
Refrigeration	Walk-in Refrigerator	14600 kWh/yr	-	$0.00	18	-
Refrigeration	Walk-in Refrigerator	10800 kWh/yr	0.07	$0.03	18	1.71
Refrigeration	Walk-in Refrigerator	10000 kWh/yr	0.09	$0.04	18	1.63
Refrigeration	Walk-in Refrigerator	9000 kWh/yr	0.11	$0.07	18	1.11
Refrigeration	Reach-in Refrigerator	3100 kWh/yr	-	$0.00	18	-
Refrigeration	Reach-in Refrigerator	2500 kWh/yr	0.01	$0.01	18	1.01
Refrigeration	Reach-in Refrigerator	2400 kWh/yr	0.01	$0.01	18	1.05
Refrigeration	Reach-in Refrigerator	1500 kWh/yr	0.03	$0.01	18	2.16
Refrigeration	Glass Door Display	15500 kWh/yr	-	$0.00	18	-
Refrigeration	Glass Door Display	14480 kWh/yr	0.02	$0.00	18	3.28
Refrigeration	Glass Door Display	11700 kWh/yr	0.07	$0.04	18	1.24
Refrigeration	Glass Door Display	8400 kWh/yr	0.14	$0.00	18	-
Refrigeration	Glass Door Display	6800 kWh/yr	0.17	$0.04	18	-
Refrigeration	Open Display Case	7000 kWh/yr	-	$0.00	18	-
Refrigeration	Open Display Case	6535 kWh/yr	0.01	$0.00	18	3.30
Refrigeration	Open Display Case	5350 kWh/yr	0.03	$0.00	18	-
Refrigeration	Open Display Case	5300 kWh/yr	0.03	$0.02	18	1.22
Refrigeration	Open Display Case	4350 kWh/yr	0.05	$0.02	18	-
Refrigeration	Icemaker	7.0 kWh/100 lbs	-	$0.00	12	-
Refrigeration	Icemaker	6.3 kWh/100 lbs	0.01	$0.00	12	1.10
Refrigeration	Icemaker	6.0 kWh/100 lbs	0.01	$0.01	12	1.04
Refrigeration	Icemaker	5.5 kWh/100 lbs	0.02	$0.02	12	0.42
Refrigeration	Vending Machine	3400 kWh/year	-	$0.00	10	-
Refrigeration	Vending Machine	2400 kWh/year	0.04	$0.00	10	4.02
Refrigeration	Vending Machine	1700 kWh/year	0.07	$0.01	10	2.28
Food Preparation	Oven	Standard	-	$0.00	12	-
Food Preparation	Oven	Energy Star	0.05	$0.00	12	92,742.15
Food Preparation	Fryer	Standard	-	$0.00	12	-
Food Preparation	Fryer	Energy Star	0.03	$0.01	12	2.24
Food Preparation	Dishwasher	Standard	-	$0.00	12	-
Food Preparation	Dishwasher	Energy Star	0.26	$0.01	12	10.69
Food Preparation	Hot Food Container	Standard	-	$0.00	12	-
Food Preparation	Hot Food Container	Energy Star	0.18	$0.04	12	2.18
Office Equipment	Desktop Computer	Standard	-	$0.00	4	-
Office Equipment	Desktop Computer	Energy Star	0.03	$0.00	4	2,002.69
Office Equipment	Laptop	Standard	-	$0.00	4	-
Office Equipment	Laptop	Energy Star	0.00	$0.00	4	617.37
Office Equipment	Server	Standard	-	$0.00	3	-
Office Equipment	Server	Energy Star	0.02	$0.00	3	7,064.06
Office Equipment	Monitor	Standard	-	$0.00	4	-
Office Equipment	Monitor	Energy Star	0.00	$0.00	4	225.87
Office Equipment	Printer/Copier/Fax	Standard	-	$0.00	6	-
Office Equipment	Printer/Copier/Fax	Energy Star	0.00	$0.00	6	2,107.23

End Use	Technology	Efficiency Definition	Savings (kWh/ sqft/yr)	Incremental Cost ($/sqft)	Lifetime (yrs)	BC Ratio
Office Equipment	POS Terminal	Standard	-	$0.00	4	-
Office Equipment	POS Terminal	Efficient	0.00	$0.00	4	0.27
Miscellaneous	Non-HVAC Motors	Standard (EPAct)	-	$0.00	15	-
Miscellaneous	Non-HVAC Motors	Standard (EPAct 2015)	0.00	$0.00	15	-
Miscellaneous	Non-HVAC Motors	High Efficiency	0.00	$0.00	15	5.35
Miscellaneous	Non-HVAC Motors	High Efficiency (2015)	0.00	$0.00	15	-
Miscellaneous	Non-HVAC Motors	Premium (NEMA)	0.00	$0.00	15	5.35
Miscellaneous	Non-HVAC Motors	Premium (NEMA 2015)	0.00	$0.00	15	-
Miscellaneous	Pool Pump	Standard	-	$0.00	15	-
Miscellaneous	Pool Pump	High Efficiency	0.00	$0.00	15	1.78
Miscellaneous	Pool Pump	Two-Speed	0.01	$0.00	15	1.04
Miscellaneous	Pool Heater	Standard	-	$0.00	15	-
Miscellaneous	Pool Heater	Heat Pump	0.02	$0.01	15	0.91
Miscellaneous	Pool Heater	Solar	0.03	$0.02	15	0.90
Miscellaneous	Miscellaneous	Standard	-	$0.00	5	-

Table C-8 Energy-Efficiency Equipment Data—Large Miscellaneous, Existing Vintage

End Use	Technology	Efficiency Definition	Savings (kWh/ sqft/yr)	Incremental Cost ($/sqft)	Lifetime (yrs)	BC Ratio
Cooling	Air-Cooled Chiller	1.5 kw/ton, COP 2.3	-	$0.00	20	-
Cooling	Air-Cooled Chiller	1.3 kw/ton, COP 2.7	0.93	$0.42	20	1.43
Cooling	Air-Cooled Chiller	1.26 kw/ton, COP 2.8	1.11	$0.54	20	1.32
Cooling	Air-Cooled Chiller	1.0 kw/ton, COP 3.5	2.31	$0.66	20	2.23
Cooling	Air-Cooled Chiller	0.97 kw/ton, COP 3.6	2.45	$0.79	20	1.99
Cooling	Water-Cooled Chiller	0.75 kw/ton, COP 4.7	-	$0.00	20	-
Cooling	Water-Cooled Chiller	0.60 kw/ton, COP 5.9	1.13	$0.16	20	4.67
Cooling	Water-Cooled Chiller	0.58 kw/ton, COP 6.1	1.28	$0.31	20	2.65
Cooling	Water-Cooled Chiller	0.55 kw/Ton, COP 6.4	1.51	$0.37	20	2.60
Cooling	Water-Cooled Chiller	0.51 kw/ton, COP 6.9	1.81	$0.58	20	2.00
Cooling	Water-Cooled Chiller	0.50 kw/Ton, COP 7.0	1.89	$0.64	20	1.89
Cooling	Water-Cooled Chiller	0.48 kw/ton, COP 7.3	2.04	$0.70	20	1.86
Cooling	Roof Top AC	EER 9.2	-	$0.00	16	-
Cooling	Roof Top AC	EER 10.1	0.51	$0.27	16	1.01
Cooling	Roof Top AC	EER 11.2	1.03	$0.52	16	1.05
Cooling	Roof Top AC	EER 12.0	1.34	$1.00	16	0.72
Cooling	Roof Top AC	Ductless Minisplit	1.88	$3.29	16	0.31
Cooling	Other Cooling	EER 9.8	-	$0.00	14	-
Cooling	Other Cooling	EER 10.0	0.11	$0.19	14	0.28
Cooling	Other Cooling	EER 10.2	0.21	$0.22	14	0.46
Cooling	Other Cooling	EER 10.4	0.32	$0.26	14	0.59
Cooling	Other Cooling	EER 10.6	0.41	$0.29	14	0.68
Cooling	Other Cooling	EER 10.8	0.51	$0.32	14	0.74
Cooling	Other Cooling	EER 12.0	1.00	$1.67	14	0.29
Heating	Electric Heating	Standard	-	$0.00	25	-
Cooling/Heating	Roof Top Heat Pump	EER 9.3	-	$0.00	16	-
Cooling/Heating	Roof Top Heat Pump	EER 10.3	0.77	$0.43	16	0.99
Cooling/Heating	Roof Top Heat Pump	EER 11.0	1.22	$0.62	16	1.10
Cooling/Heating	Roof Top Heat Pump	EER 11.7	1.62	$1.58	16	0.57
Cooling/Heating	Roof Top Heat Pump	EER 12.0	1.78	$2.06	16	0.48
Cooling/Heating	Roof Top Heat Pump	Ductless Minisplit	2.71	$3.95	16	0.38
Cooling/Heating	Roof Top Heat Pump	Geothermal	4.31	$6.83	16	0.35
Ventilation	Ventilation	Constant Volume	-	$0.00	10	-
Ventilation	Ventilation	Constant Volume with ECM	0.11	$0.29	10	0.16
Ventilation	Ventilation	Variable Air Volume	0.35	-$0.12	10	1.00
Ventilation	Ventilation	Variable Air Volume with ECM	0.46	$0.17	10	1.08
Water Heating	Water Heating	EF .97	-	$0.00	15	-
Water Heating	Water Heating	EF .98	0.02	$0.00	15	1.00
Water Heating	Water Heating	EF 2.3	0.93	$0.00	15	1.00
Interior Lighting	Screw-in	Incandescent	-	$0.00	2	-
Interior Lighting	Screw-in	90W Halogen PAR-38	0.20	$0.01	3	2.77
Interior Lighting	Screw-in	70W HIR PAR-38	0.31	$0.01	3	3.07
Interior Lighting	Screw-in	CFL	0.59	$0.01	6	22.76
Interior Lighting	Screw-in	LED	0.63	$0.18	12	1.70
Interior Lighting	High-Bay Fixtures	Metal Halides	-	$0.00	3	-
Interior Lighting	High-Bay Fixtures	LED	0.55	$0.76	15	0.49
Interior Lighting	High-Bay Fixtures	T8	0.56	-$0.02	10	1.00
Interior Lighting	High-Bay Fixtures	High Pressure Sodium	0.59	$0.00	6	1.00
Interior Lighting	High-Bay Fixtures	T5	0.71	-$0.01	10	1.00
Interior Lighting	Linear Fluorescent	T12	-	$0.00	10	-
Interior Lighting	Linear Fluorescent	LED	0.54	$1.05	15	0.30
Interior Lighting	Linear Fluorescent	T8	0.56	$0.00	10	520.47
Interior Lighting	Linear Fluorescent	Super T8	0.77	$0.01	10	44.21

End Use	Technology	Efficiency Definition	Savings (kWh/ sqft/yr)	Incremental Cost ($/sqft)	Lifetime (yrs)	BC Ratio
Exterior Lighting	Screw-in	Incandescent	-	$0.00	2	-
Exterior Lighting	Screw-in	90W Halogen PAR-38	0.10	$0.00	3	2.41
Exterior Lighting	Screw-in	70W HIR PAR-38	0.15	$0.01	3	2.67
Exterior Lighting	Screw-in	CFL	0.28	$0.00	6	20.24
Exterior Lighting	Screw-in	LED	0.30	$0.08	12	1.56
Exterior Lighting	HID	Metal Halides	-	$0.00	3	-
Exterior Lighting	HID	LED	0.15	$0.51	15	0.16
Exterior Lighting	HID	T8	0.16	$0.00	10	1.00
Exterior Lighting	HID	High Pressure Sodium	0.24	$0.00	6	1.00
Exterior Lighting	HID	T5	0.25	$0.00	10	1.00
Exterior Lighting	Linear Fluorescent	T12	-	$0.00	10	-
Exterior Lighting	Linear Fluorescent	LED	0.09	$0.35	15	0.13
Exterior Lighting	Linear Fluorescent	T8	0.09	$0.00	10	227.84
Exterior Lighting	Linear Fluorescent	Super T8	0.13	$0.00	10	19.35
Exterior Lighting	Linear Fluorescent	T5	0.15	$0.00	10	13.92
Refrigeration	Walk-in Refrigerator	14600 kWh/yr	-	$0.00	18	-
Refrigeration	Walk-in Refrigerator	10800 kWh/yr	0.06	$0.02	18	1.70
Refrigeration	Walk-in Refrigerator	10000 kWh/yr	0.07	$0.03	18	1.62
Refrigeration	Walk-in Refrigerator	9000 kWh/yr	0.09	$0.05	18	1.10
Refrigeration	Reach-in Refrigerator	3100 kWh/yr	-	$0.00	18	-
Refrigeration	Reach-in Refrigerator	2500 kWh/yr	0.01	$0.01	18	1.00
Refrigeration	Reach-in Refrigerator	2400 kWh/yr	0.01	$0.01	18	1.04
Refrigeration	Reach-in Refrigerator	1500 kWh/yr	0.02	$0.01	18	2.14
Refrigeration	Glass Door Display	15500 kWh/yr	-	$0.00	18	-
Refrigeration	Glass Door Display	14480 kWh/yr	0.02	$0.00	18	3.25
Refrigeration	Glass Door Display	11700 kWh/yr	0.06	$0.03	18	1.24
Refrigeration	Glass Door Display	8400 kWh/yr	0.11	$0.00	18	-
Refrigeration	Glass Door Display	6800 kWh/yr	0.13	$0.03	18	-
Refrigeration	Open Display Case	7000 kWh/yr	-	$0.00	18	-
Refrigeration	Open Display Case	6535 kWh/yr	0.01	$0.00	18	3.28
Refrigeration	Open Display Case	5350 kWh/yr	0.03	$0.00	18	-
Refrigeration	Open Display Case	5300 kWh/yr	0.03	$0.01	18	1.21
Refrigeration	Open Display Case	4350 kWh/yr	0.04	$0.01	18	-
Refrigeration	Icemaker	7.0 kWh/100 lbs	-	$0.00	12	-
Refrigeration	Icemaker	6.3 kWh/100 lbs	0.01	$0.00	12	1.09
Refrigeration	Icemaker	6.0 kWh/100 lbs	0.01	$0.00	12	1.03
Refrigeration	Icemaker	5.5 kWh/100 lbs	0.01	$0.02	12	0.41
Refrigeration	Vending Machine	3400 kWh/year	-	$0.00	10	-
Refrigeration	Vending Machine	2400 kWh/year	0.03	$0.00	10	3.99
Refrigeration	Vending Machine	1700 kWh/year	0.05	$0.01	10	2.26
Food Preparation	Oven	Standard	-	$0.00	12	-
Food Preparation	Oven	Energy Star	0.03	$0.00	12	75,837.68
Food Preparation	Fryer	Standard	-	$0.00	12	-
Food Preparation	Fryer	Energy Star	0.02	$0.00	12	1.83
Food Preparation	Dishwasher	Standard	-	$0.00	12	-
Food Preparation	Dishwasher	Energy Star	0.14	$0.01	12	8.74
Food Preparation	Hot Food Container	Standard	-	$0.00	12	-
Food Preparation	Hot Food Container	Energy Star	0.09	$0.02	12	1.78
Office Equipment	Desktop Computer	Standard	-	$0.00	4	-
Office Equipment	Desktop Computer	Energy Star	0.06	$0.00	4	1,975.67
Office Equipment	Laptop	Standard	-	$0.00	4	-
Office Equipment	Laptop	Energy Star	0.01	$0.00	4	609.04
Office Equipment	Server	Standard	-	$0.00	3	-
Office Equipment	Server	Energy Star	0.03	$0.00	3	6,966.86
Office Equipment	Monitor	Standard	-	$0.00	4	-
Office Equipment	Monitor	Energy Star	0.01	$0.00	4	222.82
Office Equipment	Printer/Copier/Fax	Standard	-	$0.00	6	-

End Use	Technology	Efficiency Definition	Savings (kWh/ sqft/yr)	Incremental Cost ($/sqft)	Lifetime (yrs)	BC Ratio
Office Equipment	Printer/Copier/Fax	Energy Star	0.02	$0.00	6	2,081.01
Office Equipment	POS Terminal	Standard	-	$0.00	4	-
Office Equipment	POS Terminal	Efficient	0.03	$0.02	4	0.26
Miscellaneous	Non-HVAC Motors	Standard (EPAct)	-	$0.00	15	-
Miscellaneous	Non-HVAC Motors	Standard (EPAct 2015)	0.00	$0.00	15	-
Miscellaneous	Non-HVAC Motors	High Efficiency	0.00	$0.00	15	5.32
Miscellaneous	Non-HVAC Motors	High Efficiency (2015)	0.00	$0.00	15	-
Miscellaneous	Non-HVAC Motors	Premium (NEMA)	0.00	$0.00	15	5.32
Miscellaneous	Non-HVAC Motors	Premium (NEMA 2015)	0.00	$0.00	15	-
Miscellaneous	Pool Pump	Standard	-	$0.00	15	-
Miscellaneous	Pool Pump	High Efficiency	0.00	$0.00	15	1.77
Miscellaneous	Pool Pump	Two-Speed	0.00	$0.00	15	1.04
Miscellaneous	Pool Heater	Standard	-	$0.00	15	-
Miscellaneous	Pool Heater	Heat Pump	0.00	$0.00	15	0.90
Miscellaneous	Pool Heater	Solar	0.00	$0.00	15	0.90
Miscellaneous	Miscellaneous	Standard	-	$0.00	5	-

Table C-9 Energy-Efficiency Equipment Data—Small Miscellaneous, Existing Vintage

End Use	Technology	Efficiency Definition	Savings (kWh/ sqft/yr)	Incremental Cost ($/sqft)	Lifetime (yrs)	BC Ratio
Cooling	Air-Cooled Chiller	1.5 kw/ton, COP 2.3	-	$0.00	20	-
Cooling	Air-Cooled Chiller	1.3 kw/ton, COP 2.7	0.58	$0.26	20	1.43
Cooling	Air-Cooled Chiller	1.26 kw/ton, COP 2.8	0.70	$0.34	20	1.32
Cooling	Air-Cooled Chiller	1.0 kw/ton, COP 3.5	1.46	$0.42	20	2.23
Cooling	Air-Cooled Chiller	0.97 kw/ton, COP 3.6	1.55	$0.50	20	1.99
Cooling	Water-Cooled Chiller	0.75 kw/ton, COP 4.7	-	$0.00	20	-
Cooling	Water-Cooled Chiller	0.60 kw/ton, COP 5.9	0.81	$0.11	20	4.67
Cooling	Water-Cooled Chiller	0.58 kw/ton, COP 6.1	0.91	$0.22	20	2.65
Cooling	Water-Cooled Chiller	0.55 kw/Ton, COP 6.4	1.08	$0.27	20	2.60
Cooling	Water-Cooled Chiller	0.51 kw/ton, COP 6.9	1.29	$0.41	20	2.00
Cooling	Water-Cooled Chiller	0.50 kw/Ton, COP 7.0	1.35	$0.46	20	1.89
Cooling	Water-Cooled Chiller	0.48 kw/ton, COP 7.3	1.45	$0.50	20	1.86
Cooling	Roof Top AC	EER 9.2	-	$0.00	16	-
Cooling	Roof Top AC	EER 10.1	0.40	$0.21	16	1.01
Cooling	Roof Top AC	EER 11.2	0.81	$0.41	16	1.05
Cooling	Roof Top AC	EER 12.0	1.05	$0.79	16	0.72
Cooling	Roof Top AC	Ductless Minisplit	1.47	$2.58	16	0.31
Cooling	Other Cooling	EER 9.8	-	$0.00	14	-
Cooling	Other Cooling	EER 10.0	0.09	$0.16	14	0.28
Cooling	Other Cooling	EER 10.2	0.18	$0.19	14	0.46
Cooling	Other Cooling	EER 10.4	0.27	$0.22	14	0.59
Cooling	Other Cooling	EER 10.6	0.35	$0.24	14	0.68
Cooling	Other Cooling	EER 10.8	0.43	$0.27	14	0.74
Cooling	Other Cooling	EER 12.0	0.85	$1.41	14	0.29
Heating	Electric Heating	Standard	-	$0.00	25	-
Cooling/Heating	Roof Top Heat Pump	EER 9.3	-	$0.00	16	-
Cooling/Heating	Roof Top Heat Pump	EER 10.3	0.55	$0.31	16	0.99
Cooling/Heating	Roof Top Heat Pump	EER 11.0	0.88	$0.45	16	1.10
Cooling/Heating	Roof Top Heat Pump	EER 11.7	1.17	$1.14	16	0.57
Cooling/Heating	Roof Top Heat Pump	EER 12.0	1.28	$1.49	16	0.48
Cooling/Heating	Roof Top Heat Pump	Ductless Minisplit	1.95	$2.85	16	0.38
Cooling/Heating	Roof Top Heat Pump	Geothermal	3.11	$4.94	16	0.35
Ventilation	Ventilation	Constant Volume	-	$0.00	10	-
Ventilation	Ventilation	Constant Volume with ECM	0.08	$0.15	10	0.20
Ventilation	Ventilation	Variable Air Volume	0.25	-$0.06	10	1.00
Ventilation	Ventilation	Variable Air Volume with ECM	0.32	$0.09	10	1.40
Water Heating	Water Heating	EF .97	-	$0.00	15	-
Water Heating	Water Heating	EF .98	0.01	$0.00	15	1.00
Water Heating	Water Heating	EF 2.3	0.64	$0.00	15	1.00
Interior Lighting	Screw-in	Incandescent	-	$0.00	2	-
Interior Lighting	Screw-in	90W Halogen PAR-38	0.17	$0.01	3	1.51
Interior Lighting	Screw-in	70W HIR PAR-38	0.26	$0.02	3	1.67
Interior Lighting	Screw-in	CFL	0.48	$0.01	6	12.39
Interior Lighting	Screw-in	LED	0.52	$0.27	12	0.93
Interior Lighting	High-Bay Fixtures	Metal Halides	-	$0.00	3	-
Interior Lighting	High-Bay Fixtures	LED	0.45	$0.28	15	1.06
Interior Lighting	High-Bay Fixtures	T8	0.46	-$0.01	10	1.00
Interior Lighting	High-Bay Fixtures	High Pressure Sodium	0.48	$0.00	6	1.00
Interior Lighting	High-Bay Fixtures	T5	0.58	$0.00	10	1.00
Interior Lighting	Linear Fluorescent	T12	-	$0.00	10	-
Interior Lighting	Linear Fluorescent	LED	0.44	$0.76	15	0.34
Interior Lighting	Linear Fluorescent	T8	0.46	$0.00	10	587.41
Interior Lighting	Linear Fluorescent	Super T8	0.63	$0.01	10	49.89
Exterior Lighting	Screw-in	Incandescent	-	$0.00	2	-

End Use	Technology	Efficiency Definition	Savings (kWh/ sqft/yr)	Incremental Cost ($/sqft)	Lifetime (yrs)	BC Ratio
Exterior Lighting	Screw-in	90W Halogen PAR-38	0.08	$0.00	3	2.41
Exterior Lighting	Screw-in	70W HIR PAR-38	0.13	$0.00	3	2.67
Exterior Lighting	Screw-in	CFL	0.23	$0.00	6	20.23
Exterior Lighting	Screw-in	LED	0.25	$0.07	12	1.56
Exterior Lighting	HID	Metal Halides	-	$0.00	3	-
Exterior Lighting	HID	LED	0.13	$0.43	15	0.16
Exterior Lighting	HID	T8	0.13	$0.00	10	1.00
Exterior Lighting	HID	High Pressure Sodium	0.20	$0.00	6	1.00
Exterior Lighting	HID	T5	0.21	$0.00	10	1.00
Exterior Lighting	Linear Fluorescent	T12	-	$0.00	10	-
Exterior Lighting	Linear Fluorescent	LED	0.08	$0.29	15	0.13
Exterior Lighting	Linear Fluorescent	T8	0.08	$0.00	10	227.84
Exterior Lighting	Linear Fluorescent	Super T8	0.11	$0.00	10	19.35
Exterior Lighting	Linear Fluorescent	T5	0.13	$0.00	10	13.92
Refrigeration	Walk-in Refrigerator	14600 kWh/yr	-	$0.00	18	-
Refrigeration	Walk-in Refrigerator	10800 kWh/yr	-	$0.00	18	1.00
Refrigeration	Walk-in Refrigerator	10000 kWh/yr	-	$0.00	18	1.00
Refrigeration	Walk-in Refrigerator	9000 kWh/yr	-	$0.00	18	1.00
Refrigeration	Reach-in Refrigerator	3100 kWh/yr	-	$0.00	18	-
Refrigeration	Reach-in Refrigerator	2500 kWh/yr	0.01	$0.01	18	1.00
Refrigeration	Reach-in Refrigerator	2400 kWh/yr	0.01	$0.01	18	1.04
Refrigeration	Reach-in Refrigerator	1500 kWh/yr	0.03	$0.01	18	2.14
Refrigeration	Glass Door Display	15500 kWh/yr	-	$0.00	18	-
Refrigeration	Glass Door Display	14480 kWh/yr	0.02	$0.00	18	3.25
Refrigeration	Glass Door Display	11700 kWh/yr	0.07	$0.04	18	1.24
Refrigeration	Glass Door Display	8400 kWh/yr	0.13	$0.00	18	-
Refrigeration	Glass Door Display	6800 kWh/yr	0.16	$0.04	18	-
Refrigeration	Open Display Case	7000 kWh/yr	-	$0.00	18	-
Refrigeration	Open Display Case	6535 kWh/yr	0.01	$0.00	18	3.28
Refrigeration	Open Display Case	5350 kWh/yr	0.03	$0.00	18	-
Refrigeration	Open Display Case	5300 kWh/yr	0.03	$0.02	18	1.21
Refrigeration	Open Display Case	4350 kWh/yr	0.05	$0.02	18	-
Refrigeration	Icemaker	7.0 kWh/100 lbs	-	$0.00	12	-
Refrigeration	Icemaker	6.3 kWh/100 lbs	0.01	$0.00	12	1.09
Refrigeration	Icemaker	6.0 kWh/100 lbs	0.01	$0.01	12	1.03
Refrigeration	Icemaker	5.5 kWh/100 lbs	0.02	$0.02	12	0.41
Refrigeration	Vending Machine	3400 kWh/year	-	$0.00	10	-
Refrigeration	Vending Machine	2400 kWh/year	0.02	$0.00	10	3.99
Refrigeration	Vending Machine	1700 kWh/year	0.03	$0.01	10	2.26
Food Preparation	Oven	Standard	-	$0.00	12	-
Food Preparation	Oven	Energy Star	0.03	$0.00	12	75,837.68
Food Preparation	Fryer	Standard	-	$0.00	12	-
Food Preparation	Fryer	Energy Star	-	$0.00	12	1.00
Food Preparation	Dishwasher	Standard	-	$0.00	12	-
Food Preparation	Dishwasher	Energy Star	0.17	$0.01	12	8.74
Food Preparation	Hot Food Container	Standard	-	$0.00	12	-
Food Preparation	Hot Food Container	Energy Star	-	$0.00	12	1.00
Office Equipment	Desktop Computer	Standard	-	$0.00	4	-
Office Equipment	Desktop Computer	Energy Star	0.05	$0.00	4	1,975.67
Office Equipment	Laptop	Standard	-	$0.00	4	-
Office Equipment	Laptop	Energy Star	0.01	$0.00	4	609.04
Office Equipment	Server	Standard	-	$0.00	3	-
Office Equipment	Server	Energy Star	0.05	$0.00	3	6,966.86
Office Equipment	Monitor	Standard	-	$0.00	4	-
Office Equipment	Monitor	Energy Star	0.01	$0.00	4	222.82
Office Equipment	Printer/Copier/Fax	Standard	-	$0.00	6	-

End Use	Technology	Efficiency Definition	Savings (kWh/ sqft/yr)	Incremental Cost ($/sqft)	Lifetime (yrs)	BC Ratio
Office Equipment	Printer/Copier/Fax	Energy Star	0.01	$0.00	6	2,081.01
Office Equipment	POS Terminal	Standard	-	$0.00	4	-
Office Equipment	POS Terminal	Efficient	0.03	$0.02	4	0.26
Miscellaneous	Non-HVAC Motors	Standard (EPAct)	-	$0.00	15	-
Miscellaneous	Non-HVAC Motors	Standard (EPAct 2015)	0.00	$0.00	15	-
Miscellaneous	Non-HVAC Motors	High Efficiency	0.00	$0.00	15	5.32
Miscellaneous	Non-HVAC Motors	High Efficiency (2015)	0.00	$0.00	15	-
Miscellaneous	Non-HVAC Motors	Premium (NEMA)	0.00	$0.00	15	5.32
Miscellaneous	Non-HVAC Motors	Premium (NEMA 2015)	0.00	$0.00	15	-
Miscellaneous	Pool Pump	Standard	-	$0.00	15	-
Miscellaneous	Pool Pump	High Efficiency	0.00	$0.00	15	1.77
Miscellaneous	Pool Pump	Two-Speed	0.00	$0.00	15	1.04
Miscellaneous	Pool Heater	Standard	-	$0.00	15	-
Miscellaneous	Pool Heater	Heat Pump	0.02	$0.01	15	0.90
Miscellaneous	Pool Heater	Solar	0.02	$0.01	15	0.90
Miscellaneous	Miscellaneous	Standard	-	$0.00	5	-

Table C-10 Energy-Efficiency Equipment Data—Large Office, Existing Vintage

End Use	Technology	Efficiency Definition	Savings (kWh/ sqft/yr)	Incremental Cost ($/sqft)	Lifetime (yrs)	BC Ratio
Cooling	Air-Cooled Chiller	1.5 kw/ton, COP 2.3	-	$0.00	20	-
Cooling	Air-Cooled Chiller	1.3 kw/ton, COP 2.7	1.01	$0.42	20	1.76
Cooling	Air-Cooled Chiller	1.26 kw/ton, COP 2.8	1.21	$0.55	20	1.63
Cooling	Air-Cooled Chiller	1.0 kw/ton, COP 3.5	2.52	$0.68	20	2.75
Cooling	Air-Cooled Chiller	0.97 kw/ton, COP 3.6	2.67	$0.81	20	2.46
Cooling	Water-Cooled Chiller	0.75 kw/ton, COP 4.7	-	$0.00	20	-
Cooling	Water-Cooled Chiller	0.60 kw/ton, COP 5.9	1.40	$0.18	20	5.71
Cooling	Water-Cooled Chiller	0.58 kw/ton, COP 6.1	1.59	$0.36	20	3.24
Cooling	Water-Cooled Chiller	0.55 kw/Ton, COP 6.4	1.87	$0.44	20	3.17
Cooling	Water-Cooled Chiller	0.51 kw/ton, COP 6.9	2.24	$0.68	20	2.45
Cooling	Water-Cooled Chiller	0.50 kw/Ton, COP 7.0	2.34	$0.75	20	2.31
Cooling	Water-Cooled Chiller	0.48 kw/ton, COP 7.3	2.53	$0.83	20	2.27
Cooling	Roof Top AC	EER 9.2	-	$0.00	16	-
Cooling	Roof Top AC	EER 10.1	0.68	$0.37	16	1.15
Cooling	Roof Top AC	EER 11.2	1.37	$0.71	16	1.20
Cooling	Roof Top AC	EER 12.0	1.79	$1.37	16	0.82
Cooling	Roof Top AC	Ductless Minisplit	2.57	$4.49	16	0.36
Cooling	Other Cooling	EER 9.8	-	$0.00	14	-
Cooling	Other Cooling	EER 10.0	0.15	$0.25	14	0.33
Cooling	Other Cooling	EER 10.2	0.29	$0.30	14	0.54
Cooling	Other Cooling	EER 10.4	0.42	$0.34	14	0.69
Cooling	Other Cooling	EER 10.6	0.55	$0.39	14	0.79
Cooling	Other Cooling	EER 10.8	0.68	$0.43	14	0.87
Cooling	Other Cooling	EER 12.0	1.34	$2.23	14	0.33
Heating	Electric Heating	Standard	-	$0.00	25	-
Cooling/Heating	Roof Top Heat Pump	EER 9.3	-	$0.00	16	-
Cooling/Heating	Roof Top Heat Pump	EER 10.3	0.94	$0.59	16	0.87
Cooling/Heating	Roof Top Heat Pump	EER 11.0	1.50	$0.85	16	0.96
Cooling/Heating	Roof Top Heat Pump	EER 11.7	2.00	$2.18	16	0.50
Cooling/Heating	Roof Top Heat Pump	EER 12.0	2.19	$2.84	16	0.42
Cooling/Heating	Roof Top Heat Pump	Ductless Minisplit	3.34	$5.44	16	0.33
Cooling/Heating	Roof Top Heat Pump	Geothermal	5.25	$9.40	16	0.30
Ventilation	Ventilation	Constant Volume	-	$0.00	10	-
Ventilation	Ventilation	Constant Volume with ECM	0.27	$0.43	10	0.25
Ventilation	Ventilation	Variable Air Volume	0.67	-$0.17	10	1.00
Ventilation	Ventilation	Variable Air Volume with ECM	0.94	$0.25	10	1.49
Water Heating	Water Heating	EF .97	-	$0.00	15	-
Water Heating	Water Heating	EF .98	0.01	$0.01	15	0.53
Water Heating	Water Heating	EF 2.3	0.54	$0.03	15	10.52
Interior Lighting	Screw-in	Incandescent	-	$0.00	2	-
Interior Lighting	Screw-in	90W Halogen PAR-38	0.19	$0.02	3	1.24
Interior Lighting	Screw-in	70W HIR PAR-38	0.29	$0.03	3	1.37
Interior Lighting	Screw-in	CFL	0.53	$0.01	6	10.11
Interior Lighting	Screw-in	LED	0.58	$0.39	12	0.75
Interior Lighting	High-Bay Fixtures	Metal Halides	-	$0.00	3	-
Interior Lighting	High-Bay Fixtures	LED	0.11	$0.00	15	51.15
Interior Lighting	High-Bay Fixtures	T8	0.11	$0.00	10	1.00
Interior Lighting	High-Bay Fixtures	High Pressure Sodium	0.11	$0.00	6	1.00
Interior Lighting	High-Bay Fixtures	T5	0.14	$0.00	10	1.00
Interior Lighting	Linear Fluorescent	T12	-	$0.00	10	-
Interior Lighting	Linear Fluorescent	LED	0.89	$2.80	15	0.19
Interior Lighting	Linear Fluorescent	T8	0.93	$0.00	10	339.97
Interior Lighting	Linear Fluorescent	Super T8	1.28	$0.02	10	28.88
Exterior Lighting	Screw-in	Incandescent	-	$0.00	2	-

End Use	Technology	Efficiency Definition	Savings (kWh/ sqft/yr)	Incremental Cost ($/sqft)	Lifetime (yrs)	BC Ratio
Exterior Lighting	Screw-in	90W Halogen PAR-38	0.04	$0.00	3	2.25
Exterior Lighting	Screw-in	70W HIR PAR-38	0.06	$0.00	3	2.49
Exterior Lighting	Screw-in	CFL	0.11	$0.00	6	18.88
Exterior Lighting	Screw-in	LED	0.11	$0.03	12	1.46
Exterior Lighting	HID	Metal Halides	-	$0.00	3	-
Exterior Lighting	HID	LED	0.11	$0.37	15	0.16
Exterior Lighting	HID	T8	0.11	$0.00	10	1.00
Exterior Lighting	HID	High Pressure Sodium	0.18	$0.00	6	1.00
Exterior Lighting	HID	T5	0.18	$0.00	10	1.00
Exterior Lighting	Linear Fluorescent	T12	-	$0.00	10	-
Exterior Lighting	Linear Fluorescent	LED	0.01	$0.02	15	0.13
Exterior Lighting	Linear Fluorescent	T8	0.01	$0.00	10	227.85
Exterior Lighting	Linear Fluorescent	Super T8	0.01	$0.00	10	19.35
Exterior Lighting	Linear Fluorescent	T5	0.01	$0.00	10	13.92
Refrigeration	Walk-in Refrigerator	14600 kWh/yr	-	$0.00	18	-
Refrigeration	Walk-in Refrigerator	10800 kWh/yr	-	$0.00	18	1.00
Refrigeration	Walk-in Refrigerator	10000 kWh/yr	-	$0.00	18	1.00
Refrigeration	Walk-in Refrigerator	9000 kWh/yr	-	$0.00	18	1.00
Refrigeration	Reach-in Refrigerator	3100 kWh/yr	-	$0.00	18	-
Refrigeration	Reach-in Refrigerator	2500 kWh/yr	0.01	$0.00	18	1.02
Refrigeration	Reach-in Refrigerator	2400 kWh/yr	0.01	$0.01	18	1.05
Refrigeration	Reach-in Refrigerator	1500 kWh/yr	0.02	$0.01	18	2.17
Refrigeration	Glass Door Display	15500 kWh/yr	-	$0.00	18	-
Refrigeration	Glass Door Display	14480 kWh/yr	0.01	$0.00	18	3.29
Refrigeration	Glass Door Display	11700 kWh/yr	0.05	$0.03	18	1.25
Refrigeration	Glass Door Display	8400 kWh/yr	0.09	$0.00	18	-
Refrigeration	Glass Door Display	6800 kWh/yr	0.11	$0.03	18	-
Refrigeration	Open Display Case	7000 kWh/yr	-	$0.00	18	-
Refrigeration	Open Display Case	6535 kWh/yr	0.01	$0.00	18	3.31
Refrigeration	Open Display Case	5350 kWh/yr	0.02	$0.00	18	-
Refrigeration	Open Display Case	5300 kWh/yr	0.02	$0.01	18	1.22
Refrigeration	Open Display Case	4350 kWh/yr	0.03	$0.01	18	-
Refrigeration	Icemaker	7.0 kWh/100 lbs	-	$0.00	12	-
Refrigeration	Icemaker	6.3 kWh/100 lbs	0.01	$0.00	12	1.10
Refrigeration	Icemaker	6.0 kWh/100 lbs	0.01	$0.00	12	1.04
Refrigeration	Icemaker	5.5 kWh/100 lbs	0.01	$0.01	12	0.42
Refrigeration	Vending Machine	3400 kWh/year	-	$0.00	10	-
Refrigeration	Vending Machine	2400 kWh/year	0.02	$0.00	10	4.04
Refrigeration	Vending Machine	1700 kWh/year	0.04	$0.01	10	2.29
Food Preparation	Oven	Standard	-	$0.00	12	-
Food Preparation	Oven	Energy Star	0.02	$0.00	12	99,739.96
Food Preparation	Fryer	Standard	-	$0.00	12	-
Food Preparation	Fryer	Energy Star	0.01	$0.00	12	2.41
Food Preparation	Dishwasher	Standard	-	$0.00	12	-
Food Preparation	Dishwasher	Energy Star	0.09	$0.00	12	11.50
Food Preparation	Hot Food Container	Standard	-	$0.00	12	-
Food Preparation	Hot Food Container	Energy Star	0.06	$0.01	12	2.35
Office Equipment	Desktop Computer	Standard	-	$0.00	4	-
Office Equipment	Desktop Computer	Energy Star	0.95	$0.00	4	2,031.02
Office Equipment	Laptop	Standard	-	$0.00	4	-
Office Equipment	Laptop	Energy Star	0.15	$0.00	4	626.10
Office Equipment	Server	Standard	-	$0.00	3	-
Office Equipment	Server	Energy Star	0.07	$0.00	3	7,165.93
Office Equipment	Monitor	Standard	-	$0.00	4	-
Office Equipment	Monitor	Energy Star	0.11	$0.00	4	229.06
Office Equipment	Printer/Copier/Fax	Standard	-	$0.00	6	-
Office Equipment	Printer/Copier/Fax	Energy Star	0.11	$0.00	6	2,134.71

End Use	Technology	Efficiency Definition	Savings (kWh/ sqft/yr)	Incremental Cost ($/sqft)	Lifetime (yrs)	BC Ratio
Office Equipment	POS Terminal	Standard	-	$0.00	4	-
Office Equipment	POS Terminal	Efficient	0.01	$0.00	4	0.27
Miscellaneous	Non-HVAC Motors	Standard (EPAct)	-	$0.00	15	-
Miscellaneous	Non-HVAC Motors	Standard (EPAct 2015)	0.00	$0.00	15	-
Miscellaneous	Non-HVAC Motors	High Efficiency	0.00	$0.00	15	5.61
Miscellaneous	Non-HVAC Motors	High Efficiency (2015)	0.00	$0.00	15	-
Miscellaneous	Non-HVAC Motors	Premium (NEMA)	0.00	$0.00	15	5.61
Miscellaneous	Non-HVAC Motors	Premium (NEMA 2015)	0.00	$0.00	15	-
Miscellaneous	Pool Pump	Standard	-	$0.00	15	-
Miscellaneous	Pool Pump	High Efficiency	-	$0.00	15	1.00
Miscellaneous	Pool Pump	Two-Speed	-	$0.00	15	1.00
Miscellaneous	Pool Heater	Standard	-	$0.00	15	-
Miscellaneous	Pool Heater	Heat Pump	-	$0.00	15	1.00
Miscellaneous	Pool Heater	Solar	-	$0.00	15	1.00
Miscellaneous	Miscellaneous	Standard	-	$0.00	5	-

Table C-11 Energy-Efficiency Equipment Data—Small Office, Existing Vintage

End Use	Technology	Efficiency Definition	Savings (kWh/ sqft/yr)	Incremental Cost ($/sqft)	Lifetime (yrs)	BC Ratio
Cooling	Air-Cooled Chiller	1.5 kw/ton, COP 2.3	-	$0.00	20	-
Cooling	Air-Cooled Chiller	1.3 kw/ton, COP 2.7	1.04	$0.47	20	1.43
Cooling	Air-Cooled Chiller	1.26 kw/ton, COP 2.8	1.25	$0.61	20	1.32
Cooling	Air-Cooled Chiller	1.0 kw/ton, COP 3.5	2.61	$0.75	20	2.23
Cooling	Air-Cooled Chiller	0.97 kw/ton, COP 3.6	2.77	$0.89	20	1.99
Cooling	Water-Cooled Chiller	0.75 kw/ton, COP 4.7	-	$0.00	20	-
Cooling	Water-Cooled Chiller	0.60 kw/ton, COP 5.9	1.44	$0.20	20	4.67
Cooling	Water-Cooled Chiller	0.58 kw/ton, COP 6.1	1.63	$0.40	20	2.65
Cooling	Water-Cooled Chiller	0.55 kw/Ton, COP 6.4	1.92	$0.48	20	2.60
Cooling	Water-Cooled Chiller	0.51 kw/ton, COP 6.9	2.31	$0.74	20	2.00
Cooling	Water-Cooled Chiller	0.50 kw/Ton, COP 7.0	2.40	$0.82	20	1.89
Cooling	Water-Cooled Chiller	0.48 kw/ton, COP 7.3	2.60	$0.90	20	1.86
Cooling	Roof Top AC	EER 9.2	-	$0.00	16	-
Cooling	Roof Top AC	EER 10.1	0.72	$0.38	16	1.01
Cooling	Roof Top AC	EER 11.2	1.44	$0.73	16	1.05
Cooling	Roof Top AC	EER 12.0	1.88	$1.41	16	0.72
Cooling	Roof Top AC	Ductless Minisplit	2.63	$4.61	16	0.31
Cooling	Other Cooling	EER 9.8	-	$0.00	14	-
Cooling	Other Cooling	EER 10.0	0.16	$0.28	14	0.28
Cooling	Other Cooling	EER 10.2	0.32	$0.33	14	0.46
Cooling	Other Cooling	EER 10.4	0.47	$0.38	14	0.59
Cooling	Other Cooling	EER 10.6	0.62	$0.44	14	0.68
Cooling	Other Cooling	EER 10.8	0.76	$0.49	14	0.74
Cooling	Other Cooling	EER 12.0	1.51	$2.52	14	0.29
Heating	Electric Heating	Standard	-	$0.00	25	-
Cooling/Heating	Roof Top Heat Pump	EER 9.3	-	$0.00	16	-
Cooling/Heating	Roof Top Heat Pump	EER 10.3	0.94	$0.53	16	1.02
Cooling/Heating	Roof Top Heat Pump	EER 11.0	1.49	$0.76	16	1.13
Cooling/Heating	Roof Top Heat Pump	EER 11.7	1.98	$1.94	16	0.58
Cooling/Heating	Roof Top Heat Pump	EER 12.0	2.18	$2.53	16	0.49
Cooling/Heating	Roof Top Heat Pump	Ductless Minisplit	3.32	$4.85	16	0.39
Cooling/Heating	Roof Top Heat Pump	Geothermal	5.28	$8.38	16	0.36
Ventilation	Ventilation	Constant Volume	-	$0.00	10	-
Ventilation	Ventilation	Constant Volume with ECM	0.14	$0.28	10	0.20
Ventilation	Ventilation	Variable Air Volume	0.45	-$0.12	10	1.00
Ventilation	Ventilation	Variable Air Volume with ECM	0.59	$0.17	10	1.41
Water Heating	Water Heating	EF .97	-	$0.00	15	-
Water Heating	Water Heating	EF .98	0.01	$0.00	15	1.00
Water Heating	Water Heating	EF 2.3	0.46	$0.00	15	1.00
Interior Lighting	Screw-in	Incandescent	-	$0.00	2	-
Interior Lighting	Screw-in	90W Halogen PAR-38	0.17	$0.02	3	1.14
Interior Lighting	Screw-in	70W HIR PAR-38	0.27	$0.03	3	1.26
Interior Lighting	Screw-in	CFL	0.50	$0.02	6	9.26
Interior Lighting	Screw-in	LED	0.54	$0.42	12	0.68
Interior Lighting	High-Bay Fixtures	Metal Halides	-	$0.00	3	-
Interior Lighting	High-Bay Fixtures	LED	0.10	$0.18	15	0.40
Interior Lighting	High-Bay Fixtures	T8	0.10	$0.00	10	1.00
Interior Lighting	High-Bay Fixtures	High Pressure Sodium	0.11	$0.00	6	1.00
Interior Lighting	High-Bay Fixtures	T5	0.13	$0.00	10	1.00
Interior Lighting	Linear Fluorescent	T12	-	$0.00	10	-
Interior Lighting	Linear Fluorescent	LED	0.83	$2.14	15	0.25
Interior Lighting	Linear Fluorescent	T8	0.87	$0.00	10	435.65
Interior Lighting	Linear Fluorescent	Super T8	1.20	$0.01	10	37.00
Exterior Lighting	Screw-in	Incandescent	-	$0.00	2	-
Exterior Lighting	Screw-in	90W Halogen PAR-38	0.05	$0.00	3	2.25

End Use	Technology	Efficiency Definition	Savings (kWh/ sqft/yr)	Incremental Cost ($/sqft)	Lifetime (yrs)	BC Ratio
Exterior Lighting	Screw-in	70W HIR PAR-38	0.07	$0.00	3	2.49
Exterior Lighting	Screw-in	CFL	0.14	$0.00	6	18.88
Exterior Lighting	Screw-in	LED	0.15	$0.04	12	1.46
Exterior Lighting	HID	Metal Halides	-	$0.00	3	-
Exterior Lighting	HID	LED	0.19	$0.65	15	0.16
Exterior Lighting	HID	T8	0.20	$0.00	10	1.00
Exterior Lighting	HID	High Pressure Sodium	0.31	$0.00	6	1.00
Exterior Lighting	HID	T5	0.32	$0.00	10	1.00
Exterior Lighting	Linear Fluorescent	T12	-	$0.00	10	-
Exterior Lighting	Linear Fluorescent	LED	0.01	$0.05	15	0.13
Exterior Lighting	Linear Fluorescent	T8	0.01	$0.00	10	227.86
Exterior Lighting	Linear Fluorescent	Super T8	0.02	$0.00	10	19.35
Exterior Lighting	Linear Fluorescent	T5	0.02	$0.00	10	13.92
Refrigeration	Walk-in Refrigerator	14600 kWh/yr	-	$0.00	18	-
Refrigeration	Walk-in Refrigerator	10800 kWh/yr	-	$0.00	18	1.00
Refrigeration	Walk-in Refrigerator	10000 kWh/yr	-	$0.00	18	1.00
Refrigeration	Walk-in Refrigerator	9000 kWh/yr	-	$0.00	18	1.00
Refrigeration	Reach-in Refrigerator	3100 kWh/yr	-	$0.00	18	-
Refrigeration	Reach-in Refrigerator	2500 kWh/yr	0.03	$0.02	18	1.01
Refrigeration	Reach-in Refrigerator	2400 kWh/yr	0.03	$0.02	18	1.05
Refrigeration	Reach-in Refrigerator	1500 kWh/yr	0.08	$0.02	18	2.16
Refrigeration	Glass Door Display	15500 kWh/yr	-	$0.00	18	-
Refrigeration	Glass Door Display	14480 kWh/yr	-	$0.00	18	1.00
Refrigeration	Glass Door Display	11700 kWh/yr	-	$0.00	18	1.00
Refrigeration	Glass Door Display	8400 kWh/yr	-	$0.00	18	-
Refrigeration	Glass Door Display	6800 kWh/yr	-	$0.00	18	-
Refrigeration	Open Display Case	7000 kWh/yr	-	$0.00	18	-
Refrigeration	Open Display Case	6535 kWh/yr	-	$0.00	18	1.00
Refrigeration	Open Display Case	5350 kWh/yr	-	$0.00	18	-
Refrigeration	Open Display Case	5300 kWh/yr	-	$0.00	18	1.00
Refrigeration	Open Display Case	4350 kWh/yr	-	$0.00	18	-
Refrigeration	Icemaker	7.0 kWh/100 lbs	-	$0.00	12	-
Refrigeration	Icemaker	6.3 kWh/100 lbs	0.02	$0.01	12	1.10
Refrigeration	Icemaker	6.0 kWh/100 lbs	0.03	$0.01	12	1.04
Refrigeration	Icemaker	5.5 kWh/100 lbs	0.05	$0.05	12	0.42
Refrigeration	Vending Machine	3400 kWh/year	-	$0.00	10	-
Refrigeration	Vending Machine	2400 kWh/year	0.05	$0.00	10	4.03
Refrigeration	Vending Machine	1700 kWh/year	0.08	$0.01	10	2.28
Food Preparation	Oven	Standard	-	$0.00	12	-
Food Preparation	Oven	Energy Star	0.05	$0.00	12	102,390.45
Food Preparation	Fryer	Standard	-	$0.00	12	-
Food Preparation	Fryer	Energy Star	-	$0.00	12	1.00
Food Preparation	Dishwasher	Standard	-	$0.00	12	-
Food Preparation	Dishwasher	Energy Star	0.23	$0.01	12	11.80
Food Preparation	Hot Food Container	Standard	-	$0.00	12	-
Food Preparation	Hot Food Container	Energy Star	-	$0.00	12	1.00
Office Equipment	Desktop Computer	Standard	-	$0.00	4	-
Office Equipment	Desktop Computer	Energy Star	0.39	$0.00	4	2,065.17
Office Equipment	Laptop	Standard	-	$0.00	4	-
Office Equipment	Laptop	Energy Star	0.06	$0.00	4	636.63
Office Equipment	Server	Standard	-	$0.00	3	-
Office Equipment	Server	Energy Star	0.18	$0.00	3	7,288.76
Office Equipment	Monitor	Standard	-	$0.00	4	-
Office Equipment	Monitor	Energy Star	0.04	$0.00	4	232.91
Office Equipment	Printer/Copier/Fax	Standard	-	$0.00	6	-
Office Equipment	Printer/Copier/Fax	Energy Star	0.13	$0.00	6	2,167.85

End Use	Technology	Efficiency Definition	Savings (kWh/ sqft/yr)	Incremental Cost ($/sqft)	Lifetime (yrs)	BC Ratio
Office Equipment	POS Terminal	Standard	-	$0.00	4	-
Office Equipment	POS Terminal	Efficient	0.05	$0.03	4	0.28
Miscellaneous	Non-HVAC Motors	Standard (EPAct)	-	$0.00	15	-
Miscellaneous	Non-HVAC Motors	Standard (EPAct 2015)	0.00	$0.00	15	-
Miscellaneous	Non-HVAC Motors	High Efficiency	0.00	$0.00	15	5.68
Miscellaneous	Non-HVAC Motors	High Efficiency (2015)	0.00	$0.00	15	-
Miscellaneous	Non-HVAC Motors	Premium (NEMA)	0.00	$0.00	15	5.68
Miscellaneous	Non-HVAC Motors	Premium (NEMA 2015)	0.01	$0.00	15	-
Miscellaneous	Pool Pump	Standard	-	$0.00	15	-
Miscellaneous	Pool Pump	High Efficiency	-	$0.00	15	1.00
Miscellaneous	Pool Pump	Two-Speed	-	$0.00	15	1.00
Miscellaneous	Pool Heater	Standard	-	$0.00	15	-
Miscellaneous	Pool Heater	Heat Pump	-	$0.00	15	1.00
Miscellaneous	Pool Heater	Solar	-	$0.00	15	1.00
Miscellaneous	Miscellaneous	Standard	-	$0.00	5	-

Table C-12 Energy-Efficiency Equipment Data—Restaurant, Existing Vintage

End Use	Technology	Efficiency Definition	Savings (kWh/ sqft/yr)	Incremental Cost ($/sqft)	Lifetime (yrs)	BC Ratio
Cooling	Air-Cooled Chiller	1.5 kw/ton, COP 2.3	-	$0.00	20	-
Cooling	Air-Cooled Chiller	1.3 kw/ton, COP 2.7	2.61	$0.73	20	2.64
Cooling	Air-Cooled Chiller	1.26 kw/ton, COP 2.8	3.13	$0.95	20	2.44
Cooling	Air-Cooled Chiller	1.0 kw/ton, COP 3.5	6.53	$1.17	20	4.13
Cooling	Air-Cooled Chiller	0.97 kw/ton, COP 3.6	6.92	$1.40	20	3.69
Cooling	Water-Cooled Chiller	0.75 kw/ton, COP 4.7	-	$0.00	20	-
Cooling	Water-Cooled Chiller	0.60 kw/ton, COP 5.9	3.74	$0.33	20	8.37
Cooling	Water-Cooled Chiller	0.58 kw/ton, COP 6.1	4.24	$0.66	20	4.74
Cooling	Water-Cooled Chiller	0.55 kw/Ton, COP 6.4	4.99	$0.80	20	4.65
Cooling	Water-Cooled Chiller	0.51 kw/ton, COP 6.9	5.99	$1.24	20	3.59
Cooling	Water-Cooled Chiller	0.50 kw/Ton, COP 7.0	6.24	$1.37	20	3.38
Cooling	Water-Cooled Chiller	0.48 kw/ton, COP 7.3	6.75	$1.50	20	3.33
Cooling	Roof Top AC	EER 9.2	-	$0.00	16	-
Cooling	Roof Top AC	EER 10.1	1.28	$0.49	16	1.62
Cooling	Roof Top AC	EER 11.2	2.56	$0.95	16	1.69
Cooling	Roof Top AC	EER 12.0	3.35	$1.82	16	1.15
Cooling	Roof Top AC	Ductless Minisplit	4.95	$5.97	16	0.52
Cooling	Other Cooling	EER 9.8	-	$0.00	14	-
Cooling	Other Cooling	EER 10.0	0.31	$0.54	14	0.33
Cooling	Other Cooling	EER 10.2	0.61	$0.63	14	0.54
Cooling	Other Cooling	EER 10.4	0.90	$0.73	14	0.69
Cooling	Other Cooling	EER 10.6	1.18	$0.83	14	0.79
Cooling	Other Cooling	EER 10.8	1.45	$0.93	14	0.87
Cooling	Other Cooling	EER 12.0	2.87	$4.79	14	0.33
Heating	Electric Heating	Standard	-	$0.00	25	-
Cooling/Heating	Roof Top Heat Pump	EER 9.3	-	$0.00	16	-
Cooling/Heating	Roof Top Heat Pump	EER 10.3	1.87	$0.80	16	1.25
Cooling/Heating	Roof Top Heat Pump	EER 11.0	2.98	$1.16	16	1.38
Cooling/Heating	Roof Top Heat Pump	EER 11.7	3.95	$2.96	16	0.72
Cooling/Heating	Roof Top Heat Pump	EER 12.0	4.34	$3.87	16	0.60
Cooling/Heating	Roof Top Heat Pump	Ductless Minisplit	6.62	$7.41	16	0.48
Cooling/Heating	Roof Top Heat Pump	Geothermal	10.45	$12.81	16	0.44
Ventilation	Ventilation	Constant Volume	-	$0.00	10	-
Ventilation	Ventilation	Constant Volume with ECM	0.33	$2.56	10	0.05
Ventilation	Ventilation	Variable Air Volume	0.93	-$1.04	10	1.00
Ventilation	Ventilation	Variable Air Volume with ECM	1.27	$1.52	10	0.33
Water Heating	Water Heating	EF .97	-	$0.00	15	-
Water Heating	Water Heating	EF .98	0.12	$0.10	15	0.68
Water Heating	Water Heating	EF 2.3	6.64	$0.30	15	13.32
Interior Lighting	Screw-in	Incandescent	-	$0.00	2	-
Interior Lighting	Screw-in	90W Halogen PAR-38	1.55	$0.06	3	2.95
Interior Lighting	Screw-in	70W HIR PAR-38	2.38	$0.09	3	3.27
Interior Lighting	Screw-in	CFL	4.46	$0.05	6	24.15
Interior Lighting	Screw-in	LED	4.83	$1.35	12	1.79
Interior Lighting	High-Bay Fixtures	Metal Halides	-	$0.00	3	-
Interior Lighting	High-Bay Fixtures	LED	0.24	$0.08	15	2.10
Interior Lighting	High-Bay Fixtures	T8	0.25	$0.00	10	1.00
Interior Lighting	High-Bay Fixtures	High Pressure Sodium	0.26	$0.00	6	1.00
Interior Lighting	High-Bay Fixtures	T5	0.32	$0.00	10	1.00
Interior Lighting	Linear Fluorescent	T12	-	$0.00	10	-
Interior Lighting	Linear Fluorescent	LED	0.77	$0.96	15	0.48
Interior Lighting	Linear Fluorescent	T8	0.80	$0.00	10	848.51
Interior Lighting	Linear Fluorescent	Super T8	1.11	$0.01	10	72.07
Exterior Lighting	Screw-in	Incandescent	-	$0.00	2	-

End Use	Technology	Efficiency Definition	Savings (kWh/ sqft/yr)	Incremental Cost ($/sqft)	Lifetime (yrs)	BC Ratio
Exterior Lighting	Screw-in	90W Halogen PAR-38	0.08	$0.00	3	1.80
Exterior Lighting	Screw-in	70W HIR PAR-38	0.12	$0.01	3	2.00
Exterior Lighting	Screw-in	CFL	0.22	$0.00	6	15.15
Exterior Lighting	Screw-in	LED	0.23	$0.08	12	1.17
Exterior Lighting	HID	Metal Halides	-	$0.00	3	-
Exterior Lighting	HID	LED	0.53	$1.81	15	0.16
Exterior Lighting	HID	T8	0.55	-$0.01	10	1.00
Exterior Lighting	HID	High Pressure Sodium	0.86	$0.00	6	1.00
Exterior Lighting	HID	T5	0.89	$0.01	10	1.00
Exterior Lighting	Linear Fluorescent	T12	-	$0.00	10	-
Exterior Lighting	Linear Fluorescent	LED	0.00	$0.01	15	0.13
Exterior Lighting	Linear Fluorescent	T8	0.00	$0.00	10	227.86
Exterior Lighting	Linear Fluorescent	Super T8	0.00	$0.00	10	19.35
Exterior Lighting	Linear Fluorescent	T5	0.00	$0.00	10	13.92
Refrigeration	Walk-in Refrigerator	14600 kWh/yr	-	$0.00	18	-
Refrigeration	Walk-in Refrigerator	10800 kWh/yr	0.69	$0.27	18	1.71
Refrigeration	Walk-in Refrigerator	10000 kWh/yr	0.84	$0.35	18	1.63
Refrigeration	Walk-in Refrigerator	9000 kWh/yr	1.02	$0.62	18	1.11
Refrigeration	Reach-in Refrigerator	3100 kWh/yr	-	$0.00	18	-
Refrigeration	Reach-in Refrigerator	2500 kWh/yr	0.11	$0.07	18	1.01
Refrigeration	Reach-in Refrigerator	2400 kWh/yr	0.13	$0.08	18	1.05
Refrigeration	Reach-in Refrigerator	1500 kWh/yr	0.29	$0.09	18	2.16
Refrigeration	Glass Door Display	15500 kWh/yr	-	$0.00	18	-
Refrigeration	Glass Door Display	14480 kWh/yr	0.19	$0.04	18	3.28
Refrigeration	Glass Door Display	11700 kWh/yr	0.69	$0.38	18	1.25
Refrigeration	Glass Door Display	8400 kWh/yr	1.30	$0.04	18	-
Refrigeration	Glass Door Display	6800 kWh/yr	1.59	$0.38	18	-
Refrigeration	Open Display Case	7000 kWh/yr	-	$0.00	18	-
Refrigeration	Open Display Case	6535 kWh/yr	0.08	$0.02	18	3.31
Refrigeration	Open Display Case	5350 kWh/yr	0.30	$0.02	18	-
Refrigeration	Open Display Case	5300 kWh/yr	0.31	$0.17	18	1.22
Refrigeration	Open Display Case	4350 kWh/yr	0.48	$0.17	18	-
Refrigeration	Icemaker	7.0 kWh/100 lbs	-	$0.00	12	-
Refrigeration	Icemaker	6.3 kWh/100 lbs	0.08	$0.04	12	1.10
Refrigeration	Icemaker	6.0 kWh/100 lbs	0.12	$0.05	12	1.04
Refrigeration	Icemaker	5.5 kWh/100 lbs	0.18	$0.20	12	0.42
Refrigeration	Vending Machine	3400 kWh/year	-	$0.00	10	-
Refrigeration	Vending Machine	2400 kWh/year	0.18	$0.02	10	4.03
Refrigeration	Vending Machine	1700 kWh/year	0.31	$0.05	10	2.28
Food Preparation	Oven	Standard	-	$0.00	12	-
Food Preparation	Oven	Energy Star	0.81	$0.00	12	93,128.08
Food Preparation	Fryer	Standard	-	$0.00	12	-
Food Preparation	Fryer	Energy Star	0.51	$0.11	12	2.25
Food Preparation	Dishwasher	Standard	-	$0.00	12	-
Food Preparation	Dishwasher	Energy Star	2.01	$0.09	12	10.74
Food Preparation	Hot Food Container	Standard	-	$0.00	12	-
Food Preparation	Hot Food Container	Energy Star	1.36	$0.31	12	2.19
Office Equipment	Desktop Computer	Standard	-	$0.00	4	-
Office Equipment	Desktop Computer	Energy Star	0.08	$0.00	4	2,016.49
Office Equipment	Laptop	Standard	-	$0.00	4	-
Office Equipment	Laptop	Energy Star	0.01	$0.00	4	621.62
Office Equipment	Server	Standard	-	$0.00	3	-
Office Equipment	Server	Energy Star	0.07	$0.00	3	7,113.66
Office Equipment	Monitor	Standard	-	$0.00	4	-
Office Equipment	Monitor	Energy Star	0.01	$0.00	4	227.42
Office Equipment	Printer/Copier/Fax	Standard	-	$0.00	6	-
Office Equipment	Printer/Copier/Fax	Energy Star	0.02	$0.00	6	2,120.61

End Use	Technology	Efficiency Definition	Savings (kWh/ sqft/yr)	Incremental Cost ($/sqft)	Lifetime (yrs)	BC Ratio
Office Equipment	POS Terminal	Standard	-	$0.00	4	-
Office Equipment	POS Terminal	Efficient	0.04	$0.02	4	0.27
Miscellaneous	Non-HVAC Motors	Standard (EPAct)	-	$0.00	15	-
Miscellaneous	Non-HVAC Motors	Standard (EPAct 2015)	0.01	$0.00	15	-
Miscellaneous	Non-HVAC Motors	High Efficiency	0.01	$0.00	15	5.47
Miscellaneous	Non-HVAC Motors	High Efficiency (2015)	0.02	$0.00	15	-
Miscellaneous	Non-HVAC Motors	Premium (NEMA)	0.02	$0.00	15	5.47
Miscellaneous	Non-HVAC Motors	Premium (NEMA 2015)	0.03	$0.00	15	-
Miscellaneous	Pool Pump	Standard	-	$0.00	15	-
Miscellaneous	Pool Pump	High Efficiency	-	$0.00	15	1.00
Miscellaneous	Pool Pump	Two-Speed	-	$0.00	15	1.00
Miscellaneous	Pool Heater	Standard	-	$0.00	15	-
Miscellaneous	Pool Heater	Heat Pump	-	$0.00	15	1.00
Miscellaneous	Pool Heater	Solar	-	$0.00	15	1.00
Miscellaneous	Miscellaneous	Standard	-	$0.00	5	-

Table C-13 Energy-Efficiency Equipment Data—Large Retail, Existing Vintage

End Use	Technology	Efficiency Definition	Savings (kWh/ sqft/yr)	Incremental Cost ($/sqft)	Lifetime (yrs)	BC Ratio
Cooling	Air-Cooled Chiller	1.5 kw/ton, COP 2.3	-	$0.00	20	-
Cooling	Air-Cooled Chiller	1.3 kw/ton, COP 2.7	0.95	$0.28	20	2.21
Cooling	Air-Cooled Chiller	1.26 kw/ton, COP 2.8	1.14	$0.36	20	2.04
Cooling	Air-Cooled Chiller	1.0 kw/ton, COP 3.5	2.38	$0.44	20	3.45
Cooling	Air-Cooled Chiller	0.97 kw/ton, COP 3.6	2.53	$0.53	20	3.08
Cooling	Water-Cooled Chiller	0.75 kw/ton, COP 4.7	-	$0.00	20	-
Cooling	Water-Cooled Chiller	0.60 kw/ton, COP 5.9	1.16	$0.10	20	7.15
Cooling	Water-Cooled Chiller	0.58 kw/ton, COP 6.1	1.32	$0.21	20	4.05
Cooling	Water-Cooled Chiller	0.55 kw/Ton, COP 6.4	1.55	$0.25	20	3.98
Cooling	Water-Cooled Chiller	0.51 kw/ton, COP 6.9	1.86	$0.39	20	3.07
Cooling	Water-Cooled Chiller	0.50 kw/Ton, COP 7.0	1.94	$0.43	20	2.89
Cooling	Water-Cooled Chiller	0.48 kw/ton, COP 7.3	2.10	$0.47	20	2.85
Cooling	Roof Top AC	EER 9.2	-	$0.00	16	-
Cooling	Roof Top AC	EER 10.1	0.53	$0.19	16	1.53
Cooling	Roof Top AC	EER 11.2	1.06	$0.36	16	1.59
Cooling	Roof Top AC	EER 12.0	1.38	$0.68	16	1.08
Cooling	Roof Top AC	Ductless Minisplit	2.07	$2.24	16	0.49
Cooling	Other Cooling	EER 9.8	-	$0.00	14	-
Cooling	Other Cooling	EER 10.0	0.11	$0.19	14	0.28
Cooling	Other Cooling	EER 10.2	0.22	$0.23	14	0.46
Cooling	Other Cooling	EER 10.4	0.32	$0.26	14	0.59
Cooling	Other Cooling	EER 10.6	0.42	$0.30	14	0.68
Cooling	Other Cooling	EER 10.8	0.52	$0.33	14	0.74
Cooling	Other Cooling	EER 12.0	1.03	$1.72	14	0.29
Heating	Electric Heating	Standard	-	$0.00	25	-
Cooling/Heating	Roof Top Heat Pump	EER 9.3	-	$0.00	16	-
Cooling/Heating	Roof Top Heat Pump	EER 10.3	0.89	$0.38	16	1.23
Cooling/Heating	Roof Top Heat Pump	EER 11.0	1.41	$0.54	16	1.37
Cooling/Heating	Roof Top Heat Pump	EER 11.7	1.88	$1.39	16	0.71
Cooling/Heating	Roof Top Heat Pump	EER 12.0	2.06	$1.82	16	0.59
Cooling/Heating	Roof Top Heat Pump	Ductless Minisplit	3.14	$3.49	16	0.47
Cooling/Heating	Roof Top Heat Pump	Geothermal	4.90	$6.03	16	0.43
Ventilation	Ventilation	Constant Volume	-	$0.00	10	-
Ventilation	Ventilation	Constant Volume with ECM	0.10	$0.11	10	0.33
Ventilation	Ventilation	Variable Air Volume	0.16	-$0.05	10	1.00
Ventilation	Ventilation	Variable Air Volume with ECM	0.27	$0.07	10	1.62
Water Heating	Water Heating	EF .97	-	$0.00	15	-
Water Heating	Water Heating	EF .98	0.01	$0.01	15	0.66
Water Heating	Water Heating	EF 2.3	0.45	$0.02	15	13.09
Interior Lighting	Screw-in	Incandescent	-	$0.00	2	-
Interior Lighting	Screw-in	90W Halogen PAR-38	0.26	$0.02	3	1.80
Interior Lighting	Screw-in	70W HIR PAR-38	0.41	$0.02	3	2.00
Interior Lighting	Screw-in	CFL	0.76	$0.01	6	14.82
Interior Lighting	Screw-in	LED	0.82	$0.35	12	1.11
Interior Lighting	High-Bay Fixtures	Metal Halides	-	$0.00	3	-
Interior Lighting	High-Bay Fixtures	LED	0.54	$0.53	15	0.68
Interior Lighting	High-Bay Fixtures	T8	0.55	-$0.01	10	1.00
Interior Lighting	High-Bay Fixtures	High Pressure Sodium	0.58	$0.00	6	1.00
Interior Lighting	High-Bay Fixtures	T5	0.70	-$0.01	10	1.00
Interior Lighting	Linear Fluorescent	T12	-	$0.00	10	-
Interior Lighting	Linear Fluorescent	LED	0.76	$2.38	15	0.18
Interior Lighting	Linear Fluorescent	T8	0.79	$0.00	10	323.08
Interior Lighting	Linear Fluorescent	Super T8	1.10	$0.02	10	27.44
Exterior Lighting	Screw-in	Incandescent	-	$0.00	2	-
Exterior Lighting	Screw-in	90W Halogen PAR-38	0.19	$0.01	3	2.55

End Use	Technology	Efficiency Definition	Savings (kWh/ sqft/yr)	Incremental Cost ($/sqft)	Lifetime (yrs)	BC Ratio
Exterior Lighting	Screw-in	70W HIR PAR-38	0.30	$0.01	3	2.83
Exterior Lighting	Screw-in	CFL	0.56	$0.01	6	21.42
Exterior Lighting	Screw-in	LED	0.60	$0.15	12	1.65
Exterior Lighting	HID	Metal Halides	-	$0.00	3	-
Exterior Lighting	HID	LED	0.07	$0.25	15	0.16
Exterior Lighting	HID	T8	0.08	$0.00	10	1.00
Exterior Lighting	HID	High Pressure Sodium	0.12	$0.00	6	1.00
Exterior Lighting	HID	T5	0.13	$0.00	10	1.00
Exterior Lighting	Linear Fluorescent	T12	-	$0.00	10	-
Exterior Lighting	Linear Fluorescent	LED	0.00	$0.01	15	0.13
Exterior Lighting	Linear Fluorescent	T8	0.00	$0.00	10	227.86
Exterior Lighting	Linear Fluorescent	Super T8	0.00	$0.00	10	19.35
Exterior Lighting	Linear Fluorescent	T5	0.00	$0.00	10	13.92
Refrigeration	Walk-in Refrigerator	14600 kWh/yr	-	$0.00	18	-
Refrigeration	Walk-in Refrigerator	10800 kWh/yr	0.07	$0.03	18	1.70
Refrigeration	Walk-in Refrigerator	10000 kWh/yr	0.08	$0.03	18	1.62
Refrigeration	Walk-in Refrigerator	9000 kWh/yr	0.10	$0.06	18	1.10
Refrigeration	Reach-in Refrigerator	3100 kWh/yr	-	$0.00	18	-
Refrigeration	Reach-in Refrigerator	2500 kWh/yr	0.01	$0.01	18	1.01
Refrigeration	Reach-in Refrigerator	2400 kWh/yr	0.01	$0.01	18	1.04
Refrigeration	Reach-in Refrigerator	1500 kWh/yr	0.03	$0.01	18	2.14
Refrigeration	Glass Door Display	15500 kWh/yr	-	$0.00	18	-
Refrigeration	Glass Door Display	14480 kWh/yr	0.02	$0.00	18	3.25
Refrigeration	Glass Door Display	11700 kWh/yr	0.07	$0.04	18	1.24
Refrigeration	Glass Door Display	8400 kWh/yr	0.13	$0.00	18	-
Refrigeration	Glass Door Display	6800 kWh/yr	0.16	$0.04	18	-
Refrigeration	Open Display Case	7000 kWh/yr	-	$0.00	18	-
Refrigeration	Open Display Case	6535 kWh/yr	0.01	$0.00	18	3.28
Refrigeration	Open Display Case	5350 kWh/yr	0.03	$0.00	18	-
Refrigeration	Open Display Case	5300 kWh/yr	0.03	$0.02	18	1.21
Refrigeration	Open Display Case	4350 kWh/yr	0.05	$0.02	18	-
Refrigeration	Icemaker	7.0 kWh/100 lbs	-	$0.00	12	-
Refrigeration	Icemaker	6.3 kWh/100 lbs	0.02	$0.01	12	1.09
Refrigeration	Icemaker	6.0 kWh/100 lbs	0.02	$0.01	12	1.03
Refrigeration	Icemaker	5.5 kWh/100 lbs	0.03	$0.04	12	0.41
Refrigeration	Vending Machine	3400 kWh/year	-	$0.00	10	-
Refrigeration	Vending Machine	2400 kWh/year	0.04	$0.00	10	3.99
Refrigeration	Vending Machine	1700 kWh/year	0.06	$0.01	10	2.26
Food Preparation	Oven	Standard	-	$0.00	12	-
Food Preparation	Oven	Energy Star	0.03	$0.00	12	88,777.57
Food Preparation	Fryer	Standard	-	$0.00	12	-
Food Preparation	Fryer	Energy Star	0.02	$0.00	12	2.14
Food Preparation	Dishwasher	Standard	-	$0.00	12	-
Food Preparation	Dishwasher	Energy Star	0.15	$0.01	12	10.24
Food Preparation	Hot Food Container	Standard	-	$0.00	12	-
Food Preparation	Hot Food Container	Energy Star	0.10	$0.02	12	2.09
Office Equipment	Desktop Computer	Standard	-	$0.00	4	-
Office Equipment	Desktop Computer	Energy Star	0.06	$0.00	4	1,954.19
Office Equipment	Laptop	Standard	-	$0.00	4	-
Office Equipment	Laptop	Energy Star	0.01	$0.00	4	602.42
Office Equipment	Server	Standard	-	$0.00	3	-
Office Equipment	Server	Energy Star	0.06	$0.00	3	6,889.63
Office Equipment	Monitor	Standard	-	$0.00	4	-
Office Equipment	Monitor	Energy Star	0.01	$0.00	4	220.40
Office Equipment	Printer/Copier/Fax	Standard	-	$0.00	6	-
Office Equipment	Printer/Copier/Fax	Energy Star	0.01	$0.00	6	2,060.18

End Use	Technology	Efficiency Definition	Savings (kWh/ sqft/yr)	Incremental Cost ($/sqft)	Lifetime (yrs)	BC Ratio
Office Equipment	POS Terminal	Standard	-	$0.00	4	-
Office Equipment	POS Terminal	Efficient	0.03	$0.02	4	0.26
Miscellaneous	Non-HVAC Motors	Standard (EPAct)	-	$0.00	15	-
Miscellaneous	Non-HVAC Motors	Standard (EPAct 2015)	0.00	$0.00	15	-
Miscellaneous	Non-HVAC Motors	High Efficiency	0.00	$0.00	15	5.27
Miscellaneous	Non-HVAC Motors	High Efficiency (2015)	0.00	$0.00	15	-
Miscellaneous	Non-HVAC Motors	Premium (NEMA)	0.00	$0.00	15	5.27
Miscellaneous	Non-HVAC Motors	Premium (NEMA 2015)	0.00	$0.00	15	-
Miscellaneous	Pool Pump	Standard	-	$0.00	15	-
Miscellaneous	Pool Pump	High Efficiency	-	$0.00	15	1.00
Miscellaneous	Pool Pump	Two-Speed	-	$0.00	15	1.00
Miscellaneous	Pool Heater	Standard	-	$0.00	15	-
Miscellaneous	Pool Heater	Heat Pump	-	$0.00	15	1.00
Miscellaneous	Pool Heater	Solar	-	$0.00	15	1.00
Miscellaneous	Miscellaneous	Standard	-	$0.00	5	-

Table C-14 Energy-Efficiency Equipment Data—Small Retail, Existing Vintage

End Use	Technology	Efficiency Definition	Savings (kWh/ sqft/yr)	Incremental Cost ($/sqft)	Lifetime (yrs)	BC Ratio
Cooling	Air-Cooled Chiller	1.5 kw/ton, COP 2.3	-	$0.00	20	-
Cooling	Air-Cooled Chiller	1.3 kw/ton, COP 2.7	0.78	$0.23	20	2.21
Cooling	Air-Cooled Chiller	1.26 kw/ton, COP 2.8	0.94	$0.30	20	2.04
Cooling	Air-Cooled Chiller	1.0 kw/ton, COP 3.5	1.96	$0.37	20	3.45
Cooling	Air-Cooled Chiller	0.97 kw/ton, COP 3.6	2.08	$0.43	20	3.08
Cooling	Water-Cooled Chiller	0.75 kw/ton, COP 4.7	-	$0.00	20	-
Cooling	Water-Cooled Chiller	0.60 kw/ton, COP 5.9	1.08	$0.10	20	7.15
Cooling	Water-Cooled Chiller	0.58 kw/ton, COP 6.1	1.23	$0.19	20	4.05
Cooling	Water-Cooled Chiller	0.55 kw/Ton, COP 6.4	1.44	$0.23	20	3.98
Cooling	Water-Cooled Chiller	0.51 kw/ton, COP 6.9	1.73	$0.36	20	3.07
Cooling	Water-Cooled Chiller	0.50 kw/Ton, COP 7.0	1.81	$0.40	20	2.89
Cooling	Water-Cooled Chiller	0.48 kw/ton, COP 7.3	1.95	$0.44	20	2.85
Cooling	Roof Top AC	EER 9.2	-	$0.00	16	-
Cooling	Roof Top AC	EER 10.1	0.54	$0.23	16	1.28
Cooling	Roof Top AC	EER 11.2	1.08	$0.43	16	1.33
Cooling	Roof Top AC	EER 12.0	1.41	$0.83	16	0.91
Cooling	Roof Top AC	Ductless Minisplit	2.07	$2.74	16	0.40
Cooling	Other Cooling	EER 9.8	-	$0.00	14	-
Cooling	Other Cooling	EER 10.0	0.12	$0.21	14	0.28
Cooling	Other Cooling	EER 10.2	0.24	$0.25	14	0.46
Cooling	Other Cooling	EER 10.4	0.36	$0.29	14	0.59
Cooling	Other Cooling	EER 10.6	0.47	$0.33	14	0.68
Cooling	Other Cooling	EER 10.8	0.57	$0.37	14	0.74
Cooling	Other Cooling	EER 12.0	1.13	$1.89	14	0.29
Heating	Electric Heating	Standard	-	$0.00	25	-
Cooling/Heating	Roof Top Heat Pump	EER 9.3	-	$0.00	16	-
Cooling/Heating	Roof Top Heat Pump	EER 10.3	0.82	$0.38	16	1.20
Cooling/Heating	Roof Top Heat Pump	EER 11.0	1.31	$0.55	16	1.32
Cooling/Heating	Roof Top Heat Pump	EER 11.7	1.73	$1.41	16	0.68
Cooling/Heating	Roof Top Heat Pump	EER 12.0	1.90	$1.84	16	0.58
Cooling/Heating	Roof Top Heat Pump	Ductless Minisplit	2.90	$3.52	16	0.46
Cooling/Heating	Roof Top Heat Pump	Geothermal	4.58	$6.08	16	0.42
Ventilation	Ventilation	Constant Volume	-	$0.00	10	-
Ventilation	Ventilation	Constant Volume with ECM	0.12	$0.22	10	0.22
Ventilation	Ventilation	Variable Air Volume	0.29	-$0.09	10	1.00
Ventilation	Ventilation	Variable Air Volume with ECM	0.42	$0.13	10	1.30
Water Heating	Water Heating	EF .97	-	$0.00	15	-
Water Heating	Water Heating	EF .98	0.01	$0.01	15	0.80
Water Heating	Water Heating	EF 2.3	0.45	$0.02	15	15.80
Interior Lighting	Screw-in	Incandescent	-	$0.00	2	-
Interior Lighting	Screw-in	90W Halogen PAR-38	0.27	$0.02	3	1.37
Interior Lighting	Screw-in	70W HIR PAR-38	0.42	$0.03	3	1.52
Interior Lighting	Screw-in	CFL	0.78	$0.02	6	11.25
Interior Lighting	Screw-in	LED	0.84	$0.50	12	0.83
Interior Lighting	High-Bay Fixtures	Metal Halides	-	$0.00	3	-
Interior Lighting	High-Bay Fixtures	LED	0.55	$0.17	15	2.26
Interior Lighting	High-Bay Fixtures	T8	0.56	$0.00	10	1.00
Interior Lighting	High-Bay Fixtures	High Pressure Sodium	0.60	$0.00	6	1.00
Interior Lighting	High-Bay Fixtures	T5	0.72	$0.00	10	1.00
Interior Lighting	Linear Fluorescent	T12	-	$0.00	10	-
Interior Lighting	Linear Fluorescent	LED	0.78	$2.39	15	0.20
Interior Lighting	Linear Fluorescent	T8	0.82	$0.00	10	346.46
Interior Lighting	Linear Fluorescent	Super T8	1.13	$0.02	10	29.43
Exterior Lighting	Screw-in	Incandescent	-	$0.00	2	-

End Use	Technology	Efficiency Definition	Savings (kWh/ sqft/yr)	Incremental Cost ($/sqft)	Lifetime (yrs)	BC Ratio
Exterior Lighting	Screw-in	90W Halogen PAR-38	0.16	$0.01	3	2.55
Exterior Lighting	Screw-in	70W HIR PAR-38	0.24	$0.01	3	2.83
Exterior Lighting	Screw-in	CFL	0.45	$0.00	6	21.41
Exterior Lighting	Screw-in	LED	0.48	$0.12	12	1.65
Exterior Lighting	HID	Metal Halides	-	$0.00	3	-
Exterior Lighting	HID	LED	0.06	$0.20	15	0.16
Exterior Lighting	HID	T8	0.06	$0.00	10	1.00
Exterior Lighting	HID	High Pressure Sodium	0.10	$0.00	6	1.00
Exterior Lighting	HID	T5	0.10	$0.00	10	1.00
Exterior Lighting	Linear Fluorescent	T12	-	$0.00	10	-
Exterior Lighting	Linear Fluorescent	LED	0.00	$0.00	15	0.13
Exterior Lighting	Linear Fluorescent	T8	0.00	$0.00	10	227.77
Exterior Lighting	Linear Fluorescent	Super T8	0.00	$0.00	10	19.35
Exterior Lighting	Linear Fluorescent	T5	0.00	$0.00	10	13.91
Refrigeration	Walk-in Refrigerator	14600 kWh/yr	-	$0.00	18	-
Refrigeration	Walk-in Refrigerator	10800 kWh/yr	-	$0.00	18	1.00
Refrigeration	Walk-in Refrigerator	10000 kWh/yr	-	$0.00	18	1.00
Refrigeration	Walk-in Refrigerator	9000 kWh/yr	-	$0.00	18	1.00
Refrigeration	Reach-in Refrigerator	3100 kWh/yr	-	$0.00	18	-
Refrigeration	Reach-in Refrigerator	2500 kWh/yr	0.02	$0.01	18	1.01
Refrigeration	Reach-in Refrigerator	2400 kWh/yr	0.02	$0.01	18	1.05
Refrigeration	Reach-in Refrigerator	1500 kWh/yr	0.05	$0.01	18	2.15
Refrigeration	Glass Door Display	15500 kWh/yr	-	$0.00	18	-
Refrigeration	Glass Door Display	14480 kWh/yr	0.03	$0.01	18	3.27
Refrigeration	Glass Door Display	11700 kWh/yr	0.11	$0.06	18	1.24
Refrigeration	Glass Door Display	8400 kWh/yr	0.20	$0.01	18	-
Refrigeration	Glass Door Display	6800 kWh/yr	0.25	$0.06	18	-
Refrigeration	Open Display Case	7000 kWh/yr	-	$0.00	18	-
Refrigeration	Open Display Case	6535 kWh/yr	0.01	$0.00	18	3.29
Refrigeration	Open Display Case	5350 kWh/yr	0.05	$0.00	18	-
Refrigeration	Open Display Case	5300 kWh/yr	0.05	$0.03	18	1.22
Refrigeration	Open Display Case	4350 kWh/yr	0.07	$0.03	18	-
Refrigeration	Icemaker	7.0 kWh/100 lbs	-	$0.00	12	-
Refrigeration	Icemaker	6.3 kWh/100 lbs	0.01	$0.01	12	1.10
Refrigeration	Icemaker	6.0 kWh/100 lbs	0.02	$0.01	12	1.03
Refrigeration	Icemaker	5.5 kWh/100 lbs	0.03	$0.03	12	0.42
Refrigeration	Vending Machine	3400 kWh/year	-	$0.00	10	-
Refrigeration	Vending Machine	2400 kWh/year	0.03	$0.00	10	4.01
Refrigeration	Vending Machine	1700 kWh/year	0.05	$0.01	10	2.27
Food Preparation	Oven	Standard	-	$0.00	12	-
Food Preparation	Oven	Energy Star	0.03	$0.00	12	94,681.38
Food Preparation	Fryer	Standard	-	$0.00	12	-
Food Preparation	Fryer	Energy Star	-	$0.00	12	1.00
Food Preparation	Dishwasher	Standard	-	$0.00	12	-
Food Preparation	Dishwasher	Energy Star	0.16	$0.01	12	10.92
Food Preparation	Hot Food Container	Standard	-	$0.00	12	-
Food Preparation	Hot Food Container	Energy Star	0.11	$0.02	12	2.23
Office Equipment	Desktop Computer	Standard	-	$0.00	4	-
Office Equipment	Desktop Computer	Energy Star	0.05	$0.00	4	1,995.47
Office Equipment	Laptop	Standard	-	$0.00	4	-
Office Equipment	Laptop	Energy Star	0.01	$0.00	4	615.15
Office Equipment	Server	Standard	-	$0.00	3	-
Office Equipment	Server	Energy Star	0.05	$0.00	3	7,038.10
Office Equipment	Monitor	Standard	-	$0.00	4	-
Office Equipment	Monitor	Energy Star	0.01	$0.00	4	225.05
Office Equipment	Printer/Copier/Fax	Standard	-	$0.00	6	-
Office Equipment	Printer/Copier/Fax	Energy Star	0.01	$0.00	6	2,100.23

End Use	Technology	Efficiency Definition	Savings (kWh/ sqft/yr)	Incremental Cost ($/sqft)	Lifetime (yrs)	BC Ratio
Office Equipment	POS Terminal	Standard	-	$0.00	4	-
Office Equipment	POS Terminal	Efficient	0.03	$0.02	4	0.27
Miscellaneous	Non-HVAC Motors	Standard (EPAct)	-	$0.00	15	-
Miscellaneous	Non-HVAC Motors	Standard (EPAct 2015)	0.00	$0.00	15	-
Miscellaneous	Non-HVAC Motors	High Efficiency	0.00	$0.00	15	5.43
Miscellaneous	Non-HVAC Motors	High Efficiency (2015)	0.00	$0.00	15	-
Miscellaneous	Non-HVAC Motors	Premium (NEMA)	0.01	$0.00	15	5.43
Miscellaneous	Non-HVAC Motors	Premium (NEMA 2015)	0.01	$0.00	15	-
Miscellaneous	Pool Pump	Standard	-	$0.00	15	-
Miscellaneous	Pool Pump	High Efficiency	-	$0.00	15	1.00
Miscellaneous	Pool Pump	Two-Speed	-	$0.00	15	1.00
Miscellaneous	Pool Heater	Standard	-	$0.00	15	-
Miscellaneous	Pool Heater	Heat Pump	-	$0.00	15	1.00
Miscellaneous	Pool Heater	Solar	-	$0.00	15	1.00
Miscellaneous	Miscellaneous	Standard	-	$0.00	5	-

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

End Use	Technology	Efficiency Definition	Savings (kWh/ sqft/yr)	Incremental Cost ($/sqft)	Lifetime (yrs)	BC Ratio
Cooling	Air-Cooled Chiller	1.5 kw/ton, COP 2.3	-	$0.00	20	-
Cooling	Air-Cooled Chiller	1.3 kw/ton, COP 2.7	0.63	$0.23	20	1.77
Cooling	Air-Cooled Chiller	1.26 kw/ton, COP 2.8	0.75	$0.30	20	1.63
Cooling	Air-Cooled Chiller	1.0 kw/ton, COP 3.5	1.57	$0.37	20	2.76
Cooling	Air-Cooled Chiller	0.97 kw/ton, COP 3.6	1.67	$0.43	20	2.46
Cooling	Water-Cooled Chiller	0.75 kw/ton, COP 4.7	-	$0.00	20	-
Cooling	Water-Cooled Chiller	0.60 kw/ton, COP 5.9	0.78	$0.09	20	5.64
Cooling	Water-Cooled Chiller	0.58 kw/ton, COP 6.1	0.88	$0.18	20	3.19
Cooling	Water-Cooled Chiller	0.55 kw/Ton, COP 6.4	1.04	$0.21	20	3.13
Cooling	Water-Cooled Chiller	0.51 kw/ton, COP 6.9	1.25	$0.33	20	2.42
Cooling	Water-Cooled Chiller	0.50 kw/Ton, COP 7.0	1.30	$0.37	20	2.28
Cooling	Water-Cooled Chiller	0.48 kw/ton, COP 7.3	1.40	$0.40	20	2.24
Cooling	Roof Top AC	EER 9.2	-	$0.00	16	-
Cooling	Roof Top AC	EER 10.1	0.34	$0.17	16	1.10
Cooling	Roof Top AC	EER 11.2	0.69	$0.32	16	1.14
Cooling	Roof Top AC	EER 12.0	0.90	$0.62	16	0.78
Cooling	Roof Top AC	Ductless Minisplit	1.22	$2.02	16	0.32
Cooling	Other Cooling	EER 9.8	-	$0.00	14	-
Cooling	Other Cooling	EER 10.0	0.08	$0.13	14	0.28
Cooling	Other Cooling	EER 10.2	0.15	$0.16	14	0.46
Cooling	Other Cooling	EER 10.4	0.23	$0.18	14	0.59
Cooling	Other Cooling	EER 10.6	0.30	$0.21	14	0.68
Cooling	Other Cooling	EER 10.8	0.36	$0.23	14	0.74
Cooling	Other Cooling	EER 12.0	0.72	$1.20	14	0.29
Heating	Electric Heating	Standard	-	$0.00	25	-
Cooling/Heating	Roof Top Heat Pump	EER 9.3	-	$0.00	16	-
Cooling/Heating	Roof Top Heat Pump	EER 10.3	0.62	$0.35	16	0.99
Cooling/Heating	Roof Top Heat Pump	EER 11.0	0.99	$0.50	16	1.10
Cooling/Heating	Roof Top Heat Pump	EER 11.7	1.31	$1.28	16	0.57
Cooling/Heating	Roof Top Heat Pump	EER 12.0	1.44	$1.67	16	0.48
Cooling/Heating	Roof Top Heat Pump	Ductless Minisplit	2.19	$3.19	16	0.38
Cooling/Heating	Roof Top Heat Pump	Geothermal	3.45	$5.52	16	0.35
Ventilation	Ventilation	Constant Volume	-	$0.00	10	-
Ventilation	Ventilation	Constant Volume with ECM	0.02	$0.53	10	0.02
Ventilation	Ventilation	Variable Air Volume	0.05	-$0.21	10	1.00
Ventilation	Ventilation	Variable Air Volume with ECM	0.08	$0.31	10	0.10
Water Heating	Water Heating	EF .97	-	$0.00	15	-
Water Heating	Water Heating	EF .98	0.00	$0.00	15	0.71
Water Heating	Water Heating	EF 2.3	0.13	$0.01	15	13.95
Interior Lighting	Screw-in	Incandescent	-	$0.00	2	-
Interior Lighting	Screw-in	90W Halogen PAR-38	0.03	$0.00	3	1.60
Interior Lighting	Screw-in	70W HIR PAR-38	0.05	$0.00	3	1.78
Interior Lighting	Screw-in	CFL	0.09	$0.00	6	13.04
Interior Lighting	Screw-in	LED	0.10	$0.05	12	0.96
Interior Lighting	High-Bay Fixtures	Metal Halides	-	$0.00	3	-
Interior Lighting	High-Bay Fixtures	LED	0.59	$1.17	15	0.37
Interior Lighting	High-Bay Fixtures	T8	0.60	-$0.03	10	1.00
Interior Lighting	High-Bay Fixtures	High Pressure Sodium	0.64	$0.01	6	1.00
Interior Lighting	High-Bay Fixtures	T5	0.76	-$0.02	10	1.00
Interior Lighting	Linear Fluorescent	T12	-	$0.00	10	-
Interior Lighting	Linear Fluorescent	LED	0.25	$0.34	15	0.45
Interior Lighting	Linear Fluorescent	T8	0.25	$0.00	10	798.05
Interior Lighting	Linear Fluorescent	Super T8	0.35	$0.00	10	67.78
Exterior Lighting	Screw-in	Incandescent	-	$0.00	2	-
Exterior Lighting	Screw-in	90W Halogen PAR-38	0.00	$0.00	3	2.29

End Use	Technology	Efficiency Definition	Savings (kWh/ sqft/yr)	Incremental Cost ($/sqft)	Lifetime (yrs)	BC Ratio
Exterior Lighting	Screw-in	70W HIR PAR-38	0.00	$0.00	3	2.55
Exterior Lighting	Screw-in	CFL	0.00	$0.00	6	19.27
Exterior Lighting	Screw-in	LED	0.00	$0.00	12	1.49
Exterior Lighting	HID	Metal Halides	-	$0.00	3	-
Exterior Lighting	HID	LED	0.11	$0.38	15	0.16
Exterior Lighting	HID	T8	0.12	$0.00	10	1.00
Exterior Lighting	HID	High Pressure Sodium	0.18	$0.00	6	1.00
Exterior Lighting	HID	T5	0.19	$0.00	10	1.00
Exterior Lighting	Linear Fluorescent	T12	-	$0.00	10	-
Exterior Lighting	Linear Fluorescent	LED	0.00	$0.00	15	0.13
Exterior Lighting	Linear Fluorescent	T8	0.00	$0.00	10	227.86
Exterior Lighting	Linear Fluorescent	Super T8	0.00	$0.00	10	19.35
Exterior Lighting	Linear Fluorescent	T5	0.00	$0.00	10	13.92
Refrigeration	Walk-in Refrigerator	14600 kWh/yr	-	$0.00	18	-
Refrigeration	Walk-in Refrigerator	10800 kWh/yr	-	$0.00	18	1.00
Refrigeration	Walk-in Refrigerator	10000 kWh/yr	-	$0.00	18	1.00
Refrigeration	Walk-in Refrigerator	9000 kWh/yr	-	$0.00	18	1.00
Refrigeration	Reach-in Refrigerator	3100 kWh/yr	-	$0.00	18	-
Refrigeration	Reach-in Refrigerator	2500 kWh/yr	-	$0.00	18	1.00
Refrigeration	Reach-in Refrigerator	2400 kWh/yr	-	$0.00	18	1.00
Refrigeration	Reach-in Refrigerator	1500 kWh/yr	-	$0.00	18	1.00
Refrigeration	Glass Door Display	15500 kWh/yr	-	$0.00	18	-
Refrigeration	Glass Door Display	14480 kWh/yr	-	$0.00	18	1.00
Refrigeration	Glass Door Display	11700 kWh/yr	-	$0.00	18	1.00
Refrigeration	Glass Door Display	8400 kWh/yr	-	$0.00	18	-
Refrigeration	Glass Door Display	6800 kWh/yr	-	$0.00	18	-
Refrigeration	Open Display Case	7000 kWh/yr	-	$0.00	18	-
Refrigeration	Open Display Case	6535 kWh/yr	-	$0.00	18	1.00
Refrigeration	Open Display Case	5350 kWh/yr	-	$0.00	18	-
Refrigeration	Open Display Case	5300 kWh/yr	-	$0.00	18	1.00
Refrigeration	Open Display Case	4350 kWh/yr	-	$0.00	18	-
Refrigeration	Icemaker	7.0 kWh/100 lbs	-	$0.00	12	-
Refrigeration	Icemaker	6.3 kWh/100 lbs	0.06	$0.02	12	1.10
Refrigeration	Icemaker	6.0 kWh/100 lbs	0.08	$0.04	12	1.04
Refrigeration	Icemaker	5.5 kWh/100 lbs	0.12	$0.13	12	0.42
Refrigeration	Vending Machine	3400 kWh/year	-	$0.00	10	-
Refrigeration	Vending Machine	2400 kWh/year	0.12	$0.01	10	4.03
Refrigeration	Vending Machine	1700 kWh/year	0.20	$0.04	10	2.28
Food Preparation	Oven	Standard	-	$0.00	12	-
Food Preparation	Oven	Energy Star	0.03	$0.00	12	98,116.49
Food Preparation	Fryer	Standard	-	$0.00	12	-
Food Preparation	Fryer	Energy Star	-	$0.00	12	1.00
Food Preparation	Dishwasher	Standard	-	$0.00	12	-
Food Preparation	Dishwasher	Energy Star	-	$0.00	12	1.00
Food Preparation	Hot Food Container	Standard	-	$0.00	12	-
Food Preparation	Hot Food Container	Energy Star	-	$0.00	12	1.00
Office Equipment	Desktop Computer	Standard	-	$0.00	4	-
Office Equipment	Desktop Computer	Energy Star	0.03	$0.00	4	2,047.03
Office Equipment	Laptop	Standard	-	$0.00	4	-
Office Equipment	Laptop	Energy Star	0.00	$0.00	4	631.04
Office Equipment	Server	Standard	-	$0.00	3	-
Office Equipment	Server	Energy Star	0.03	$0.00	3	7,223.52
Office Equipment	Monitor	Standard	-	$0.00	4	-
Office Equipment	Monitor	Energy Star	0.00	$0.00	4	230.87
Office Equipment	Printer/Copier/Fax	Standard	-	$0.00	6	-
Office Equipment	Printer/Copier/Fax	Energy Star	0.00	$0.00	6	2,150.25

End Use	Technology	Efficiency Definition	Savings (kWh/ sqft/yr)	Incremental Cost ($/sqft)	Lifetime (yrs)	BC Ratio
Office Equipment	POS Terminal	Standard	-	$0.00	4	-
Office Equipment	POS Terminal	Efficient	0.01	$0.01	4	0.27
Miscellaneous	Non-HVAC Motors	Standard (EPAct)	-	$0.00	15	-
Miscellaneous	Non-HVAC Motors	Standard (EPAct 2015)	0.00	$0.00	15	-
Miscellaneous	Non-HVAC Motors	High Efficiency	0.00	$0.00	15	5.60
Miscellaneous	Non-HVAC Motors	High Efficiency (2015)	0.00	$0.00	15	-
Miscellaneous	Non-HVAC Motors	Premium (NEMA)	0.00	$0.00	15	5.60
Miscellaneous	Non-HVAC Motors	Premium (NEMA 2015)	0.00	$0.00	15	-
Miscellaneous	Pool Pump	Standard	-	$0.00	15	-
Miscellaneous	Pool Pump	High Efficiency	-	$0.00	15	1.00
Miscellaneous	Pool Pump	Two-Speed	-	$0.00	15	1.00
Miscellaneous	Pool Heater	Standard	-	$0.00	15	-
Miscellaneous	Pool Heater	Heat Pump	-	$0.00	15	1.00
Miscellaneous	Pool Heater	Solar	-	$0.00	15	1.00
Miscellaneous	Miscellaneous	Standard	-	$0.00	5	-

Table C-16 Energy-Efficiency Equipment Data—Refrigerated Warehouse, Existing Vintage

End Use	Technology	Efficiency Definition	Savings (kWh/ sqft/yr)	Incremental Cost ($/sqft)	Lifetime (yrs)	BC Ratio
Cooling	Air-Cooled Chiller	1.5 kw/ton, COP 2.3	-	$0.00	20	-
Cooling	Air-Cooled Chiller	1.3 kw/ton, COP 2.7	0.61	$0.22	20	1.77
Cooling	Air-Cooled Chiller	1.26 kw/ton, COP 2.8	0.74	$0.29	20	1.63
Cooling	Air-Cooled Chiller	1.0 kw/ton, COP 3.5	1.54	$0.36	20	2.76
Cooling	Air-Cooled Chiller	0.97 kw/ton, COP 3.6	1.63	$0.42	20	2.46
Cooling	Water-Cooled Chiller	0.75 kw/ton, COP 4.7	-	$0.00	20	-
Cooling	Water-Cooled Chiller	0.60 kw/ton, COP 5.9	0.76	$0.09	20	5.64
Cooling	Water-Cooled Chiller	0.58 kw/ton, COP 6.1	0.86	$0.17	20	3.19
Cooling	Water-Cooled Chiller	0.55 kw/Ton, COP 6.4	1.02	$0.21	20	3.13
Cooling	Water-Cooled Chiller	0.51 kw/ton, COP 6.9	1.22	$0.32	20	2.42
Cooling	Water-Cooled Chiller	0.50 kw/Ton, COP 7.0	1.27	$0.36	20	2.28
Cooling	Water-Cooled Chiller	0.48 kw/ton, COP 7.3	1.37	$0.39	20	2.24
Cooling	Roof Top AC	EER 9.2	-	$0.00	16	-
Cooling	Roof Top AC	EER 10.1	0.33	$0.16	16	1.10
Cooling	Roof Top AC	EER 11.2	0.67	$0.31	16	1.14
Cooling	Roof Top AC	EER 12.0	0.88	$0.60	16	0.78
Cooling	Roof Top AC	Ductless Minisplit	1.19	$1.98	16	0.32
Cooling	Other Cooling	EER 9.8	-	$0.00	14	-
Cooling	Other Cooling	EER 10.0	0.08	$0.13	14	0.28
Cooling	Other Cooling	EER 10.2	0.15	$0.16	14	0.46
Cooling	Other Cooling	EER 10.4	0.22	$0.18	14	0.59
Cooling	Other Cooling	EER 10.6	0.29	$0.20	14	0.68
Cooling	Other Cooling	EER 10.8	0.35	$0.23	14	0.74
Cooling	Other Cooling	EER 12.0	0.70	$1.17	14	0.29
Heating	Electric Heating	Standard	-	$0.00	25	-
Cooling/Heating	Roof Top Heat Pump	EER 9.3	-	$0.00	16	-
Cooling/Heating	Roof Top Heat Pump	EER 10.3	0.60	$0.33	16	0.99
Cooling/Heating	Roof Top Heat Pump	EER 11.0	0.95	$0.48	16	1.10
Cooling/Heating	Roof Top Heat Pump	EER 11.7	1.26	$1.23	16	0.57
Cooling/Heating	Roof Top Heat Pump	EER 12.0	1.39	$1.61	16	0.48
Cooling/Heating	Roof Top Heat Pump	Ductless Minisplit	2.11	$3.08	16	0.38
Cooling/Heating	Roof Top Heat Pump	Geothermal	3.33	$5.32	16	0.35
Ventilation	Ventilation	Constant Volume	-	$0.00	10	-
Ventilation	Ventilation	Constant Volume with ECM	0.08	$1.92	10	0.02
Ventilation	Ventilation	Variable Air Volume	0.20	-$0.78	10	1.00
Ventilation	Ventilation	Variable Air Volume with ECM	0.28	$1.14	10	0.10
Water Heating	Water Heating	EF .97	-	$0.00	15	-
Water Heating	Water Heating	EF .98	0.00	$0.00	15	0.71
Water Heating	Water Heating	EF 2.3	0.27	$0.01	15	14.00
Interior Lighting	Screw-in	Incandescent	-	$0.00	2	-
Interior Lighting	Screw-in	90W Halogen PAR-38	0.02	$0.00	3	1.52
Interior Lighting	Screw-in	70W HIR PAR-38	0.04	$0.00	3	1.69
Interior Lighting	Screw-in	CFL	0.07	$0.00	6	12.38
Interior Lighting	Screw-in	LED	0.07	$0.04	12	0.91
Interior Lighting	High-Bay Fixtures	Metal Halides	-	$0.00	3	-
Interior Lighting	High-Bay Fixtures	LED	0.45	$0.84	15	0.38
Interior Lighting	High-Bay Fixtures	T8	0.45	-$0.02	10	1.00
Interior Lighting	High-Bay Fixtures	High Pressure Sodium	0.48	$0.00	6	1.00
Interior Lighting	High-Bay Fixtures	T5	0.58	-$0.01	10	1.00
Interior Lighting	Linear Fluorescent	T12	-	$0.00	10	-
Interior Lighting	Linear Fluorescent	LED	0.19	$0.31	15	0.38
Interior Lighting	Linear Fluorescent	T8	0.19	$0.00	10	671.30
Interior Lighting	Linear Fluorescent	Super T8	0.27	$0.00	10	57.02

End Use	Technology	Efficiency Definition	Savings (kWh/ sqft/yr)	Incremental Cost ($/sqft)	Lifetime (yrs)	BC Ratio
Exterior Lighting	Screw-in	Incandescent	-	$0.00	2	-
Exterior Lighting	Screw-in	90W Halogen PAR-38	0.00	$0.00	3	2.29
Exterior Lighting	Screw-in	70W HIR PAR-38	0.00	$0.00	3	2.54
Exterior Lighting	Screw-in	CFL	0.00	$0.00	6	19.27
Exterior Lighting	Screw-in	LED	0.00	$0.00	12	1.49
Exterior Lighting	HID	Metal Halides	-	$0.00	3	-
Exterior Lighting	HID	LED	0.13	$0.43	15	0.16
Exterior Lighting	HID	T8	0.13	$0.00	10	1.00
Exterior Lighting	HID	High Pressure Sodium	0.20	$0.00	6	1.00
Exterior Lighting	HID	T5	0.21	$0.00	10	1.00
Exterior Lighting	Linear Fluorescent	T12	-	$0.00	10	-
Exterior Lighting	Linear Fluorescent	LED	0.00	$0.00	15	0.13
Exterior Lighting	Linear Fluorescent	T8	0.00	$0.00	10	227.82
Exterior Lighting	Linear Fluorescent	Super T8	0.00	$0.00	10	19.35
Exterior Lighting	Linear Fluorescent	T5	0.00	$0.00	10	13.91
Refrigeration	Walk-in Refrigerator	14600 kWh/yr	-	$0.00	18	-
Refrigeration	Walk-in Refrigerator	10800 kWh/yr	2.92	$1.15	18	1.71
Refrigeration	Walk-in Refrigerator	10000 kWh/yr	3.53	$1.46	18	1.64
Refrigeration	Walk-in Refrigerator	9000 kWh/yr	4.30	$2.61	18	1.11
Refrigeration	Reach-in Refrigerator	3100 kWh/yr	-	$0.00	18	-
Refrigeration	Reach-in Refrigerator	2500 kWh/yr	-	$0.00	18	1.00
Refrigeration	Reach-in Refrigerator	2400 kWh/yr	-	$0.00	18	1.00
Refrigeration	Reach-in Refrigerator	1500 kWh/yr	-	$0.00	18	1.00
Refrigeration	Glass Door Display	15500 kWh/yr	-	$0.00	18	-
Refrigeration	Glass Door Display	14480 kWh/yr	-	$0.00	18	1.00
Refrigeration	Glass Door Display	11700 kWh/yr	-	$0.00	18	1.00
Refrigeration	Glass Door Display	8400 kWh/yr	-	$0.00	18	-
Refrigeration	Glass Door Display	6800 kWh/yr	-	$0.00	18	-
Refrigeration	Open Display Case	7000 kWh/yr	-	$0.00	18	-
Refrigeration	Open Display Case	6535 kWh/yr	-	$0.00	18	1.00
Refrigeration	Open Display Case	5350 kWh/yr	-	$0.00	18	-
Refrigeration	Open Display Case	5300 kWh/yr	-	$0.00	18	1.00
Refrigeration	Open Display Case	4350 kWh/yr	-	$0.00	18	-
Refrigeration	Icemaker	7.0 kWh/100 lbs	-	$0.00	12	-
Refrigeration	Icemaker	6.3 kWh/100 lbs	0.01	$0.00	12	1.10
Refrigeration	Icemaker	6.0 kWh/100 lbs	0.01	$0.00	12	1.04
Refrigeration	Icemaker	5.5 kWh/100 lbs	0.01	$0.01	12	0.42
Refrigeration	Vending Machine	3400 kWh/year	-	$0.00	10	-
Refrigeration	Vending Machine	2400 kWh/year	0.01	$0.00	10	4.03
Refrigeration	Vending Machine	1700 kWh/year	0.02	$0.00	10	2.28
Food Preparation	Oven	Standard	-	$0.00	12	-
Food Preparation	Oven	Energy Star	0.06	$0.00	12	98,119.68
Food Preparation	Fryer	Standard	-	$0.00	12	-
Food Preparation	Fryer	Energy Star	-	$0.00	12	1.00
Food Preparation	Dishwasher	Standard	-	$0.00	12	-
Food Preparation	Dishwasher	Energy Star	-	$0.00	12	1.00
Food Preparation	Hot Food Container	Standard	-	$0.00	12	-
Food Preparation	Hot Food Container	Energy Star	-	$0.00	12	1.00
Office Equipment	Desktop Computer	Standard	-	$0.00	4	-
Office Equipment	Desktop Computer	Energy Star	0.03	$0.00	4	2,046.85
Office Equipment	Laptop	Standard	-	$0.00	4	-
Office Equipment	Laptop	Energy Star	0.00	$0.00	4	630.98
Office Equipment	Server	Standard	-	$0.00	3	-
Office Equipment	Server	Energy Star	0.02	$0.00	3	7,222.85
Office Equipment	Monitor	Standard	-	$0.00	4	-
Office Equipment	Monitor	Energy Star	0.00	$0.00	4	230.85
Office Equipment	Printer/Copier/Fax	Standard	-	$0.00	6	-

End Use	Technology	Efficiency Definition	Savings (kWh/ sqft/yr)	Incremental Cost ($/sqft)	Lifetime (yrs)	BC Ratio
Office Equipment	Printer/Copier/Fax	Energy Star	0.00	$0.00	6	2,150.07
Office Equipment	POS Terminal	Standard	-	$0.00	4	-
Office Equipment	POS Terminal	Efficient	0.01	$0.00	4	0.27
Miscellaneous	Non-HVAC Motors	Standard (EPAct)	-	$0.00	15	-
Miscellaneous	Non-HVAC Motors	Standard (EPAct 2015)	0.00	$0.00	15	-
Miscellaneous	Non-HVAC Motors	High Efficiency	0.00	$0.00	15	5.60
Miscellaneous	Non-HVAC Motors	High Efficiency (2015)	0.00	$0.00	15	-
Miscellaneous	Non-HVAC Motors	Premium (NEMA)	0.00	$0.00	15	5.60
Miscellaneous	Non-HVAC Motors	Premium (NEMA 2015)	0.00	$0.00	15	-
Miscellaneous	Pool Pump	Standard	-	$0.00	15	-
Miscellaneous	Pool Pump	High Efficiency	-	$0.00	15	1.00
Miscellaneous	Pool Pump	Two-Speed	-	$0.00	15	1.00
Miscellaneous	Pool Heater	Standard	-	$0.00	15	-
Miscellaneous	Pool Heater	Heat Pump	-	$0.00	15	1.00
Miscellaneous	Pool Heater	Solar	-	$0.00	15	1.00
Miscellaneous	Miscellaneous	Standard	-	$0.00	5	-

Table C-17 Energy-Efficiency Equipment Data—College, New Vintage

End Use	Technology	Efficiency Definition	Savings (kWh/ sqft/yr)	Incremental Cost ($/sqft)	Lifetime (yrs)	BC Ratio
Cooling	Air-Cooled Chiller	1.5 kw/ton, COP 2.3	-	$0.00	20	-
Cooling	Air-Cooled Chiller	1.3 kw/ton, COP 2.7	1.10	$2.01	20	0.35
Cooling	Air-Cooled Chiller	1.26 kw/ton, COP 2.8	1.32	$2.61	20	0.32
Cooling	Air-Cooled Chiller	1.0 kw/ton, COP 3.5	2.74	$3.21	20	0.55
Cooling	Air-Cooled Chiller	0.97 kw/ton, COP 3.6	2.91	$3.81	20	0.49
Cooling	Water-Cooled Chiller	0.75 kw/ton, COP 4.7	-	$0.00	20	-
Cooling	Water-Cooled Chiller	0.60 kw/ton, COP 5.9	1.80	$0.75	20	1.55
Cooling	Water-Cooled Chiller	0.58 kw/ton, COP 6.1	2.05	$1.49	20	0.88
Cooling	Water-Cooled Chiller	0.55 kw/Ton, COP 6.4	2.41	$1.79	20	0.86
Cooling	Water-Cooled Chiller	0.51 kw/ton, COP 6.9	2.89	$2.79	20	0.66
Cooling	Water-Cooled Chiller	0.50 kw/Ton, COP 7.0	3.01	$3.09	20	0.63
Cooling	Water-Cooled Chiller	0.48 kw/ton, COP 7.3	3.25	$3.39	20	0.62
Cooling	Roof Top AC	EER 9.2	-	$0.00	16	-
Cooling	Roof Top AC	EER 10.1	0.55	$1.14	16	0.26
Cooling	Roof Top AC	EER 11.2	1.11	$2.20	16	0.27
Cooling	Roof Top AC	EER 12.0	1.45	$4.22	16	0.18
Cooling	Roof Top AC	Ductless Minisplit	1.98	$13.85	16	0.08
Cooling	Other Cooling	EER 9.8	-	$0.00	14	-
Cooling	Other Cooling	EER 10.0	0.11	$1.07	14	0.05
Cooling	Other Cooling	EER 10.2	0.22	$1.27	14	0.08
Cooling	Other Cooling	EER 10.4	0.33	$1.46	14	0.11
Cooling	Other Cooling	EER 10.6	0.43	$1.66	14	0.12
Cooling	Other Cooling	EER 10.8	0.52	$1.85	14	0.13
Cooling	Other Cooling	EER 12.0	1.03	$9.56	14	0.05
Heating	Electric Heating	Standard	-	$0.00	25	-
Cooling/Heating	Roof Top Heat Pump	EER 9.3	-	$0.00	16	-
Cooling/Heating	Roof Top Heat Pump	EER 10.3	0.79	$0.93	16	0.49
Cooling/Heating	Roof Top Heat Pump	EER 11.0	1.26	$1.34	16	0.54
Cooling/Heating	Roof Top Heat Pump	EER 11.7	1.67	$3.44	16	0.28
Cooling/Heating	Roof Top Heat Pump	EER 12.0	1.83	$4.49	16	0.24
Cooling/Heating	Roof Top Heat Pump	Ductless Minisplit	2.80	$8.60	16	0.19
Cooling/Heating	Roof Top Heat Pump	Geothermal	4.82	$14.87	16	0.19
Ventilation	Ventilation	Constant Volume	-	$0.00	10	-
Ventilation	Ventilation	Constant Volume with ECM	0.16	$0.34	10	0.19
Ventilation	Ventilation	Variable Air Volume	0.58	-$0.14	10	1.00
Ventilation	Ventilation	Variable Air Volume with ECM	0.71	$0.20	10	1.39
Water Heating	Water Heating	EF .97	-	$0.00	15	-
Water Heating	Water Heating	EF .98	0.02	$0.03	15	0.38
Water Heating	Water Heating	EF 2.3	1.12	$0.09	15	7.53
Interior Lighting	Screw-in	Incandescent	-	$0.00	2	-
Interior Lighting	Screw-in	90W Halogen PAR-38	0.43	$0.03	3	1.94
Interior Lighting	Screw-in	70W HIR PAR-38	0.66	$0.04	3	2.16
Interior Lighting	Screw-in	CFL	1.23	$0.02	6	15.90
Interior Lighting	Screw-in	LED	1.33	$0.56	12	1.18
Interior Lighting	High-Bay Fixtures	Metal Halides	-	$0.00	3	-
Interior Lighting	High-Bay Fixtures	LED	0.08	$0.10	15	0.56
Interior Lighting	High-Bay Fixtures	T8	0.08	$0.00	10	1.00
Interior Lighting	High-Bay Fixtures	High Pressure Sodium	0.09	$0.00	6	1.00
Interior Lighting	High-Bay Fixtures	T5	0.11	$0.00	10	1.00
Interior Lighting	Linear Fluorescent	T12	-	$0.00	10	-
Interior Lighting	Linear Fluorescent	LED	0.55	$2.32	15	0.14
Interior Lighting	Linear Fluorescent	T8	0.57	$0.00	10	251.82
Interior Lighting	Linear Fluorescent	Super T8	0.79	$0.02	10	21.39
Exterior Lighting	Screw-in	Incandescent	-	$0.00	2	-
Exterior Lighting	Screw-in	90W Halogen PAR-38	0.04	$0.00	3	2.20

End Use	Technology	Efficiency Definition	Savings (kWh/ sqft/yr)	Incremental Cost ($/sqft)	Lifetime (yrs)	BC Ratio
Exterior Lighting	Screw-in	70W HIR PAR-38	0.06	$0.00	3	2.44
Exterior Lighting	Screw-in	CFL	0.11	$0.00	6	18.50
Exterior Lighting	Screw-in	LED	0.12	$0.03	12	1.43
Exterior Lighting	HID	Metal Halides	-	$0.00	3	-
Exterior Lighting	HID	LED	0.15	$0.50	15	0.16
Exterior Lighting	HID	T8	0.15	$0.00	10	1.00
Exterior Lighting	HID	High Pressure Sodium	0.24	$0.00	6	1.00
Exterior Lighting	HID	T5	0.25	$0.00	10	1.00
Exterior Lighting	Linear Fluorescent	T12	-	$0.00	10	-
Exterior Lighting	Linear Fluorescent	LED	0.00	$0.00	15	0.13
Exterior Lighting	Linear Fluorescent	T8	0.00	$0.00	10	227.85
Exterior Lighting	Linear Fluorescent	Super T8	0.00	$0.00	10	19.35
Exterior Lighting	Linear Fluorescent	T5	0.00	$0.00	10	13.92
Refrigeration	Walk-in Refrigerator	14600 kWh/yr	-	$0.00	18	-
Refrigeration	Walk-in Refrigerator	10800 kWh/yr	0.03	$0.01	18	1.71
Refrigeration	Walk-in Refrigerator	10000 kWh/yr	0.03	$0.01	18	1.64
Refrigeration	Walk-in Refrigerator	9000 kWh/yr	0.04	$0.02	18	1.11
Refrigeration	Reach-in Refrigerator	3100 kWh/yr	-	$0.00	18	-
Refrigeration	Reach-in Refrigerator	2500 kWh/yr	0.01	$0.01	18	1.01
Refrigeration	Reach-in Refrigerator	2400 kWh/yr	0.01	$0.01	18	1.05
Refrigeration	Reach-in Refrigerator	1500 kWh/yr	0.02	$0.01	18	2.16
Refrigeration	Glass Door Display	15500 kWh/yr	-	$0.00	18	-
Refrigeration	Glass Door Display	14480 kWh/yr	0.01	$0.00	18	3.28
Refrigeration	Glass Door Display	11700 kWh/yr	0.03	$0.01	18	1.25
Refrigeration	Glass Door Display	8400 kWh/yr	0.05	$0.00	18	-
Refrigeration	Glass Door Display	6800 kWh/yr	0.06	$0.01	18	-
Refrigeration	Open Display Case	7000 kWh/yr	-	$0.00	18	-
Refrigeration	Open Display Case	6535 kWh/yr	0.00	$0.00	18	3.31
Refrigeration	Open Display Case	5350 kWh/yr	0.01	$0.00	18	-
Refrigeration	Open Display Case	5300 kWh/yr	0.01	$0.01	18	1.22
Refrigeration	Open Display Case	4350 kWh/yr	0.02	$0.01	18	-
Refrigeration	Icemaker	7.0 kWh/100 lbs	-	$0.00	12	-
Refrigeration	Icemaker	6.3 kWh/100 lbs	0.01	$0.00	12	1.10
Refrigeration	Icemaker	6.0 kWh/100 lbs	0.01	$0.00	12	1.04
Refrigeration	Icemaker	5.5 kWh/100 lbs	0.01	$0.02	12	0.42
Refrigeration	Vending Machine	3400 kWh/year	-	$0.00	10	-
Refrigeration	Vending Machine	2400 kWh/year	0.01	$0.00	10	4.03
Refrigeration	Vending Machine	1700 kWh/year	0.02	$0.00	10	2.28
Food Preparation	Oven	Standard	-	$0.00	12	-
Food Preparation	Oven	Energy Star	0.04	$0.00	12	94,572.93
Food Preparation	Fryer	Standard	-	$0.00	12	-
Food Preparation	Fryer	Energy Star	0.02	$0.01	12	2.28
Food Preparation	Dishwasher	Standard	-	$0.00	12	-
Food Preparation	Dishwasher	Energy Star	0.19	$0.01	12	10.90
Food Preparation	Hot Food Container	Standard	-	$0.00	12	-
Food Preparation	Hot Food Container	Energy Star	0.13	$0.03	12	2.22
Office Equipment	Desktop Computer	Standard	-	$0.00	4	-
Office Equipment	Desktop Computer	Energy Star	0.15	$0.00	4	2,018.52
Office Equipment	Laptop	Standard	-	$0.00	4	-
Office Equipment	Laptop	Energy Star	0.02	$0.00	4	622.25
Office Equipment	Server	Standard	-	$0.00	3	-
Office Equipment	Server	Energy Star	0.05	$0.00	3	7,120.99
Office Equipment	Monitor	Standard	-	$0.00	4	-
Office Equipment	Monitor	Energy Star	0.02	$0.00	4	227.65
Office Equipment	Printer/Copier/Fax	Standard	-	$0.00	6	-
Office Equipment	Printer/Copier/Fax	Energy Star	0.03	$0.00	6	2,122.59

End Use	Technology	Efficiency Definition	Savings (kWh/ sqft/yr)	Incremental Cost ($/sqft)	Lifetime (yrs)	BC Ratio
Office Equipment	POS Terminal	Standard	-	$0.00	4	-
Office Equipment	POS Terminal	Efficient	0.03	$0.02	4	0.27
Miscellaneous	Non-HVAC Motors	Standard (EPAct)	-	$0.00	15	-
Miscellaneous	Non-HVAC Motors	Standard (EPAct 2015)	0.00	$0.00	15	-
Miscellaneous	Non-HVAC Motors	High Efficiency	0.00	$0.00	15	5.55
Miscellaneous	Non-HVAC Motors	High Efficiency (2015)	0.00	$0.00	15	-
Miscellaneous	Non-HVAC Motors	Premium (NEMA)	0.00	$0.00	15	5.55
Miscellaneous	Non-HVAC Motors	Premium (NEMA 2015)	0.00	$0.00	15	-
Miscellaneous	Pool Pump	Standard	-	$0.00	15	-
Miscellaneous	Pool Pump	High Efficiency	0.00	$0.00	15	1.84
Miscellaneous	Pool Pump	Two-Speed	0.00	$0.00	15	1.08
Miscellaneous	Pool Heater	Standard	-	$0.00	15	-
Miscellaneous	Pool Heater	Heat Pump	0.01	$0.01	15	0.94
Miscellaneous	Pool Heater	Solar	0.01	$0.01	15	0.94
Miscellaneous	Miscellaneous	Standard	-	$0.00	5	-

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

End Use	Technology	Efficiency Definition	Savings (kWh/ sqft/yr)	Incremental Cost ($/sqft)	Lifetime (yrs)	BC Ratio
Cooling	Air-Cooled Chiller	1.5 kw/ton, COP 2.3	-	$0.00	20	-
Cooling	Air-Cooled Chiller	1.3 kw/ton, COP 2.7	0.57	$1.04	20	0.35
Cooling	Air-Cooled Chiller	1.26 kw/ton, COP 2.8	0.68	$1.35	20	0.32
Cooling	Air-Cooled Chiller	1.0 kw/ton, COP 3.5	1.42	$1.66	20	0.55
Cooling	Air-Cooled Chiller	0.97 kw/ton, COP 3.6	1.50	$1.97	20	0.49
Cooling	Water-Cooled Chiller	0.75 kw/ton, COP 4.7	-	$0.00	20	-
Cooling	Water-Cooled Chiller	0.60 kw/ton, COP 5.9	0.93	$0.39	20	1.55
Cooling	Water-Cooled Chiller	0.58 kw/ton, COP 6.1	1.06	$0.77	20	0.88
Cooling	Water-Cooled Chiller	0.55 kw/Ton, COP 6.4	1.25	$0.93	20	0.86
Cooling	Water-Cooled Chiller	0.51 kw/ton, COP 6.9	1.50	$1.44	20	0.66
Cooling	Water-Cooled Chiller	0.50 kw/Ton, COP 7.0	1.56	$1.60	20	0.63
Cooling	Water-Cooled Chiller	0.48 kw/ton, COP 7.3	1.68	$1.75	20	0.62
Cooling	Roof Top AC	EER 9.2	-	$0.00	16	-
Cooling	Roof Top AC	EER 10.1	0.29	$0.59	16	0.26
Cooling	Roof Top AC	EER 11.2	0.58	$1.14	16	0.27
Cooling	Roof Top AC	EER 12.0	0.75	$2.19	16	0.18
Cooling	Roof Top AC	Ductless Minisplit	1.03	$7.17	16	0.08
Cooling	Other Cooling	EER 9.8	-	$0.00	14	-
Cooling	Other Cooling	EER 10.0	0.06	$0.55	14	0.05
Cooling	Other Cooling	EER 10.2	0.11	$0.66	14	0.08
Cooling	Other Cooling	EER 10.4	0.17	$0.76	14	0.11
Cooling	Other Cooling	EER 10.6	0.22	$0.86	14	0.12
Cooling	Other Cooling	EER 10.8	0.27	$0.96	14	0.13
Cooling	Other Cooling	EER 12.0	0.54	$4.95	14	0.05
Heating	Electric Heating	Standard	-	$0.00	25	-
Cooling/Heating	Roof Top Heat Pump	EER 9.3	-	$0.00	16	-
Cooling/Heating	Roof Top Heat Pump	EER 10.3	0.42	$0.50	16	0.54
Cooling/Heating	Roof Top Heat Pump	EER 11.0	0.67	$0.71	16	0.60
Cooling/Heating	Roof Top Heat Pump	EER 11.7	0.89	$1.83	16	0.31
Cooling/Heating	Roof Top Heat Pump	EER 12.0	0.98	$2.39	16	0.26
Cooling/Heating	Roof Top Heat Pump	Ductless Minisplit	1.49	$4.58	16	0.21
Cooling/Heating	Roof Top Heat Pump	Geothermal	2.57	$7.92	16	0.21
Ventilation	Ventilation	Constant Volume	-	$0.00	10	-
Ventilation	Ventilation	Constant Volume with ECM	0.08	$0.18	10	0.19
Ventilation	Ventilation	Variable Air Volume	0.30	-$0.07	10	1.00
Ventilation	Ventilation	Variable Air Volume with ECM	0.36	$0.10	10	1.39
Water Heating	Water Heating	EF .97	-	$0.00	15	-
Water Heating	Water Heating	EF .98	0.01	$0.02	15	0.40
Water Heating	Water Heating	EF 2.3	0.58	$0.05	15	7.81
Interior Lighting	Screw-in	Incandescent	-	$0.00	2	-
Interior Lighting	Screw-in	90W Halogen PAR-38	0.08	$0.02	3	0.43
Interior Lighting	Screw-in	70W HIR PAR-38	0.12	$0.03	3	0.47
Interior Lighting	Screw-in	CFL	0.22	$0.02	6	3.45
Interior Lighting	Screw-in	LED	0.24	$0.53	12	0.25
Interior Lighting	High-Bay Fixtures	Metal Halides	-	$0.00	3	-
Interior Lighting	High-Bay Fixtures	LED	0.12	$0.22	15	0.43
Interior Lighting	High-Bay Fixtures	T8	0.13	-$0.01	10	1.00
Interior Lighting	High-Bay Fixtures	High Pressure Sodium	0.13	$0.00	6	1.00
Interior Lighting	High-Bay Fixtures	T5	0.16	$0.00	10	1.00
Interior Lighting	Linear Fluorescent	T12	-	$0.00	10	-
Interior Lighting	Linear Fluorescent	LED	0.72	$1.77	15	0.27
Interior Lighting	Linear Fluorescent	T8	0.75	$0.00	10	475.99
Interior Lighting	Linear Fluorescent	Super T8	1.04	$0.01	10	40.43
Exterior Lighting	Screw-in	Incandescent	-	$0.00	2	-

End Use	Technology	Efficiency Definition	Savings (kWh/ sqft/yr)	Incremental Cost ($/sqft)	Lifetime (yrs)	BC Ratio
Exterior Lighting	Screw-in	90W Halogen PAR-38	0.02	$0.00	3	2.20
Exterior Lighting	Screw-in	70W HIR PAR-38	0.03	$0.00	3	2.44
Exterior Lighting	Screw-in	CFL	0.06	$0.00	6	18.50
Exterior Lighting	Screw-in	LED	0.07	$0.02	12	1.43
Exterior Lighting	HID	Metal Halides	-	$0.00	3	-
Exterior Lighting	HID	LED	0.11	$0.37	15	0.16
Exterior Lighting	HID	T8	0.11	$0.00	10	1.00
Exterior Lighting	HID	High Pressure Sodium	0.17	$0.00	6	1.00
Exterior Lighting	HID	T5	0.18	$0.00	10	1.00
Exterior Lighting	Linear Fluorescent	T12	-	$0.00	10	-
Exterior Lighting	Linear Fluorescent	LED	0.00	$0.00	15	0.13
Exterior Lighting	Linear Fluorescent	T8	0.00	$0.00	10	227.85
Exterior Lighting	Linear Fluorescent	Super T8	0.00	$0.00	10	19.35
Exterior Lighting	Linear Fluorescent	T5	0.00	$0.00	10	13.92
Refrigeration	Walk-in Refrigerator	14600 kWh/yr	-	$0.00	18	-
Refrigeration	Walk-in Refrigerator	10800 kWh/yr	0.03	$0.01	18	1.72
Refrigeration	Walk-in Refrigerator	10000 kWh/yr	0.04	$0.01	18	1.65
Refrigeration	Walk-in Refrigerator	9000 kWh/yr	0.04	$0.03	18	1.12
Refrigeration	Reach-in Refrigerator	3100 kWh/yr	-	$0.00	18	-
Refrigeration	Reach-in Refrigerator	2500 kWh/yr	0.01	$0.01	18	1.02
Refrigeration	Reach-in Refrigerator	2400 kWh/yr	0.01	$0.01	18	1.06
Refrigeration	Reach-in Refrigerator	1500 kWh/yr	0.02	$0.01	18	2.18
Refrigeration	Glass Door Display	15500 kWh/yr	-	$0.00	18	-
Refrigeration	Glass Door Display	14480 kWh/yr	0.01	$0.00	18	3.31
Refrigeration	Glass Door Display	11700 kWh/yr	0.03	$0.02	18	1.26
Refrigeration	Glass Door Display	8400 kWh/yr	0.05	$0.00	18	-
Refrigeration	Glass Door Display	6800 kWh/yr	0.07	$0.02	18	-
Refrigeration	Open Display Case	7000 kWh/yr	-	$0.00	18	-
Refrigeration	Open Display Case	6535 kWh/yr	0.00	$0.00	18	3.33
Refrigeration	Open Display Case	5350 kWh/yr	0.01	$0.00	18	-
Refrigeration	Open Display Case	5300 kWh/yr	0.01	$0.01	18	1.23
Refrigeration	Open Display Case	4350 kWh/yr	0.02	$0.01	18	-
Refrigeration	Icemaker	7.0 kWh/100 lbs	-	$0.00	12	-
Refrigeration	Icemaker	6.3 kWh/100 lbs	0.01	$0.00	12	1.11
Refrigeration	Icemaker	6.0 kWh/100 lbs	0.01	$0.00	12	1.05
Refrigeration	Icemaker	5.5 kWh/100 lbs	0.01	$0.02	12	0.42
Refrigeration	Vending Machine	3400 kWh/year	-	$0.00	10	-
Refrigeration	Vending Machine	2400 kWh/year	0.02	$0.00	10	4.06
Refrigeration	Vending Machine	1700 kWh/year	0.03	$0.00	10	2.30
Food Preparation	Oven	Standard	-	$0.00	12	-
Food Preparation	Oven	Energy Star	0.02	$0.00	12	110,574.77
Food Preparation	Fryer	Standard	-	$0.00	12	-
Food Preparation	Fryer	Energy Star	0.01	$0.00	12	2.67
Food Preparation	Dishwasher	Standard	-	$0.00	12	-
Food Preparation	Dishwasher	Energy Star	0.11	$0.00	12	12.75
Food Preparation	Hot Food Container	Standard	-	$0.00	12	-
Food Preparation	Hot Food Container	Energy Star	0.07	$0.02	12	2.60
Office Equipment	Desktop Computer	Standard	-	$0.00	4	-
Office Equipment	Desktop Computer	Energy Star	0.07	$0.00	4	2,208.46
Office Equipment	Laptop	Standard	-	$0.00	4	-
Office Equipment	Laptop	Energy Star	0.01	$0.00	4	680.80
Office Equipment	Server	Standard	-	$0.00	3	-
Office Equipment	Server	Energy Star	0.05	$0.00	3	7,804.08
Office Equipment	Monitor	Standard	-	$0.00	4	-
Office Equipment	Monitor	Energy Star	0.01	$0.00	4	249.07
Office Equipment	Printer/Copier/Fax	Standard	-	$0.00	6	-
Office Equipment	Printer/Copier/Fax	Energy Star	0.03	$0.00	6	2,306.86

End Use	Technology	Efficiency Definition	Savings (kWh/ sqft/yr)	Incremental Cost ($/sqft)	Lifetime (yrs)	BC Ratio
Office Equipment	POS Terminal	Standard	-	$0.00	4	-
Office Equipment	POS Terminal	Efficient	0.01	$0.01	4	0.29
Miscellaneous	Non-HVAC Motors	Standard (EPAct)	-	$0.00	15	-
Miscellaneous	Non-HVAC Motors	Standard (EPAct 2015)	0.00	$0.00	15	-
Miscellaneous	Non-HVAC Motors	High Efficiency	0.00	$0.00	15	6.01
Miscellaneous	Non-HVAC Motors	High Efficiency (2015)	0.00	$0.00	15	-
Miscellaneous	Non-HVAC Motors	Premium (NEMA)	0.00	$0.00	15	6.01
Miscellaneous	Non-HVAC Motors	Premium (NEMA 2015)	0.00	$0.00	15	-
Miscellaneous	Pool Pump	Standard	-	$0.00	15	-
Miscellaneous	Pool Pump	High Efficiency	0.00	$0.00	15	2.00
Miscellaneous	Pool Pump	Two-Speed	0.00	$0.00	15	1.17
Miscellaneous	Pool Heater	Standard	-	$0.00	15	-
Miscellaneous	Pool Heater	Heat Pump	0.00	$0.00	15	1.02
Miscellaneous	Pool Heater	Solar	0.00	$0.00	15	1.01
Miscellaneous	Miscellaneous	Standard	-	$0.00	5	-

Table C-19 Energy-Efficiency Equipment Data—Large Grocery, New Vintage

End Use	Technology	Efficiency Definition	Savings (kWh/ sqft/yr)	Incremental Cost ($/sqft)	Lifetime (yrs)	BC Ratio
Cooling	Air-Cooled Chiller	1.5 kw/ton, COP 2.3	-	$0.00	20	-
Cooling	Air-Cooled Chiller	1.3 kw/ton, COP 2.7	1.66	$0.58	20	1.82
Cooling	Air-Cooled Chiller	1.26 kw/ton, COP 2.8	1.99	$0.76	20	1.68
Cooling	Air-Cooled Chiller	1.0 kw/ton, COP 3.5	4.14	$0.93	20	2.85
Cooling	Air-Cooled Chiller	0.97 kw/ton, COP 3.6	4.39	$1.11	20	2.54
Cooling	Water-Cooled Chiller	0.75 kw/ton, COP 4.7	-	$0.00	20	-
Cooling	Water-Cooled Chiller	0.60 kw/ton, COP 5.9	1.96	$0.22	20	5.73
Cooling	Water-Cooled Chiller	0.58 kw/ton, COP 6.1	2.22	$0.44	20	3.25
Cooling	Water-Cooled Chiller	0.55 kw/Ton, COP 6.4	2.61	$0.53	20	3.19
Cooling	Water-Cooled Chiller	0.51 kw/ton, COP 6.9	3.13	$0.82	20	2.46
Cooling	Water-Cooled Chiller	0.50 kw/Ton, COP 7.0	3.27	$0.91	20	2.31
Cooling	Water-Cooled Chiller	0.48 kw/ton, COP 7.3	3.53	$0.99	20	2.28
Cooling	Roof Top AC	EER 9.2	-	$0.00	16	-
Cooling	Roof Top AC	EER 10.1	0.79	$4.45	16	0.10
Cooling	Roof Top AC	EER 11.2	1.59	$8.57	16	0.10
Cooling	Roof Top AC	EER 12.0	2.08	$16.45	16	0.07
Cooling	Roof Top AC	Ductless Minisplit	2.89	$53.96	16	0.03
Cooling	Other Cooling	EER 9.8	-	$0.00	14	-
Cooling	Other Cooling	EER 10.0	0.19	$0.33	14	0.29
Cooling	Other Cooling	EER 10.2	0.38	$0.39	14	0.47
Cooling	Other Cooling	EER 10.4	0.56	$0.44	14	0.60
Cooling	Other Cooling	EER 10.6	0.73	$0.50	14	0.69
Cooling	Other Cooling	EER 10.8	0.90	$0.56	14	0.76
Cooling	Other Cooling	EER 12.0	1.78	$2.91	14	0.29
Heating	Electric Heating	Standard	-	$0.00	25	-
Cooling/Heating	Roof Top Heat Pump	EER 9.3	-	$0.00	16	-
Cooling/Heating	Roof Top Heat Pump	EER 10.3	1.06	$0.59	16	1.07
Cooling/Heating	Roof Top Heat Pump	EER 11.0	1.69	$0.85	16	1.19
Cooling/Heating	Roof Top Heat Pump	EER 11.7	2.25	$2.17	16	0.62
Cooling/Heating	Roof Top Heat Pump	EER 12.0	2.46	$2.83	16	0.52
Cooling/Heating	Roof Top Heat Pump	Ductless Minisplit	3.76	$5.42	16	0.41
Cooling/Heating	Roof Top Heat Pump	Geothermal	5.89	$9.37	16	0.37
Ventilation	Ventilation	Constant Volume	-	$0.00	10	-
Ventilation	Ventilation	Constant Volume with ECM	0.20	$0.49	10	0.16
Ventilation	Ventilation	Variable Air Volume	0.18	-$0.20	10	1.00
Ventilation	Ventilation	Variable Air Volume with ECM	0.45	$0.29	10	0.62
Water Heating	Water Heating	EF .97	-	$0.00	15	-
Water Heating	Water Heating	EF .98	0.02	$0.02	15	0.69
Water Heating	Water Heating	EF 2.3	1.27	$0.06	15	13.74
Interior Lighting	Screw-in	Incandescent	-	$0.00	2	-
Interior Lighting	Screw-in	90W Halogen PAR-38	0.38	$0.03	3	1.48
Interior Lighting	Screw-in	70W HIR PAR-38	0.58	$0.04	3	1.64
Interior Lighting	Screw-in	CFL	1.09	$0.02	6	12.09
Interior Lighting	Screw-in	LED	1.18	$0.66	12	0.90
Interior Lighting	High-Bay Fixtures	Metal Halides	-	$0.00	3	-
Interior Lighting	High-Bay Fixtures	LED	0.55	$0.03	15	12.04
Interior Lighting	High-Bay Fixtures	T8	0.56	$0.00	10	1.00
Interior Lighting	High-Bay Fixtures	High Pressure Sodium	0.60	$0.00	6	1.00
Interior Lighting	High-Bay Fixtures	T5	0.72	$0.00	10	1.00
Interior Lighting	Linear Fluorescent	T12	-	$0.00	10	-
Interior Lighting	Linear Fluorescent	LED	1.57	$2.91	15	0.32
Interior Lighting	Linear Fluorescent	T8	1.63	$0.00	10	570.27
Interior Lighting	Linear Fluorescent	Super T8	2.26	$0.02	10	48.44
Exterior Lighting	Screw-in	Incandescent	-	$0.00	2	-
Exterior Lighting	Screw-in	90W Halogen PAR-38	0.09	$0.00	3	2.17

End Use	Technology	Efficiency Definition	Savings (kWh/ sqft/yr)	Incremental Cost ($/sqft)	Lifetime (yrs)	BC Ratio
Exterior Lighting	Screw-in	70W HIR PAR-38	0.13	$0.01	3	2.41
Exterior Lighting	Screw-in	CFL	0.25	$0.00	6	18.27
Exterior Lighting	Screw-in	LED	0.27	$0.08	12	1.41
Exterior Lighting	HID	Metal Halides	-	$0.00	3	-
Exterior Lighting	HID	LED	0.22	$0.75	15	0.16
Exterior Lighting	HID	T8	0.23	-$0.01	10	1.00
Exterior Lighting	HID	High Pressure Sodium	0.36	$0.00	6	1.00
Exterior Lighting	HID	T5	0.37	$0.00	10	1.00
Exterior Lighting	Linear Fluorescent	T12	-	$0.00	10	-
Exterior Lighting	Linear Fluorescent	LED	0.01	$0.03	15	0.13
Exterior Lighting	Linear Fluorescent	T8	0.01	$0.00	10	227.85
Exterior Lighting	Linear Fluorescent	Super T8	0.01	$0.00	10	19.35
Exterior Lighting	Linear Fluorescent	T5	0.01	$0.00	10	13.92
Refrigeration	Walk-in Refrigerator	14600 kWh/yr	-	$0.00	18	-
Refrigeration	Walk-in Refrigerator	10800 kWh/yr	1.41	$0.56	18	1.71
Refrigeration	Walk-in Refrigerator	10000 kWh/yr	1.71	$0.70	18	1.63
Refrigeration	Walk-in Refrigerator	9000 kWh/yr	2.08	$1.26	18	1.11
Refrigeration	Reach-in Refrigerator	3100 kWh/yr	-	$0.00	18	-
Refrigeration	Reach-in Refrigerator	2500 kWh/yr	0.06	$0.04	18	1.01
Refrigeration	Reach-in Refrigerator	2400 kWh/yr	0.07	$0.04	18	1.05
Refrigeration	Reach-in Refrigerator	1500 kWh/yr	0.15	$0.05	18	2.16
Refrigeration	Glass Door Display	15500 kWh/yr	-	$0.00	18	-
Refrigeration	Glass Door Display	14480 kWh/yr	0.96	$0.20	18	3.27
Refrigeration	Glass Door Display	11700 kWh/yr	3.59	$1.95	18	1.24
Refrigeration	Glass Door Display	8400 kWh/yr	6.72	$0.20	18	-
Refrigeration	Glass Door Display	6800 kWh/yr	8.23	$1.95	18	-
Refrigeration	Open Display Case	7000 kWh/yr	-	$0.00	18	-
Refrigeration	Open Display Case	6535 kWh/yr	0.44	$0.09	18	3.30
Refrigeration	Open Display Case	5350 kWh/yr	1.56	$0.09	18	-
Refrigeration	Open Display Case	5300 kWh/yr	1.61	$0.89	18	1.22
Refrigeration	Open Display Case	4350 kWh/yr	2.51	$0.89	18	-
Refrigeration	Icemaker	7.0 kWh/100 lbs	-	$0.00	12	-
Refrigeration	Icemaker	6.3 kWh/100 lbs	0.02	$0.01	12	1.10
Refrigeration	Icemaker	6.0 kWh/100 lbs	0.02	$0.01	12	1.03
Refrigeration	Icemaker	5.5 kWh/100 lbs	0.04	$0.04	12	0.42
Refrigeration	Vending Machine	3400 kWh/year	-	$0.00	10	-
Refrigeration	Vending Machine	2400 kWh/year	0.08	$0.01	10	4.01
Refrigeration	Vending Machine	1700 kWh/year	0.13	$0.02	10	2.27
Food Preparation	Oven	Standard	-	$0.00	12	-
Food Preparation	Oven	Energy Star	0.09	$0.00	12	96,282.52
Food Preparation	Fryer	Standard	-	$0.00	12	-
Food Preparation	Fryer	Energy Star	0.06	$0.01	12	2.32
Food Preparation	Dishwasher	Standard	-	$0.00	12	-
Food Preparation	Dishwasher	Energy Star	0.47	$0.02	12	11.10
Food Preparation	Hot Food Container	Standard	-	$0.00	12	-
Food Preparation	Hot Food Container	Energy Star	0.32	$0.07	12	2.26
Office Equipment	Desktop Computer	Standard	-	$0.00	4	-
Office Equipment	Desktop Computer	Energy Star	0.06	$0.00	4	2,010.93
Office Equipment	Laptop	Standard	-	$0.00	4	-
Office Equipment	Laptop	Energy Star	0.01	$0.00	4	619.91
Office Equipment	Server	Standard	-	$0.00	3	-
Office Equipment	Server	Energy Star	0.03	$0.00	3	7,093.69
Office Equipment	Monitor	Standard	-	$0.00	4	-
Office Equipment	Monitor	Energy Star	0.01	$0.00	4	226.80
Office Equipment	Printer/Copier/Fax	Standard	-	$0.00	6	-
Office Equipment	Printer/Copier/Fax	Energy Star	0.01	$0.00	6	2,115.22

End Use	Technology	Efficiency Definition	Savings (kWh/ sqft/yr)	Incremental Cost ($/sqft)	Lifetime (yrs)	BC Ratio
Office Equipment	POS Terminal	Standard	-	$0.00	4	-
Office Equipment	POS Terminal	Efficient	0.04	$0.02	4	0.27
Miscellaneous	Non-HVAC Motors	Standard (EPAct)	-	$0.00	15	-
Miscellaneous	Non-HVAC Motors	Standard (EPAct 2015)	0.00	$0.00	15	-
Miscellaneous	Non-HVAC Motors	High Efficiency	0.00	$0.00	15	5.43
Miscellaneous	Non-HVAC Motors	High Efficiency (2015)	0.00	$0.00	15	-
Miscellaneous	Non-HVAC Motors	Premium (NEMA)	0.00	$0.00	15	5.43
Miscellaneous	Non-HVAC Motors	Premium (NEMA 2015)	0.00	$0.00	15	-
Miscellaneous	Pool Pump	Standard	-	$0.00	15	-
Miscellaneous	Pool Pump	High Efficiency	-	$0.00	15	1.00
Miscellaneous	Pool Pump	Two-Speed	-	$0.00	15	1.00
Miscellaneous	Pool Heater	Standard	-	$0.00	15	-
Miscellaneous	Pool Heater	Heat Pump	-	$0.00	15	1.00
Miscellaneous	Pool Heater	Solar	-	$0.00	15	1.00
Miscellaneous	Miscellaneous	Standard	-	$0.00	5	-

Table C-20 Energy-Efficiency Equipment Data—Small Grocery, New Vintage

End Use	Technology	Efficiency Definition	Savings (kWh/ sqft/yr)	Incremental Cost ($/sqft)	Lifetime (yrs)	BC Ratio
Cooling	Air-Cooled Chiller	1.5 kw/ton, COP 2.3	-	$0.00	20	-
Cooling	Air-Cooled Chiller	1.3 kw/ton, COP 2.7	1.55	$0.54	20	1.82
Cooling	Air-Cooled Chiller	1.26 kw/ton, COP 2.8	1.86	$0.71	20	1.68
Cooling	Air-Cooled Chiller	1.0 kw/ton, COP 3.5	3.87	$0.87	20	2.85
Cooling	Air-Cooled Chiller	0.97 kw/ton, COP 3.6	4.10	$1.04	20	2.54
Cooling	Water-Cooled Chiller	0.75 kw/ton, COP 4.7	-	$0.00	20	-
Cooling	Water-Cooled Chiller	0.60 kw/ton, COP 5.9	1.83	$0.20	20	5.73
Cooling	Water-Cooled Chiller	0.58 kw/ton, COP 6.1	2.07	$0.41	20	3.25
Cooling	Water-Cooled Chiller	0.55 kw/Ton, COP 6.4	2.44	$0.49	20	3.19
Cooling	Water-Cooled Chiller	0.51 kw/ton, COP 6.9	2.93	$0.77	20	2.46
Cooling	Water-Cooled Chiller	0.50 kw/Ton, COP 7.0	3.05	$0.85	20	2.31
Cooling	Water-Cooled Chiller	0.48 kw/ton, COP 7.3	3.30	$0.93	20	2.28
Cooling	Roof Top AC	EER 9.2	-	$0.00	16	-
Cooling	Roof Top AC	EER 10.1	0.74	$4.17	16	0.10
Cooling	Roof Top AC	EER 11.2	1.49	$8.01	16	0.10
Cooling	Roof Top AC	EER 12.0	1.95	$15.38	16	0.07
Cooling	Roof Top AC	Ductless Minisplit	2.71	$50.47	16	0.03
Cooling	Other Cooling	EER 9.8	-	$0.00	14	-
Cooling	Other Cooling	EER 10.0	0.18	$0.30	14	0.29
Cooling	Other Cooling	EER 10.2	0.36	$0.36	14	0.47
Cooling	Other Cooling	EER 10.4	0.53	$0.42	14	0.60
Cooling	Other Cooling	EER 10.6	0.69	$0.47	14	0.69
Cooling	Other Cooling	EER 10.8	0.84	$0.53	14	0.76
Cooling	Other Cooling	EER 12.0	1.67	$2.72	14	0.29
Heating	Electric Heating	Standard	-	$0.00	25	-
Cooling/Heating	Roof Top Heat Pump	EER 9.3	-	$0.00	16	-
Cooling/Heating	Roof Top Heat Pump	EER 10.3	1.00	$0.55	16	1.07
Cooling/Heating	Roof Top Heat Pump	EER 11.0	1.59	$0.80	16	1.19
Cooling/Heating	Roof Top Heat Pump	EER 11.7	2.11	$2.04	16	0.62
Cooling/Heating	Roof Top Heat Pump	EER 12.0	2.32	$2.66	16	0.52
Cooling/Heating	Roof Top Heat Pump	Ductless Minisplit	3.54	$5.10	16	0.41
Cooling/Heating	Roof Top Heat Pump	Geothermal	5.54	$8.82	16	0.37
Ventilation	Ventilation	Constant Volume	-	$0.00	10	-
Ventilation	Ventilation	Constant Volume with ECM	0.18	$0.44	10	0.16
Ventilation	Ventilation	Variable Air Volume	0.17	-$0.18	10	1.00
Ventilation	Ventilation	Variable Air Volume with ECM	0.40	$0.26	10	0.62
Water Heating	Water Heating	EF .97	-	$0.00	15	-
Water Heating	Water Heating	EF .98	0.02	$0.02	15	0.69
Water Heating	Water Heating	EF 2.3	1.01	$0.04	15	13.74
Interior Lighting	Screw-in	Incandescent	-	$0.00	2	-
Interior Lighting	Screw-in	90W Halogen PAR-38	0.36	$0.03	3	1.54
Interior Lighting	Screw-in	70W HIR PAR-38	0.55	$0.04	3	1.71
Interior Lighting	Screw-in	CFL	1.02	$0.02	6	12.59
Interior Lighting	Screw-in	LED	1.11	$0.59	12	0.93
Interior Lighting	High-Bay Fixtures	Metal Halides	-	$0.00	3	-
Interior Lighting	High-Bay Fixtures	LED	0.49	$0.03	15	11.96
Interior Lighting	High-Bay Fixtures	T8	0.50	$0.00	10	1.00
Interior Lighting	High-Bay Fixtures	High Pressure Sodium	0.53	$0.00	6	1.00
Interior Lighting	High-Bay Fixtures	T5	0.64	$0.00	10	1.00
Interior Lighting	Linear Fluorescent	T12	-	$0.00	10	-
Interior Lighting	Linear Fluorescent	LED	1.40	$2.62	15	0.32
Interior Lighting	Linear Fluorescent	T8	1.46	$0.00	10	566.19
Interior Lighting	Linear Fluorescent	Super T8	2.02	$0.02	10	48.09
Exterior Lighting	Screw-in	Incandescent	-	$0.00	2	-

End Use	Technology	Efficiency Definition	Savings (kWh/ sqft/yr)	Incremental Cost ($/sqft)	Lifetime (yrs)	BC Ratio
Exterior Lighting	Screw-in	90W Halogen PAR-38	0.07	$0.00	3	2.17
Exterior Lighting	Screw-in	70W HIR PAR-38	0.11	$0.00	3	2.41
Exterior Lighting	Screw-in	CFL	0.20	$0.00	6	18.27
Exterior Lighting	Screw-in	LED	0.21	$0.06	12	1.41
Exterior Lighting	HID	Metal Halides	-	$0.00	3	-
Exterior Lighting	HID	LED	0.18	$0.60	15	0.16
Exterior Lighting	HID	T8	0.18	$0.00	10	1.00
Exterior Lighting	HID	High Pressure Sodium	0.29	$0.00	6	1.00
Exterior Lighting	HID	T5	0.30	$0.00	10	1.00
Exterior Lighting	Linear Fluorescent	T12	-	$0.00	10	-
Exterior Lighting	Linear Fluorescent	LED	0.01	$0.03	15	0.13
Exterior Lighting	Linear Fluorescent	T8	0.01	$0.00	10	227.85
Exterior Lighting	Linear Fluorescent	Super T8	0.01	$0.00	10	19.35
Exterior Lighting	Linear Fluorescent	T5	0.01	$0.00	10	13.92
Refrigeration	Walk-in Refrigerator	14600 kWh/yr	-	$0.00	18	-
Refrigeration	Walk-in Refrigerator	10800 kWh/yr	0.82	$0.32	18	1.71
Refrigeration	Walk-in Refrigerator	10000 kWh/yr	0.99	$0.41	18	1.63
Refrigeration	Walk-in Refrigerator	9000 kWh/yr	1.20	$0.73	18	1.11
Refrigeration	Reach-in Refrigerator	3100 kWh/yr	-	$0.00	18	-
Refrigeration	Reach-in Refrigerator	2500 kWh/yr	0.12	$0.08	18	1.01
Refrigeration	Reach-in Refrigerator	2400 kWh/yr	0.13	$0.09	18	1.05
Refrigeration	Reach-in Refrigerator	1500 kWh/yr	0.31	$0.10	18	2.16
Refrigeration	Glass Door Display	15500 kWh/yr	-	$0.00	18	-
Refrigeration	Glass Door Display	14480 kWh/yr	0.78	$0.16	18	3.27
Refrigeration	Glass Door Display	11700 kWh/yr	2.91	$1.58	18	1.24
Refrigeration	Glass Door Display	8400 kWh/yr	5.45	$0.16	18	-
Refrigeration	Glass Door Display	6800 kWh/yr	6.67	$1.58	18	-
Refrigeration	Open Display Case	7000 kWh/yr	-	$0.00	18	-
Refrigeration	Open Display Case	6535 kWh/yr	0.36	$0.07	18	3.30
Refrigeration	Open Display Case	5350 kWh/yr	1.27	$0.07	18	-
Refrigeration	Open Display Case	5300 kWh/yr	1.30	$0.72	18	1.22
Refrigeration	Open Display Case	4350 kWh/yr	2.03	$0.72	18	-
Refrigeration	Icemaker	7.0 kWh/100 lbs	-	$0.00	12	-
Refrigeration	Icemaker	6.3 kWh/100 lbs	0.07	$0.03	12	1.10
Refrigeration	Icemaker	6.0 kWh/100 lbs	0.10	$0.05	12	1.03
Refrigeration	Icemaker	5.5 kWh/100 lbs	0.15	$0.17	12	0.42
Refrigeration	Vending Machine	3400 kWh/year	-	$0.00	10	-
Refrigeration	Vending Machine	2400 kWh/year	0.15	$0.02	10	4.01
Refrigeration	Vending Machine	1700 kWh/year	0.26	$0.05	10	2.27
Food Preparation	Oven	Standard	-	$0.00	12	-
Food Preparation	Oven	Energy Star	0.08	$0.00	12	96,282.52
Food Preparation	Fryer	Standard	-	$0.00	12	-
Food Preparation	Fryer	Energy Star	0.05	$0.01	12	2.32
Food Preparation	Dishwasher	Standard	-	$0.00	12	-
Food Preparation	Dishwasher	Energy Star	0.38	$0.02	12	11.10
Food Preparation	Hot Food Container	Standard	-	$0.00	12	-
Food Preparation	Hot Food Container	Energy Star	0.25	$0.06	12	2.26
Office Equipment	Desktop Computer	Standard	-	$0.00	4	-
Office Equipment	Desktop Computer	Energy Star	0.04	$0.00	4	2,010.93
Office Equipment	Laptop	Standard	-	$0.00	4	-
Office Equipment	Laptop	Energy Star	0.01	$0.00	4	619.91
Office Equipment	Server	Standard	-	$0.00	3	-
Office Equipment	Server	Energy Star	0.04	$0.00	3	7,093.69
Office Equipment	Monitor	Standard	-	$0.00	4	-
Office Equipment	Monitor	Energy Star	0.00	$0.00	4	226.80
Office Equipment	Printer/Copier/Fax	Standard	-	$0.00	6	-
Office Equipment	Printer/Copier/Fax	Energy Star	0.01	$0.00	6	2,115.22

End Use	Technology	Efficiency Definition	Savings (kWh/ sqft/yr)	Incremental Cost ($/sqft)	Lifetime (yrs)	BC Ratio
Office Equipment	POS Terminal	Standard	-	$0.00	4	-
Office Equipment	POS Terminal	Efficient	0.01	$0.01	4	0.27
Miscellaneous	Non-HVAC Motors	Standard (EPAct)	-	$0.00	15	-
Miscellaneous	Non-HVAC Motors	Standard (EPAct 2015)	0.00	$0.00	15	-
Miscellaneous	Non-HVAC Motors	High Efficiency	0.00	$0.00	15	5.43
Miscellaneous	Non-HVAC Motors	High Efficiency (2015)	0.01	$0.00	15	-
Miscellaneous	Non-HVAC Motors	Premium (NEMA)	0.01	$0.00	15	5.43
Miscellaneous	Non-HVAC Motors	Premium (NEMA 2015)	0.01	$0.00	15	-
Miscellaneous	Pool Pump	Standard	-	$0.00	15	-
Miscellaneous	Pool Pump	High Efficiency	-	$0.00	15	1.00
Miscellaneous	Pool Pump	Two-Speed	-	$0.00	15	1.00
Miscellaneous	Pool Heater	Standard	-	$0.00	15	-
Miscellaneous	Pool Heater	Heat Pump	-	$0.00	15	1.00
Miscellaneous	Pool Heater	Solar	-	$0.00	15	1.00
Miscellaneous	Miscellaneous	Standard	-	$0.00	5	-

Table C-21 Energy-Efficiency Equipment Data—Health, New Vintage

End Use	Technology	Efficiency Definition	Savings (kWh/ sqft/yr)	Incremental Cost ($/sqft)	Lifetime (yrs)	BC Ratio
Cooling	Air-Cooled Chiller	1.5 kw/ton, COP 2.3	-	$0.00	20	-
Cooling	Air-Cooled Chiller	1.3 kw/ton, COP 2.7	2.36	$0.87	20	2.00
Cooling	Air-Cooled Chiller	1.26 kw/ton, COP 2.8	2.83	$1.14	20	1.85
Cooling	Air-Cooled Chiller	1.0 kw/ton, COP 3.5	5.89	$1.40	20	3.13
Cooling	Air-Cooled Chiller	0.97 kw/ton, COP 3.6	6.25	$1.66	20	2.79
Cooling	Water-Cooled Chiller	0.75 kw/ton, COP 4.7	-	$0.00	20	-
Cooling	Water-Cooled Chiller	0.60 kw/ton, COP 5.9	3.33	$0.35	20	7.03
Cooling	Water-Cooled Chiller	0.58 kw/ton, COP 6.1	3.78	$0.70	20	3.98
Cooling	Water-Cooled Chiller	0.55 kw/Ton, COP 6.4	4.44	$0.84	20	3.91
Cooling	Water-Cooled Chiller	0.51 kw/ton, COP 6.9	5.33	$1.31	20	3.01
Cooling	Water-Cooled Chiller	0.50 kw/Ton, COP 7.0	5.56	$1.45	20	2.84
Cooling	Water-Cooled Chiller	0.48 kw/ton, COP 7.3	6.00	$1.60	20	2.79
Cooling	Roof Top AC	EER 9.2	-	$0.00	16	-
Cooling	Roof Top AC	EER 10.1	1.07	$0.30	16	2.22
Cooling	Roof Top AC	EER 11.2	2.15	$0.58	16	2.31
Cooling	Roof Top AC	EER 12.0	2.81	$1.12	16	1.57
Cooling	Roof Top AC	Ductless Minisplit	3.83	$3.66	16	0.65
Cooling	Other Cooling	EER 9.8	-	$0.00	14	-
Cooling	Other Cooling	EER 10.0	0.19	$0.31	14	0.33
Cooling	Other Cooling	EER 10.2	0.37	$0.37	14	0.55
Cooling	Other Cooling	EER 10.4	0.54	$0.43	14	0.70
Cooling	Other Cooling	EER 10.6	0.71	$0.49	14	0.81
Cooling	Other Cooling	EER 10.8	0.87	$0.54	14	0.89
Cooling	Other Cooling	EER 12.0	1.72	$2.80	14	0.34
Heating	Electric Heating	Standard	-	$0.00	25	-
Cooling/Heating	Roof Top Heat Pump	EER 9.3	-	$0.00	16	-
Cooling/Heating	Roof Top Heat Pump	EER 10.3	1.19	$0.37	16	1.79
Cooling/Heating	Roof Top Heat Pump	EER 11.0	1.89	$0.54	16	1.99
Cooling/Heating	Roof Top Heat Pump	EER 11.7	2.50	$1.38	16	1.03
Cooling/Heating	Roof Top Heat Pump	EER 12.0	2.75	$1.80	16	0.86
Cooling/Heating	Roof Top Heat Pump	Ductless Minisplit	4.20	$3.45	16	0.69
Cooling/Heating	Roof Top Heat Pump	Geothermal	7.46	$5.97	16	0.71
Ventilation	Ventilation	Constant Volume	-	$0.00	10	-
Ventilation	Ventilation	Constant Volume with ECM	0.33	$0.34	10	0.39
Ventilation	Ventilation	Variable Air Volume	0.97	-$0.14	10	1.00
Ventilation	Ventilation	Variable Air Volume with ECM	1.29	$0.20	10	2.62
Water Heating	Water Heating	EF .97	-	$0.00	15	-
Water Heating	Water Heating	EF .98	0.03	$0.03	15	0.68
Water Heating	Water Heating	EF 2.3	1.89	$0.09	15	13.37
Interior Lighting	Screw-in	Incandescent	-	$0.00	2	-
Interior Lighting	Screw-in	90W Halogen PAR-38	0.39	$0.01	3	3.87
Interior Lighting	Screw-in	70W HIR PAR-38	0.61	$0.02	3	4.29
Interior Lighting	Screw-in	CFL	1.13	$0.01	6	31.73
Interior Lighting	Screw-in	LED	1.23	$0.26	12	2.36
Interior Lighting	High-Bay Fixtures	Metal Halides	-	$0.00	3	-
Interior Lighting	High-Bay Fixtures	LED	0.03	$0.01	15	1.47
Interior Lighting	High-Bay Fixtures	T8	0.03	$0.00	10	1.00
Interior Lighting	High-Bay Fixtures	High Pressure Sodium	0.03	$0.00	6	1.00
Interior Lighting	High-Bay Fixtures	T5	0.04	$0.00	10	1.00
Interior Lighting	Linear Fluorescent	T12	-	$0.00	10	-
Interior Lighting	Linear Fluorescent	LED	0.99	$1.52	15	0.39
Interior Lighting	Linear Fluorescent	T8	1.03	$0.00	10	681.75
Interior Lighting	Linear Fluorescent	Super T8	1.43	$0.01	10	57.91
Exterior Lighting	Screw-in	Incandescent	-	$0.00	2	-
Exterior Lighting	Screw-in	90W Halogen PAR-38	0.01	$0.00	3	2.37

End Use	Technology	Efficiency Definition	Savings (kWh/ sqft/yr)	Incremental Cost ($/sqft)	Lifetime (yrs)	BC Ratio
Exterior Lighting	Screw-in	70W HIR PAR-38	0.02	$0.00	3	2.62
Exterior Lighting	Screw-in	CFL	0.03	$0.00	6	19.87
Exterior Lighting	Screw-in	LED	0.03	$0.01	12	1.54
Exterior Lighting	HID	Metal Halides	-	$0.00	3	-
Exterior Lighting	HID	LED	0.11	$0.38	15	0.16
Exterior Lighting	HID	T8	0.12	$0.00	10	1.00
Exterior Lighting	HID	High Pressure Sodium	0.18	$0.00	6	1.00
Exterior Lighting	HID	T5	0.19	$0.00	10	1.00
Exterior Lighting	Linear Fluorescent	T12	-	$0.00	10	-
Exterior Lighting	Linear Fluorescent	LED	0.00	$0.00	15	0.13
Exterior Lighting	Linear Fluorescent	T8	0.00	$0.00	10	227.85
Exterior Lighting	Linear Fluorescent	Super T8	0.00	$0.00	10	19.35
Exterior Lighting	Linear Fluorescent	T5	0.00	$0.00	10	13.92
Refrigeration	Walk-in Refrigerator	14600 kWh/yr	-	$0.00	18	-
Refrigeration	Walk-in Refrigerator	10800 kWh/yr	0.04	$0.02	18	1.72
Refrigeration	Walk-in Refrigerator	10000 kWh/yr	0.05	$0.02	18	1.64
Refrigeration	Walk-in Refrigerator	9000 kWh/yr	0.06	$0.04	18	1.12
Refrigeration	Reach-in Refrigerator	3100 kWh/yr	-	$0.00	18	-
Refrigeration	Reach-in Refrigerator	2500 kWh/yr	0.01	$0.00	18	1.02
Refrigeration	Reach-in Refrigerator	2400 kWh/yr	0.01	$0.00	18	1.06
Refrigeration	Reach-in Refrigerator	1500 kWh/yr	0.02	$0.01	18	2.17
Refrigeration	Glass Door Display	15500 kWh/yr	-	$0.00	18	-
Refrigeration	Glass Door Display	14480 kWh/yr	0.01	$0.00	18	3.29
Refrigeration	Glass Door Display	11700 kWh/yr	0.04	$0.02	18	1.25
Refrigeration	Glass Door Display	8400 kWh/yr	0.08	$0.00	18	-
Refrigeration	Glass Door Display	6800 kWh/yr	0.09	$0.02	18	-
Refrigeration	Open Display Case	7000 kWh/yr	-	$0.00	18	-
Refrigeration	Open Display Case	6535 kWh/yr	0.01	$0.00	18	3.32
Refrigeration	Open Display Case	5350 kWh/yr	0.02	$0.00	18	-
Refrigeration	Open Display Case	5300 kWh/yr	0.02	$0.01	18	1.23
Refrigeration	Open Display Case	4350 kWh/yr	0.03	$0.01	18	-
Refrigeration	Icemaker	7.0 kWh/100 lbs	-	$0.00	12	-
Refrigeration	Icemaker	6.3 kWh/100 lbs	0.01	$0.00	12	1.11
Refrigeration	Icemaker	6.0 kWh/100 lbs	0.01	$0.01	12	1.04
Refrigeration	Icemaker	5.5 kWh/100 lbs	0.02	$0.02	12	0.42
Refrigeration	Vending Machine	3400 kWh/year	-	$0.00	10	-
Refrigeration	Vending Machine	2400 kWh/year	0.02	$0.00	10	4.05
Refrigeration	Vending Machine	1700 kWh/year	0.04	$0.01	10	2.29
Food Preparation	Oven	Standard	-	$0.00	12	-
Food Preparation	Oven	Energy Star	0.10	$0.00	12	93,022.83
Food Preparation	Fryer	Standard	-	$0.00	12	-
Food Preparation	Fryer	Energy Star	0.06	$0.01	12	2.24
Food Preparation	Dishwasher	Standard	-	$0.00	12	-
Food Preparation	Dishwasher	Energy Star	0.48	$0.02	12	10.72
Food Preparation	Hot Food Container	Standard	-	$0.00	12	-
Food Preparation	Hot Food Container	Energy Star	0.33	$0.07	12	2.19
Office Equipment	Desktop Computer	Standard	-	$0.00	4	-
Office Equipment	Desktop Computer	Energy Star	0.18	$0.00	4	2,032.04
Office Equipment	Laptop	Standard	-	$0.00	4	-
Office Equipment	Laptop	Energy Star	0.03	$0.00	4	626.42
Office Equipment	Server	Standard	-	$0.00	3	-
Office Equipment	Server	Energy Star	0.04	$0.00	3	7,169.59
Office Equipment	Monitor	Standard	-	$0.00	4	-
Office Equipment	Monitor	Energy Star	0.02	$0.00	4	229.18
Office Equipment	Printer/Copier/Fax	Standard	-	$0.00	6	-
Office Equipment	Printer/Copier/Fax	Energy Star	0.06	$0.00	6	2,135.70

End Use	Technology	Efficiency Definition	Savings (kWh/ sqft/yr)	Incremental Cost ($/sqft)	Lifetime (yrs)	BC Ratio
Office Equipment	POS Terminal	Standard	-	$0.00	4	-
Office Equipment	POS Terminal	Efficient	0.06	$0.03	4	0.27
Miscellaneous	Non-HVAC Motors	Standard (EPAct)	-	$0.00	15	-
Miscellaneous	Non-HVAC Motors	Standard (EPAct 2015)	0.00	$0.00	15	-
Miscellaneous	Non-HVAC Motors	High Efficiency	0.00	$0.00	15	5.47
Miscellaneous	Non-HVAC Motors	High Efficiency (2015)	0.00	$0.00	15	-
Miscellaneous	Non-HVAC Motors	Premium (NEMA)	0.01	$0.00	15	5.47
Miscellaneous	Non-HVAC Motors	Premium (NEMA 2015)	0.01	$0.00	15	-
Miscellaneous	Pool Pump	Standard	-	$0.00	15	-
Miscellaneous	Pool Pump	High Efficiency	0.00	$0.00	15	1.81
Miscellaneous	Pool Pump	Two-Speed	0.00	$0.00	15	1.07
Miscellaneous	Pool Heater	Standard	-	$0.00	15	-
Miscellaneous	Pool Heater	Heat Pump	0.02	$0.01	15	0.93
Miscellaneous	Pool Heater	Solar	0.02	$0.02	15	0.92
Miscellaneous	Miscellaneous	Standard	-	$0.00	5	-

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

End Use	Technology	Efficiency Definition	Savings (kWh/ sqft/yr)	Incremental Cost ($/sqft)	Lifetime (yrs)	BC Ratio
Cooling	Air-Cooled Chiller	1.5 kw/ton, COP 2.3	-	$0.00	20	-
Cooling	Air-Cooled Chiller	1.3 kw/ton, COP 2.7	0.76	$0.22	20	2.50
Cooling	Air-Cooled Chiller	1.26 kw/ton, COP 2.8	0.92	$0.28	20	2.30
Cooling	Air-Cooled Chiller	1.0 kw/ton, COP 3.5	1.91	$0.35	20	3.90
Cooling	Air-Cooled Chiller	0.97 kw/ton, COP 3.6	2.02	$0.41	20	3.48
Cooling	Water-Cooled Chiller	0.75 kw/ton, COP 4.7	-	$0.00	20	-
Cooling	Water-Cooled Chiller	0.60 kw/ton, COP 5.9	0.71	$0.06	20	8.04
Cooling	Water-Cooled Chiller	0.58 kw/ton, COP 6.1	0.80	$0.13	20	4.56
Cooling	Water-Cooled Chiller	0.55 kw/Ton, COP 6.4	0.94	$0.15	20	4.47
Cooling	Water-Cooled Chiller	0.51 kw/ton, COP 6.9	1.13	$0.23	20	3.45
Cooling	Water-Cooled Chiller	0.50 kw/Ton, COP 7.0	1.18	$0.26	20	3.25
Cooling	Water-Cooled Chiller	0.48 kw/ton, COP 7.3	1.27	$0.28	20	3.20
Cooling	Roof Top AC	EER 9.2	-	$0.00	16	-
Cooling	Roof Top AC	EER 10.1	0.22	$0.08	16	1.71
Cooling	Roof Top AC	EER 11.2	0.43	$0.15	16	1.78
Cooling	Roof Top AC	EER 12.0	0.57	$0.28	16	1.21
Cooling	Roof Top AC	Ductless Minisplit	0.85	$0.92	16	0.56
Cooling	Other Cooling	EER 9.8	-	$0.00	14	-
Cooling	Other Cooling	EER 10.0	0.13	$0.22	14	0.32
Cooling	Other Cooling	EER 10.2	0.25	$0.26	14	0.53
Cooling	Other Cooling	EER 10.4	0.37	$0.30	14	0.68
Cooling	Other Cooling	EER 10.6	0.49	$0.34	14	0.78
Cooling	Other Cooling	EER 10.8	0.60	$0.38	14	0.85
Cooling	Other Cooling	EER 12.0	1.19	$1.94	14	0.33
Heating	Electric Heating	Standard	-	$0.00	25	-
Cooling/Heating	Roof Top Heat Pump	EER 9.3	-	$0.00	16	-
Cooling/Heating	Roof Top Heat Pump	EER 10.3	0.27	$0.10	16	1.47
Cooling/Heating	Roof Top Heat Pump	EER 11.0	0.43	$0.14	16	1.63
Cooling/Heating	Roof Top Heat Pump	EER 11.7	0.57	$0.37	16	0.84
Cooling/Heating	Roof Top Heat Pump	EER 12.0	0.63	$0.48	16	0.71
Cooling/Heating	Roof Top Heat Pump	Ductless Minisplit	0.95	$0.93	16	0.56
Cooling/Heating	Roof Top Heat Pump	Geothermal	3.10	$1.60	16	1.06
Ventilation	Ventilation	Constant Volume	-	$0.00	10	-
Ventilation	Ventilation	Constant Volume with ECM	0.12	$0.15	10	0.33
Ventilation	Ventilation	Variable Air Volume	0.16	-$0.06	10	1.00
Ventilation	Ventilation	Variable Air Volume with ECM	0.31	$0.09	10	1.40
Water Heating	Water Heating	EF .97	-	$0.00	15	-
Water Heating	Water Heating	EF .98	0.05	$0.08	15	0.38
Water Heating	Water Heating	EF 2.3	2.84	$0.23	15	7.54
Interior Lighting	Screw-in	Incandescent	-	$0.00	2	-
Interior Lighting	Screw-in	90W Halogen PAR-38	1.41	$0.05	3	3.20
Interior Lighting	Screw-in	70W HIR PAR-38	2.17	$0.07	3	3.55
Interior Lighting	Screw-in	CFL	4.06	$0.04	6	26.27
Interior Lighting	Screw-in	LED	4.39	$1.10	12	1.96
Interior Lighting	High-Bay Fixtures	Metal Halides	-	$0.00	3	-
Interior Lighting	High-Bay Fixtures	LED	0.04	$0.03	15	1.07
Interior Lighting	High-Bay Fixtures	T8	0.04	$0.00	10	1.00
Interior Lighting	High-Bay Fixtures	High Pressure Sodium	0.05	$0.00	6	1.00
Interior Lighting	High-Bay Fixtures	T5	0.06	$0.00	10	1.00
Interior Lighting	Linear Fluorescent	T12	-	$0.00	10	-
Interior Lighting	Linear Fluorescent	LED	0.46	$0.25	15	1.12
Interior Lighting	Linear Fluorescent	T8	0.48	$0.00	10	1,956.41
Interior Lighting	Linear Fluorescent	Super T8	0.67	$0.00	10	166.17
Exterior Lighting	Screw-in	Incandescent	-	$0.00	2	-

End Use	Technology	Efficiency Definition	Savings (kWh/ sqft/yr)	Incremental Cost ($/sqft)	Lifetime (yrs)	BC Ratio
Exterior Lighting	Screw-in	90W Halogen PAR-38	0.08	$0.00	3	2.37
Exterior Lighting	Screw-in	70W HIR PAR-38	0.12	$0.00	3	2.63
Exterior Lighting	Screw-in	CFL	0.23	$0.00	6	19.88
Exterior Lighting	Screw-in	LED	0.24	$0.07	12	1.54
Exterior Lighting	HID	Metal Halides	-	$0.00	3	-
Exterior Lighting	HID	LED	0.12	$0.43	15	0.16
Exterior Lighting	HID	T8	0.13	$0.00	10	1.00
Exterior Lighting	HID	High Pressure Sodium	0.20	$0.00	6	1.00
Exterior Lighting	HID	T5	0.21	$0.00	10	1.00
Exterior Lighting	Linear Fluorescent	T12	-	$0.00	10	-
Exterior Lighting	Linear Fluorescent	LED	0.00	$0.00	15	0.13
Exterior Lighting	Linear Fluorescent	T8	0.00	$0.00	10	227.85
Exterior Lighting	Linear Fluorescent	Super T8	0.00	$0.00	10	19.35
Exterior Lighting	Linear Fluorescent	T5	0.00	$0.00	10	13.92
Refrigeration	Walk-in Refrigerator	14600 kWh/yr	-	$0.00	18	-
Refrigeration	Walk-in Refrigerator	10800 kWh/yr	0.07	$0.03	18	1.71
Refrigeration	Walk-in Refrigerator	10000 kWh/yr	0.09	$0.04	18	1.63
Refrigeration	Walk-in Refrigerator	9000 kWh/yr	0.11	$0.07	18	1.11
Refrigeration	Reach-in Refrigerator	3100 kWh/yr	-	$0.00	18	-
Refrigeration	Reach-in Refrigerator	2500 kWh/yr	0.01	$0.01	18	1.01
Refrigeration	Reach-in Refrigerator	2400 kWh/yr	0.01	$0.01	18	1.05
Refrigeration	Reach-in Refrigerator	1500 kWh/yr	0.03	$0.01	18	2.16
Refrigeration	Glass Door Display	15500 kWh/yr	-	$0.00	18	-
Refrigeration	Glass Door Display	14480 kWh/yr	0.02	$0.00	18	3.28
Refrigeration	Glass Door Display	11700 kWh/yr	0.07	$0.04	18	1.24
Refrigeration	Glass Door Display	8400 kWh/yr	0.14	$0.00	18	-
Refrigeration	Glass Door Display	6800 kWh/yr	0.17	$0.04	18	-
Refrigeration	Open Display Case	7000 kWh/yr	-	$0.00	18	-
Refrigeration	Open Display Case	6535 kWh/yr	0.01	$0.00	18	3.30
Refrigeration	Open Display Case	5350 kWh/yr	0.03	$0.00	18	-
Refrigeration	Open Display Case	5300 kWh/yr	0.03	$0.02	18	1.22
Refrigeration	Open Display Case	4350 kWh/yr	0.05	$0.02	18	-
Refrigeration	Icemaker	7.0 kWh/100 lbs	-	$0.00	12	-
Refrigeration	Icemaker	6.3 kWh/100 lbs	0.01	$0.00	12	1.10
Refrigeration	Icemaker	6.0 kWh/100 lbs	0.01	$0.01	12	1.04
Refrigeration	Icemaker	5.5 kWh/100 lbs	0.02	$0.02	12	0.42
Refrigeration	Vending Machine	3400 kWh/year	-	$0.00	10	-
Refrigeration	Vending Machine	2400 kWh/year	0.04	$0.00	10	4.02
Refrigeration	Vending Machine	1700 kWh/year	0.07	$0.01	10	2.28
Food Preparation	Oven	Standard	-	$0.00	12	-
Food Preparation	Oven	Energy Star	0.05	$0.00	12	92,742.15
Food Preparation	Fryer	Standard	-	$0.00	12	-
Food Preparation	Fryer	Energy Star	0.03	$0.01	12	2.24
Food Preparation	Dishwasher	Standard	-	$0.00	12	-
Food Preparation	Dishwasher	Energy Star	0.26	$0.01	12	10.69
Food Preparation	Hot Food Container	Standard	-	$0.00	12	-
Food Preparation	Hot Food Container	Energy Star	0.18	$0.04	12	2.18
Office Equipment	Desktop Computer	Standard	-	$0.00	4	-
Office Equipment	Desktop Computer	Energy Star	0.03	$0.00	4	2,002.69
Office Equipment	Laptop	Standard	-	$0.00	4	-
Office Equipment	Laptop	Energy Star	0.00	$0.00	4	617.37
Office Equipment	Server	Standard	-	$0.00	3	-
Office Equipment	Server	Energy Star	0.02	$0.00	3	7,064.06
Office Equipment	Monitor	Standard	-	$0.00	4	-
Office Equipment	Monitor	Energy Star	0.00	$0.00	4	225.87
Office Equipment	Printer/Copier/Fax	Standard	-	$0.00	6	-
Office Equipment	Printer/Copier/Fax	Energy Star	0.00	$0.00	6	2,107.23

End Use	Technology	Efficiency Definition	Savings (kWh/ sqft/yr)	Incremental Cost ($/sqft)	Lifetime (yrs)	BC Ratio
Office Equipment	POS Terminal	Standard	-	$0.00	4	-
Office Equipment	POS Terminal	Efficient	0.00	$0.00	4	0.27
Miscellaneous	Non-HVAC Motors	Standard (EPAct)	-	$0.00	15	-
Miscellaneous	Non-HVAC Motors	Standard (EPAct 2015)	0.00	$0.00	15	-
Miscellaneous	Non-HVAC Motors	High Efficiency	0.00	$0.00	15	5.35
Miscellaneous	Non-HVAC Motors	High Efficiency (2015)	0.00	$0.00	15	-
Miscellaneous	Non-HVAC Motors	Premium (NEMA)	0.00	$0.00	15	5.35
Miscellaneous	Non-HVAC Motors	Premium (NEMA 2015)	0.00	$0.00	15	-
Miscellaneous	Pool Pump	Standard	-	$0.00	15	-
Miscellaneous	Pool Pump	High Efficiency	0.00	$0.00	15	1.78
Miscellaneous	Pool Pump	Two-Speed	0.01	$0.00	15	1.04
Miscellaneous	Pool Heater	Standard	-	$0.00	15	-
Miscellaneous	Pool Heater	Heat Pump	0.02	$0.01	15	0.91
Miscellaneous	Pool Heater	Solar	0.03	$0.02	15	0.90
Miscellaneous	Miscellaneous	Standard	-	$0.00	5	-

Table C-23 Energy-Efficiency Equipment Data—Large Miscellaneous, New Vintage

End Use	Technology	Efficiency Definition	Savings (kWh/ sqft/yr)	Incremental Cost ($/sqft)	Lifetime (yrs)	BC Ratio
Cooling	Air-Cooled Chiller	1.5 kw/ton, COP 2.3	-	$0.00	20	-
Cooling	Air-Cooled Chiller	1.3 kw/ton, COP 2.7	0.91	$0.44	20	1.32
Cooling	Air-Cooled Chiller	1.26 kw/ton, COP 2.8	1.09	$0.57	20	1.22
Cooling	Air-Cooled Chiller	1.0 kw/ton, COP 3.5	2.27	$0.71	20	2.06
Cooling	Air-Cooled Chiller	0.97 kw/ton, COP 3.6	2.40	$0.84	20	1.84
Cooling	Water-Cooled Chiller	0.75 kw/ton, COP 4.7	-	$0.00	20	-
Cooling	Water-Cooled Chiller	0.60 kw/ton, COP 5.9	1.09	$0.16	20	4.24
Cooling	Water-Cooled Chiller	0.58 kw/ton, COP 6.1	1.23	$0.33	20	2.40
Cooling	Water-Cooled Chiller	0.55 kw/Ton, COP 6.4	1.45	$0.40	20	2.36
Cooling	Water-Cooled Chiller	0.51 kw/ton, COP 6.9	1.74	$0.62	20	1.82
Cooling	Water-Cooled Chiller	0.50 kw/Ton, COP 7.0	1.82	$0.68	20	1.71
Cooling	Water-Cooled Chiller	0.48 kw/ton, COP 7.3	1.96	$0.75	20	1.69
Cooling	Roof Top AC	EER 9.2	-	$0.00	16	-
Cooling	Roof Top AC	EER 10.1	0.47	$0.24	16	1.04
Cooling	Roof Top AC	EER 11.2	0.94	$0.46	16	1.09
Cooling	Roof Top AC	EER 12.0	1.23	$0.89	16	0.74
Cooling	Roof Top AC	Ductless Minisplit	1.78	$2.93	16	0.33
Cooling	Other Cooling	EER 9.8	-	$0.00	14	-
Cooling	Other Cooling	EER 10.0	0.10	$0.17	14	0.29
Cooling	Other Cooling	EER 10.2	0.20	$0.20	14	0.47
Cooling	Other Cooling	EER 10.4	0.29	$0.23	14	0.60
Cooling	Other Cooling	EER 10.6	0.38	$0.26	14	0.69
Cooling	Other Cooling	EER 10.8	0.47	$0.29	14	0.76
Cooling	Other Cooling	EER 12.0	0.92	$1.51	14	0.29
Heating	Electric Heating	Standard	-	$0.00	25	-
Cooling/Heating	Roof Top Heat Pump	EER 9.3	-	$0.00	16	-
Cooling/Heating	Roof Top Heat Pump	EER 10.3	0.73	$0.42	16	0.98
Cooling/Heating	Roof Top Heat Pump	EER 11.0	1.17	$0.60	16	1.08
Cooling/Heating	Roof Top Heat Pump	EER 11.7	1.55	$1.53	16	0.56
Cooling/Heating	Roof Top Heat Pump	EER 12.0	1.70	$2.00	16	0.47
Cooling/Heating	Roof Top Heat Pump	Ductless Minisplit	2.60	$3.83	16	0.38
Cooling/Heating	Roof Top Heat Pump	Geothermal	4.32	$6.62	16	0.36
Ventilation	Ventilation	Constant Volume	-	$0.00	10	-
Ventilation	Ventilation	Constant Volume with ECM	0.10	$0.19	10	0.21
Ventilation	Ventilation	Variable Air Volume	0.29	-$0.08	10	1.00
Ventilation	Ventilation	Variable Air Volume with ECM	0.39	$0.11	10	1.37
Water Heating	Water Heating	EF .97	-	$0.00	15	-
Water Heating	Water Heating	EF .98	0.02	$0.00	15	1.00
Water Heating	Water Heating	EF 2.3	0.93	$0.00	15	1.00
Interior Lighting	Screw-in	Incandescent	-	$0.00	2	-
Interior Lighting	Screw-in	90W Halogen PAR-38	0.22	$0.01	3	2.94
Interior Lighting	Screw-in	70W HIR PAR-38	0.33	$0.01	3	3.26
Interior Lighting	Screw-in	CFL	0.62	$0.01	6	24.18
Interior Lighting	Screw-in	LED	0.67	$0.18	12	1.81
Interior Lighting	High-Bay Fixtures	Metal Halides	-	$0.00	3	-
Interior Lighting	High-Bay Fixtures	LED	0.40	$0.76	15	0.35
Interior Lighting	High-Bay Fixtures	T8	0.40	-$0.02	10	1.00
Interior Lighting	High-Bay Fixtures	High Pressure Sodium	0.43	$0.00	6	1.00
Interior Lighting	High-Bay Fixtures	T5	0.51	-$0.01	10	1.00
Interior Lighting	Linear Fluorescent	T12	-	$0.00	10	-
Interior Lighting	Linear Fluorescent	LED	0.59	$1.05	15	0.33
Interior Lighting	Linear Fluorescent	T8	0.62	$0.00	10	575.49
Interior Lighting	Linear Fluorescent	Super T8	0.86	$0.01	10	48.88
Exterior Lighting	Screw-in	Incandescent	-	$0.00	2	-
Exterior Lighting	Screw-in	90W Halogen PAR-38	0.10	$0.00	3	2.39

End Use	Technology	Efficiency Definition	Savings (kWh/ sqft/yr)	Incremental Cost ($/sqft)	Lifetime (yrs)	BC Ratio
Exterior Lighting	Screw-in	70W HIR PAR-38	0.15	$0.01	3	2.65
Exterior Lighting	Screw-in	CFL	0.28	$0.00	6	20.06
Exterior Lighting	Screw-in	LED	0.30	$0.08	12	1.55
Exterior Lighting	HID	Metal Halides	-	$0.00	3	-
Exterior Lighting	HID	LED	0.15	$0.51	15	0.16
Exterior Lighting	HID	T8	0.16	$0.00	10	1.00
Exterior Lighting	HID	High Pressure Sodium	0.24	$0.00	6	1.00
Exterior Lighting	HID	T5	0.25	$0.00	10	1.00
Exterior Lighting	Linear Fluorescent	T12	-	$0.00	10	-
Exterior Lighting	Linear Fluorescent	LED	0.09	$0.35	15	0.13
Exterior Lighting	Linear Fluorescent	T8	0.09	$0.00	10	227.84
Exterior Lighting	Linear Fluorescent	Super T8	0.13	$0.00	10	19.35
Exterior Lighting	Linear Fluorescent	T5	0.15	$0.00	10	13.92
Refrigeration	Walk-in Refrigerator	14600 kWh/yr	-	$0.00	18	-
Refrigeration	Walk-in Refrigerator	10800 kWh/yr	0.06	$0.02	18	1.70
Refrigeration	Walk-in Refrigerator	10000 kWh/yr	0.07	$0.03	18	1.62
Refrigeration	Walk-in Refrigerator	9000 kWh/yr	0.09	$0.05	18	1.10
Refrigeration	Reach-in Refrigerator	3100 kWh/yr	-	$0.00	18	-
Refrigeration	Reach-in Refrigerator	2500 kWh/yr	0.01	$0.01	18	1.00
Refrigeration	Reach-in Refrigerator	2400 kWh/yr	0.01	$0.01	18	1.04
Refrigeration	Reach-in Refrigerator	1500 kWh/yr	0.02	$0.01	18	2.14
Refrigeration	Glass Door Display	15500 kWh/yr	-	$0.00	18	-
Refrigeration	Glass Door Display	14480 kWh/yr	0.02	$0.00	18	3.25
Refrigeration	Glass Door Display	11700 kWh/yr	0.06	$0.03	18	1.24
Refrigeration	Glass Door Display	8400 kWh/yr	0.11	$0.00	18	-
Refrigeration	Glass Door Display	6800 kWh/yr	0.13	$0.03	18	-
Refrigeration	Open Display Case	7000 kWh/yr	-	$0.00	18	-
Refrigeration	Open Display Case	6535 kWh/yr	0.01	$0.00	18	3.28
Refrigeration	Open Display Case	5350 kWh/yr	0.03	$0.00	18	-
Refrigeration	Open Display Case	5300 kWh/yr	0.03	$0.01	18	1.21
Refrigeration	Open Display Case	4350 kWh/yr	0.04	$0.01	18	-
Refrigeration	Icemaker	7.0 kWh/100 lbs	-	$0.00	12	-
Refrigeration	Icemaker	6.3 kWh/100 lbs	0.01	$0.00	12	1.09
Refrigeration	Icemaker	6.0 kWh/100 lbs	0.01	$0.00	12	1.03
Refrigeration	Icemaker	5.5 kWh/100 lbs	0.01	$0.02	12	0.41
Refrigeration	Vending Machine	3400 kWh/year	-	$0.00	10	-
Refrigeration	Vending Machine	2400 kWh/year	0.03	$0.00	10	3.99
Refrigeration	Vending Machine	1700 kWh/year	0.05	$0.01	10	2.26
Food Preparation	Oven	Standard	-	$0.00	12	-
Food Preparation	Oven	Energy Star	0.03	$0.00	12	75,837.68
Food Preparation	Fryer	Standard	-	$0.00	12	-
Food Preparation	Fryer	Energy Star	0.02	$0.00	12	1.83
Food Preparation	Dishwasher	Standard	-	$0.00	12	-
Food Preparation	Dishwasher	Energy Star	0.14	$0.01	12	8.74
Food Preparation	Hot Food Container	Standard	-	$0.00	12	-
Food Preparation	Hot Food Container	Energy Star	0.09	$0.02	12	1.78
Office Equipment	Desktop Computer	Standard	-	$0.00	4	-
Office Equipment	Desktop Computer	Energy Star	0.06	$0.00	4	1,975.67
Office Equipment	Laptop	Standard	-	$0.00	4	-
Office Equipment	Laptop	Energy Star	0.01	$0.00	4	609.04
Office Equipment	Server	Standard	-	$0.00	3	-
Office Equipment	Server	Energy Star	0.03	$0.00	3	6,966.86
Office Equipment	Monitor	Standard	-	$0.00	4	-
Office Equipment	Monitor	Energy Star	0.01	$0.00	4	222.82
Office Equipment	Printer/Copier/Fax	Standard	-	$0.00	6	-
Office Equipment	Printer/Copier/Fax	Energy Star	0.02	$0.00	6	2,081.01

End Use	Technology	Efficiency Definition	Savings (kWh/ sqft/yr)	Incremental Cost ($/sqft)	Lifetime (yrs)	BC Ratio
Office Equipment	POS Terminal	Standard	-	$0.00	4	-
Office Equipment	POS Terminal	Efficient	0.03	$0.02	4	0.26
Miscellaneous	Non-HVAC Motors	Standard (EPAct)	-	$0.00	15	-
Miscellaneous	Non-HVAC Motors	Standard (EPAct 2015)	0.00	$0.00	15	-
Miscellaneous	Non-HVAC Motors	High Efficiency	0.00	$0.00	15	5.32
Miscellaneous	Non-HVAC Motors	High Efficiency (2015)	0.00	$0.00	15	-
Miscellaneous	Non-HVAC Motors	Premium (NEMA)	0.00	$0.00	15	5.32
Miscellaneous	Non-HVAC Motors	Premium (NEMA 2015)	0.00	$0.00	15	-
Miscellaneous	Pool Pump	Standard	-	$0.00	15	-
Miscellaneous	Pool Pump	High Efficiency	0.00	$0.00	15	1.77
Miscellaneous	Pool Pump	Two-Speed	0.00	$0.00	15	1.04
Miscellaneous	Pool Heater	Standard	-	$0.00	15	-
Miscellaneous	Pool Heater	Heat Pump	0.00	$0.00	15	0.90
Miscellaneous	Pool Heater	Solar	0.00	$0.00	15	0.90
Miscellaneous	Miscellaneous	Standard	-	$0.00	5	-

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

End Use	Technology	Efficiency Definition	Savings (kWh/ sqft/yr)	Incremental Cost ($/sqft)	Lifetime (yrs)	BC Ratio
Cooling	Air-Cooled Chiller	1.5 kw/ton, COP 2.3	-	$0.00	20	-
Cooling	Air-Cooled Chiller	1.3 kw/ton, COP 2.7	0.48	$0.23	20	1.32
Cooling	Air-Cooled Chiller	1.26 kw/ton, COP 2.8	0.57	$0.30	20	1.22
Cooling	Air-Cooled Chiller	1.0 kw/ton, COP 3.5	1.19	$0.37	20	2.06
Cooling	Air-Cooled Chiller	0.97 kw/ton, COP 3.6	1.26	$0.44	20	1.84
Cooling	Water-Cooled Chiller	0.75 kw/ton, COP 4.7	-	$0.00	20	-
Cooling	Water-Cooled Chiller	0.60 kw/ton, COP 5.9	0.78	$0.12	20	4.24
Cooling	Water-Cooled Chiller	0.58 kw/ton, COP 6.1	0.88	$0.24	20	2.40
Cooling	Water-Cooled Chiller	0.55 kw/Ton, COP 6.4	1.04	$0.28	20	2.36
Cooling	Water-Cooled Chiller	0.51 kw/ton, COP 6.9	1.24	$0.44	20	1.82
Cooling	Water-Cooled Chiller	0.50 kw/Ton, COP 7.0	1.30	$0.49	20	1.71
Cooling	Water-Cooled Chiller	0.48 kw/ton, COP 7.3	1.40	$0.53	20	1.69
Cooling	Roof Top AC	EER 9.2	-	$0.00	16	-
Cooling	Roof Top AC	EER 10.1	0.37	$0.19	16	1.04
Cooling	Roof Top AC	EER 11.2	0.74	$0.36	16	1.09
Cooling	Roof Top AC	EER 12.0	0.97	$0.70	16	0.74
Cooling	Roof Top AC	Ductless Minisplit	1.40	$2.30	16	0.33
Cooling	Other Cooling	EER 9.8	-	$0.00	14	-
Cooling	Other Cooling	EER 10.0	0.09	$0.14	14	0.29
Cooling	Other Cooling	EER 10.2	0.17	$0.17	14	0.47
Cooling	Other Cooling	EER 10.4	0.25	$0.19	14	0.60
Cooling	Other Cooling	EER 10.6	0.32	$0.22	14	0.69
Cooling	Other Cooling	EER 10.8	0.39	$0.25	14	0.76
Cooling	Other Cooling	EER 12.0	0.78	$1.27	14	0.29
Heating	Electric Heating	Standard	-	$0.00	25	-
Cooling/Heating	Roof Top Heat Pump	EER 9.3	-	$0.00	16	-
Cooling/Heating	Roof Top Heat Pump	EER 10.3	0.53	$0.30	16	0.98
Cooling/Heating	Roof Top Heat Pump	EER 11.0	0.84	$0.43	16	1.08
Cooling/Heating	Roof Top Heat Pump	EER 11.7	1.12	$1.11	16	0.56
Cooling/Heating	Roof Top Heat Pump	EER 12.0	1.23	$1.44	16	0.47
Cooling/Heating	Roof Top Heat Pump	Ductless Minisplit	1.88	$2.77	16	0.38
Cooling/Heating	Roof Top Heat Pump	Geothermal	3.12	$4.78	16	0.36
Ventilation	Ventilation	Constant Volume	-	$0.00	10	-
Ventilation	Ventilation	Constant Volume with ECM	0.07	$0.13	10	0.20
Ventilation	Ventilation	Variable Air Volume	0.19	-$0.05	10	1.00
Ventilation	Ventilation	Variable Air Volume with ECM	0.25	$0.08	10	1.30
Water Heating	Water Heating	EF .97	-	$0.00	15	-
Water Heating	Water Heating	EF .98	0.01	$0.00	15	1.00
Water Heating	Water Heating	EF 2.3	0.64	$0.00	15	1.00
Interior Lighting	Screw-in	Incandescent	-	$0.00	2	-
Interior Lighting	Screw-in	90W Halogen PAR-38	0.18	$0.01	3	1.64
Interior Lighting	Screw-in	70W HIR PAR-38	0.28	$0.02	3	1.82
Interior Lighting	Screw-in	CFL	0.52	$0.01	6	13.47
Interior Lighting	Screw-in	LED	0.56	$0.27	12	1.01
Interior Lighting	High-Bay Fixtures	Metal Halides	-	$0.00	3	-
Interior Lighting	High-Bay Fixtures	LED	0.33	$0.28	15	0.79
Interior Lighting	High-Bay Fixtures	T8	0.34	-$0.01	10	1.00
Interior Lighting	High-Bay Fixtures	High Pressure Sodium	0.36	$0.00	6	1.00
Interior Lighting	High-Bay Fixtures	T5	0.43	$0.00	10	1.00
Interior Lighting	Linear Fluorescent	T12	-	$0.00	10	-
Interior Lighting	Linear Fluorescent	LED	0.50	$0.76	15	0.38
Interior Lighting	Linear Fluorescent	T8	0.52	$0.00	10	664.73
Interior Lighting	Linear Fluorescent	Super T8	0.72	$0.01	10	56.46
Exterior Lighting	Screw-in	Incandescent	-	$0.00	2	-

End Use	Technology	Efficiency Definition	Savings (kWh/ sqft/yr)	Incremental Cost ($/sqft)	Lifetime (yrs)	BC Ratio
Exterior Lighting	Screw-in	90W Halogen PAR-38	0.08	$0.00	3	2.39
Exterior Lighting	Screw-in	70W HIR PAR-38	0.12	$0.00	3	2.65
Exterior Lighting	Screw-in	CFL	0.23	$0.00	6	20.04
Exterior Lighting	Screw-in	LED	0.25	$0.07	12	1.55
Exterior Lighting	HID	Metal Halides	-	$0.00	3	-
Exterior Lighting	HID	LED	0.13	$0.43	15	0.16
Exterior Lighting	HID	T8	0.13	$0.00	10	1.00
Exterior Lighting	HID	High Pressure Sodium	0.20	$0.00	6	1.00
Exterior Lighting	HID	T5	0.21	$0.00	10	1.00
Exterior Lighting	Linear Fluorescent	T12	-	$0.00	10	-
Exterior Lighting	Linear Fluorescent	LED	0.08	$0.29	15	0.13
Exterior Lighting	Linear Fluorescent	T8	0.08	$0.00	10	227.84
Exterior Lighting	Linear Fluorescent	Super T8	0.11	$0.00	10	19.35
Exterior Lighting	Linear Fluorescent	T5	0.13	$0.00	10	13.92
Refrigeration	Walk-in Refrigerator	14600 kWh/yr	-	$0.00	18	-
Refrigeration	Walk-in Refrigerator	10800 kWh/yr	-	$0.00	18	1.00
Refrigeration	Walk-in Refrigerator	10000 kWh/yr	-	$0.00	18	1.00
Refrigeration	Walk-in Refrigerator	9000 kWh/yr	-	$0.00	18	1.00
Refrigeration	Reach-in Refrigerator	3100 kWh/yr	-	$0.00	18	-
Refrigeration	Reach-in Refrigerator	2500 kWh/yr	0.01	$0.01	18	1.00
Refrigeration	Reach-in Refrigerator	2400 kWh/yr	0.01	$0.01	18	1.04
Refrigeration	Reach-in Refrigerator	1500 kWh/yr	0.03	$0.01	18	2.14
Refrigeration	Glass Door Display	15500 kWh/yr	-	$0.00	18	-
Refrigeration	Glass Door Display	14480 kWh/yr	0.02	$0.00	18	3.25
Refrigeration	Glass Door Display	11700 kWh/yr	0.07	$0.04	18	1.24
Refrigeration	Glass Door Display	8400 kWh/yr	0.13	$0.00	18	-
Refrigeration	Glass Door Display	6800 kWh/yr	0.16	$0.04	18	-
Refrigeration	Open Display Case	7000 kWh/yr	-	$0.00	18	-
Refrigeration	Open Display Case	6535 kWh/yr	0.01	$0.00	18	3.28
Refrigeration	Open Display Case	5350 kWh/yr	0.03	$0.00	18	-
Refrigeration	Open Display Case	5300 kWh/yr	0.03	$0.02	18	1.21
Refrigeration	Open Display Case	4350 kWh/yr	0.05	$0.02	18	-
Refrigeration	Icemaker	7.0 kWh/100 lbs	-	$0.00	12	-
Refrigeration	Icemaker	6.3 kWh/100 lbs	0.01	$0.00	12	1.09
Refrigeration	Icemaker	6.0 kWh/100 lbs	0.01	$0.01	12	1.03
Refrigeration	Icemaker	5.5 kWh/100 lbs	0.02	$0.02	12	0.41
Refrigeration	Vending Machine	3400 kWh/year	-	$0.00	10	-
Refrigeration	Vending Machine	2400 kWh/year	0.02	$0.00	10	3.99
Refrigeration	Vending Machine	1700 kWh/year	0.03	$0.01	10	2.26
Food Preparation	Oven	Standard	-	$0.00	12	-
Food Preparation	Oven	Energy Star	0.03	$0.00	12	75,837.68
Food Preparation	Fryer	Standard	-	$0.00	12	-
Food Preparation	Fryer	Energy Star	-	$0.00	12	1.00
Food Preparation	Dishwasher	Standard	-	$0.00	12	-
Food Preparation	Dishwasher	Energy Star	0.17	$0.01	12	8.74
Food Preparation	Hot Food Container	Standard	-	$0.00	12	-
Food Preparation	Hot Food Container	Energy Star	-	$0.00	12	1.00
Office Equipment	Desktop Computer	Standard	-	$0.00	4	-
Office Equipment	Desktop Computer	Energy Star	0.05	$0.00	4	1,975.67
Office Equipment	Laptop	Standard	-	$0.00	4	-
Office Equipment	Laptop	Energy Star	0.01	$0.00	4	609.04
Office Equipment	Server	Standard	-	$0.00	3	-
Office Equipment	Server	Energy Star	0.05	$0.00	3	6,966.86
Office Equipment	Monitor	Standard	-	$0.00	4	-
Office Equipment	Monitor	Energy Star	0.01	$0.00	4	222.82
Office Equipment	Printer/Copier/Fax	Standard	-	$0.00	6	-
Office Equipment	Printer/Copier/Fax	Energy Star	0.01	$0.00	6	2,081.01

End Use	Technology	Efficiency Definition	Savings (kWh/ sqft/yr)	Incremental Cost ($/sqft)	Lifetime (yrs)	BC Ratio
Office Equipment	POS Terminal	Standard	-	$0.00	4	-
Office Equipment	POS Terminal	Efficient	0.03	$0.02	4	0.26
Miscellaneous	Non-HVAC Motors	Standard (EPAct)	-	$0.00	15	-
Miscellaneous	Non-HVAC Motors	Standard (EPAct 2015)	0.00	$0.00	15	-
Miscellaneous	Non-HVAC Motors	High Efficiency	0.00	$0.00	15	5.32
Miscellaneous	Non-HVAC Motors	High Efficiency (2015)	0.00	$0.00	15	-
Miscellaneous	Non-HVAC Motors	Premium (NEMA)	0.00	$0.00	15	5.32
Miscellaneous	Non-HVAC Motors	Premium (NEMA 2015)	0.00	$0.00	15	-
Miscellaneous	Pool Pump	Standard	-	$0.00	15	-
Miscellaneous	Pool Pump	High Efficiency	0.00	$0.00	15	1.77
Miscellaneous	Pool Pump	Two-Speed	0.00	$0.00	15	1.04
Miscellaneous	Pool Heater	Standard	-	$0.00	15	-
Miscellaneous	Pool Heater	Heat Pump	0.02	$0.01	15	0.90
Miscellaneous	Pool Heater	Solar	0.02	$0.01	15	0.90
Miscellaneous	Miscellaneous	Standard	-	$0.00	5	-

Table C-25 Energy-Efficiency Equipment Data—Large Office, New Vintage

End Use	Technology	Efficiency Definition	Savings (kWh/ sqft/yr)	Incremental Cost ($/sqft)	Lifetime (yrs)	BC Ratio
Cooling	Air-Cooled Chiller	1.5 kw/ton, COP 2.3	-	$0.00	20	-
Cooling	Air-Cooled Chiller	1.3 kw/ton, COP 2.7	0.97	$0.46	20	1.55
Cooling	Air-Cooled Chiller	1.26 kw/ton, COP 2.8	1.16	$0.60	20	1.43
Cooling	Air-Cooled Chiller	1.0 kw/ton, COP 3.5	2.42	$0.74	20	2.42
Cooling	Air-Cooled Chiller	0.97 kw/ton, COP 3.6	2.56	$0.88	20	2.16
Cooling	Water-Cooled Chiller	0.75 kw/ton, COP 4.7	-	$0.00	20	-
Cooling	Water-Cooled Chiller	0.60 kw/ton, COP 5.9	1.32	$0.20	20	4.90
Cooling	Water-Cooled Chiller	0.58 kw/ton, COP 6.1	1.49	$0.40	20	2.78
Cooling	Water-Cooled Chiller	0.55 kw/Ton, COP 6.4	1.76	$0.48	20	2.73
Cooling	Water-Cooled Chiller	0.51 kw/ton, COP 6.9	2.11	$0.74	20	2.10
Cooling	Water-Cooled Chiller	0.50 kw/Ton, COP 7.0	2.20	$0.82	20	1.98
Cooling	Water-Cooled Chiller	0.48 kw/ton, COP 7.3	2.38	$0.90	20	1.95
Cooling	Roof Top AC	EER 9.2	-	$0.00	16	-
Cooling	Roof Top AC	EER 10.1	0.63	$0.35	16	1.13
Cooling	Roof Top AC	EER 11.2	1.26	$0.67	16	1.18
Cooling	Roof Top AC	EER 12.0	1.65	$1.29	16	0.80
Cooling	Roof Top AC	Ductless Minisplit	2.42	$4.23	16	0.36
Cooling	Other Cooling	EER 9.8	-	$0.00	14	-
Cooling	Other Cooling	EER 10.0	0.13	$0.23	14	0.33
Cooling	Other Cooling	EER 10.2	0.26	$0.27	14	0.55
Cooling	Other Cooling	EER 10.4	0.39	$0.31	14	0.70
Cooling	Other Cooling	EER 10.6	0.51	$0.35	14	0.81
Cooling	Other Cooling	EER 10.8	0.62	$0.39	14	0.89
Cooling	Other Cooling	EER 12.0	1.23	$2.01	14	0.34
Heating	Electric Heating	Standard	-	$0.00	25	-
Cooling/Heating	Roof Top Heat Pump	EER 9.3	-	$0.00	16	-
Cooling/Heating	Roof Top Heat Pump	EER 10.3	0.86	$0.55	16	0.84
Cooling/Heating	Roof Top Heat Pump	EER 11.0	1.37	$0.80	16	0.93
Cooling/Heating	Roof Top Heat Pump	EER 11.7	1.82	$2.05	16	0.48
Cooling/Heating	Roof Top Heat Pump	EER 12.0	2.00	$2.67	16	0.41
Cooling/Heating	Roof Top Heat Pump	Ductless Minisplit	3.05	$5.11	16	0.32
Cooling/Heating	Roof Top Heat Pump	Geothermal	4.96	$8.84	16	0.30
Ventilation	Ventilation	Constant Volume	-	$0.00	10	-
Ventilation	Ventilation	Constant Volume with ECM	0.24	$0.39	10	0.25
Ventilation	Ventilation	Variable Air Volume	0.60	-$0.16	10	1.00
Ventilation	Ventilation	Variable Air Volume with ECM	0.84	$0.23	10	1.46
Water Heating	Water Heating	EF .97	-	$0.00	15	-
Water Heating	Water Heating	EF .98	0.01	$0.01	15	0.53
Water Heating	Water Heating	EF 2.3	0.54	$0.03	15	10.52
Interior Lighting	Screw-in	Incandescent	-	$0.00	2	-
Interior Lighting	Screw-in	90W Halogen PAR-38	0.18	$0.02	3	1.20
Interior Lighting	Screw-in	70W HIR PAR-38	0.28	$0.03	3	1.34
Interior Lighting	Screw-in	CFL	0.52	$0.01	6	9.84
Interior Lighting	Screw-in	LED	0.56	$0.39	12	0.73
Interior Lighting	High-Bay Fixtures	Metal Halides	-	$0.00	3	-
Interior Lighting	High-Bay Fixtures	LED	0.07	$0.00	15	34.25
Interior Lighting	High-Bay Fixtures	T8	0.07	$0.00	10	1.00
Interior Lighting	High-Bay Fixtures	High Pressure Sodium	0.08	$0.00	6	1.00
Interior Lighting	High-Bay Fixtures	T5	0.09	$0.00	10	1.00
Interior Lighting	Linear Fluorescent	T12	-	$0.00	10	-
Interior Lighting	Linear Fluorescent	LED	0.91	$2.80	15	0.20
Interior Lighting	Linear Fluorescent	T8	0.95	$0.00	10	348.40
Interior Lighting	Linear Fluorescent	Super T8	1.32	$0.02	10	29.59
Exterior Lighting	Screw-in	Incandescent	-	$0.00	2	-
Exterior Lighting	Screw-in	90W Halogen PAR-38	0.04	$0.00	3	2.20

End Use	Technology	Efficiency Definition	Savings (kWh/ sqft/yr)	Incremental Cost ($/sqft)	Lifetime (yrs)	BC Ratio
Exterior Lighting	Screw-in	70W HIR PAR-38	0.06	$0.00	3	2.44
Exterior Lighting	Screw-in	CFL	0.10	$0.00	6	18.50
Exterior Lighting	Screw-in	LED	0.11	$0.03	12	1.43
Exterior Lighting	HID	Metal Halides	-	$0.00	3	-
Exterior Lighting	HID	LED	0.11	$0.37	15	0.16
Exterior Lighting	HID	T8	0.11	$0.00	10	1.00
Exterior Lighting	HID	High Pressure Sodium	0.18	$0.00	6	1.00
Exterior Lighting	HID	T5	0.18	$0.00	10	1.00
Exterior Lighting	Linear Fluorescent	T12	-	$0.00	10	-
Exterior Lighting	Linear Fluorescent	LED	0.01	$0.02	15	0.13
Exterior Lighting	Linear Fluorescent	T8	0.01	$0.00	10	227.85
Exterior Lighting	Linear Fluorescent	Super T8	0.01	$0.00	10	19.35
Exterior Lighting	Linear Fluorescent	T5	0.01	$0.00	10	13.92
Refrigeration	Walk-in Refrigerator	14600 kWh/yr	-	$0.00	18	-
Refrigeration	Walk-in Refrigerator	10800 kWh/yr	-	$0.00	18	1.00
Refrigeration	Walk-in Refrigerator	10000 kWh/yr	-	$0.00	18	1.00
Refrigeration	Walk-in Refrigerator	9000 kWh/yr	-	$0.00	18	1.00
Refrigeration	Reach-in Refrigerator	3100 kWh/yr	-	$0.00	18	-
Refrigeration	Reach-in Refrigerator	2500 kWh/yr	0.01	$0.00	18	1.02
Refrigeration	Reach-in Refrigerator	2400 kWh/yr	0.01	$0.01	18	1.05
Refrigeration	Reach-in Refrigerator	1500 kWh/yr	0.02	$0.01	18	2.17
Refrigeration	Glass Door Display	15500 kWh/yr	-	$0.00	18	-
Refrigeration	Glass Door Display	14480 kWh/yr	0.01	$0.00	18	3.29
Refrigeration	Glass Door Display	11700 kWh/yr	0.05	$0.03	18	1.25
Refrigeration	Glass Door Display	8400 kWh/yr	0.09	$0.00	18	-
Refrigeration	Glass Door Display	6800 kWh/yr	0.11	$0.03	18	-
Refrigeration	Open Display Case	7000 kWh/yr	-	$0.00	18	-
Refrigeration	Open Display Case	6535 kWh/yr	0.01	$0.00	18	3.31
Refrigeration	Open Display Case	5350 kWh/yr	0.02	$0.00	18	-
Refrigeration	Open Display Case	5300 kWh/yr	0.02	$0.01	18	1.22
Refrigeration	Open Display Case	4350 kWh/yr	0.03	$0.01	18	-
Refrigeration	Icemaker	7.0 kWh/100 lbs	-	$0.00	12	-
Refrigeration	Icemaker	6.3 kWh/100 lbs	0.01	$0.00	12	1.10
Refrigeration	Icemaker	6.0 kWh/100 lbs	0.01	$0.00	12	1.04
Refrigeration	Icemaker	5.5 kWh/100 lbs	0.01	$0.01	12	0.42
Refrigeration	Vending Machine	3400 kWh/year	-	$0.00	10	-
Refrigeration	Vending Machine	2400 kWh/year	0.02	$0.00	10	4.04
Refrigeration	Vending Machine	1700 kWh/year	0.04	$0.01	10	2.29
Food Preparation	Oven	Standard	-	$0.00	12	-
Food Preparation	Oven	Energy Star	0.02	$0.00	12	99,739.96
Food Preparation	Fryer	Standard	-	$0.00	12	-
Food Preparation	Fryer	Energy Star	0.01	$0.00	12	2.41
Food Preparation	Dishwasher	Standard	-	$0.00	12	-
Food Preparation	Dishwasher	Energy Star	0.09	$0.00	12	11.50
Food Preparation	Hot Food Container	Standard	-	$0.00	12	-
Food Preparation	Hot Food Container	Energy Star	0.06	$0.01	12	2.35
Office Equipment	Desktop Computer	Standard	-	$0.00	4	-
Office Equipment	Desktop Computer	Energy Star	0.95	$0.00	4	2,031.02
Office Equipment	Laptop	Standard	-	$0.00	4	-
Office Equipment	Laptop	Energy Star	0.15	$0.00	4	626.10
Office Equipment	Server	Standard	-	$0.00	3	-
Office Equipment	Server	Energy Star	0.07	$0.00	3	7,165.93
Office Equipment	Monitor	Standard	-	$0.00	4	-
Office Equipment	Monitor	Energy Star	0.11	$0.00	4	229.06
Office Equipment	Printer/Copier/Fax	Standard	-	$0.00	6	-
Office Equipment	Printer/Copier/Fax	Energy Star	0.11	$0.00	6	2,134.71

End Use	Technology	Efficiency Definition	Savings (kWh/ sqft/yr)	Incremental Cost ($/sqft)	Lifetime (yrs)	BC Ratio
Office Equipment	POS Terminal	Standard	-	$0.00	4	-
Office Equipment	POS Terminal	Efficient	0.01	$0.00	4	0.27
Miscellaneous	Non-HVAC Motors	Standard (EPAct)	-	$0.00	15	-
Miscellaneous	Non-HVAC Motors	Standard (EPAct 2015)	0.00	$0.00	15	-
Miscellaneous	Non-HVAC Motors	High Efficiency	0.00	$0.00	15	5.61
Miscellaneous	Non-HVAC Motors	High Efficiency (2015)	0.00	$0.00	15	-
Miscellaneous	Non-HVAC Motors	Premium (NEMA)	0.00	$0.00	15	5.61
Miscellaneous	Non-HVAC Motors	Premium (NEMA 2015)	0.00	$0.00	15	-
Miscellaneous	Pool Pump	Standard	-	$0.00	15	-
Miscellaneous	Pool Pump	High Efficiency	-	$0.00	15	1.00
Miscellaneous	Pool Pump	Two-Speed	-	$0.00	15	1.00
Miscellaneous	Pool Heater	Standard	-	$0.00	15	-
Miscellaneous	Pool Heater	Heat Pump	-	$0.00	15	1.00
Miscellaneous	Pool Heater	Solar	-	$0.00	15	1.00
Miscellaneous	Miscellaneous	Standard	-	$0.00	5	-

Table C-26 Energy-Efficiency Equipment Data—Small Office, New Vintage

End Use	Technology	Efficiency Definition	Savings (kWh/ sqft/yr)	Incremental Cost ($/sqft)	Lifetime (yrs)	BC Ratio
Cooling	Air-Cooled Chiller	1.5 kw/ton, COP 2.3	-	$0.00	20	-
Cooling	Air-Cooled Chiller	1.3 kw/ton, COP 2.7	1.02	$0.50	20	1.32
Cooling	Air-Cooled Chiller	1.26 kw/ton, COP 2.8	1.23	$0.65	20	1.22
Cooling	Air-Cooled Chiller	1.0 kw/ton, COP 3.5	2.56	$0.80	20	2.06
Cooling	Air-Cooled Chiller	0.97 kw/ton, COP 3.6	2.71	$0.94	20	1.84
Cooling	Water-Cooled Chiller	0.75 kw/ton, COP 4.7	-	$0.00	20	-
Cooling	Water-Cooled Chiller	0.60 kw/ton, COP 5.9	1.39	$0.21	20	4.24
Cooling	Water-Cooled Chiller	0.58 kw/ton, COP 6.1	1.57	$0.42	20	2.40
Cooling	Water-Cooled Chiller	0.55 kw/Ton, COP 6.4	1.85	$0.50	20	2.36
Cooling	Water-Cooled Chiller	0.51 kw/ton, COP 6.9	2.22	$0.78	20	1.82
Cooling	Water-Cooled Chiller	0.50 kw/Ton, COP 7.0	2.32	$0.87	20	1.71
Cooling	Water-Cooled Chiller	0.48 kw/ton, COP 7.3	2.50	$0.95	20	1.69
Cooling	Roof Top AC	EER 9.2	-	$0.00	16	-
Cooling	Roof Top AC	EER 10.1	0.66	$0.34	16	1.04
Cooling	Roof Top AC	EER 11.2	1.32	$0.65	16	1.09
Cooling	Roof Top AC	EER 12.0	1.72	$1.25	16	0.74
Cooling	Roof Top AC	Ductless Minisplit	2.50	$4.10	16	0.33
Cooling	Other Cooling	EER 9.8	-	$0.00	14	-
Cooling	Other Cooling	EER 10.0	0.15	$0.25	14	0.29
Cooling	Other Cooling	EER 10.2	0.30	$0.30	14	0.47
Cooling	Other Cooling	EER 10.4	0.44	$0.35	14	0.60
Cooling	Other Cooling	EER 10.6	0.57	$0.39	14	0.69
Cooling	Other Cooling	EER 10.8	0.70	$0.44	14	0.76
Cooling	Other Cooling	EER 12.0	1.39	$2.27	14	0.29
Heating	Electric Heating	Standard	-	$0.00	25	-
Cooling/Heating	Roof Top Heat Pump	EER 9.3	-	$0.00	16	-
Cooling/Heating	Roof Top Heat Pump	EER 10.3	0.82	$0.47	16	1.01
Cooling/Heating	Roof Top Heat Pump	EER 11.0	1.31	$0.67	16	1.12
Cooling/Heating	Roof Top Heat Pump	EER 11.7	1.74	$1.72	16	0.58
Cooling/Heating	Roof Top Heat Pump	EER 12.0	1.91	$2.25	16	0.49
Cooling/Heating	Roof Top Heat Pump	Ductless Minisplit	2.92	$4.31	16	0.39
Cooling/Heating	Roof Top Heat Pump	Geothermal	4.85	$7.45	16	0.37
Ventilation	Ventilation	Constant Volume	-	$0.00	10	-
Ventilation	Ventilation	Constant Volume with ECM	0.12	$0.24	10	0.20
Ventilation	Ventilation	Variable Air Volume	0.35	-$0.10	10	1.00
Ventilation	Ventilation	Variable Air Volume with ECM	0.47	$0.14	10	1.30
Water Heating	Water Heating	EF .97	-	$0.00	15	-
Water Heating	Water Heating	EF .98	0.01	$0.00	15	1.00
Water Heating	Water Heating	EF 2.3	0.46	$0.00	15	1.00
Interior Lighting	Screw-in	Incandescent	-	$0.00	2	-
Interior Lighting	Screw-in	90W Halogen PAR-38	0.17	$0.02	3	1.10
Interior Lighting	Screw-in	70W HIR PAR-38	0.26	$0.03	3	1.22
Interior Lighting	Screw-in	CFL	0.48	$0.02	6	8.92
Interior Lighting	Screw-in	LED	0.52	$0.42	12	0.65
Interior Lighting	High-Bay Fixtures	Metal Halides	-	$0.00	3	-
Interior Lighting	High-Bay Fixtures	LED	0.07	$0.18	15	0.26
Interior Lighting	High-Bay Fixtures	T8	0.07	$0.00	10	1.00
Interior Lighting	High-Bay Fixtures	High Pressure Sodium	0.07	$0.00	6	1.00
Interior Lighting	High-Bay Fixtures	T5	0.08	$0.00	10	1.00
Interior Lighting	Linear Fluorescent	T12	-	$0.00	10	-
Interior Lighting	Linear Fluorescent	LED	0.84	$2.14	15	0.25
Interior Lighting	Linear Fluorescent	T8	0.88	$0.00	10	441.49
Interior Lighting	Linear Fluorescent	Super T8	1.22	$0.01	10	37.50
Exterior Lighting	Screw-in	Incandescent	-	$0.00	2	-

End Use	Technology	Efficiency Definition	Savings (kWh/ sqft/yr)	Incremental Cost ($/sqft)	Lifetime (yrs)	BC Ratio
Exterior Lighting	Screw-in	90W Halogen PAR-38	0.05	$0.00	3	2.20
Exterior Lighting	Screw-in	70W HIR PAR-38	0.07	$0.00	3	2.44
Exterior Lighting	Screw-in	CFL	0.13	$0.00	6	18.51
Exterior Lighting	Screw-in	LED	0.15	$0.04	12	1.43
Exterior Lighting	HID	Metal Halides	-	$0.00	3	-
Exterior Lighting	HID	LED	0.19	$0.65	15	0.16
Exterior Lighting	HID	T8	0.20	$0.00	10	1.00
Exterior Lighting	HID	High Pressure Sodium	0.31	$0.00	6	1.00
Exterior Lighting	HID	T5	0.32	$0.00	10	1.00
Exterior Lighting	Linear Fluorescent	T12	-	$0.00	10	-
Exterior Lighting	Linear Fluorescent	LED	0.01	$0.05	15	0.13
Exterior Lighting	Linear Fluorescent	T8	0.01	$0.00	10	227.86
Exterior Lighting	Linear Fluorescent	Super T8	0.02	$0.00	10	19.35
Exterior Lighting	Linear Fluorescent	T5	0.02	$0.00	10	13.92
Refrigeration	Walk-in Refrigerator	14600 kWh/yr	-	$0.00	18	-
Refrigeration	Walk-in Refrigerator	10800 kWh/yr	-	$0.00	18	1.00
Refrigeration	Walk-in Refrigerator	10000 kWh/yr	-	$0.00	18	1.00
Refrigeration	Walk-in Refrigerator	9000 kWh/yr	-	$0.00	18	1.00
Refrigeration	Reach-in Refrigerator	3100 kWh/yr	-	$0.00	18	-
Refrigeration	Reach-in Refrigerator	2500 kWh/yr	0.03	$0.02	18	1.01
Refrigeration	Reach-in Refrigerator	2400 kWh/yr	0.03	$0.02	18	1.05
Refrigeration	Reach-in Refrigerator	1500 kWh/yr	0.08	$0.02	18	2.16
Refrigeration	Glass Door Display	15500 kWh/yr	-	$0.00	18	-
Refrigeration	Glass Door Display	14480 kWh/yr	-	$0.00	18	1.00
Refrigeration	Glass Door Display	11700 kWh/yr	-	$0.00	18	1.00
Refrigeration	Glass Door Display	8400 kWh/yr	-	$0.00	18	-
Refrigeration	Glass Door Display	6800 kWh/yr	-	$0.00	18	-
Refrigeration	Open Display Case	7000 kWh/yr	-	$0.00	18	-
Refrigeration	Open Display Case	6535 kWh/yr	-	$0.00	18	1.00
Refrigeration	Open Display Case	5350 kWh/yr	-	$0.00	18	-
Refrigeration	Open Display Case	5300 kWh/yr	-	$0.00	18	1.00
Refrigeration	Open Display Case	4350 kWh/yr	-	$0.00	18	-
Refrigeration	Icemaker	7.0 kWh/100 lbs	-	$0.00	12	-
Refrigeration	Icemaker	6.3 kWh/100 lbs	0.02	$0.01	12	1.10
Refrigeration	Icemaker	6.0 kWh/100 lbs	0.03	$0.01	12	1.04
Refrigeration	Icemaker	5.5 kWh/100 lbs	0.05	$0.05	12	0.42
Refrigeration	Vending Machine	3400 kWh/year	-	$0.00	10	-
Refrigeration	Vending Machine	2400 kWh/year	0.05	$0.00	10	4.03
Refrigeration	Vending Machine	1700 kWh/year	0.08	$0.01	10	2.28
Food Preparation	Oven	Standard	-	$0.00	12	-
Food Preparation	Oven	Energy Star	0.05	$0.00	12	102,390.45
Food Preparation	Fryer	Standard	-	$0.00	12	-
Food Preparation	Fryer	Energy Star	-	$0.00	12	1.00
Food Preparation	Dishwasher	Standard	-	$0.00	12	-
Food Preparation	Dishwasher	Energy Star	0.23	$0.01	12	11.80
Food Preparation	Hot Food Container	Standard	-	$0.00	12	-
Food Preparation	Hot Food Container	Energy Star	-	$0.00	12	1.00
Office Equipment	Desktop Computer	Standard	-	$0.00	4	-
Office Equipment	Desktop Computer	Energy Star	0.39	$0.00	4	2,065.17
Office Equipment	Laptop	Standard	-	$0.00	4	-
Office Equipment	Laptop	Energy Star	0.06	$0.00	4	636.63
Office Equipment	Server	Standard	-	$0.00	3	-
Office Equipment	Server	Energy Star	0.18	$0.00	3	7,288.76
Office Equipment	Monitor	Standard	-	$0.00	4	-
Office Equipment	Monitor	Energy Star	0.04	$0.00	4	232.91
Office Equipment	Printer/Copier/Fax	Standard	-	$0.00	6	-
Office Equipment	Printer/Copier/Fax	Energy Star	0.13	$0.00	6	2,167.85

End Use	Technology	Efficiency Definition	Savings (kWh/ sqft/yr)	Incremental Cost ($/sqft)	Lifetime (yrs)	BC Ratio
Office Equipment	POS Terminal	Standard	-	$0.00	4	-
Office Equipment	POS Terminal	Efficient	0.05	$0.03	4	0.28
Miscellaneous	Non-HVAC Motors	Standard (EPAct)	-	$0.00	15	-
Miscellaneous	Non-HVAC Motors	Standard (EPAct 2015)	0.00	$0.00	15	-
Miscellaneous	Non-HVAC Motors	High Efficiency	0.00	$0.00	15	5.68
Miscellaneous	Non-HVAC Motors	High Efficiency (2015)	0.00	$0.00	15	-
Miscellaneous	Non-HVAC Motors	Premium (NEMA)	0.00	$0.00	15	5.68
Miscellaneous	Non-HVAC Motors	Premium (NEMA 2015)	0.01	$0.00	15	-
Miscellaneous	Pool Pump	Standard	-	$0.00	15	-
Miscellaneous	Pool Pump	High Efficiency	-	$0.00	15	1.00
Miscellaneous	Pool Pump	Two-Speed	-	$0.00	15	1.00
Miscellaneous	Pool Heater	Standard	-	$0.00	15	-
Miscellaneous	Pool Heater	Heat Pump	-	$0.00	15	1.00
Miscellaneous	Pool Heater	Solar	-	$0.00	15	1.00
Miscellaneous	Miscellaneous	Standard	-	$0.00	5	-

Table C-27 Energy-Efficiency Equipment Data—Restaurant, New Vintage

End Use	Technology	Efficiency Definition	Savings (kWh/ sqft/yr)	Incremental Cost ($/sqft)	Lifetime (yrs)	BC Ratio
Cooling	Air-Cooled Chiller	1.5 kw/ton, COP 2.3	-	$0.00	20	-
Cooling	Air-Cooled Chiller	1.3 kw/ton, COP 2.7	2.36	$0.99	20	1.78
Cooling	Air-Cooled Chiller	1.26 kw/ton, COP 2.8	2.84	$1.28	20	1.65
Cooling	Air-Cooled Chiller	1.0 kw/ton, COP 3.5	5.91	$1.58	20	2.79
Cooling	Air-Cooled Chiller	0.97 kw/ton, COP 3.6	6.27	$1.87	20	2.49
Cooling	Water-Cooled Chiller	0.75 kw/ton, COP 4.7	-	$0.00	20	-
Cooling	Water-Cooled Chiller	0.60 kw/ton, COP 5.9	3.48	$0.45	20	5.81
Cooling	Water-Cooled Chiller	0.58 kw/ton, COP 6.1	3.95	$0.89	20	3.29
Cooling	Water-Cooled Chiller	0.55 kw/Ton, COP 6.4	4.65	$1.07	20	3.23
Cooling	Water-Cooled Chiller	0.51 kw/ton, COP 6.9	5.58	$1.66	20	2.49
Cooling	Water-Cooled Chiller	0.50 kw/Ton, COP 7.0	5.81	$1.84	20	2.35
Cooling	Water-Cooled Chiller	0.48 kw/ton, COP 7.3	6.28	$2.02	20	2.31
Cooling	Roof Top AC	EER 9.2	-	$0.00	16	-
Cooling	Roof Top AC	EER 10.1	1.13	$0.50	16	1.41
Cooling	Roof Top AC	EER 11.2	2.26	$0.96	16	1.47
Cooling	Roof Top AC	EER 12.0	2.96	$1.85	16	1.00
Cooling	Roof Top AC	Ductless Minisplit	4.38	$6.07	16	0.45
Cooling	Other Cooling	EER 9.8	-	$0.00	14	-
Cooling	Other Cooling	EER 10.0	0.29	$0.48	14	0.33
Cooling	Other Cooling	EER 10.2	0.57	$0.57	14	0.55
Cooling	Other Cooling	EER 10.4	0.83	$0.66	14	0.70
Cooling	Other Cooling	EER 10.6	1.09	$0.75	14	0.81
Cooling	Other Cooling	EER 10.8	1.34	$0.84	14	0.89
Cooling	Other Cooling	EER 12.0	2.65	$4.32	14	0.34
Heating	Electric Heating	Standard	-	$0.00	25	-
Cooling/Heating	Roof Top Heat Pump	EER 9.3	-	$0.00	16	-
Cooling/Heating	Roof Top Heat Pump	EER 10.3	1.81	$0.89	16	1.09
Cooling/Heating	Roof Top Heat Pump	EER 11.0	2.88	$1.28	16	1.21
Cooling/Heating	Roof Top Heat Pump	EER 11.7	3.82	$3.28	16	0.62
Cooling/Heating	Roof Top Heat Pump	EER 12.0	4.19	$4.29	16	0.52
Cooling/Heating	Roof Top Heat Pump	Ductless Minisplit	6.40	$8.21	16	0.42
Cooling/Heating	Roof Top Heat Pump	Geothermal	10.09	$14.20	16	0.38
Ventilation	Ventilation	Constant Volume	-	$0.00	10	-
Ventilation	Ventilation	Constant Volume with ECM	0.24	$2.36	10	0.04
Ventilation	Ventilation	Variable Air Volume	0.62	-$0.96	10	1.00
Ventilation	Ventilation	Variable Air Volume with ECM	0.88	$1.40	10	0.25
Water Heating	Water Heating	EF .97	-	$0.00	15	-
Water Heating	Water Heating	EF .98	0.12	$0.10	15	0.68
Water Heating	Water Heating	EF 2.3	6.64	$0.30	15	13.32
Interior Lighting	Screw-in	Incandescent	-	$0.00	2	-
Interior Lighting	Screw-in	90W Halogen PAR-38	1.58	$0.06	3	3.01
Interior Lighting	Screw-in	70W HIR PAR-38	2.43	$0.09	3	3.34
Interior Lighting	Screw-in	CFL	4.56	$0.05	6	24.66
Interior Lighting	Screw-in	LED	4.93	$1.35	12	1.83
Interior Lighting	High-Bay Fixtures	Metal Halides	-	$0.00	3	-
Interior Lighting	High-Bay Fixtures	LED	0.16	$0.08	15	1.39
Interior Lighting	High-Bay Fixtures	T8	0.16	$0.00	10	1.00
Interior Lighting	High-Bay Fixtures	High Pressure Sodium	0.17	$0.00	6	1.00
Interior Lighting	High-Bay Fixtures	T5	0.21	$0.00	10	1.00
Interior Lighting	Linear Fluorescent	T12	-	$0.00	10	-
Interior Lighting	Linear Fluorescent	LED	0.77	$0.96	15	0.49
Interior Lighting	Linear Fluorescent	T8	0.80	$0.00	10	857.42
Interior Lighting	Linear Fluorescent	Super T8	1.12	$0.01	10	72.83
Exterior Lighting	Screw-in	Incandescent	-	$0.00	2	-
Exterior Lighting	Screw-in	90W Halogen PAR-38	0.07	$0.00	3	1.71

End Use	Technology	Efficiency Definition	Savings (kWh/ sqft/yr)	Incremental Cost ($/sqft)	Lifetime (yrs)	BC Ratio
Exterior Lighting	Screw-in	70W HIR PAR-38	0.11	$0.01	3	1.89
Exterior Lighting	Screw-in	CFL	0.21	$0.00	6	14.33
Exterior Lighting	Screw-in	LED	0.22	$0.08	12	1.11
Exterior Lighting	HID	Metal Halides	-	$0.00	3	-
Exterior Lighting	HID	LED	0.53	$1.81	15	0.16
Exterior Lighting	HID	T8	0.55	-$0.01	10	1.00
Exterior Lighting	HID	High Pressure Sodium	0.86	$0.00	6	1.00
Exterior Lighting	HID	T5	0.89	$0.01	10	1.00
Exterior Lighting	Linear Fluorescent	T12	-	$0.00	10	-
Exterior Lighting	Linear Fluorescent	LED	0.00	$0.01	15	0.13
Exterior Lighting	Linear Fluorescent	T8	0.00	$0.00	10	227.86
Exterior Lighting	Linear Fluorescent	Super T8	0.00	$0.00	10	19.35
Exterior Lighting	Linear Fluorescent	T5	0.00	$0.00	10	13.92
Refrigeration	Walk-in Refrigerator	14600 kWh/yr	-	$0.00	18	-
Refrigeration	Walk-in Refrigerator	10800 kWh/yr	0.69	$0.27	18	1.71
Refrigeration	Walk-in Refrigerator	10000 kWh/yr	0.84	$0.35	18	1.63
Refrigeration	Walk-in Refrigerator	9000 kWh/yr	1.02	$0.62	18	1.11
Refrigeration	Reach-in Refrigerator	3100 kWh/yr	-	$0.00	18	-
Refrigeration	Reach-in Refrigerator	2500 kWh/yr	0.11	$0.07	18	1.01
Refrigeration	Reach-in Refrigerator	2400 kWh/yr	0.13	$0.08	18	1.05
Refrigeration	Reach-in Refrigerator	1500 kWh/yr	0.29	$0.09	18	2.16
Refrigeration	Glass Door Display	15500 kWh/yr	-	$0.00	18	-
Refrigeration	Glass Door Display	14480 kWh/yr	0.19	$0.04	18	3.28
Refrigeration	Glass Door Display	11700 kWh/yr	0.69	$0.38	18	1.25
Refrigeration	Glass Door Display	8400 kWh/yr	1.30	$0.04	18	-
Refrigeration	Glass Door Display	6800 kWh/yr	1.59	$0.38	18	-
Refrigeration	Open Display Case	7000 kWh/yr	-	$0.00	18	-
Refrigeration	Open Display Case	6535 kWh/yr	0.08	$0.02	18	3.31
Refrigeration	Open Display Case	5350 kWh/yr	0.30	$0.02	18	-
Refrigeration	Open Display Case	5300 kWh/yr	0.31	$0.17	18	1.22
Refrigeration	Open Display Case	4350 kWh/yr	0.48	$0.17	18	-
Refrigeration	Icemaker	7.0 kWh/100 lbs	-	$0.00	12	-
Refrigeration	Icemaker	6.3 kWh/100 lbs	0.08	$0.04	12	1.10
Refrigeration	Icemaker	6.0 kWh/100 lbs	0.12	$0.05	12	1.04
Refrigeration	Icemaker	5.5 kWh/100 lbs	0.18	$0.20	12	0.42
Refrigeration	Vending Machine	3400 kWh/year	-	$0.00	10	-
Refrigeration	Vending Machine	2400 kWh/year	0.18	$0.02	10	4.03
Refrigeration	Vending Machine	1700 kWh/year	0.31	$0.05	10	2.28
Food Preparation	Oven	Standard	-	$0.00	12	-
Food Preparation	Oven	Energy Star	0.81	$0.00	12	93,128.08
Food Preparation	Fryer	Standard	-	$0.00	12	-
Food Preparation	Fryer	Energy Star	0.51	$0.11	12	2.25
Food Preparation	Dishwasher	Standard	-	$0.00	12	-
Food Preparation	Dishwasher	Energy Star	2.01	$0.09	12	10.74
Food Preparation	Hot Food Container	Standard	-	$0.00	12	-
Food Preparation	Hot Food Container	Energy Star	1.36	$0.31	12	2.19
Office Equipment	Desktop Computer	Standard	-	$0.00	4	-
Office Equipment	Desktop Computer	Energy Star	0.08	$0.00	4	2,016.49
Office Equipment	Laptop	Standard	-	$0.00	4	-
Office Equipment	Laptop	Energy Star	0.01	$0.00	4	621.62
Office Equipment	Server	Standard	-	$0.00	3	-
Office Equipment	Server	Energy Star	0.07	$0.00	3	7,113.66
Office Equipment	Monitor	Standard	-	$0.00	4	-
Office Equipment	Monitor	Energy Star	0.01	$0.00	4	227.42
Office Equipment	Printer/Copier/Fax	Standard	-	$0.00	6	-
Office Equipment	Printer/Copier/Fax	Energy Star	0.02	$0.00	6	2,120.61

End Use	Technology	Efficiency Definition	Savings (kWh/ sqft/yr)	Incremental Cost ($/sqft)	Lifetime (yrs)	BC Ratio
Office Equipment	POS Terminal	Standard	-	$0.00	4	-
Office Equipment	POS Terminal	Efficient	0.04	$0.02	4	0.27
Miscellaneous	Non-HVAC Motors	Standard (EPAct)	-	$0.00	15	-
Miscellaneous	Non-HVAC Motors	Standard (EPAct 2015)	0.01	$0.00	15	-
Miscellaneous	Non-HVAC Motors	High Efficiency	0.01	$0.00	15	5.47
Miscellaneous	Non-HVAC Motors	High Efficiency (2015)	0.02	$0.00	15	-
Miscellaneous	Non-HVAC Motors	Premium (NEMA)	0.02	$0.00	15	5.47
Miscellaneous	Non-HVAC Motors	Premium (NEMA 2015)	0.03	$0.00	15	-
Miscellaneous	Pool Pump	Standard	-	$0.00	15	-
Miscellaneous	Pool Pump	High Efficiency	-	$0.00	15	1.00
Miscellaneous	Pool Pump	Two-Speed	-	$0.00	15	1.00
Miscellaneous	Pool Heater	Standard	-	$0.00	15	-
Miscellaneous	Pool Heater	Heat Pump	-	$0.00	15	1.00
Miscellaneous	Pool Heater	Solar	-	$0.00	15	1.00
Miscellaneous	Miscellaneous	Standard	-	$0.00	5	-

Table C-28 Energy-Efficiency Equipment Data—Large Retail, New Vintage

End Use	Technology	Efficiency Definition	Savings (kWh/ sqft/yr)	Incremental Cost ($/sqft)	Lifetime (yrs)	BC Ratio
Cooling	Air-Cooled Chiller	1.5 kw/ton, COP 2.3	-	$0.00	20	-
Cooling	Air-Cooled Chiller	1.3 kw/ton, COP 2.7	0.88	$0.31	20	1.82
Cooling	Air-Cooled Chiller	1.26 kw/ton, COP 2.8	1.06	$0.40	20	1.68
Cooling	Air-Cooled Chiller	1.0 kw/ton, COP 3.5	2.21	$0.50	20	2.85
Cooling	Air-Cooled Chiller	0.97 kw/ton, COP 3.6	2.34	$0.59	20	2.54
Cooling	Water-Cooled Chiller	0.75 kw/ton, COP 4.7	-	$0.00	20	-
Cooling	Water-Cooled Chiller	0.60 kw/ton, COP 5.9	1.04	$0.12	20	5.73
Cooling	Water-Cooled Chiller	0.58 kw/ton, COP 6.1	1.18	$0.23	20	3.25
Cooling	Water-Cooled Chiller	0.55 kw/Ton, COP 6.4	1.39	$0.28	20	3.19
Cooling	Water-Cooled Chiller	0.51 kw/ton, COP 6.9	1.67	$0.44	20	2.46
Cooling	Water-Cooled Chiller	0.50 kw/Ton, COP 7.0	1.74	$0.48	20	2.31
Cooling	Water-Cooled Chiller	0.48 kw/ton, COP 7.3	1.88	$0.53	20	2.28
Cooling	Roof Top AC	EER 9.2	-	$0.00	16	-
Cooling	Roof Top AC	EER 10.1	0.48	$0.17	16	1.49
Cooling	Roof Top AC	EER 11.2	0.97	$0.33	16	1.55
Cooling	Roof Top AC	EER 12.0	1.27	$0.64	16	1.06
Cooling	Roof Top AC	Ductless Minisplit	1.89	$2.11	16	0.48
Cooling	Other Cooling	EER 9.8	-	$0.00	14	-
Cooling	Other Cooling	EER 10.0	0.10	$0.17	14	0.29
Cooling	Other Cooling	EER 10.2	0.20	$0.21	14	0.47
Cooling	Other Cooling	EER 10.4	0.30	$0.24	14	0.60
Cooling	Other Cooling	EER 10.6	0.39	$0.27	14	0.69
Cooling	Other Cooling	EER 10.8	0.48	$0.30	14	0.76
Cooling	Other Cooling	EER 12.0	0.95	$1.55	14	0.29
Heating	Electric Heating	Standard	-	$0.00	25	-
Cooling/Heating	Roof Top Heat Pump	EER 9.3	-	$0.00	16	-
Cooling/Heating	Roof Top Heat Pump	EER 10.3	0.74	$0.32	16	1.21
Cooling/Heating	Roof Top Heat Pump	EER 11.0	1.18	$0.46	16	1.34
Cooling/Heating	Roof Top Heat Pump	EER 11.7	1.57	$1.19	16	0.69
Cooling/Heating	Roof Top Heat Pump	EER 12.0	1.72	$1.55	16	0.58
Cooling/Heating	Roof Top Heat Pump	Ductless Minisplit	2.63	$2.98	16	0.46
Cooling/Heating	Roof Top Heat Pump	Geothermal	4.11	$5.15	16	0.42
Ventilation	Ventilation	Constant Volume	-	$0.00	10	-
Ventilation	Ventilation	Constant Volume with ECM	0.08	$0.11	10	0.31
Ventilation	Ventilation	Variable Air Volume	0.09	-$0.04	10	1.00
Ventilation	Ventilation	Variable Air Volume with ECM	0.19	$0.06	10	1.25
Water Heating	Water Heating	EF .97	-	$0.00	15	-
Water Heating	Water Heating	EF .98	0.01	$0.01	15	0.74
Water Heating	Water Heating	EF 2.3	0.45	$0.02	15	14.55
Interior Lighting	Screw-in	Incandescent	-	$0.00	2	-
Interior Lighting	Screw-in	90W Halogen PAR-38	0.29	$0.02	3	1.99
Interior Lighting	Screw-in	70W HIR PAR-38	0.45	$0.02	3	2.21
Interior Lighting	Screw-in	CFL	0.84	$0.01	6	16.38
Interior Lighting	Screw-in	LED	0.91	$0.35	12	1.23
Interior Lighting	High-Bay Fixtures	Metal Halides	-	$0.00	3	-
Interior Lighting	High-Bay Fixtures	LED	0.38	$0.53	15	0.48
Interior Lighting	High-Bay Fixtures	T8	0.39	-$0.01	10	1.00
Interior Lighting	High-Bay Fixtures	High Pressure Sodium	0.42	$0.00	6	1.00
Interior Lighting	High-Bay Fixtures	T5	0.50	-$0.01	10	1.00
Interior Lighting	Linear Fluorescent	T12	-	$0.00	10	-
Interior Lighting	Linear Fluorescent	LED	0.83	$2.38	15	0.20
Interior Lighting	Linear Fluorescent	T8	0.87	$0.00	10	352.19
Interior Lighting	Linear Fluorescent	Super T8	1.20	$0.02	10	29.91
Exterior Lighting	Screw-in	Incandescent	-	$0.00	2	-

End Use	Technology	Efficiency Definition	Savings (kWh/ sqft/yr)	Incremental Cost ($/sqft)	Lifetime (yrs)	BC Ratio
Exterior Lighting	Screw-in	90W Halogen PAR-38	0.19	$0.01	3	2.54
Exterior Lighting	Screw-in	70W HIR PAR-38	0.30	$0.01	3	2.82
Exterior Lighting	Screw-in	CFL	0.56	$0.01	6	21.37
Exterior Lighting	Screw-in	LED	0.60	$0.15	12	1.65
Exterior Lighting	HID	Metal Halides	-	$0.00	3	-
Exterior Lighting	HID	LED	0.07	$0.25	15	0.16
Exterior Lighting	HID	T8	0.08	$0.00	10	1.00
Exterior Lighting	HID	High Pressure Sodium	0.12	$0.00	6	1.00
Exterior Lighting	HID	T5	0.13	$0.00	10	1.00
Exterior Lighting	Linear Fluorescent	T12	-	$0.00	10	-
Exterior Lighting	Linear Fluorescent	LED	0.00	$0.01	15	0.13
Exterior Lighting	Linear Fluorescent	T8	0.00	$0.00	10	227.86
Exterior Lighting	Linear Fluorescent	Super T8	0.00	$0.00	10	19.35
Exterior Lighting	Linear Fluorescent	T5	0.00	$0.00	10	13.92
Refrigeration	Walk-in Refrigerator	14600 kWh/yr	-	$0.00	18	-
Refrigeration	Walk-in Refrigerator	10800 kWh/yr	0.07	$0.03	18	1.70
Refrigeration	Walk-in Refrigerator	10000 kWh/yr	0.08	$0.03	18	1.62
Refrigeration	Walk-in Refrigerator	9000 kWh/yr	0.10	$0.06	18	1.10
Refrigeration	Reach-in Refrigerator	3100 kWh/yr	-	$0.00	18	-
Refrigeration	Reach-in Refrigerator	2500 kWh/yr	0.01	$0.01	18	1.01
Refrigeration	Reach-in Refrigerator	2400 kWh/yr	0.01	$0.01	18	1.04
Refrigeration	Reach-in Refrigerator	1500 kWh/yr	0.03	$0.01	18	2.14
Refrigeration	Glass Door Display	15500 kWh/yr	-	$0.00	18	-
Refrigeration	Glass Door Display	14480 kWh/yr	0.02	$0.00	18	3.25
Refrigeration	Glass Door Display	11700 kWh/yr	0.07	$0.04	18	1.24
Refrigeration	Glass Door Display	8400 kWh/yr	0.13	$0.00	18	-
Refrigeration	Glass Door Display	6800 kWh/yr	0.16	$0.04	18	-
Refrigeration	Open Display Case	7000 kWh/yr	-	$0.00	18	-
Refrigeration	Open Display Case	6535 kWh/yr	0.01	$0.00	18	3.28
Refrigeration	Open Display Case	5350 kWh/yr	0.03	$0.00	18	-
Refrigeration	Open Display Case	5300 kWh/yr	0.03	$0.02	18	1.21
Refrigeration	Open Display Case	4350 kWh/yr	0.05	$0.02	18	-
Refrigeration	Icemaker	7.0 kWh/100 lbs	-	$0.00	12	-
Refrigeration	Icemaker	6.3 kWh/100 lbs	0.02	$0.01	12	1.09
Refrigeration	Icemaker	6.0 kWh/100 lbs	0.02	$0.01	12	1.03
Refrigeration	Icemaker	5.5 kWh/100 lbs	0.03	$0.04	12	0.41
Refrigeration	Vending Machine	3400 kWh/year	-	$0.00	10	-
Refrigeration	Vending Machine	2400 kWh/year	0.04	$0.00	10	3.99
Refrigeration	Vending Machine	1700 kWh/year	0.06	$0.01	10	2.26
Food Preparation	Oven	Standard	-	$0.00	12	-
Food Preparation	Oven	Energy Star	0.03	$0.00	12	88,777.57
Food Preparation	Fryer	Standard	-	$0.00	12	-
Food Preparation	Fryer	Energy Star	0.02	$0.00	12	2.14
Food Preparation	Dishwasher	Standard	-	$0.00	12	-
Food Preparation	Dishwasher	Energy Star	0.15	$0.01	12	10.24
Food Preparation	Hot Food Container	Standard	-	$0.00	12	-
Food Preparation	Hot Food Container	Energy Star	0.10	$0.02	12	2.09
Office Equipment	Desktop Computer	Standard	-	$0.00	4	-
Office Equipment	Desktop Computer	Energy Star	0.06	$0.00	4	1,954.19
Office Equipment	Laptop	Standard	-	$0.00	4	-
Office Equipment	Laptop	Energy Star	0.01	$0.00	4	602.42
Office Equipment	Server	Standard	-	$0.00	3	-
Office Equipment	Server	Energy Star	0.06	$0.00	3	6,889.63
Office Equipment	Monitor	Standard	-	$0.00	4	-
Office Equipment	Monitor	Energy Star	0.01	$0.00	4	220.40
Office Equipment	Printer/Copier/Fax	Standard	-	$0.00	6	-
Office Equipment	Printer/Copier/Fax	Energy Star	0.01	$0.00	6	2,060.18

End Use	Technology	Efficiency Definition	Savings (kWh/ sqft/yr)	Incremental Cost ($/sqft)	Lifetime (yrs)	BC Ratio
Office Equipment	POS Terminal	Standard	-	$0.00	4	-
Office Equipment	POS Terminal	Efficient	0.03	$0.02	4	0.26
Miscellaneous	Non-HVAC Motors	Standard (EPAct)	-	$0.00	15	-
Miscellaneous	Non-HVAC Motors	Standard (EPAct 2015)	0.00	$0.00	15	-
Miscellaneous	Non-HVAC Motors	High Efficiency	0.00	$0.00	15	5.27
Miscellaneous	Non-HVAC Motors	High Efficiency (2015)	0.00	$0.00	15	-
Miscellaneous	Non-HVAC Motors	Premium (NEMA)	0.00	$0.00	15	5.27
Miscellaneous	Non-HVAC Motors	Premium (NEMA 2015)	0.00	$0.00	15	-
Miscellaneous	Pool Pump	Standard	-	$0.00	15	-
Miscellaneous	Pool Pump	High Efficiency	-	$0.00	15	1.00
Miscellaneous	Pool Pump	Two-Speed	-	$0.00	15	1.00
Miscellaneous	Pool Heater	Standard	-	$0.00	15	-
Miscellaneous	Pool Heater	Heat Pump	-	$0.00	15	1.00
Miscellaneous	Pool Heater	Solar	-	$0.00	15	1.00
Miscellaneous	Miscellaneous	Standard	-	$0.00	5	-

Table C-29 Energy-Efficiency Equipment Data—Small Retail, New Vintage

End Use	Technology	Efficiency Definition	Savings (kWh/ sqft/yr)	Incremental Cost ($/sqft)	Lifetime (yrs)	BC Ratio
Cooling	Air-Cooled Chiller	1.5 kw/ton, COP 2.3	-	$0.00	20	-
Cooling	Air-Cooled Chiller	1.3 kw/ton, COP 2.7	0.73	$0.26	20	1.82
Cooling	Air-Cooled Chiller	1.26 kw/ton, COP 2.8	0.87	$0.33	20	1.68
Cooling	Air-Cooled Chiller	1.0 kw/ton, COP 3.5	1.82	$0.41	20	2.85
Cooling	Air-Cooled Chiller	0.97 kw/ton, COP 3.6	1.93	$0.49	20	2.54
Cooling	Water-Cooled Chiller	0.75 kw/ton, COP 4.7	-	$0.00	20	-
Cooling	Water-Cooled Chiller	0.60 kw/ton, COP 5.9	0.97	$0.11	20	5.73
Cooling	Water-Cooled Chiller	0.58 kw/ton, COP 6.1	1.10	$0.22	20	3.25
Cooling	Water-Cooled Chiller	0.55 kw/Ton, COP 6.4	1.30	$0.26	20	3.19
Cooling	Water-Cooled Chiller	0.51 kw/ton, COP 6.9	1.56	$0.41	20	2.46
Cooling	Water-Cooled Chiller	0.50 kw/Ton, COP 7.0	1.62	$0.45	20	2.31
Cooling	Water-Cooled Chiller	0.48 kw/ton, COP 7.3	1.75	$0.49	20	2.28
Cooling	Roof Top AC	EER 9.2	-	$0.00	16	-
Cooling	Roof Top AC	EER 10.1	0.52	$0.19	16	1.49
Cooling	Roof Top AC	EER 11.2	1.04	$0.36	16	1.56
Cooling	Roof Top AC	EER 12.0	1.36	$0.69	16	1.06
Cooling	Roof Top AC	Ductless Minisplit	1.96	$2.26	16	0.46
Cooling	Other Cooling	EER 9.8	-	$0.00	14	-
Cooling	Other Cooling	EER 10.0	0.11	$0.19	14	0.29
Cooling	Other Cooling	EER 10.2	0.22	$0.23	14	0.47
Cooling	Other Cooling	EER 10.4	0.33	$0.26	14	0.60
Cooling	Other Cooling	EER 10.6	0.43	$0.30	14	0.69
Cooling	Other Cooling	EER 10.8	0.53	$0.33	14	0.76
Cooling	Other Cooling	EER 12.0	1.05	$1.71	14	0.29
Heating	Electric Heating	Standard	-	$0.00	25	-
Cooling/Heating	Roof Top Heat Pump	EER 9.3	-	$0.00	16	-
Cooling/Heating	Roof Top Heat Pump	EER 10.3	0.77	$0.32	16	1.35
Cooling/Heating	Roof Top Heat Pump	EER 11.0	1.22	$0.45	16	1.50
Cooling/Heating	Roof Top Heat Pump	EER 11.7	1.62	$1.16	16	0.77
Cooling/Heating	Roof Top Heat Pump	EER 12.0	1.78	$1.52	16	0.65
Cooling/Heating	Roof Top Heat Pump	Ductless Minisplit	2.71	$2.90	16	0.52
Cooling/Heating	Roof Top Heat Pump	Geothermal	4.47	$5.02	16	0.49
Ventilation	Ventilation	Constant Volume	-	$0.00	10	-
Ventilation	Ventilation	Constant Volume with ECM	0.09	$0.19	10	0.18
Ventilation	Ventilation	Variable Air Volume	0.16	-$0.08	10	1.00
Ventilation	Ventilation	Variable Air Volume with ECM	0.27	$0.11	10	0.93
Water Heating	Water Heating	EF .97	-	$0.00	15	-
Water Heating	Water Heating	EF .98	0.01	$0.01	15	0.40
Water Heating	Water Heating	EF 2.3	0.45	$0.03	15	7.90
Interior Lighting	Screw-in	Incandescent	-	$0.00	2	-
Interior Lighting	Screw-in	90W Halogen PAR-38	0.30	$0.02	3	1.54
Interior Lighting	Screw-in	70W HIR PAR-38	0.47	$0.03	3	1.71
Interior Lighting	Screw-in	CFL	0.87	$0.02	6	12.61
Interior Lighting	Screw-in	LED	0.95	$0.50	12	0.94
Interior Lighting	High-Bay Fixtures	Metal Halides	-	$0.00	3	-
Interior Lighting	High-Bay Fixtures	LED	0.40	$0.17	15	1.63
Interior Lighting	High-Bay Fixtures	T8	0.41	$0.00	10	1.00
Interior Lighting	High-Bay Fixtures	High Pressure Sodium	0.43	$0.00	6	1.00
Interior Lighting	High-Bay Fixtures	T5	0.52	$0.00	10	1.00
Interior Lighting	Linear Fluorescent	T12	-	$0.00	10	-
Interior Lighting	Linear Fluorescent	LED	0.87	$2.39	15	0.22
Interior Lighting	Linear Fluorescent	T8	0.90	$0.00	10	383.19
Interior Lighting	Linear Fluorescent	Super T8	1.25	$0.02	10	32.55
Exterior Lighting	Screw-in	Incandescent	-	$0.00	2	-
Exterior Lighting	Screw-in	90W Halogen PAR-38	0.15	$0.01	3	2.54

End Use	Technology	Efficiency Definition	Savings (kWh/ sqft/yr)	Incremental Cost ($/sqft)	Lifetime (yrs)	BC Ratio
Exterior Lighting	Screw-in	70W HIR PAR-38	0.24	$0.01	3	2.82
Exterior Lighting	Screw-in	CFL	0.44	$0.00	6	21.36
Exterior Lighting	Screw-in	LED	0.48	$0.12	12	1.65
Exterior Lighting	HID	Metal Halides	-	$0.00	3	-
Exterior Lighting	HID	LED	0.06	$0.20	15	0.16
Exterior Lighting	HID	T8	0.06	$0.00	10	1.00
Exterior Lighting	HID	High Pressure Sodium	0.10	$0.00	6	1.00
Exterior Lighting	HID	T5	0.10	$0.00	10	1.00
Exterior Lighting	Linear Fluorescent	T12	-	$0.00	10	-
Exterior Lighting	Linear Fluorescent	LED	0.00	$0.00	15	0.13
Exterior Lighting	Linear Fluorescent	T8	0.00	$0.00	10	227.77
Exterior Lighting	Linear Fluorescent	Super T8	0.00	$0.00	10	19.35
Exterior Lighting	Linear Fluorescent	T5	0.00	$0.00	10	13.91
Refrigeration	Walk-in Refrigerator	14600 kWh/yr	-	$0.00	18	-
Refrigeration	Walk-in Refrigerator	10800 kWh/yr	-	$0.00	18	1.00
Refrigeration	Walk-in Refrigerator	10000 kWh/yr	-	$0.00	18	1.00
Refrigeration	Walk-in Refrigerator	9000 kWh/yr	-	$0.00	18	1.00
Refrigeration	Reach-in Refrigerator	3100 kWh/yr	-	$0.00	18	-
Refrigeration	Reach-in Refrigerator	2500 kWh/yr	0.02	$0.01	18	1.01
Refrigeration	Reach-in Refrigerator	2400 kWh/yr	0.02	$0.01	18	1.05
Refrigeration	Reach-in Refrigerator	1500 kWh/yr	0.05	$0.01	18	2.15
Refrigeration	Glass Door Display	15500 kWh/yr	-	$0.00	18	-
Refrigeration	Glass Door Display	14480 kWh/yr	0.03	$0.01	18	3.27
Refrigeration	Glass Door Display	11700 kWh/yr	0.11	$0.06	18	1.24
Refrigeration	Glass Door Display	8400 kWh/yr	0.20	$0.01	18	-
Refrigeration	Glass Door Display	6800 kWh/yr	0.25	$0.06	18	-
Refrigeration	Open Display Case	7000 kWh/yr	-	$0.00	18	-
Refrigeration	Open Display Case	6535 kWh/yr	0.01	$0.00	18	3.29
Refrigeration	Open Display Case	5350 kWh/yr	0.05	$0.00	18	-
Refrigeration	Open Display Case	5300 kWh/yr	0.05	$0.03	18	1.22
Refrigeration	Open Display Case	4350 kWh/yr	0.07	$0.03	18	-
Refrigeration	Icemaker	7.0 kWh/100 lbs	-	$0.00	12	-
Refrigeration	Icemaker	6.3 kWh/100 lbs	0.01	$0.01	12	1.10
Refrigeration	Icemaker	6.0 kWh/100 lbs	0.02	$0.01	12	1.03
Refrigeration	Icemaker	5.5 kWh/100 lbs	0.03	$0.03	12	0.42
Refrigeration	Vending Machine	3400 kWh/year	-	$0.00	10	-
Refrigeration	Vending Machine	2400 kWh/year	0.03	$0.00	10	4.01
Refrigeration	Vending Machine	1700 kWh/year	0.05	$0.01	10	2.27
Food Preparation	Oven	Standard	-	$0.00	12	-
Food Preparation	Oven	Energy Star	0.03	$0.00	12	94,681.38
Food Preparation	Fryer	Standard	-	$0.00	12	-
Food Preparation	Fryer	Energy Star	-	$0.00	12	1.00
Food Preparation	Dishwasher	Standard	-	$0.00	12	-
Food Preparation	Dishwasher	Energy Star	0.16	$0.01	12	10.92
Food Preparation	Hot Food Container	Standard	-	$0.00	12	-
Food Preparation	Hot Food Container	Energy Star	0.11	$0.02	12	2.23
Office Equipment	Desktop Computer	Standard	-	$0.00	4	-
Office Equipment	Desktop Computer	Energy Star	0.05	$0.00	4	1,995.47
Office Equipment	Laptop	Standard	-	$0.00	4	-
Office Equipment	Laptop	Energy Star	0.01	$0.00	4	615.15
Office Equipment	Server	Standard	-	$0.00	3	-
Office Equipment	Server	Energy Star	0.05	$0.00	3	7,038.10
Office Equipment	Monitor	Standard	-	$0.00	4	-
Office Equipment	Monitor	Energy Star	0.01	$0.00	4	225.05
Office Equipment	Printer/Copier/Fax	Standard	-	$0.00	6	-
Office Equipment	Printer/Copier/Fax	Energy Star	0.01	$0.00	6	2,100.23

End Use	Technology	Efficiency Definition	Savings (kWh/ sqft/yr)	Incremental Cost ($/sqft)	Lifetime (yrs)	BC Ratio
Office Equipment	POS Terminal	Standard	-	$0.00	4	-
Office Equipment	POS Terminal	Efficient	0.03	$0.02	4	0.27
Miscellaneous	Non-HVAC Motors	Standard (EPAct)	-	$0.00	15	-
Miscellaneous	Non-HVAC Motors	Standard (EPAct 2015)	0.00	$0.00	15	-
Miscellaneous	Non-HVAC Motors	High Efficiency	0.00	$0.00	15	5.43
Miscellaneous	Non-HVAC Motors	High Efficiency (2015)	0.00	$0.00	15	-
Miscellaneous	Non-HVAC Motors	Premium (NEMA)	0.01	$0.00	15	5.43
Miscellaneous	Non-HVAC Motors	Premium (NEMA 2015)	0.01	$0.00	15	-
Miscellaneous	Pool Pump	Standard	-	$0.00	15	-
Miscellaneous	Pool Pump	High Efficiency	-	$0.00	15	1.00
Miscellaneous	Pool Pump	Two-Speed	-	$0.00	15	1.00
Miscellaneous	Pool Heater	Standard	-	$0.00	15	-
Miscellaneous	Pool Heater	Heat Pump	-	$0.00	15	1.00
Miscellaneous	Pool Heater	Solar	-	$0.00	15	1.00
Miscellaneous	Miscellaneous	Standard	-	$0.00	5	-

Table C-30 Energy-Efficiency Equipment Data—Warehouse, New Vintage

End Use	Technology	Efficiency Definition	Savings (kWh/ sqft/yr)	Incremental Cost ($/sqft)	Lifetime (yrs)	BC Ratio
Cooling	Air-Cooled Chiller	1.5 kw/ton, COP 2.3	-	$0.00	20	-
Cooling	Air-Cooled Chiller	1.3 kw/ton, COP 2.7	0.60	$0.25	20	1.53
Cooling	Air-Cooled Chiller	1.26 kw/ton, COP 2.8	0.72	$0.33	20	1.41
Cooling	Air-Cooled Chiller	1.0 kw/ton, COP 3.5	1.51	$0.40	20	2.39
Cooling	Air-Cooled Chiller	0.97 kw/ton, COP 3.6	1.60	$0.48	20	2.14
Cooling	Water-Cooled Chiller	0.75 kw/ton, COP 4.7	-	$0.00	20	-
Cooling	Water-Cooled Chiller	0.60 kw/ton, COP 5.9	0.73	$0.10	20	4.83
Cooling	Water-Cooled Chiller	0.58 kw/ton, COP 6.1	0.83	$0.20	20	2.74
Cooling	Water-Cooled Chiller	0.55 kw/Ton, COP 6.4	0.98	$0.23	20	2.69
Cooling	Water-Cooled Chiller	0.51 kw/ton, COP 6.9	1.18	$0.36	20	2.07
Cooling	Water-Cooled Chiller	0.50 kw/Ton, COP 7.0	1.23	$0.40	20	1.95
Cooling	Water-Cooled Chiller	0.48 kw/ton, COP 7.3	1.33	$0.44	20	1.92
Cooling	Roof Top AC	EER 9.2	-	$0.00	16	-
Cooling	Roof Top AC	EER 10.1	0.32	$0.14	16	1.21
Cooling	Roof Top AC	EER 11.2	0.64	$0.27	16	1.26
Cooling	Roof Top AC	EER 12.0	0.84	$0.52	16	0.86
Cooling	Roof Top AC	Ductless Minisplit	1.20	$1.72	16	0.37
Cooling	Other Cooling	EER 9.8	-	$0.00	14	-
Cooling	Other Cooling	EER 10.0	0.07	$0.12	14	0.29
Cooling	Other Cooling	EER 10.2	0.14	$0.14	14	0.47
Cooling	Other Cooling	EER 10.4	0.21	$0.17	14	0.60
Cooling	Other Cooling	EER 10.6	0.27	$0.19	14	0.69
Cooling	Other Cooling	EER 10.8	0.33	$0.21	14	0.76
Cooling	Other Cooling	EER 12.0	0.66	$1.08	14	0.29
Heating	Electric Heating	Standard	-	$0.00	25	-
Cooling/Heating	Roof Top Heat Pump	EER 9.3	-	$0.00	16	-
Cooling/Heating	Roof Top Heat Pump	EER 10.3	0.58	$0.28	16	1.14
Cooling/Heating	Roof Top Heat Pump	EER 11.0	0.92	$0.40	16	1.26
Cooling/Heating	Roof Top Heat Pump	EER 11.7	1.22	$1.04	16	0.65
Cooling/Heating	Roof Top Heat Pump	EER 12.0	1.34	$1.35	16	0.55
Cooling/Heating	Roof Top Heat Pump	Ductless Minisplit	2.04	$2.59	16	0.44
Cooling/Heating	Roof Top Heat Pump	Geothermal	3.46	$4.48	16	0.43
Ventilation	Ventilation	Constant Volume	-	$0.00	10	-
Ventilation	Ventilation	Constant Volume with ECM	0.02	$0.47	10	0.01
Ventilation	Ventilation	Variable Air Volume	0.03	-$0.19	10	1.00
Ventilation	Ventilation	Variable Air Volume with ECM	0.05	$0.28	10	0.07
Water Heating	Water Heating	EF .97	-	$0.00	15	-
Water Heating	Water Heating	EF .98	0.00	$0.00	15	0.78
Water Heating	Water Heating	EF 2.3	0.13	$0.01	15	15.50
Interior Lighting	Screw-in	Incandescent	-	$0.00	2	-
Interior Lighting	Screw-in	90W Halogen PAR-38	0.04	$0.00	3	1.86
Interior Lighting	Screw-in	70W HIR PAR-38	0.06	$0.00	3	2.06
Interior Lighting	Screw-in	CFL	0.10	$0.00	6	15.15
Interior Lighting	Screw-in	LED	0.11	$0.05	12	1.12
Interior Lighting	High-Bay Fixtures	Metal Halides	-	$0.00	3	-
Interior Lighting	High-Bay Fixtures	LED	0.46	$1.17	15	0.29
Interior Lighting	High-Bay Fixtures	T8	0.47	-$0.03	10	1.00
Interior Lighting	High-Bay Fixtures	High Pressure Sodium	0.50	$0.01	6	1.00
Interior Lighting	High-Bay Fixtures	T5	0.60	-$0.02	10	1.00
Interior Lighting	Linear Fluorescent	T12	-	$0.00	10	-
Interior Lighting	Linear Fluorescent	LED	0.29	$0.34	15	0.54
Interior Lighting	Linear Fluorescent	T8	0.31	$0.00	10	959.06
Interior Lighting	Linear Fluorescent	Super T8	0.43	$0.00	10	81.46
Exterior Lighting	Screw-in	Incandescent	-	$0.00	2	-

End Use	Technology	Efficiency Definition	Savings (kWh/ sqft/yr)	Incremental Cost ($/sqft)	Lifetime (yrs)	BC Ratio
Exterior Lighting	Screw-in	90W Halogen PAR-38	0.00	$0.00	3	2.25
Exterior Lighting	Screw-in	70W HIR PAR-38	0.00	$0.00	3	2.50
Exterior Lighting	Screw-in	CFL	0.00	$0.00	6	18.93
Exterior Lighting	Screw-in	LED	0.00	$0.00	12	1.46
Exterior Lighting	HID	Metal Halides	-	$0.00	3	-
Exterior Lighting	HID	LED	0.11	$0.38	15	0.16
Exterior Lighting	HID	T8	0.12	$0.00	10	1.00
Exterior Lighting	HID	High Pressure Sodium	0.18	$0.00	6	1.00
Exterior Lighting	HID	T5	0.19	$0.00	10	1.00
Exterior Lighting	Linear Fluorescent	T12	-	$0.00	10	-
Exterior Lighting	Linear Fluorescent	LED	0.00	$0.00	15	0.13
Exterior Lighting	Linear Fluorescent	T8	0.00	$0.00	10	227.86
Exterior Lighting	Linear Fluorescent	Super T8	0.00	$0.00	10	19.35
Exterior Lighting	Linear Fluorescent	T5	0.00	$0.00	10	13.92
Refrigeration	Walk-in Refrigerator	14600 kWh/yr	-	$0.00	18	-
Refrigeration	Walk-in Refrigerator	10800 kWh/yr	-	$0.00	18	1.00
Refrigeration	Walk-in Refrigerator	10000 kWh/yr	-	$0.00	18	1.00
Refrigeration	Walk-in Refrigerator	9000 kWh/yr	-	$0.00	18	1.00
Refrigeration	Reach-in Refrigerator	3100 kWh/yr	-	$0.00	18	-
Refrigeration	Reach-in Refrigerator	2500 kWh/yr	-	$0.00	18	1.00
Refrigeration	Reach-in Refrigerator	2400 kWh/yr	-	$0.00	18	1.00
Refrigeration	Reach-in Refrigerator	1500 kWh/yr	-	$0.00	18	1.00
Refrigeration	Glass Door Display	15500 kWh/yr	-	$0.00	18	-
Refrigeration	Glass Door Display	14480 kWh/yr	-	$0.00	18	1.00
Refrigeration	Glass Door Display	11700 kWh/yr	-	$0.00	18	1.00
Refrigeration	Glass Door Display	8400 kWh/yr	-	$0.00	18	-
Refrigeration	Glass Door Display	6800 kWh/yr	-	$0.00	18	-
Refrigeration	Open Display Case	7000 kWh/yr	-	$0.00	18	-
Refrigeration	Open Display Case	6535 kWh/yr	-	$0.00	18	1.00
Refrigeration	Open Display Case	5350 kWh/yr	-	$0.00	18	-
Refrigeration	Open Display Case	5300 kWh/yr	-	$0.00	18	1.00
Refrigeration	Open Display Case	4350 kWh/yr	-	$0.00	18	-
Refrigeration	Icemaker	7.0 kWh/100 lbs	-	$0.00	12	-
Refrigeration	Icemaker	6.3 kWh/100 lbs	0.06	$0.02	12	1.10
Refrigeration	Icemaker	6.0 kWh/100 lbs	0.08	$0.04	12	1.04
Refrigeration	Icemaker	5.5 kWh/100 lbs	0.12	$0.13	12	0.42
Refrigeration	Vending Machine	3400 kWh/year	-	$0.00	10	-
Refrigeration	Vending Machine	2400 kWh/year	0.12	$0.01	10	4.03
Refrigeration	Vending Machine	1700 kWh/year	0.20	$0.04	10	2.28
Food Preparation	Oven	Standard	-	$0.00	12	-
Food Preparation	Oven	Energy Star	0.03	$0.00	12	98,116.49
Food Preparation	Fryer	Standard	-	$0.00	12	-
Food Preparation	Fryer	Energy Star	-	$0.00	12	1.00
Food Preparation	Dishwasher	Standard	-	$0.00	12	-
Food Preparation	Dishwasher	Energy Star	-	$0.00	12	1.00
Food Preparation	Hot Food Container	Standard	-	$0.00	12	-
Food Preparation	Hot Food Container	Energy Star	-	$0.00	12	1.00
Office Equipment	Desktop Computer	Standard	-	$0.00	4	-
Office Equipment	Desktop Computer	Energy Star	0.03	$0.00	4	2,047.03
Office Equipment	Laptop	Standard	-	$0.00	4	-
Office Equipment	Laptop	Energy Star	0.00	$0.00	4	631.04
Office Equipment	Server	Standard	-	$0.00	3	-
Office Equipment	Server	Energy Star	0.03	$0.00	3	7,223.52
Office Equipment	Monitor	Standard	-	$0.00	4	-
Office Equipment	Monitor	Energy Star	0.00	$0.00	4	230.87
Office Equipment	Printer/Copier/Fax	Standard	-	$0.00	6	-
Office Equipment	Printer/Copier/Fax	Energy Star	0.00	$0.00	6	2,150.25

End Use	Technology	Efficiency Definition	Savings (kWh/ sqft/yr)	Incremental Cost ($/sqft)	Lifetime (yrs)	BC Ratio
Office Equipment	POS Terminal	Standard	-	$0.00	4	-
Office Equipment	POS Terminal	Efficient	0.01	$0.01	4	0.27
Miscellaneous	Non-HVAC Motors	Standard (EPAct)	-	$0.00	15	-
Miscellaneous	Non-HVAC Motors	Standard (EPAct 2015)	0.00	$0.00	15	-
Miscellaneous	Non-HVAC Motors	High Efficiency	0.00	$0.00	15	5.60
Miscellaneous	Non-HVAC Motors	High Efficiency (2015)	0.00	$0.00	15	-
Miscellaneous	Non-HVAC Motors	Premium (NEMA)	0.00	$0.00	15	5.60
Miscellaneous	Non-HVAC Motors	Premium (NEMA 2015)	0.00	$0.00	15	-
Miscellaneous	Pool Pump	Standard	-	$0.00	15	-
Miscellaneous	Pool Pump	High Efficiency	-	$0.00	15	1.00
Miscellaneous	Pool Pump	Two-Speed	-	$0.00	15	1.00
Miscellaneous	Pool Heater	Standard	-	$0.00	15	-
Miscellaneous	Pool Heater	Heat Pump	-	$0.00	15	1.00
Miscellaneous	Pool Heater	Solar	-	$0.00	15	1.00
Miscellaneous	Miscellaneous	Standard	-	$0.00	5	-

Table C-31 Energy-Efficiency Equipment Data—Refrigerated Warehouse, New Vintage

End Use	Technology	Efficiency Definition	Savings (kWh/ sqft/yr)	Incremental Cost ($/sqft)	Lifetime (yrs)	BC Ratio
Cooling	Air-Cooled Chiller	1.5 kw/ton, COP 2.3	-	$0.00	20	-
Cooling	Air-Cooled Chiller	1.3 kw/ton, COP 2.7	0.59	$0.25	20	1.53
Cooling	Air-Cooled Chiller	1.26 kw/ton, COP 2.8	0.71	$0.32	20	1.41
Cooling	Air-Cooled Chiller	1.0 kw/ton, COP 3.5	1.47	$0.39	20	2.39
Cooling	Air-Cooled Chiller	0.97 kw/ton, COP 3.6	1.56	$0.47	20	2.14
Cooling	Water-Cooled Chiller	0.75 kw/ton, COP 4.7	-	$0.00	20	-
Cooling	Water-Cooled Chiller	0.60 kw/ton, COP 5.9	0.72	$0.10	20	4.83
Cooling	Water-Cooled Chiller	0.58 kw/ton, COP 6.1	0.81	$0.19	20	2.74
Cooling	Water-Cooled Chiller	0.55 kw/Ton, COP 6.4	0.96	$0.23	20	2.69
Cooling	Water-Cooled Chiller	0.51 kw/ton, COP 6.9	1.15	$0.36	20	2.07
Cooling	Water-Cooled Chiller	0.50 kw/Ton, COP 7.0	1.20	$0.39	20	1.95
Cooling	Water-Cooled Chiller	0.48 kw/ton, COP 7.3	1.29	$0.43	20	1.92
Cooling	Roof Top AC	EER 9.2	-	$0.00	16	-
Cooling	Roof Top AC	EER 10.1	0.31	$0.14	16	1.21
Cooling	Roof Top AC	EER 11.2	0.63	$0.27	16	1.26
Cooling	Roof Top AC	EER 12.0	0.82	$0.51	16	0.86
Cooling	Roof Top AC	Ductless Minisplit	1.17	$1.68	16	0.37
Cooling	Other Cooling	EER 9.8	-	$0.00	14	-
Cooling	Other Cooling	EER 10.0	0.07	$0.12	14	0.29
Cooling	Other Cooling	EER 10.2	0.14	$0.14	14	0.47
Cooling	Other Cooling	EER 10.4	0.20	$0.16	14	0.60
Cooling	Other Cooling	EER 10.6	0.27	$0.18	14	0.69
Cooling	Other Cooling	EER 10.8	0.33	$0.20	14	0.76
Cooling	Other Cooling	EER 12.0	0.65	$1.06	14	0.29
Heating	Electric Heating	Standard	-	$0.00	25	-
Cooling/Heating	Roof Top Heat Pump	EER 9.3	-	$0.00	16	-
Cooling/Heating	Roof Top Heat Pump	EER 10.3	0.56	$0.27	16	1.13
Cooling/Heating	Roof Top Heat Pump	EER 11.0	0.89	$0.39	16	1.26
Cooling/Heating	Roof Top Heat Pump	EER 11.7	1.18	$1.00	16	0.65
Cooling/Heating	Roof Top Heat Pump	EER 12.0	1.29	$1.30	16	0.55
Cooling/Heating	Roof Top Heat Pump	Ductless Minisplit	1.97	$2.50	16	0.44
Cooling/Heating	Roof Top Heat Pump	Geothermal	3.33	$4.32	16	0.43
Ventilation	Ventilation	Constant Volume	-	$0.00	10	-
Ventilation	Ventilation	Constant Volume with ECM	0.06	$1.71	10	0.01
Ventilation	Ventilation	Variable Air Volume	0.11	-$0.70	10	1.00
Ventilation	Ventilation	Variable Air Volume with ECM	0.18	$1.01	10	0.07
Water Heating	Water Heating	EF .97	-	$0.00	15	-
Water Heating	Water Heating	EF .98	0.00	$0.00	15	0.79
Water Heating	Water Heating	EF 2.3	0.27	$0.01	15	15.56
Interior Lighting	Screw-in	Incandescent	-	$0.00	2	-
Interior Lighting	Screw-in	90W Halogen PAR-38	0.03	$0.00	3	1.77
Interior Lighting	Screw-in	70W HIR PAR-38	0.04	$0.00	3	1.97
Interior Lighting	Screw-in	CFL	0.08	$0.00	6	14.46
Interior Lighting	Screw-in	LED	0.09	$0.04	12	1.07
Interior Lighting	High-Bay Fixtures	Metal Halides	-	$0.00	3	-
Interior Lighting	High-Bay Fixtures	LED	0.35	$0.84	15	0.30
Interior Lighting	High-Bay Fixtures	T8	0.36	-$0.02	10	1.00
Interior Lighting	High-Bay Fixtures	High Pressure Sodium	0.38	$0.00	6	1.00
Interior Lighting	High-Bay Fixtures	T5	0.46	-$0.01	10	1.00
Interior Lighting	Linear Fluorescent	T12	-	$0.00	10	-
Interior Lighting	Linear Fluorescent	LED	0.22	$0.31	15	0.46
Interior Lighting	Linear Fluorescent	T8	0.23	$0.00	10	811.53
Interior Lighting	Linear Fluorescent	Super T8	0.32	$0.00	10	68.93
Exterior Lighting	Screw-in	Incandescent	-	$0.00	2	-

End Use	Technology	Efficiency Definition	Savings (kWh/ sqft/yr)	Incremental Cost ($/sqft)	Lifetime (yrs)	BC Ratio
Exterior Lighting	Screw-in	90W Halogen PAR-38	0.00	$0.00	3	2.25
Exterior Lighting	Screw-in	70W HIR PAR-38	0.00	$0.00	3	2.50
Exterior Lighting	Screw-in	CFL	0.00	$0.00	6	18.93
Exterior Lighting	Screw-in	LED	0.00	$0.00	12	1.46
Exterior Lighting	HID	Metal Halides	-	$0.00	3	-
Exterior Lighting	HID	LED	0.13	$0.43	15	0.16
Exterior Lighting	HID	T8	0.13	$0.00	10	1.00
Exterior Lighting	HID	High Pressure Sodium	0.20	$0.00	6	1.00
Exterior Lighting	HID	T5	0.21	$0.00	10	1.00
Exterior Lighting	Linear Fluorescent	T12	-	$0.00	10	-
Exterior Lighting	Linear Fluorescent	LED	0.00	$0.00	15	0.13
Exterior Lighting	Linear Fluorescent	T8	0.00	$0.00	10	227.82
Exterior Lighting	Linear Fluorescent	Super T8	0.00	$0.00	10	19.35
Exterior Lighting	Linear Fluorescent	T5	0.00	$0.00	10	13.91
Refrigeration	Walk-in Refrigerator	14600 kWh/yr	-	$0.00	18	-
Refrigeration	Walk-in Refrigerator	10800 kWh/yr	3.50	$1.38	18	1.71
Refrigeration	Walk-in Refrigerator	10000 kWh/yr	4.24	$1.75	18	1.64
Refrigeration	Walk-in Refrigerator	9000 kWh/yr	5.16	$3.13	18	1.11
Refrigeration	Reach-in Refrigerator	3100 kWh/yr	-	$0.00	18	-
Refrigeration	Reach-in Refrigerator	2500 kWh/yr	-	$0.00	18	1.00
Refrigeration	Reach-in Refrigerator	2400 kWh/yr	-	$0.00	18	1.00
Refrigeration	Reach-in Refrigerator	1500 kWh/yr	-	$0.00	18	1.00
Refrigeration	Glass Door Display	15500 kWh/yr	-	$0.00	18	-
Refrigeration	Glass Door Display	14480 kWh/yr	-	$0.00	18	1.00
Refrigeration	Glass Door Display	11700 kWh/yr	-	$0.00	18	1.00
Refrigeration	Glass Door Display	8400 kWh/yr	-	$0.00	18	-
Refrigeration	Glass Door Display	6800 kWh/yr	-	$0.00	18	-
Refrigeration	Open Display Case	7000 kWh/yr	-	$0.00	18	-
Refrigeration	Open Display Case	6535 kWh/yr	-	$0.00	18	1.00
Refrigeration	Open Display Case	5350 kWh/yr	-	$0.00	18	-
Refrigeration	Open Display Case	5300 kWh/yr	-	$0.00	18	1.00
Refrigeration	Open Display Case	4350 kWh/yr	-	$0.00	18	-
Refrigeration	Icemaker	7.0 kWh/100 lbs	-	$0.00	12	-
Refrigeration	Icemaker	6.3 kWh/100 lbs	0.01	$0.00	12	1.10
Refrigeration	Icemaker	6.0 kWh/100 lbs	0.01	$0.00	12	1.04
Refrigeration	Icemaker	5.5 kWh/100 lbs	0.01	$0.01	12	0.42
Refrigeration	Vending Machine	3400 kWh/year	-	$0.00	10	-
Refrigeration	Vending Machine	2400 kWh/year	0.01	$0.00	10	4.03
Refrigeration	Vending Machine	1700 kWh/year	0.02	$0.00	10	2.28
Food Preparation	Oven	Standard	-	$0.00	12	-
Food Preparation	Oven	Energy Star	0.06	$0.00	12	98,119.68
Food Preparation	Fryer	Standard	-	$0.00	12	-
Food Preparation	Fryer	Energy Star	-	$0.00	12	1.00
Food Preparation	Dishwasher	Standard	-	$0.00	12	-
Food Preparation	Dishwasher	Energy Star	-	$0.00	12	1.00
Food Preparation	Hot Food Container	Standard	-	$0.00	12	-
Food Preparation	Hot Food Container	Energy Star	-	$0.00	12	1.00
Office Equipment	Desktop Computer	Standard	-	$0.00	4	-
Office Equipment	Desktop Computer	Energy Star	0.03	$0.00	4	2,046.85
Office Equipment	Laptop	Standard	-	$0.00	4	-
Office Equipment	Laptop	Energy Star	0.00	$0.00	4	630.98
Office Equipment	Server	Standard	-	$0.00	3	-
Office Equipment	Server	Energy Star	0.02	$0.00	3	7,222.85
Office Equipment	Monitor	Standard	-	$0.00	4	-
Office Equipment	Monitor	Energy Star	0.00	$0.00	4	230.85
Office Equipment	Printer/Copier/Fax	Standard	-	$0.00	6	-

End Use	Technology	Efficiency Definition	Savings (kWh/ sqft/yr)	Incremental Cost ($/sqft)	Lifetime (yrs)	BC Ratio
Office Equipment	Printer/Copier/Fax	Energy Star	0.00	$0.00	6	2,150.07
Office Equipment	POS Terminal	Standard	-	$0.00	4	-
Office Equipment	POS Terminal	Efficient	0.01	$0.00	4	0.27
Miscellaneous	Non-HVAC Motors	Standard (EPAct)	-	$0.00	15	-
Miscellaneous	Non-HVAC Motors	Standard (EPAct 2015)	0.00	$0.00	15	-
Miscellaneous	Non-HVAC Motors	High Efficiency	0.00	$0.00	15	5.60
Miscellaneous	Non-HVAC Motors	High Efficiency (2015)	0.00	$0.00	15	-
Miscellaneous	Non-HVAC Motors	Premium (NEMA)	0.00	$0.00	15	5.60
Miscellaneous	Non-HVAC Motors	Premium (NEMA 2015)	0.00	$0.00	15	-
Miscellaneous	Pool Pump	Standard	-	$0.00	15	-
Miscellaneous	Pool Pump	High Efficiency	-	$0.00	15	1.00
Miscellaneous	Pool Pump	Two-Speed	-	$0.00	15	1.00
Miscellaneous	Pool Heater	Standard	-	$0.00	15	-
Miscellaneous	Pool Heater	Heat Pump	-	$0.00	15	1.00
Miscellaneous	Pool Heater	Solar	-	$0.00	15	1.00
Miscellaneous	Miscellaneous	Standard	-	$0.00	5	-

Table C-32 Energy-Efficiency Measure Data—College, Existing Vintage

Measure	End Use	Energy Savings	Demand Savings	Base Satura-tion	Appl./ Feas.	Cost ($/sqft)	Life-time (yrs)	BC Ratio
Chiller - VSD	Cooling	28%	33%	3%	100%	$1.17	20	2.65
Chiller - Condenser Water Temperature Reset	Cooling	9%	7%	30%	100%	$0.09	4	1.41
Chiller - Economizer	Cooling	9%	0%	11%	90%	$0.15	10	4.17
Chiller - Thermal Energy Storage	Cooling	0%	25%	73%	90%	$0.15	15	7.37
Air-Cooled Chiller - High Efficiency Fans	Cooling	0%	0%	25%	74%	$0.04	10	0.03
Water-Cooled Chiller - Condenser Water Temperature Reset	Cooling	15%	7%	30%	100%	$0.09	4	2.45
Water-Cooled Chiller - Cooling Tower, High-Efficiency Fans	Cooling	0%	0%	25%	74%	$0.04	10	0.03
Heat Pump - Maintenance	Cooling/Heating	14%	14%	33%	100%	$0.06	4	3.70
RTU - Maintenance	Cooling	14%	14%	33%	100%	$0.06	4	2.05
Ventilation - Variable Speed Control	Ventilation	21%	7%	0%	0%	$0.34	10	0.38
Ventilation - CO2 Controlled	Ventilation	5%	7%	1%	10%	$1.60	10	0.02
Ventilation - Exhaust Hood Sensor Control	Ventilation	3%	1%	1%	10%	$0.04	10	0.38
Fans - Energy-Efficient Motors	Ventilation	1%	1%	11%	100%	$0.34	10	0.01
Pumps - High-Efficiency Motors	Cooling	0%	0%	0%	0%	$0.00	-	3.00
Pumps - High-Efficiency Motors	Cooling/Heating	0%	0%	0%	0%	$0.00	-	3.00
Pumps - High-Efficiency Motors	Heating	0%	0%	0%	0%	$0.00	-	3.00
Pumps - Variable Speed Control	Cooling	8%	0%	0%	0%	$0.44	10	0.61
Pumps - Variable Speed Control	Cooling/Heating	0%	0%	0%	0%	$0.44	10	0.61
Pumps - Variable Speed Control	Heating	4%	4%	0%	0%	$0.44	10	0.61
Insulation - Ducting	Cooling	4%	2%	56%	100%	$0.41	20	0.33
Insulation - Ducting	Cooling/Heating	0%	4%	56%	100%	$0.41	20	0.33
Insulation - Ducting	Heating	0%	0%	56%	100%	$0.41	20	0.33
Insulation - Ceiling	Cooling	12%	11%	2%	25%	$0.85	20	0.73
Insulation - Ceiling	Cooling/Heating	12%	4%	2%	25%	$0.85	20	0.73
Insulation - Ceiling	Heating	7%	7%	2%	25%	$0.85	20	0.73
Insulation - Wall Cavity	Cooling	0%	0%	44%	75%	$1.50	20	0.34
Insulation - Wall Cavity	Cooling/Heating	15%	9%	44%	75%	$1.50	20	0.34
Insulation - Wall Cavity	Heating	17%	17%	44%	75%	$1.50	20	0.34
HVAC - Duct Repair and Sealing	Cooling	8%	6%	5%	50%	$0.38	18	1.12
HVAC - Duct Repair and Sealing	Cooling/Heating	7%	6%	5%	50%	$0.38	18	1.12
HVAC - Duct Repair and Sealing	Heating	6%	7%	5%	50%	$0.38	18	1.12
Roofs - Cool Roof	Cooling	3%	3%	22%	100%	$0.18	15	0.51
Roofs - Cool Roof	Cooling/Heating	0%	0%	22%	100%	$0.18	15	0.51
Roofs - Cool Roof	Heating	0%	0%	22%	100%	$0.18	15	0.51
Windows - High Efficiency	Cooling	6%	3%	44%	100%	$2.10	20	0.13
Windows - High Efficiency	Cooling/Heating	0%	0%	44%	100%	$2.10	20	0.13
Windows - High Efficiency	Heating	2%	2%	44%	100%	$2.10	20	0.13
Energy Management System	Cooling	8%	14%	19%	85%	$0.70	14	0.79
Energy Management System	Cooling/Heating	7%	6%	19%	85%	$0.70	14	0.79
Energy Management System	Heating	6%	6%	19%	85%	$0.70	14	0.79
Energy Management System	Interior Lighting	9%	9%	19%	85%	$0.70	14	0.79
Energy Management System	Exterior Lighting	9%	9%	19%	85%	$0.70	14	0.79
Thermostat - Clock/Programmable	Cooling	6%	0%	44%	50%	$0.13	11	6.32
Thermostat - Clock/Programmable	Cooling/Heating	0%	0%	44%	50%	$0.13	11	6.32
Thermostat - Clock/Programmable	Heating	33%	33%	44%	50%	$0.13	11	6.32
Interior Lighting - LED Exit Lighting	Interior Lighting	2%	2%	9%	90%	$0.00	16	34.7
Interior Lighting - Occupancy Sensors	Interior Lighting	10%	5%	11%	75%	$0.44	8	0.25
Interior Lighting - Task Lighting	Interior Lighting	10%	10%	11%	100%	$0.24	5	0.30
Interior Lighting - Time Clocks and Timers (lighting)	Interior Lighting	5%	3%	0%	75%	$0.30	8	0.18
Interior Lighting - Fluorescent Delamp and Install Reflectors	Interior Lighting	30%	8%	56%	75%	$0.50	11	0.82
Interior Fluorescent - Bi-Level Fixture w/Occupancy Sensor	Interior Lighting	10%	5%	10%	30%	$0.20	8	0.37

Measure	End Use	Energy Savings	Demand Savings	Base Satura-tion	Appl./ Feas.	Cost ($/sqft)	Life-time (yrs)	BC Ratio
Interior Fluorescent - Photocell-Controlled Dimming Ballasts	Interior Lighting	25%	13%	33%	60%	$0.40	8	0.47
Indoor Lighting - Daylighting Controls	Interior Lighting	20%	20%	0%	20%	$0.34	8	0.64
Lighting Retrocommissioning	Interior Lighting	6%	8%	67%	90%	$0.05	5	0.99
Lighting Retrocommissioning	Exterior Lighting	6%	3%	67%	90%	$0.05	5	0.99
Water Heating - Heat Trap	Water Heating	9%	9%	5%	25%	$2.36	-	-
Water Heating - Faucet Aerators and Low Flow Nozzles	Water Heating	4%	4%	56%	100%	$0.03	9	1.09
Water Heating - Pipe Insulation	Water Heating	6%	6%	44%	99%	$0.28	15	0.24
Water Heating - Tank Blanket	Water Heating	10%	3%	0%	0%	$0.04	10	2.21
Water Heating - Hot Water Saver	Water Heating	5%	1%	0%	100%	$0.04	5	0.60
Water Heating - High Efficiency Circulation Pump	Water Heating	0%	0%	0%	0%	$0.00	-	1.00
Water Heating - Install Timer	Water Heating	9%	9%	5%	25%	$0.04	-	-
Water Heating - Thermostat Setback	Water Heating	10%	10%	10%	100%	$0.11	10	0.80
Water Heating - Solar Water Heating System	Water Heating	70%	70%	1%	85%	$2.46	-	-
Refrigerator - Decommissioning and Recycling	Refrigeration	90%	90%	10%	50%	$0.13	8	0.99
Refrigerator - Anti-Sweat Heater	Refrigeration	5%	3%	0%	100%	$0.20	12	0.01
Refrigerator - Door Gasket Replacement	Refrigeration	4%	2%	5%	100%	$0.10	4	0.01
Display Case - LED Lighting	Refrigeration	0%	0%	0%	0%	$0.00	-	2.00
Open Display Case - Night Covers	Refrigeration	6%	3%	5%	100%	$0.05	8	0.02
Vending Machine - Controller	Refrigeration	15%	11%	2%	10%	$0.27	5	0.01
Office Electronics - Plug Load Occupancy Sensors	Office Equipment	10%	5%	42%	75%	$0.28	8	0.09
Office Electronics - ENERGY STAR Power Supplies	Office Equipment	1%	1%	10%	100%	$0.00	7	20.5
Non-HVAC Motors - Variable Speed Control	Miscellaneous	1%	0%	11%	75%	$0.10	10	0.00
Pool Pump - Timer	Miscellaneous	60%	15%	11%	45%	$0.36	10	0.00

Table C-33 Energy-Efficiency Measure Data—School, Existing Vintage

Measure	End Use	Energy Savings	Demand Savings	Base Satura-tion	Appl./ Feas.	Cost ($/sqft)	Life-time (yrs)	BC Ratio
Chiller - VSD	Cooling	28%	33%	15%	88%	$1.17	20	1.37
Chiller - Condenser Water Temperature Reset	Cooling	9%	7%	30%	100%	$0.09	4	0.73
Chiller - Economizer	Cooling	8%	0%	4%	65%	$0.15	10	1.99
Chiller - Thermal Energy Storage	Cooling	0%	25%	44%	65%	$0.15	15	7.37
Air-Cooled Chiller - High Efficiency Fans	Cooling	0%	0%	15%	44%	$0.04	10	0.02
Water-Cooled Chiller - Condenser Water Temperature Reset	Cooling	15%	7%	30%	100%	$0.09	4	1.27
Water-Cooled Chiller - Cooling Tower, High-Efficiency Fans	Cooling	0%	0%	15%	44%	$0.04	10	0.02
Heat Pump - Maintenance	Cooling/Heating	14%	14%	33%	100%	$0.06	4	2.21
RTU - Maintenance	Cooling	14%	14%	33%	100%	$0.06	4	1.06
Ventilation - Variable Speed Control	Ventilation	20%	7%	0%	0%	$0.34	10	0.18
Ventilation - CO2 Controlled	Ventilation	5%	7%	1%	15%	$1.60	10	0.01
Ventilation - Exhaust Hood Sensor Control	Ventilation	1%	1%	1%	15%	$0.04	10	0.10
Fans - Energy-Efficient Motors	Ventilation	1%	1%	11%	100%	$0.34	10	0.01
Pumps - High-Efficiency Motors	Cooling	0%	0%	0%	0%	$0.00	-	3.00
Pumps - High-Efficiency Motors	Cooling/Heating	0%	0%	0%	0%	$0.00	-	3.00
Pumps - High-Efficiency Motors	Heating	0%	0%	0%	0%	$0.00	-	3.00
Pumps - Variable Speed Control	Cooling	8%	0%	0%	0%	$0.44	10	0.34
Pumps - Variable Speed Control	Cooling/Heating	0%	0%	0%	0%	$0.44	10	0.34
Pumps - Variable Speed Control	Heating	4%	4%	0%	0%	$0.44	10	0.34
Insulation - Ducting	Cooling	4%	2%	27%	100%	$0.41	20	0.17
Insulation - Ducting	Cooling/Heating	0%	4%	27%	100%	$0.41	20	0.17
Insulation - Ducting	Heating	0%	0%	27%	100%	$0.41	20	0.17
Insulation - Ceiling	Cooling	12%	11%	7%	25%	$0.85	20	0.40
Insulation - Ceiling	Cooling/Heating	12%	4%	7%	25%	$0.85	20	0.40
Insulation - Ceiling	Heating	7%	7%	7%	25%	$0.85	20	0.40
Insulation - Wall Cavity	Cooling	0%	0%	19%	75%	$1.50	20	0.22
Insulation - Wall Cavity	Cooling/Heating	15%	9%	19%	75%	$1.50	20	0.22
Insulation - Wall Cavity	Heating	17%	17%	19%	75%	$1.50	20	0.22
HVAC - Duct Repair and Sealing	Cooling	6%	8%	5%	50%	$0.38	18	0.52
HVAC - Duct Repair and Sealing	Cooling/Heating	6%	9%	5%	50%	$0.38	18	0.52
HVAC - Duct Repair and Sealing	Heating	5%	9%	5%	50%	$0.38	18	0.52
Roofs - Cool Roof	Cooling	3%	3%	50%	100%	$0.18	15	0.26
Roofs - Cool Roof	Cooling/Heating	0%	0%	50%	100%	$0.18	15	0.26
Roofs - Cool Roof	Heating	0%	0%	50%	100%	$0.18	15	0.26
Windows - High Efficiency	Cooling	6%	3%	73%	100%	$2.10	20	0.07
Windows - High Efficiency	Cooling/Heating	0%	0%	73%	100%	$2.10	20	0.07
Windows - High Efficiency	Heating	2%	2%	73%	100%	$2.10	20	0.07
Energy Management System	Cooling	8%	14%	19%	85%	$0.70	14	0.56
Energy Management System	Cooling/Heating	7%	6%	19%	85%	$0.70	14	0.56
Energy Management System	Heating	6%	6%	19%	85%	$0.70	14	0.56
Energy Management System	Interior Lighting	9%	9%	19%	85%	$0.70	14	0.56
Energy Management System	Exterior Lighting	9%	9%	19%	85%	$0.70	14	0.56
Thermostat - Clock/Programmable	Cooling	6%	0%	50%	50%	$0.13	11	3.91
Thermostat - Clock/Programmable	Cooling/Heating	0%	0%	50%	50%	$0.13	11	3.91
Thermostat - Clock/Programmable	Heating	33%	33%	50%	50%	$0.13	11	3.91
Interior Lighting - LED Exit Lighting	Interior Lighting	2%	2%	9%	90%	$0.00	16	36.8
Interior Lighting - Occupancy Sensors	Interior Lighting	10%	5%	15%	75%	$0.44	8	0.26
Interior Lighting - Task Lighting	Interior Lighting	10%	10%	4%	100%	$0.24	5	0.32
Interior Lighting - Time Clocks and Timers (lighting)	Interior Lighting	5%	3%	4%	75%	$0.30	8	0.19
Interior Lighting - Fluorescent Delamp and Install Reflectors	Interior Lighting	30%	8%	19%	75%	$0.50	11	0.87
Interior Fluorescent - Bi-Level Fixture w/Occupancy Sensor	Interior Lighting	10%	5%	10%	30%	$0.40	8	0.12

Measure	End Use	Energy Savings	Demand Savings	Base Satura-tion	Appl./ Feas.	Cost ($/sqft)	Life-time (yrs)	BC Ratio
Interior Fluorescent - Photocell-Controlled Dimming Ballasts	Interior Lighting	25%	13%	8%	60%	$0.45	8	0.26
Indoor Lighting - Daylighting Controls	Interior Lighting	20%	20%	12%	25%	$0.34	8	0.68
Lighting Retrocommissioning	Interior Lighting	6%	8%	31%	90%	$0.05	5	1.02
Lighting Retrocommissioning	Exterior Lighting	6%	3%	31%	90%	$0.05	5	1.02
Water Heating - Heat Trap	Water Heating	9%	9%	5%	25%	$2.36	-	-
Water Heating - Faucet Aerators and Low Flow Nozzles	Water Heating	4%	4%	31%	100%	$0.03	9	0.59
Water Heating - Pipe Insulation	Water Heating	6%	6%	15%	41%	$0.28	15	0.13
Water Heating - Tank Blanket	Water Heating	10%	3%	0%	0%	$0.04	10	1.20
Water Heating - Hot Water Saver	Water Heating	5%	1%	0%	100%	$0.04	5	0.33
Water Heating - High Efficiency Circulation Pump	Water Heating	0%	0%	0%	0%	$0.00	-	1.00
Water Heating - Install Timer	Water Heating	9%	9%	5%	25%	$0.04	-	-
Water Heating - Thermostat Setback	Water Heating	10%	10%	10%	100%	$0.11	10	0.44
Water Heating - Solar Water Heating System	Water Heating	70%	70%	1%	85%	$2.46	-	-
Refrigerator - Decommissioning and Recycling	Refrigeration	90%	90%	10%	50%	$0.13	8	1.08
Refrigerator - Anti-Sweat Heater	Refrigeration	5%	3%	0%	100%	$0.20	12	0.01
Refrigerator - Door Gasket Replacement	Refrigeration	4%	2%	5%	100%	$0.10	4	0.01
Display Case - LED Lighting	Refrigeration	0%	0%	0%	0%	$0.00	-	2.00
Open Display Case - Night Covers	Refrigeration	6%	3%	5%	100%	$0.05	8	0.02
Vending Machine - Controller	Refrigeration	15%	11%	2%	10%	$0.27	5	0.01
Office Electronics - Plug Load Occupancy Sensors	Office Equipment	10%	5%	13%	75%	$0.28	8	0.06
Office Electronics - ENERGY STAR Power Supplies	Office Equipment	1%	1%	10%	100%	$0.00	7	14.2
Non-HVAC Motors - Variable Speed Control	Miscellaneous	1%	0%	4%	75%	$0.10	10	0.00
Pool Pump - Timer	Miscellaneous	60%	15%	0%	45%	$0.36	10	0.00

Table C-34 Energy-Efficiency Measure Data—Large Grocery, Existing Vintage

Measure	End Use	Energy Savings	Demand Savings	Base Satura-tion	Appl./ Feas.	Cost ($/sqft)	Life-time (yrs)	BC Ratio
Chiller - VSD	Cooling	26%	32%	0%	0%	$1.17	20	3.14
Chiller - Condenser Water Temperature Reset	Cooling	10%	7%	0%	0%	$0.37	4	0.50
Chiller - Economizer	Cooling	9%	2%	0%	65%	$0.15	10	5.47
Chiller - Thermal Energy Storage	Cooling	0%	25%	45%	65%	$0.15	15	1.51
Air-Cooled Chiller - High Efficiency Fans	Cooling	0%	0%	0%	0%	$0.04	10	0.04
Water-Cooled Chiller - Condenser Water Temperature Reset	Cooling	14%	7%	0%	0%	$0.37	4	0.60
Water-Cooled Chiller - Cooling Tower, High-Efficiency Fans	Cooling	0%	0%	0%	0%	$0.04	10	0.03
Heat Pump - Maintenance	Cooling/Heating	14%	14%	14%	100%	$0.06	4	4.69
RTU - Maintenance	Cooling	14%	15%	14%	100%	$0.06	4	3.45
Ventilation - Variable Speed Control	Ventilation	4%	4%	0%	0%	$0.34	10	0.10
Ventilation - CO2 Controlled	Ventilation	1%	13%	1%	20%	$0.21	10	0.04
Ventilation - Exhaust Hood Sensor Control	Ventilation	15%	1%	1%	20%	$0.07	10	1.94
Fans - Energy-Efficient Motors	Ventilation	1%	1%	11%	100%	$0.05	10	0.24
Pumps - High-Efficiency Motors	Cooling	0%	0%	0%	0%	$0.00	-	3.00
Pumps - High-Efficiency Motors	Cooling/Heating	0%	0%	0%	0%	$0.00	-	3.00
Pumps - High-Efficiency Motors	Heating	0%	0%	0%	0%	$0.00	-	3.00
Pumps - Variable Speed Control	Cooling	8%	0%	0%	0%	$0.44	10	0.74
Pumps - Variable Speed Control	Cooling/Heating	0%	0%	0%	0%	$0.44	10	0.74
Pumps - Variable Speed Control	Heating	4%	4%	0%	0%	$0.44	10	0.74
Insulation - Ducting	Cooling	2%	2%	33%	100%	$0.41	20	0.26
Insulation - Ducting	Cooling/Heating	0%	0%	33%	100%	$0.41	20	0.26
Insulation - Ducting	Heating	0%	0%	33%	100%	$0.41	20	0.26
Insulation - Ceiling	Cooling	47%	31%	7%	25%	$0.85	20	3.24
Insulation - Ceiling	Cooling/Heating	9%	9%	7%	25%	$0.85	20	3.24
Insulation - Ceiling	Heating	15%	15%	7%	25%	$0.85	20	3.24
Insulation - Wall Cavity	Cooling	50%	51%	11%	75%	$0.08	20	34.4
Insulation - Wall Cavity	Cooling/Heating	10%	30%	11%	75%	$0.08	20	34.4
Insulation - Wall Cavity	Heating	6%	6%	11%	75%	$0.08	20	34.4
HVAC - Duct Repair and Sealing	Cooling	13%	14%	5%	50%	$0.38	18	2.00
HVAC - Duct Repair and Sealing	Cooling/Heating	10%	10%	5%	50%	$0.38	18	2.00
HVAC - Duct Repair and Sealing	Heating	7%	7%	5%	50%	$0.38	18	2.00
Roofs - Cool Roof	Cooling	10%	16%	67%	100%	$0.17	15	2.56
Roofs - Cool Roof	Cooling/Heating	0%	0%	67%	100%	$0.17	15	2.56
Roofs - Cool Roof	Heating	0%	0%	67%	100%	$0.17	15	2.56
Windows - High Efficiency	Cooling	14%	5%	33%	100%	$0.88	20	0.87
Windows - High Efficiency	Cooling/Heating	0%	0%	33%	100%	$0.88	20	0.87
Windows - High Efficiency	Heating	3%	3%	33%	100%	$0.88	20	0.87
Energy Management System	Cooling	8%	14%	0%	85%	$0.70	14	1.17
Energy Management System	Cooling/Heating	8%	6%	0%	85%	$0.70	14	1.17
Energy Management System	Heating	6%	6%	0%	85%	$0.70	14	1.17
Energy Management System	Interior Lighting	9%	9%	0%	85%	$0.70	14	1.17
Energy Management System	Exterior Lighting	9%	9%	0%	85%	$0.70	14	1.17
Thermostat - Clock/Programmable	Cooling	13%	0%	33%	50%	$0.13	11	4.33
Thermostat - Clock/Programmable	Cooling/Heating	0%	0%	33%	50%	$0.13	11	4.33
Thermostat - Clock/Programmable	Heating	7%	7%	33%	50%	$0.13	11	4.33
Interior Lighting - LED Exit Lighting	Interior Lighting	2%	2%	9%	90%	$0.00	16	82.2
Interior Lighting - Occupancy Sensors	Interior Lighting	5%	5%	0%	75%	$0.44	8	0.29
Interior Lighting - Task Lighting	Interior Lighting	1%	10%	0%	100%	$0.24	5	0.07
Interior Lighting - Time Clocks and Timers (lighting)	Interior Lighting	5%	3%	11%	75%	$0.20	8	0.64
Interior Lighting - Fluorescent Delamp and Install Reflectors	Interior Lighting	20%	8%	44%	99%	$0.40	11	1.62
Interior Fluorescent - Bi-Level Fixture w/Occupancy Sensor	Interior Lighting	10%	5%	10%	30%	$0.50	8	0.35

Measure	End Use	Energy Savings	Demand Savings	Base Satura-tion	Appl./ Feas.	Cost ($/sqft)	Life-time (yrs)	BC Ratio
Interior Fluorescent - Photocell-Controlled Dimming Ballasts	Interior Lighting	25%	13%	11%	60%	$0.50	8	0.88
Indoor Lighting - Daylighting Controls	Interior Lighting	10%	10%	22%	100%	$0.05	8	5.13
Lighting Retrocommissioning	Interior Lighting	6%	8%	56%	80%	$0.05	5	2.26
Lighting Retrocommissioning	Exterior Lighting	6%	3%	56%	80%	$0.05	5	2.26
Water Heating - Heat Trap	Water Heating	9%	9%	5%	25%	$2.36	-	-
Water Heating - Faucet Aerators and Low Flow Nozzles	Water Heating	4%	4%	22%	100%	$0.03	9	1.20
Water Heating - Pipe Insulation	Water Heating	6%	6%	22%	100%	$0.28	15	0.26
Water Heating - Tank Blanket	Water Heating	10%	3%	40%	100%	$0.04	10	2.45
Water Heating - Hot Water Saver	Water Heating	5%	1%	0%	100%	$0.04	5	0.66
Water Heating - High Efficiency Circulation Pump	Water Heating	0%	0%	0%	0%	$0.00	-	1.00
Water Heating - Install Timer	Water Heating	9%	9%	5%	25%	$0.04	-	-
Water Heating - Thermostat Setback	Water Heating	10%	10%	0%	100%	$0.11	10	0.89
Water Heating - Solar Water Heating System	Water Heating	70%	70%	1%	85%	$2.46	-	-
Refrigerator - Decommissioning and Recycling	Refrigeration	90%	90%	10%	50%	$0.13	8	51.7
Refrigerator - Anti-Sweat Heater	Refrigeration	20%	3%	0%	100%	$0.20	12	6.40
Refrigerator - Door Gasket Replacement	Refrigeration	4%	2%	5%	100%	$0.10	4	0.83
Display Case - LED Lighting	Refrigeration	38%	38%	12%	56%	$0.04	8	54.3
Open Display Case - Night Covers	Refrigeration	6%	3%	5%	100%	$0.05	8	2.16
Vending Machine - Controller	Refrigeration	15%	11%	2%	10%	$0.27	5	0.03
Office Electronics - Plug Load Occupancy Sensors	Office Equipment	10%	5%	7%	75%	$0.30	8	0.04
Office Electronics - ENERGY STAR Power Supplies	Office Equipment	1%	1%	10%	100%	$0.00	7	10.3
Non-HVAC Motors - Variable Speed Control	Miscellaneous	1%	0%	0%	75%	$0.10	10	0.00
Pool Pump - Timer	Miscellaneous	60%	15%	0%	45%	$0.44	10	-

Table C-35 Energy-Efficiency Measure Data—Small Grocery, Existing Vintage

Measure	End Use	Energy Savings	Demand Savings	Base Satura-tion	Appl./ Feas.	Cost ($/sqft)	Life-time (yrs)	BC Ratio
Chiller - VSD	Cooling	26%	32%	0%	0%	$1.17	20	2.94
Chiller - Condenser Water Temperature Reset	Cooling	10%	7%	0%	0%	$0.37	4	0.47
Chiller - Economizer	Cooling	9%	2%	0%	65%	$0.15	10	5.11
Chiller - Thermal Energy Storage	Cooling	0%	25%	45%	65%	$0.15	15	1.51
Air-Cooled Chiller - High Efficiency Fans	Cooling	0%	0%	0%	0%	$0.04	10	0.03
Water-Cooled Chiller - Condenser Water Temperature Reset	Cooling	14%	7%	0%	0%	$0.37	4	0.56
Water-Cooled Chiller - Cooling Tower, High-Efficiency Fans	Cooling	0%	0%	0%	0%	$0.04	10	0.03
Heat Pump - Maintenance	Cooling/Heating	14%	14%	14%	100%	$0.06	4	4.42
RTU - Maintenance	Cooling	14%	15%	14%	100%	$0.06	4	3.23
Ventilation - Variable Speed Control	Ventilation	4%	4%	0%	0%	$0.34	10	0.09
Ventilation - CO2 Controlled	Ventilation	1%	13%	1%	20%	$0.21	10	0.04
Ventilation - Exhaust Hood Sensor Control	Ventilation	15%	1%	1%	20%	$0.07	10	1.74
Fans - Energy-Efficient Motors	Ventilation	1%	1%	11%	100%	$0.05	10	0.22
Pumps - High-Efficiency Motors	Cooling	0%	0%	0%	0%	$0.00	-	3.00
Pumps - High-Efficiency Motors	Cooling/Heating	0%	0%	0%	0%	$0.00	-	3.00
Pumps - High-Efficiency Motors	Heating	0%	0%	0%	0%	$0.00	-	3.00
Pumps - Variable Speed Control	Cooling	8%	0%	0%	0%	$0.44	10	0.68
Pumps - Variable Speed Control	Cooling/Heating	0%	0%	0%	0%	$0.44	10	0.68
Pumps - Variable Speed Control	Heating	4%	4%	0%	0%	$0.44	10	0.68
Insulation - Ducting	Cooling	2%	2%	33%	100%	$0.41	20	0.24
Insulation - Ducting	Cooling/Heating	0%	0%	33%	100%	$0.41	20	0.24
Insulation - Ducting	Heating	0%	0%	33%	100%	$0.41	20	0.24
Insulation - Ceiling	Cooling	47%	31%	7%	25%	$0.85	20	3.00
Insulation - Ceiling	Cooling/Heating	9%	9%	7%	25%	$0.85	20	3.00
Insulation - Ceiling	Heating	15%	15%	7%	25%	$0.85	20	3.00
Insulation - Wall Cavity	Cooling	50%	51%	11%	75%	$0.08	20	31.9
Insulation - Wall Cavity	Cooling/Heating	10%	30%	11%	75%	$0.08	20	31.9
Insulation - Wall Cavity	Heating	6%	6%	11%	75%	$0.08	20	31.9
HVAC - Duct Repair and Sealing	Cooling	13%	14%	5%	50%	$0.38	18	1.85
HVAC - Duct Repair and Sealing	Cooling/Heating	10%	10%	5%	50%	$0.38	18	1.85
HVAC - Duct Repair and Sealing	Heating	7%	7%	5%	50%	$0.38	18	1.85
Roofs - Cool Roof	Cooling	10%	16%	67%	100%	$0.17	15	2.38
Roofs - Cool Roof	Cooling/Heating	0%	0%	67%	100%	$0.17	15	2.38
Roofs - Cool Roof	Heating	0%	0%	67%	100%	$0.17	15	2.38
Windows - High Efficiency	Cooling	14%	5%	33%	100%	$0.88	20	0.80
Windows - High Efficiency	Cooling/Heating	0%	0%	33%	100%	$0.88	20	0.80
Windows - High Efficiency	Heating	3%	3%	33%	100%	$0.88	20	0.80
Energy Management System	Cooling	8%	14%	0%	85%	$0.70	14	1.07
Energy Management System	Cooling/Heating	8%	6%	0%	85%	$0.70	14	1.07
Energy Management System	Heating	6%	6%	0%	85%	$0.70	14	1.07
Energy Management System	Interior Lighting	9%	9%	0%	85%	$0.70	14	1.07
Energy Management System	Exterior Lighting	9%	9%	0%	85%	$0.70	14	1.07
Thermostat - Clock/Programmable	Cooling	13%	0%	33%	50%	$0.13	11	4.00
Thermostat - Clock/Programmable	Cooling/Heating	0%	0%	33%	50%	$0.13	11	4.00
Thermostat - Clock/Programmable	Heating	7%	7%	33%	50%	$0.13	11	4.00
Interior Lighting - LED Exit Lighting	Interior Lighting	2%	2%	9%	90%	$0.00	16	74.0
Interior Lighting - Occupancy Sensors	Interior Lighting	5%	5%	0%	75%	$0.44	8	0.26
Interior Lighting - Task Lighting	Interior Lighting	1%	10%	0%	100%	$0.24	5	0.06
Interior Lighting - Time Clocks and Timers (lighting)	Interior Lighting	5%	3%	11%	75%	$0.20	8	0.58
Interior Lighting - Fluorescent Delamp and Install Reflectors	Interior Lighting	20%	8%	44%	99%	$0.40	11	1.46
Interior Fluorescent - Bi-Level Fixture w/Occupancy Sensor	Interior Lighting	10%	5%	10%	30%	$0.50	8	0.32

Measure	End Use	Energy Savings	Demand Savings	Base Satura-tion	Appl./ Feas.	Cost ($/sqft)	Life-time (yrs)	BC Ratio
Interior Fluorescent - Photocell-Controlled Dimming Ballasts	Interior Lighting	25%	13%	11%	60%	$0.50	8	0.79
Indoor Lighting - Daylighting Controls	Interior Lighting	10%	10%	22%	100%	$0.05	8	4.62
Lighting Retrocommissioning	Interior Lighting	6%	8%	56%	80%	$0.05	5	2.01
Lighting Retrocommissioning	Exterior Lighting	6%	3%	56%	80%	$0.05	5	2.01
Water Heating - Heat Trap	Water Heating	9%	9%	5%	25%	$2.36	-	-
Water Heating - Faucet Aerators and Low Flow Nozzles	Water Heating	4%	4%	22%	100%	$0.03	9	0.96
Water Heating - Pipe Insulation	Water Heating	6%	6%	22%	100%	$0.28	15	0.21
Water Heating - Tank Blanket	Water Heating	10%	3%	40%	100%	$0.04	10	1.96
Water Heating - Hot Water Saver	Water Heating	5%	1%	0%	100%	$0.04	5	0.53
Water Heating - High Efficiency Circulation Pump	Water Heating	0%	0%	0%	0%	$0.00	-	1.00
Water Heating - Install Timer	Water Heating	9%	9%	5%	25%	$0.04	-	-
Water Heating - Thermostat Setback	Water Heating	10%	10%	0%	100%	$0.11	10	0.71
Water Heating - Solar Water Heating System	Water Heating	70%	70%	1%	85%	$2.46	-	-
Refrigerator - Decommissioning and Recycling	Refrigeration	90%	90%	10%	50%	$0.13	8	41.8
Refrigerator - Anti-Sweat Heater	Refrigeration	20%	3%	0%	100%	$0.20	12	5.19
Refrigerator - Door Gasket Replacement	Refrigeration	4%	2%	5%	100%	$0.10	4	0.69
Display Case - LED Lighting	Refrigeration	38%	38%	12%	56%	$0.04	8	44.0
Open Display Case - Night Covers	Refrigeration	6%	3%	5%	100%	$0.05	8	1.75
Vending Machine - Controller	Refrigeration	15%	11%	2%	10%	$0.27	5	0.06
Office Electronics - Plug Load Occupancy Sensors	Office Equipment	10%	5%	7%	75%	$0.30	8	0.04
Office Electronics - ENERGY STAR Power Supplies	Office Equipment	1%	1%	10%	100%	$0.00	7	8.56
Non-HVAC Motors - Variable Speed Control	Miscellaneous	1%	0%	0%	75%	$0.10	10	0.01
Pool Pump - Timer	Miscellaneous	60%	15%	0%	45%	$0.44	10	-

Table C-36 Energy-Efficiency Measure Data—Health, Existing Vintage

Measure	End Use	Energy Savings	Demand Savings	Base Satura-tion	Appl./ Feas.	Cost ($/sqft)	Life-time (yrs)	BC Ratio
Chiller - VSD	Cooling	33%	33%	3%	100%	$1.17	20	6.23
Chiller - Condenser Water Temperature Reset	Cooling	8%	7%	30%	100%	$0.31	4	0.77
Chiller - Economizer	Cooling	13%	13%	2%	90%	$0.15	10	12.10
Chiller - Thermal Energy Storage	Cooling	0%	25%	73%	90%	$0.15	15	0.98
Air-Cooled Chiller - High Efficiency Fans	Cooling	0%	0%	25%	74%	$0.04	10	0.09
Water-Cooled Chiller - Condenser Water Temperature Reset	Cooling	11%	7%	30%	100%	$0.30	4	1.13
Water-Cooled Chiller - Cooling Tower, High-Efficiency Fans	Cooling	0%	0%	25%	74%	$0.04	10	0.08
Heat Pump - Maintenance	Cooling/Heating	14%	14%	33%	100%	$0.06	4	5.50
RTU - Maintenance	Cooling	14%	14%	33%	100%	$0.03	4	8.24
Ventilation - Variable Speed Control	Ventilation	3%	7%	0%	0%	$0.34	10	0.14
Ventilation - CO2 Controlled	Ventilation	3%	7%	1%	10%	$1.60	10	0.03
Ventilation - Exhaust Hood Sensor Control	Ventilation	3%	1%	1%	10%	$0.06	10	0.64
Fans - Energy-Efficient Motors	Ventilation	1%	1%	6%	100%	$0.14	10	0.06
Pumps - High-Efficiency Motors	Cooling	0%	0%	0%	0%	$0.00	-	3.00
Pumps - High-Efficiency Motors	Cooling/Heating	0%	0%	0%	0%	$0.00	-	3.00
Pumps - High-Efficiency Motors	Heating	0%	0%	0%	0%	$0.00	-	3.00
Pumps - Variable Speed Control	Cooling	5%	5%	0%	0%	$0.44	10	0.75
Pumps - Variable Speed Control	Cooling/Heating	0%	0%	0%	0%	$0.44	10	0.75
Pumps - Variable Speed Control	Heating	3%	3%	0%	0%	$0.44	10	0.75
Insulation - Ducting	Cooling	3%	2%	10%	100%	$0.41	20	0.61
Insulation - Ducting	Cooling/Heating	1%	4%	10%	100%	$0.41	20	0.61
Insulation - Ducting	Heating	0%	0%	10%	100%	$0.41	20	0.61
Insulation - Ceiling	Cooling	20%	11%	2%	25%	$0.85	20	1.97
Insulation - Ceiling	Cooling/Heating	9%	4%	2%	25%	$0.85	20	1.97
Insulation - Ceiling	Heating	6%	6%	2%	25%	$0.85	20	1.97
Insulation - Wall Cavity	Cooling	5%	10%	15%	75%	$0.08	20	23.5
Insulation - Wall Cavity	Cooling/Heating	32%	9%	15%	75%	$0.08	20	23.5
Insulation - Wall Cavity	Heating	42%	42%	15%	75%	$0.08	20	23.5
HVAC - Duct Repair and Sealing	Cooling	1%	1%	5%	50%	$0.38	18	0.18
HVAC - Duct Repair and Sealing	Cooling/Heating	1%	1%	5%	50%	$0.38	18	0.18
HVAC - Duct Repair and Sealing	Heating	1%	1%	5%	50%	$0.38	18	0.18
Roofs - Cool Roof	Cooling	5%	3%	39%	100%	$0.08	15	3.86
Roofs - Cool Roof	Cooling/Heating	0%	0%	39%	100%	$0.08	15	3.86
Roofs - Cool Roof	Heating	0%	0%	39%	100%	$0.08	15	3.86
Windows - High Efficiency	Cooling	6%	3%	66%	100%	$2.30	20	0.28
Windows - High Efficiency	Cooling/Heating	0%	0%	66%	100%	$2.30	20	0.28
Windows - High Efficiency	Heating	6%	6%	66%	100%	$2.30	20	0.28
Energy Management System	Cooling	15%	14%	0%	85%	$0.70	14	2.09
Energy Management System	Cooling/Heating	14%	13%	0%	85%	$0.70	14	2.09
Energy Management System	Heating	12%	12%	0%	85%	$0.70	14	2.09
Energy Management System	Interior Lighting	9%	9%	0%	85%	$0.70	14	2.09
Energy Management System	Exterior Lighting	9%	9%	0%	85%	$0.70	14	2.09
Thermostat - Clock/Programmable	Cooling	6%	6%	63%	68%	$0.13	11	8.84
Thermostat - Clock/Programmable	Cooling/Heating	0%	0%	63%	68%	$0.13	11	8.84
Thermostat - Clock/Programmable	Heating	33%	33%	63%	68%	$0.13	11	8.84
Interior Lighting - LED Exit Lighting	Interior Lighting	2%	2%	9%	90%	$0.00	16	50.2
Interior Lighting - Occupancy Sensors	Interior Lighting	5%	5%	5%	75%	$0.44	8	0.18
Interior Lighting - Task Lighting	Interior Lighting	3%	10%	10%	100%	$0.24	5	0.13
Interior Lighting - Time Clocks and Timers (lighting)	Interior Lighting	5%	3%	7%	75%	$0.20	8	0.39
Interior Lighting - Fluorescent Delamp and Install Reflectors	Interior Lighting	23%	8%	12%	50%	$0.50	11	0.91

Measure	End Use	Energy Savings	Demand Savings	Base Satura-tion	Appl./ Feas.	Cost ($/sqft)	Life-time (yrs)	BC Ratio
Interior Fluorescent - Bi-Level Fixture w/Occupancy Sensor	Interior Lighting	10%	5%	10%	30%	$0.20	8	0.58
Interior Fluorescent - Photocell-Controlled Dimming Ballasts	Interior Lighting	25%	13%	10%	60%	$0.40	8	0.72
Indoor Lighting - Daylighting Controls	Interior Lighting	10%	10%	15%	39%	$0.38	8	0.41
Lighting Retrocommissioning	Interior Lighting	6%	8%	12%	90%	$0.03	5	2.23
Lighting Retrocommissioning	Exterior Lighting	6%	3%	12%	90%	$0.03	5	2.23
Water Heating - Heat Trap	Water Heating	9%	9%	5%	25%	$2.36	-	-
Water Heating - Faucet Aerators and Low Flow Nozzles	Water Heating	4%	4%	20%	100%	$0.03	9	1.79
Water Heating - Pipe Insulation	Water Heating	6%	6%	15%	39%	$0.28	15	0.39
Water Heating - Tank Blanket	Water Heating	10%	3%	0%	0%	$0.04	10	3.65
Water Heating - Hot Water Saver	Water Heating	5%	1%	0%	100%	$0.04	5	0.99
Water Heating - High Efficiency Circulation Pump	Water Heating	0%	0%	0%	0%	$0.00	-	1.00
Water Heating - Install Timer	Water Heating	9%	9%	5%	25%	$0.10	-	-
Water Heating - Thermostat Setback	Water Heating	10%	10%	0%	100%	$0.11	10	1.33
Water Heating - Solar Water Heating System	Water Heating	70%	70%	1%	85%	$2.46	-	-
Refrigerator - Decommissioning and Recycling	Refrigeration	90%	90%	10%	50%	$0.13	8	1.45
Refrigerator - Anti-Sweat Heater	Refrigeration	5%	3%	0%	100%	$0.20	12	0.02
Refrigerator - Door Gasket Replacement	Refrigeration	4%	2%	5%	100%	$0.10	4	0.01
Display Case - LED Lighting	Refrigeration	0%	0%	0%	0%	$0.00	-	2.00
Open Display Case - Night Covers	Refrigeration	6%	3%	5%	100%	$0.05	8	0.03
Vending Machine - Controller	Refrigeration	15%	11%	2%	10%	$0.27	5	0.01
Office Electronics - Plug Load Occupancy Sensors	Office Equipment	10%	5%	42%	75%	$0.28	8	0.11
Office Electronics - ENERGY STAR Power Supplies	Office Equipment	1%	1%	10%	100%	$0.00	7	24.6
Non-HVAC Motors - Variable Speed Control	Miscellaneous	1%	0%	2%	75%	$0.10	10	0.01
Pool Pump - Timer	Miscellaneous	60%	15%	2%	45%	$0.36	10	0.01

Table C-37 Energy-Efficiency Measure Data—Lodging, Existing Vintage

Measure	End Use	Energy Savings	Demand Savings	Base Satura-tion	Appl./ Feas.	Cost ($/sqft)	Life-time (yrs)	BC Ratio
Chiller - VSD	Cooling	24%	32%	15%	88%	$1.17	20	1.03
Chiller - Condenser Water Temperature Reset	Cooling	9%	7%	30%	100%	$0.05	4	1.44
Chiller - Economizer	Cooling	1%	1%	0%	65%	$0.15	10	0.28
Chiller - Thermal Energy Storage	Cooling	0%	25%	44%	65%	$0.15	15	0.69
Air-Cooled Chiller - High Efficiency Fans	Cooling	0%	0%	15%	44%	$0.04	10	0.02
Water-Cooled Chiller - Condenser Water Temperature Reset	Cooling	10%	7%	30%	100%	$0.05	4	1.10
Water-Cooled Chiller - Cooling Tower, High-Efficiency Fans	Cooling	0%	0%	15%	44%	$0.04	10	0.01
Heat Pump - Maintenance	Cooling/Heating	10%	5%	14%	100%	$0.03	4	4.29
RTU - Maintenance	Cooling	10%	5%	14%	100%	$0.03	4	3.83
Ventilation - Variable Speed Control	Ventilation	2%	2%	0%	0%	$0.34	10	0.03
Ventilation - CO2 Controlled	Ventilation	3%	13%	1%	20%	$1.60	10	0.01
Ventilation - Exhaust Hood Sensor Control	Ventilation	3%	1%	1%	20%	$0.01	10	1.44
Fans - Energy-Efficient Motors	Ventilation	1%	1%	11%	100%	$0.14	10	0.03
Pumps - High-Efficiency Motors	Cooling	0%	0%	0%	0%	$0.00	-	3.00
Pumps - High-Efficiency Motors	Cooling/Heating	0%	0%	0%	0%	$0.00	-	3.00
Pumps - High-Efficiency Motors	Heating	0%	0%	0%	0%	$0.00	-	3.00
Pumps - Variable Speed Control	Cooling	9%	9%	0%	0%	$0.44	10	0.63
Pumps - Variable Speed Control	Cooling/Heating	0%	0%	0%	0%	$0.44	10	0.63
Pumps - Variable Speed Control	Heating	5%	5%	0%	0%	$0.44	10	0.63
Insulation - Ducting	Cooling	2%	2%	5%	100%	$0.41	20	0.22
Insulation - Ducting	Cooling/Heating	0%	0%	5%	100%	$0.41	20	0.22
Insulation - Ducting	Heating	0%	0%	5%	100%	$0.41	20	0.22
Insulation - Ceiling	Cooling	5%	20%	7%	25%	$0.03	20	8.85
Insulation - Ceiling	Cooling/Heating	9%	10%	7%	25%	$0.03	20	8.85
Insulation - Ceiling	Heating	5%	5%	7%	25%	$0.03	20	8.85
Insulation - Wall Cavity	Cooling	0%	0%	10%	75%	$0.08	20	1.23
Insulation - Wall Cavity	Cooling/Heating	3%	0%	10%	75%	$0.08	20	1.23
Insulation - Wall Cavity	Heating	7%	7%	10%	75%	$0.08	20	1.23
HVAC - Duct Repair and Sealing	Cooling	2%	3%	5%	50%	$0.38	18	0.21
HVAC - Duct Repair and Sealing	Cooling/Heating	2%	3%	5%	50%	$0.38	18	0.21
HVAC - Duct Repair and Sealing	Heating	2%	3%	5%	50%	$0.38	18	0.21
Roofs - Cool Roof	Cooling	2%	3%	33%	100%	$0.04	15	1.54
Roofs - Cool Roof	Cooling/Heating	0%	0%	33%	100%	$0.04	15	1.54
Roofs - Cool Roof	Heating	0%	0%	33%	100%	$0.04	15	1.54
Windows - High Efficiency	Cooling	6%	4%	62%	100%	$0.73	20	0.44
Windows - High Efficiency	Cooling/Heating	0%	0%	62%	100%	$0.73	20	0.44
Windows - High Efficiency	Heating	6%	6%	62%	100%	$0.73	20	0.44
Energy Management System	Cooling	18%	14%	10%	85%	$0.70	14	1.37
Energy Management System	Cooling/Heating	17%	14%	10%	85%	$0.70	14	1.37
Energy Management System	Heating	12%	12%	10%	85%	$0.70	14	1.37
Energy Management System	Interior Lighting	10%	10%	10%	85%	$0.70	14	1.37
Energy Management System	Exterior Lighting	10%	10%	10%	85%	$0.70	14	1.37
Thermostat - Clock/Programmable	Cooling	6%	6%	52%	57%	$0.13	11	3.70
Thermostat - Clock/Programmable	Cooling/Heating	0%	0%	52%	57%	$0.13	11	3.70
Thermostat - Clock/Programmable	Heating	33%	33%	52%	57%	$0.13	11	3.70
Hotel - Guest Room Controls	Cooling	0%	0%	0%	0%	$0.14	8	1.03
Hotel - Guest Room Controls	Interior Lighting	15%	11%	0%	0%	$0.14	8	1.03
Interior Lighting - LED Exit Lighting	Interior Lighting	2%	2%	9%	90%	$0.00	16	47.0
Interior Lighting - Occupancy Sensors	Interior Lighting	3%	5%	14%	75%	$0.44	8	0.08
Interior Lighting - Task Lighting	Interior Lighting	2%	10%	10%	100%	$0.24	5	0.08
Interior Lighting - Time Clocks and Timers (lighting)	Interior Lighting	5%	3%	5%	75%	$0.20	8	0.37
Interior Lighting - Fluorescent Delamp and	Interior Lighting	15%	8%	0%	75%	$1.35	11	0.21

Measure	End Use	Energy Savings	Demand Savings	Base Satura-tion	Appl./ Feas.	Cost ($/sqft)	Life-time (yrs)	BC Ratio
Install Reflectors								
Interior Fluorescent - Bi-Level Fixture w/Occupancy Sensor	Interior Lighting	10%	5%	10%	30%	$0.50	8	0.04
Interior Fluorescent - Photocell-Controlled Dimming Ballasts	Interior Lighting	25%	13%	10%	60%	$0.50	8	0.11
Indoor Lighting - Daylighting Controls	Interior Lighting	5%	5%	10%	25%	$0.15	8	0.49
Lighting Retrocommissioning	Interior Lighting	6%	8%	43%	80%	$3.50	5	0.02
Lighting Retrocommissioning	Exterior Lighting	6%	3%	43%	80%	$3.50	5	0.02
Water Heating - Heat Trap	Water Heating	9%	9%	5%	25%	$2.36	-	-
Water Heating - Faucet Aerators and Low Flow Nozzles	Water Heating	4%	4%	33%	100%	$0.03	9	2.70
Water Heating - Pipe Insulation	Water Heating	6%	6%	24%	58%	$0.28	15	0.59
Water Heating - Tank Blanket	Water Heating	10%	3%	0%	0%	$0.04	10	5.49
Water Heating - Hot Water Saver	Water Heating	5%	1%	0%	100%	$0.10	5	0.59
Water Heating - High Efficiency Circulation Pump	Water Heating	0%	0%	0%	0%	$0.00	-	1.00
Water Heating - Install Timer	Water Heating	9%	9%	5%	25%	$0.04	-	-
Water Heating - Thermostat Setback	Water Heating	10%	10%	0%	100%	$0.11	10	2.00
Water Heating - Solar Water Heating System	Water Heating	70%	70%	1%	85%	$2.46	-	-
Refrigerator - Decommissioning and Recycling	Refrigeration	90%	90%	10%	50%	$0.13	8	2.41
Refrigerator - Anti-Sweat Heater	Refrigeration	5%	3%	0%	100%	$0.20	12	0.03
Refrigerator - Door Gasket Replacement	Refrigeration	4%	2%	5%	100%	$0.10	4	0.03
Display Case - LED Lighting	Refrigeration	0%	0%	0%	0%	$0.00	-	2.00
Open Display Case - Night Covers	Refrigeration	6%	3%	5%	100%	$0.05	8	0.06
Vending Machine - Controller	Refrigeration	15%	11%	2%	10%	$0.27	5	0.01
Office Electronics - Plug Load Occupancy Sensors	Office Equipment	10%	5%	13%	75%	$0.28	8	0.02
Office Electronics - ENERGY STAR Power Supplies	Office Equipment	1%	1%	10%	100%	$0.00	7	5.00
Non-HVAC Motors - Variable Speed Control	Miscellaneous	1%	0%	0%	75%	$0.10	10	0.00
Pool Pump - Timer	Miscellaneous	1%	15%	43%	64%	$0.36	10	0.00

Table C-38 Energy-Efficiency Measure Data—Large Miscellaneous, Existing Vintage

Measure	End Use	Energy Savings	Demand Savings	Base Satura-tion	Appl./ Feas.	Cost ($/sqft)	Life-time (yrs)	BC Ratio
Chiller - VSD	Cooling	32%	33%	15%	88%	$1.17	20	1.84
Chiller - Condenser Water Temperature Reset	Cooling	9%	10%	30%	100%	$0.52	4	0.16
Chiller - Economizer	Cooling	10%	0%	2%	65%	$0.15	10	2.83
Chiller - Thermal Energy Storage	Cooling	0%	25%	44%	65%	$0.15	15	1.47
Air-Cooled Chiller - High Efficiency Fans	Cooling	0%	0%	15%	44%	$0.04	10	0.01
Water-Cooled Chiller - Condenser Water Temperature Reset	Cooling	31%	10%	30%	100%	$0.57	4	0.44
Water-Cooled Chiller - Cooling Tower, High-Efficiency Fans	Cooling	0%	0%	15%	44%	$0.04	10	0.01
Heat Pump - Maintenance	Cooling/Heating	10%	14%	33%	100%	$0.06	4	2.26
RTU - Maintenance	Cooling	14%	14%	33%	100%	$0.06	4	1.86
Ventilation - Variable Speed Control	Ventilation	2%	2%	0%	0%	$0.34	10	0.02
Ventilation - CO2 Controlled	Ventilation	5%	13%	1%	20%	$0.21	10	0.08
Ventilation - Exhaust Hood Sensor Control	Ventilation	0%	0%	1%	20%	$0.03	10	-
Fans - Energy-Efficient Motors	Ventilation	1%	1%	11%	100%	$0.14	10	0.02
Pumps - High-Efficiency Motors	Cooling	0%	0%	0%	0%	$0.00	-	3.00
Pumps - High-Efficiency Motors	Cooling/Heating	0%	0%	0%	0%	$0.00	-	3.00
Pumps - High-Efficiency Motors	Heating	0%	0%	0%	0%	$0.00	-	3.00
Pumps - Variable Speed Control	Cooling	8%	0%	0%	0%	$0.13	10	1.62
Pumps - Variable Speed Control	Cooling/Heating	0%	0%	0%	0%	$0.13	10	1.62
Pumps - Variable Speed Control	Heating	5%	5%	0%	0%	$0.13	10	1.62
Insulation - Ducting	Cooling	2%	2%	18%	100%	$0.41	20	0.16
Insulation - Ducting	Cooling/Heating	1%	3%	18%	100%	$0.41	20	0.16
Insulation - Ducting	Heating	0%	0%	18%	100%	$0.41	20	0.16
Insulation - Ceiling	Cooling	11%	36%	7%	25%	$0.85	20	0.76
Insulation - Ceiling	Cooling/Heating	21%	16%	7%	25%	$0.85	20	0.76
Insulation - Ceiling	Heating	18%	18%	7%	25%	$0.85	20	0.76
Insulation - Wall Cavity	Cooling	0%	0%	23%	75%	$0.08	20	9.95
Insulation - Wall Cavity	Cooling/Heating	21%	21%	23%	75%	$0.08	20	9.95
Insulation - Wall Cavity	Heating	44%	44%	23%	75%	$0.08	20	9.95
HVAC - Duct Repair and Sealing	Cooling	1%	1%	5%	50%	$0.38	18	0.11
HVAC - Duct Repair and Sealing	Cooling/Heating	0%	0%	5%	50%	$0.38	18	0.11
HVAC - Duct Repair and Sealing	Heating	0%	0%	5%	50%	$0.38	18	0.11
Roofs - Cool Roof	Cooling	5%	7%	36%	100%	$0.08	15	1.51
Roofs - Cool Roof	Cooling/Heating	0%	0%	36%	100%	$0.08	15	1.51
Roofs - Cool Roof	Heating	0%	0%	36%	100%	$0.08	15	1.51
Windows - High Efficiency	Cooling	12%	24%	63%	100%	$0.88	20	0.63
Windows - High Efficiency	Cooling/Heating	0%	0%	63%	100%	$0.88	20	0.63
Windows - High Efficiency	Heating	11%	11%	63%	100%	$0.88	20	0.63
Energy Management System	Cooling	33%	14%	10%	85%	$0.70	14	1.98
Energy Management System	Cooling/Heating	24%	24%	10%	85%	$0.70	14	1.98
Energy Management System	Heating	28%	28%	10%	85%	$0.70	14	1.98
Energy Management System	Interior Lighting	9%	9%	10%	85%	$0.70	14	1.98
Energy Management System	Exterior Lighting	9%	9%	10%	85%	$0.70	14	1.98
Thermostat - Clock/Programmable	Cooling	8%	0%	45%	50%	$0.13	11	4.26
Thermostat - Clock/Programmable	Cooling/Heating	0%	0%	45%	50%	$0.13	11	4.26
Thermostat - Clock/Programmable	Heating	31%	31%	45%	50%	$0.13	11	4.26
Interior Lighting - LED Exit Lighting	Interior Lighting	2%	2%	9%	90%	$0.00	16	37.6
Interior Lighting - Occupancy Sensors	Interior Lighting	10%	5%	7%	75%	$0.44	8	0.27
Interior Lighting - Task Lighting	Interior Lighting	10%	10%	18%	100%	$0.24	5	0.32
Interior Lighting - Time Clocks and Timers (lighting)	Interior Lighting	5%	3%	5%	75%	$0.30	8	0.20
Interior Lighting - Fluorescent Delamp and Install Reflectors	Interior Lighting	30%	8%	15%	90%	$0.50	11	0.89
Interior Fluorescent - Bi-Level Fixture w/Occupancy Sensor	Interior Lighting	10%	5%	10%	30%	$0.50	8	0.05

Measure	End Use	Energy Savings	Demand Savings	Base Satura-tion	Appl./ Feas.	Cost ($/sqft)	Life-time (yrs)	BC Ratio
Interior Fluorescent - Photocell-Controlled Dimming Ballasts	Interior Lighting	25%	13%	9%	60%	$0.50	8	0.11
Indoor Lighting - Daylighting Controls	Interior Lighting	20%	20%	8%	25%	$0.29	8	0.82
Lighting Retrocommissioning	Interior Lighting	6%	8%	34%	80%	$0.05	5	1.18
Lighting Retrocommissioning	Exterior Lighting	6%	3%	34%	80%	$0.05	5	1.18
Water Heating - Heat Trap	Water Heating	9%	9%	5%	25%	$2.36	-	-
Water Heating - Faucet Aerators and Low Flow Nozzles	Water Heating	4%	4%	27%	100%	$0.03	9	0.86
Water Heating - Pipe Insulation	Water Heating	6%	6%	24%	58%	$0.28	15	0.19
Water Heating - Tank Blanket	Water Heating	10%	3%	0%	0%	$0.04	10	1.74
Water Heating - Hot Water Saver	Water Heating	5%	1%	0%	100%	$0.04	5	0.47
Water Heating - High Efficiency Circulation Pump	Water Heating	0%	0%	0%	0%	$0.00	-	1.00
Water Heating - Install Timer	Water Heating	9%	9%	5%	25%	$0.04	-	-
Water Heating - Thermostat Setback	Water Heating	10%	10%	5%	100%	$0.11	10	0.63
Water Heating - Solar Water Heating System	Water Heating	70%	70%	1%	85%	$2.46	-	-
Refrigerator - Decommissioning and Recycling	Refrigeration	90%	90%	10%	50%	$0.13	8	1.90
Refrigerator - Anti-Sweat Heater	Refrigeration	5%	3%	0%	100%	$0.20	12	0.03
Refrigerator - Door Gasket Replacement	Refrigeration	4%	2%	5%	100%	$0.10	4	0.02
Display Case - LED Lighting	Refrigeration	0%	0%	0%	0%	$0.00	-	2.00
Open Display Case - Night Covers	Refrigeration	6%	3%	5%	100%	$0.05	8	0.04
Vending Machine - Controller	Refrigeration	15%	11%	2%	10%	$0.27	5	0.01
Office Electronics - Plug Load Occupancy Sensors	Office Equipment	10%	5%	13%	75%	$0.30	8	0.04
Office Electronics - ENERGY STAR Power Supplies	Office Equipment	1%	1%	10%	100%	$0.00	7	10.3
Non-HVAC Motors - Variable Speed Control	Miscellaneous	1%	0%	1%	75%	$0.10	10	0.00
Pool Pump - Timer	Miscellaneous	60%	15%	1%	45%	$0.36	10	0.00

Table C-39 Energy-Efficiency Measure Data—Small Miscellaneous, Existing Vintage

Measure	End Use	Energy Savings	Demand Savings	Base Satura-tion	Appl./ Feas.	Cost ($/sqft)	Life-time (yrs)	BC Ratio
Chiller - VSD	Cooling	32%	33%	15%	88%	$1.17	20	1.32
Chiller - Condenser Water Temperature Reset	Cooling	9%	10%	30%	100%	$0.52	4	0.11
Chiller - Economizer	Cooling	10%	0%	2%	65%	$0.15	10	2.03
Chiller - Thermal Energy Storage	Cooling	0%	25%	44%	65%	$0.15	15	1.47
Air-Cooled Chiller - High Efficiency Fans	Cooling	0%	0%	15%	44%	$0.04	10	0.01
Water-Cooled Chiller - Condenser Water Temperature Reset	Cooling	31%	10%	30%	100%	$0.57	4	0.33
Water-Cooled Chiller - Cooling Tower, High-Efficiency Fans	Cooling	0%	0%	15%	44%	$0.04	10	0.01
Heat Pump - Maintenance	Cooling/Heating	10%	14%	14%	100%	$0.06	4	1.63
RTU - Maintenance	Cooling	14%	14%	14%	100%	$0.06	4	1.46
Ventilation - Variable Speed Control	Ventilation	2%	2%	0%	0%	$0.34	10	0.02
Ventilation - CO2 Controlled	Ventilation	5%	13%	1%	20%	$0.21	10	0.06
Ventilation - Exhaust Hood Sensor Control	Ventilation	0%	0%	1%	20%	$0.03	10	-
Fans - Energy-Efficient Motors	Ventilation	1%	1%	11%	100%	$0.14	10	0.02
Pumps - High-Efficiency Motors	Cooling	0%	0%	0%	0%	$0.00	-	3.00
Pumps - High-Efficiency Motors	Cooling/Heating	0%	0%	0%	0%	$0.00	-	3.00
Pumps - High-Efficiency Motors	Heating	0%	0%	0%	0%	$0.00	-	3.00
Pumps - Variable Speed Control	Cooling	8%	0%	0%	0%	$0.13	10	1.21
Pumps - Variable Speed Control	Cooling/Heating	0%	0%	0%	0%	$0.13	10	1.21
Pumps - Variable Speed Control	Heating	5%	5%	0%	0%	$0.13	10	1.21
Insulation - Ducting	Cooling	2%	2%	18%	100%	$0.41	20	0.12
Insulation - Ducting	Cooling/Heating	1%	3%	18%	100%	$0.41	20	0.12
Insulation - Ducting	Heating	0%	0%	18%	100%	$0.41	20	0.12
Insulation - Ceiling	Cooling	11%	36%	7%	25%	$0.85	20	0.55
Insulation - Ceiling	Cooling/Heating	21%	16%	7%	25%	$0.85	20	0.55
Insulation - Ceiling	Heating	18%	18%	7%	25%	$0.85	20	0.55
Insulation - Wall Cavity	Cooling	0%	0%	23%	75%	$0.08	20	6.77
Insulation - Wall Cavity	Cooling/Heating	21%	21%	23%	75%	$0.08	20	6.77
Insulation - Wall Cavity	Heating	44%	44%	23%	75%	$0.08	20	6.77
HVAC - Duct Repair and Sealing	Cooling	1%	1%	5%	50%	$0.38	18	0.08
HVAC - Duct Repair and Sealing	Cooling/Heating	0%	0%	5%	50%	$0.38	18	0.08
HVAC - Duct Repair and Sealing	Heating	0%	0%	5%	50%	$0.38	18	0.08
Roofs - Cool Roof	Cooling	5%	7%	36%	100%	$0.08	15	1.18
Roofs - Cool Roof	Cooling/Heating	0%	0%	36%	100%	$0.08	15	1.18
Roofs - Cool Roof	Heating	0%	0%	36%	100%	$0.08	15	1.18
Windows - High Efficiency	Cooling	12%	24%	63%	100%	$0.88	20	0.47
Windows - High Efficiency	Cooling/Heating	0%	0%	63%	100%	$0.88	20	0.47
Windows - High Efficiency	Heating	11%	11%	63%	100%	$0.88	20	0.47
Energy Management System	Cooling	33%	14%	10%	85%	$0.70	14	1.50
Energy Management System	Cooling/Heating	24%	24%	10%	85%	$0.70	14	1.50
Energy Management System	Heating	28%	28%	10%	85%	$0.70	14	1.50
Energy Management System	Interior Lighting	9%	9%	10%	85%	$0.70	14	1.50
Energy Management System	Exterior Lighting	9%	9%	10%	85%	$0.70	14	1.50
Thermostat - Clock/Programmable	Cooling	8%	0%	45%	50%	$0.13	11	3.02
Thermostat - Clock/Programmable	Cooling/Heating	0%	0%	45%	50%	$0.13	11	3.02
Thermostat - Clock/Programmable	Heating	31%	31%	45%	50%	$0.13	11	3.02
Interior Lighting - LED Exit Lighting	Interior Lighting	2%	2%	9%	90%	$0.00	16	30.6
Interior Lighting - Occupancy Sensors	Interior Lighting	10%	5%	7%	75%	$0.44	8	0.22
Interior Lighting - Task Lighting	Interior Lighting	10%	10%	18%	100%	$0.24	5	0.26
Interior Lighting - Time Clocks and Timers (lighting)	Interior Lighting	5%	3%	5%	75%	$0.30	8	0.16
Interior Lighting - Fluorescent Delamp and Install Reflectors	Interior Lighting	30%	8%	15%	90%	$0.50	11	0.72
Interior Fluorescent - Bi-Level Fixture	Interior Lighting	10%	5%	10%	30%	$0.50	8	0.04

Measure	End Use	Energy Savings	Demand Savings	Base Satura-tion	Appl./ Feas.	Cost ($/sqft)	Life-time (yrs)	BC Ratio
w/Occupancy Sensor								
Interior Fluorescent - Photocell-Controlled Dimming Ballasts	Interior Lighting	25%	13%	9%	60%	$0.50	8	0.09
Indoor Lighting - Daylighting Controls	Interior Lighting	20%	20%	8%	25%	$0.29	8	0.67
Lighting Retrocommissioning	Interior Lighting	6%	8%	34%	80%	$0.05	5	0.96
Lighting Retrocommissioning	Exterior Lighting	6%	3%	34%	80%	$0.05	5	0.96
Water Heating - Heat Trap	Water Heating	9%	9%	5%	25%	$2.36	-	-
Water Heating - Faucet Aerators and Low Flow Nozzles	Water Heating	4%	4%	27%	100%	$0.03	9	0.59
Water Heating - Pipe Insulation	Water Heating	6%	6%	24%	58%	$0.28	15	0.13
Water Heating - Tank Blanket	Water Heating	10%	3%	0%	0%	$0.04	10	1.20
Water Heating - Hot Water Saver	Water Heating	5%	1%	0%	100%	$0.04	5	0.32
Water Heating - High Efficiency Circulation Pump	Water Heating	0%	0%	0%	0%	$0.00	-	1.00
Water Heating - Install Timer	Water Heating	9%	9%	5%	25%	$0.04	-	-
Water Heating - Thermostat Setback	Water Heating	10%	10%	5%	100%	$0.11	10	0.44
Water Heating - Solar Water Heating System	Water Heating	70%	70%	1%	85%	$2.46	-	-
Refrigerator - Decommissioning and Recycling	Refrigeration	90%	90%	10%	50%	$0.13	8	1.35
Refrigerator - Anti-Sweat Heater	Refrigeration	5%	3%	0%	100%	$0.20	12	0.03
Refrigerator - Door Gasket Replacement	Refrigeration	4%	2%	5%	100%	$0.10	4	0.02
Display Case - LED Lighting	Refrigeration	0%	0%	0%	0%	$0.00	-	2.00
Open Display Case - Night Covers	Refrigeration	6%	3%	5%	100%	$0.05	8	0.05
Vending Machine - Controller	Refrigeration	15%	11%	2%	10%	$0.27	5	0.01
Office Electronics - Plug Load Occupancy Sensors	Office Equipment	10%	5%	13%	75%	$0.28	8	0.05
Office Electronics - ENERGY STAR Power Supplies	Office Equipment	1%	1%	10%	100%	$0.00	7	10.4
Non-HVAC Motors - Variable Speed Control	Miscellaneous	1%	0%	1%	75%	$0.10	10	0.00
Pool Pump - Timer	Miscellaneous	60%	15%	1%	45%	$0.36	10	0.01

Table C-40 Energy-Efficiency Measure Data—Large Office, Existing Vintage

Measure	End Use	Energy Savings	Demand Savings	Base Satura-tion	Appl./ Feas.	Cost ($/sqft)	Life-time (yrs)	BC Ratio
Chiller - VSD	Cooling	32%	33%	15%	88%	$1.17	20	2.41
Chiller - Condenser Water Temperature Reset	Cooling	9%	9%	30%	100%	$0.52	4	0.21
Chiller - Economizer	Cooling	9%	9%	25%	65%	$0.15	10	3.53
Chiller - Thermal Energy Storage	Cooling	0%	25%	44%	65%	$0.15	15	4.82
Air-Cooled Chiller - High Efficiency Fans	Cooling	0%	0%	15%	44%	$0.04	10	0.02
Water-Cooled Chiller - Condenser Water Temperature Reset	Cooling	31%	9%	30%	100%	$0.57	4	0.66
Water-Cooled Chiller - Cooling Tower, High-Efficiency Fans	Cooling	0%	0%	15%	44%	$0.04	10	0.02
Heat Pump - Maintenance	Cooling/Heating	11%	14%	33%	100%	$0.06	4	2.52
RTU - Maintenance	Cooling	14%	14%	33%	100%	$0.06	4	2.96
Ventilation - Variable Speed Control	Ventilation	2%	1%	0%	0%	$0.34	10	0.06
Ventilation - CO2 Controlled	Ventilation	5%	7%	1%	15%	$0.21	10	0.24
Ventilation - Exhaust Hood Sensor Control	Ventilation	0%	0%	1%	15%	$0.03	10	-
Fans - Energy-Efficient Motors	Ventilation	1%	1%	11%	100%	$0.14	10	0.06
Pumps - High-Efficiency Motors	Cooling	0%	0%	0%	0%	$0.00	-	3.00
Pumps - High-Efficiency Motors	Cooling/Heating	0%	0%	0%	0%	$0.00	-	3.00
Pumps - High-Efficiency Motors	Heating	0%	0%	0%	0%	$0.00	-	3.00
Pumps - Variable Speed Control	Cooling	8%	8%	0%	0%	$0.13	10	2.14
Pumps - Variable Speed Control	Cooling/Heating	0%	0%	0%	0%	$0.13	10	2.14
Pumps - Variable Speed Control	Heating	5%	5%	0%	0%	$0.13	10	2.14
Insulation - Ducting	Cooling	2%	2%	17%	100%	$0.41	20	0.24
Insulation - Ducting	Cooling/Heating	0%	0%	17%	100%	$0.41	20	0.24
Insulation - Ducting	Heating	0%	0%	17%	100%	$0.41	20	0.24
Insulation - Ceiling	Cooling	11%	12%	7%	25%	$0.85	20	0.89
Insulation - Ceiling	Cooling/Heating	8%	6%	7%	25%	$0.85	20	0.89
Insulation - Ceiling	Heating	18%	18%	7%	25%	$0.85	20	0.89
Insulation - Wall Cavity	Cooling	0%	0%	17%	75%	$0.08	20	6.89
Insulation - Wall Cavity	Cooling/Heating	16%	0%	17%	75%	$0.08	20	6.89
Insulation - Wall Cavity	Heating	34%	34%	17%	75%	$0.08	20	6.89
HVAC - Duct Repair and Sealing	Cooling	13%	14%	5%	50%	$0.38	18	1.95
HVAC - Duct Repair and Sealing	Cooling/Heating	14%	14%	5%	50%	$0.38	18	1.95
HVAC - Duct Repair and Sealing	Heating	15%	14%	5%	50%	$0.38	18	1.95
Roofs - Cool Roof	Cooling	5%	2%	42%	100%	$0.08	15	2.24
Roofs - Cool Roof	Cooling/Heating	0%	0%	42%	100%	$0.08	15	2.24
Roofs - Cool Roof	Heating	0%	0%	42%	100%	$0.08	15	2.24
Windows - High Efficiency	Cooling	12%	16%	75%	100%	$0.88	20	0.80
Windows - High Efficiency	Cooling/Heating	0%	0%	75%	100%	$0.88	20	0.80
Windows - High Efficiency	Heating	11%	11%	75%	100%	$0.88	20	0.80
Energy Management System	Cooling	33%	14%	8%	100%	$0.70	14	2.34
Energy Management System	Cooling/Heating	31%	17%	8%	100%	$0.70	14	2.34
Energy Management System	Heating	24%	24%	8%	100%	$0.70	14	2.34
Energy Management System	Interior Lighting	9%	9%	8%	100%	$0.70	14	2.34
Energy Management System	Exterior Lighting	9%	9%	8%	100%	$0.70	14	2.34
Thermostat - Clock/Programmable	Cooling	6%	6%	58%	63%	$0.13	11	4.24
Thermostat - Clock/Programmable	Cooling/Heating	0%	0%	58%	63%	$0.13	11	4.24
Thermostat - Clock/Programmable	Heating	33%	33%	58%	63%	$0.13	11	4.24
Interior Lighting - LED Exit Lighting	Interior Lighting	2%	2%	9%	90%	$0.00	16	43.5
Interior Lighting - Occupancy Sensors	Interior Lighting	10%	5%	25%	75%	$0.05	8	2.72
Interior Lighting - Task Lighting	Interior Lighting	10%	10%	42%	100%	$0.24	5	0.38
Interior Lighting - Time Clocks and Timers (lighting)	Interior Lighting	5%	3%	8%	75%	$0.30	8	0.23
Interior Lighting - Fluorescent Delamp and Install Reflectors	Interior Lighting	30%	8%	33%	90%	$0.50	11	1.03
Interior Fluorescent - Bi-Level Fixture	Interior Lighting	10%	5%	10%	30%	$0.40	8	0.25

Measure	End Use	Energy Savings	Demand Savings	Base Satura-tion	Appl./ Feas.	Cost ($/sqft)	Life-time (yrs)	BC Ratio
w/Occupancy Sensor								
Interior Fluorescent - Photocell-Controlled Dimming Ballasts	Interior Lighting	25%	13%	33%	60%	$0.45	8	0.55
Indoor Lighting - Daylighting Controls	Interior Lighting	10%	10%	8%	25%	$0.29	8	0.48
Lighting Retrocommissioning	Interior Lighting	6%	8%	67%	90%	$0.05	5	1.19
Lighting Retrocommissioning	Exterior Lighting	6%	3%	67%	90%	$0.05	5	1.19
Water Heating - Heat Trap	Water Heating	9%	9%	5%	25%	$2.36	-	-
Water Heating - Faucet Aerators and Low Flow Nozzles	Water Heating	4%	4%	42%	100%	$0.03	9	0.52
Water Heating - Pipe Insulation	Water Heating	6%	6%	33%	77%	$0.28	15	0.11
Water Heating - Tank Blanket	Water Heating	10%	3%	0%	0%	$0.04	10	1.06
Water Heating - Hot Water Saver	Water Heating	5%	1%	0%	100%	$0.04	5	0.29
Water Heating - High Efficiency Circulation Pump	Water Heating	0%	0%	0%	0%	$0.00	-	1.00
Water Heating - Install Timer	Water Heating	9%	9%	5%	25%	$0.04	-	-
Water Heating - Thermostat Setback	Water Heating	10%	10%	5%	100%	$0.11	10	0.38
Water Heating - Solar Water Heating System	Water Heating	70%	70%	1%	85%	$2.46	-	-
Refrigerator - Decommissioning and Recycling	Refrigeration	90%	90%	10%	50%	$0.13	8	0.98
Refrigerator - Anti-Sweat Heater	Refrigeration	5%	3%	0%	100%	$0.20	12	0.02
Refrigerator - Door Gasket Replacement	Refrigeration	4%	2%	5%	100%	$0.10	4	0.02
Display Case - LED Lighting	Refrigeration	0%	0%	0%	0%	$0.00	-	2.00
Open Display Case - Night Covers	Refrigeration	6%	3%	5%	100%	$0.05	8	0.04
Vending Machine - Controller	Refrigeration	15%	11%	2%	10%	$0.27	5	0.01
Office Electronics - Plug Load Occupancy Sensors	Office Equipment	10%	5%	13%	75%	$0.28	8	0.45
Office Electronics - ENERGY STAR Power Supplies	Office Equipment	1%	1%	10%	100%	$0.00	7	101
Non-HVAC Motors - Variable Speed Control	Miscellaneous	1%	0%	8%	75%	$0.10	10	0.00
Pool Pump - Timer	Miscellaneous	60%	15%	8%	45%	$0.36	10	-

Table C-41 Energy-Efficiency Measure Data—Small Office, Existing Vintage

Measure	End Use	Energy Savings	Demand Savings	Base Satura-tion	Appl./ Feas.	Cost ($/sqft)	Life-time (yrs)	BC Ratio
Chiller - VSD	Cooling	32%	33%	0%	0%	$1.17	20	2.28
Chiller - Condenser Water Temperature Reset	Cooling	9%	10%	0%	0%	$0.52	4	0.20
Chiller - Economizer	Cooling	11%	0%	4%	65%	$0.15	10	3.72
Chiller - Thermal Energy Storage	Cooling	0%	25%	45%	65%	$0.15	15	5.30
Air-Cooled Chiller - High Efficiency Fans	Cooling	0%	0%	0%	0%	$0.04	10	0.02
Water-Cooled Chiller - Condenser Water Temperature Reset	Cooling	31%	10%	0%	0%	$0.57	4	0.56
Water-Cooled Chiller - Cooling Tower, High-Efficiency Fans	Cooling	0%	0%	0%	0%	$0.04	10	0.02
Heat Pump - Maintenance	Cooling/Heating	10%	14%	14%	100%	$0.06	4	2.85
RTU - Maintenance	Cooling	14%	14%	14%	100%	$0.06	4	2.58
Ventilation - Variable Speed Control	Ventilation	2%	2%	0%	0%	$0.34	10	0.03
Ventilation - CO2 Controlled	Ventilation	5%	13%	1%	20%	$0.21	10	0.11
Ventilation - Exhaust Hood Sensor Control	Ventilation	0%	0%	1%	20%	$0.03	10	-
Fans - Energy-Efficient Motors	Ventilation	1%	1%	11%	100%	$0.14	10	0.03
Pumps - High-Efficiency Motors	Cooling	0%	0%	0%	0%	$0.00	-	3.00
Pumps - High-Efficiency Motors	Cooling/Heating	0%	0%	0%	0%	$0.00	-	3.00
Pumps - High-Efficiency Motors	Heating	0%	0%	0%	0%	$0.00	-	3.00
Pumps - Variable Speed Control	Cooling	8%	0%	0%	0%	$0.13	10	2.10
Pumps - Variable Speed Control	Cooling/Heating	0%	0%	0%	0%	$0.13	10	2.10
Pumps - Variable Speed Control	Heating	5%	5%	0%	0%	$0.13	10	2.10
Insulation - Ducting	Cooling	2%	2%	15%	100%	$0.41	20	0.22
Insulation - Ducting	Cooling/Heating	1%	3%	15%	100%	$0.41	20	0.22
Insulation - Ducting	Heating	0%	0%	15%	100%	$0.41	20	0.22
Insulation - Ceiling	Cooling	11%	36%	7%	25%	$0.85	20	0.94
Insulation - Ceiling	Cooling/Heating	21%	16%	7%	25%	$0.85	20	0.94
Insulation - Ceiling	Heating	18%	18%	7%	25%	$0.85	20	0.94
Insulation - Wall Cavity	Cooling	0%	0%	16%	75%	$0.08	20	10.9
Insulation - Wall Cavity	Cooling/Heating	21%	21%	16%	75%	$0.08	20	10.9
Insulation - Wall Cavity	Heating	44%	44%	16%	75%	$0.08	20	10.9
HVAC - Duct Repair and Sealing	Cooling	13%	14%	5%	50%	$0.38	18	2.12
HVAC - Duct Repair and Sealing	Cooling/Heating	15%	14%	5%	50%	$0.38	18	2.12
HVAC - Duct Repair and Sealing	Heating	17%	15%	5%	50%	$0.38	18	2.12
Roofs - Cool Roof	Cooling	5%	7%	42%	100%	$0.08	15	2.07
Roofs - Cool Roof	Cooling/Heating	0%	0%	42%	100%	$0.08	15	2.07
Roofs - Cool Roof	Heating	0%	0%	42%	100%	$0.08	15	2.07
Windows - High Efficiency	Cooling	12%	24%	67%	100%	$0.88	20	0.81
Windows - High Efficiency	Cooling/Heating	0%	0%	67%	100%	$0.88	20	0.81
Windows - High Efficiency	Heating	11%	11%	67%	100%	$0.88	20	0.81
Energy Management System	Cooling	33%	14%	6%	85%	$0.70	14	2.35
Energy Management System	Cooling/Heating	31%	24%	6%	85%	$0.70	14	2.35
Energy Management System	Heating	24%	24%	6%	85%	$0.70	14	2.35
Energy Management System	Interior Lighting	9%	9%	6%	85%	$0.70	14	2.35
Energy Management System	Exterior Lighting	9%	9%	6%	85%	$0.70	14	2.35
Thermostat - Clock/Programmable	Cooling	8%	0%	58%	63%	$0.13	11	5.03
Thermostat - Clock/Programmable	Cooling/Heating	0%	0%	58%	63%	$0.13	11	5.03
Thermostat - Clock/Programmable	Heating	31%	31%	58%	63%	$0.13	11	5.03
Interior Lighting - LED Exit Lighting	Interior Lighting	2%	2%	9%	90%	$0.00	16	42.4
Interior Lighting - Occupancy Sensors	Interior Lighting	10%	5%	5%	75%	$0.05	8	2.66
Interior Lighting - Task Lighting	Interior Lighting	10%	10%	17%	100%	$0.24	5	0.37
Interior Lighting - Time Clocks and Timers (lighting)	Interior Lighting	5%	3%	5%	75%	$0.30	8	0.22
Interior Lighting - Fluorescent Delamp and Install Reflectors	Interior Lighting	30%	8%	15%	90%	$0.50	11	1.01
Interior Fluorescent - Bi-Level Fixture	Interior Lighting	10%	5%	10%	30%	$0.50	8	0.16

Measure	End Use	Energy Savings	Demand Savings	Base Satura-tion	Appl./ Feas.	Cost ($/sqft)	Life-time (yrs)	BC Ratio
w/Occupancy Sensor								
Interior Fluorescent - Photocell-Controlled Dimming Ballasts	Interior Lighting	25%	13%	11%	60%	$0.50	8	0.40
Indoor Lighting - Daylighting Controls	Interior Lighting	10%	10%	11%	100%	$0.29	8	0.47
Lighting Retrocommissioning	Interior Lighting	6%	8%	26%	80%	$0.05	5	1.24
Lighting Retrocommissioning	Exterior Lighting	6%	3%	26%	80%	$0.05	5	1.24
Water Heating - Heat Trap	Water Heating	9%	9%	5%	25%	$2.36	-	-
Water Heating - Faucet Aerators and Low Flow Nozzles	Water Heating	4%	4%	26%	100%	$0.03	9	0.45
Water Heating - Pipe Insulation	Water Heating	6%	6%	16%	100%	$0.28	15	0.10
Water Heating - Tank Blanket	Water Heating	10%	3%	40%	100%	$0.04	10	0.91
Water Heating - Hot Water Saver	Water Heating	5%	1%	0%	100%	$0.04	5	0.25
Water Heating - High Efficiency Circulation Pump	Water Heating	0%	0%	0%	0%	$0.00	-	1.00
Water Heating - Install Timer	Water Heating	9%	9%	5%	25%	$0.04	-	-
Water Heating - Thermostat Setback	Water Heating	10%	10%	5%	100%	$0.11	10	0.33
Water Heating - Solar Water Heating System	Water Heating	70%	70%	1%	85%	$2.46	-	-
Refrigerator - Decommissioning and Recycling	Refrigeration	90%	90%	10%	50%	$0.13	8	1.25
Refrigerator - Anti-Sweat Heater	Refrigeration	5%	3%	0%	100%	$0.20	12	-
Refrigerator - Door Gasket Replacement	Refrigeration	4%	2%	5%	100%	$0.10	4	0.01
Display Case - LED Lighting	Refrigeration	0%	0%	0%	0%	$0.00	-	2.00
Open Display Case - Night Covers	Refrigeration	6%	3%	5%	100%	$0.05	8	-
Vending Machine - Controller	Refrigeration	15%	11%	2%	10%	$0.27	5	0.02
Office Electronics - Plug Load Occupancy Sensors	Office Equipment	10%	5%	7%	75%	$0.20	8	0.40
Office Electronics - ENERGY STAR Power Supplies	Office Equipment	1%	1%	10%	100%	$0.00	7	64.3
Non-HVAC Motors - Variable Speed Control	Miscellaneous	1%	0%	2%	75%	$0.10	10	0.01
Pool Pump - Timer	Miscellaneous	60%	15%	2%	45%	$0.36	10	-

Table C-42 Energy-Efficiency Measure Data—Restaurant, Existing Vintage

Measure	End Use	Energy Savings	Demand Savings	Base Satura-tion	Appl./ Feas.	Cost ($/sqft)	Life-time (yrs)	BC Ratio
Chiller - VSD	Cooling	26%	32%	0%	0%	$1.17	20	5.73
Chiller - Condenser Water Temperature Reset	Cooling	10%	7%	0%	0%	$1.75	4	0.19
Chiller - Economizer	Cooling	10%	2%	0%	65%	$0.15	10	10.8
Chiller - Thermal Energy Storage	Cooling	0%	25%	45%	65%	$0.15	15	7.74
Air-Cooled Chiller - High Efficiency Fans	Cooling	0%	0%	0%	0%	$0.04	10	0.06
Water-Cooled Chiller - Condenser Water Temperature Reset	Cooling	14%	7%	0%	0%	$1.73	4	0.27
Water-Cooled Chiller - Cooling Tower, High-Efficiency Fans	Cooling	0%	0%	0%	0%	$0.04	10	0.06
Heat Pump - Maintenance	Cooling/Heating	14%	14%	14%	100%	$0.06	4	5.90
RTU - Maintenance	Cooling	14%	15%	14%	100%	$0.08	4	4.37
Ventilation - Variable Speed Control	Ventilation	2%	2%	0%	0%	$0.34	10	0.10
Ventilation - CO2 Controlled	Ventilation	1%	13%	1%	20%	$1.60	10	0.01
Ventilation - Exhaust Hood Sensor Control	Ventilation	25%	13%	1%	20%	$0.08	10	4.49
Fans - Energy-Efficient Motors	Ventilation	1%	1%	11%	100%	$0.14	10	0.07
Pumps - High-Efficiency Motors	Cooling	0%	0%	0%	0%	$0.00	-	3.00
Pumps - High-Efficiency Motors	Cooling/Heating	0%	0%	0%	0%	$0.00	-	3.00
Pumps - High-Efficiency Motors	Heating	0%	0%	0%	0%	$0.00	-	3.00
Pumps - Variable Speed Control	Cooling	8%	8%	0%	0%	$0.44	10	1.18
Pumps - Variable Speed Control	Cooling/Heating	0%	0%	0%	0%	$0.44	10	1.18
Pumps - Variable Speed Control	Heating	4%	4%	0%	0%	$0.44	10	1.18
Insulation - Ducting	Cooling	1%	3%	11%	100%	$0.41	20	0.29
Insulation - Ducting	Cooling/Heating	0%	5%	11%	100%	$0.41	20	0.29
Insulation - Ducting	Heating	0%	0%	11%	100%	$0.41	20	0.29
Insulation - Ceiling	Cooling	17%	31%	7%	25%	$0.11	20	16.7
Insulation - Ceiling	Cooling/Heating	9%	13%	7%	25%	$0.11	20	16.7
Insulation - Ceiling	Heating	15%	15%	7%	25%	$0.11	20	16.7
Insulation - Wall Cavity	Cooling	0%	0%	11%	75%	$0.08	20	12.8
Insulation - Wall Cavity	Cooling/Heating	0%	0%	11%	75%	$0.08	20	12.8
Insulation - Wall Cavity	Heating	40%	40%	11%	75%	$0.08	20	12.8
HVAC - Duct Repair and Sealing	Cooling	10%	11%	5%	50%	$0.38	18	2.69
HVAC - Duct Repair and Sealing	Cooling/Heating	10%	11%	5%	50%	$0.38	18	2.69
HVAC - Duct Repair and Sealing	Heating	10%	11%	5%	50%	$0.38	18	2.69
Roofs - Cool Roof	Cooling	4%	7%	36%	100%	$0.05	15	5.69
Roofs - Cool Roof	Cooling/Heating	0%	0%	36%	100%	$0.05	15	5.69
Roofs - Cool Roof	Heating	0%	0%	36%	100%	$0.05	15	5.69
Windows - High Efficiency	Cooling	9%	19%	54%	100%	$2.00	20	0.44
Windows - High Efficiency	Cooling/Heating	0%	0%	54%	100%	$2.00	20	0.44
Windows - High Efficiency	Heating	3%	3%	54%	100%	$2.00	20	0.44
Energy Management System	Cooling	8%	14%	7%	85%	$0.70	14	1.58
Energy Management System	Cooling/Heating	8%	13%	7%	85%	$0.70	14	1.58
Energy Management System	Heating	6%	6%	7%	85%	$0.70	14	1.58
Energy Management System	Interior Lighting	9%	9%	7%	85%	$0.70	14	1.58
Energy Management System	Exterior Lighting	9%	9%	7%	85%	$0.70	14	1.58
Thermostat - Clock/Programmable	Cooling	3%	3%	50%	50%	$0.13	11	2.02
Thermostat - Clock/Programmable	Cooling/Heating	0%	0%	50%	50%	$0.13	11	2.02
Thermostat - Clock/Programmable	Heating	6%	6%	50%	50%	$0.13	11	2.02
Interior Lighting - LED Exit Lighting	Interior Lighting	2%	2%	9%	90%	$0.00	16	79.8
Interior Lighting - Occupancy Sensors	Interior Lighting	10%	5%	0%	75%	$0.44	8	0.57
Interior Lighting - Task Lighting	Interior Lighting	1%	10%	4%	100%	$0.24	5	0.07
Interior Lighting - Time Clocks and Timers (lighting)	Interior Lighting	5%	3%	4%	75%	$0.20	8	0.63
Interior Lighting - Fluorescent Delamp and Install Reflectors	Interior Lighting	15%	8%	7%	75%	$0.55	11	0.87
Interior Fluorescent - Bi-Level Fixture w/Occupancy Sensor	Interior Lighting	10%	5%	10%	30%	$0.50	8	0.10

Measure	End Use	Energy Savings	Demand Savings	Base Satura-tion	Appl./ Feas.	Cost ($/sqft)	Life-time (yrs)	BC Ratio
Interior Fluorescent - Photocell-Controlled Dimming Ballasts	Interior Lighting	25%	13%	0%	60%	$0.50	8	0.26
Indoor Lighting - Daylighting Controls	Interior Lighting	5%	5%	0%	100%	$0.34	8	0.37
Lighting Retrocommissioning	Interior Lighting	6%	8%	11%	80%	$3.50	5	0.04
Lighting Retrocommissioning	Exterior Lighting	6%	3%	11%	80%	$3.50	5	0.04
Water Heating - Heat Trap	Water Heating	0%	0%	5%	25%	$2.36	-	-
Water Heating - Faucet Aerators and Low Flow Nozzles	Water Heating	4%	4%	29%	100%	$0.03	9	6.19
Water Heating - Pipe Insulation	Water Heating	6%	6%	11%	100%	$0.28	15	1.36
Water Heating - Tank Blanket	Water Heating	10%	3%	40%	100%	$0.04	10	12.6
Water Heating - Hot Water Saver	Water Heating	5%	1%	0%	100%	$0.04	5	3.41
Water Heating - High Efficiency Circulation Pump	Water Heating	0%	0%	0%	0%	$0.00	-	1.00
Water Heating - Install Timer	Water Heating	9%	9%	5%	25%	$0.10	-	-
Water Heating - Thermostat Setback	Water Heating	10%	10%	5%	100%	$0.05	10	10.1
Water Heating - Solar Water Heating System	Water Heating	70%	70%	1%	85%	$2.46	-	-
Refrigerator - Decommissioning and Recycling	Refrigeration	90%	90%	10%	50%	$0.13	8	21.6
Refrigerator - Anti-Sweat Heater	Refrigeration	5%	3%	0%	100%	$0.20	12	0.30
Refrigerator - Door Gasket Replacement	Refrigeration	4%	2%	5%	100%	$0.10	4	0.24
Display Case - LED Lighting	Refrigeration	0%	0%	0%	0%	$0.00	-	2.00
Open Display Case - Night Covers	Refrigeration	6%	3%	5%	100%	$0.05	8	0.52
Vending Machine - Controller	Refrigeration	15%	11%	2%	10%	$0.27	5	0.07
Office Electronics - Plug Load Occupancy Sensors	Office Equipment	10%	5%	7%	75%	$0.30	8	0.07
Office Electronics - ENERGY STAR Power Supplies	Office Equipment	1%	1%	10%	100%	$0.00	7	18.0
Non-HVAC Motors - Variable Speed Control	Miscellaneous	1%	0%	0%	75%	$0.10	10	0.03
Pool Pump - Timer	Miscellaneous	60%	15%	0%	45%	$0.36	10	-

Table C-43 Energy-Efficiency Measure Data—Large Retail, Existing Vintage

Measure	End Use	Energy Savings	Demand Savings	Base Satura-tion	Appl./ Feas.	Cost ($/sqft)	Life-time (yrs)	BC Ratio
Chiller - VSD	Cooling	27%	33%	0%	0%	$1.17	20	1.68
Chiller - Condenser Water Temperature Reset	Cooling	10%	7%	0%	0%	$0.87	4	0.11
Chiller - Economizer	Cooling	10%	0%	4%	65%	$0.15	10	3.20
Chiller - Thermal Energy Storage	Cooling	0%	25%	45%	65%	$0.15	15	4.54
Air-Cooled Chiller - High Efficiency Fans	Cooling	0%	0%	0%	0%	$0.04	10	0.02
Water-Cooled Chiller - Condenser Water Temperature Reset	Cooling	14%	7%	0%	0%	$0.86	4	0.14
Water-Cooled Chiller - Cooling Tower, High-Efficiency Fans	Cooling	0%	0%	0%	0%	$0.04	10	0.02
Heat Pump - Maintenance	Cooling/Heating	12%	14%	33%	100%	$0.03	4	4.75
RTU - Maintenance	Cooling	14%	15%	33%	100%	$0.08	4	1.42
Ventilation - Variable Speed Control	Ventilation	1%	1%	0%	0%	$0.34	10	0.01
Ventilation - CO2 Controlled	Ventilation	2%	13%	1%	20%	$1.60	10	0.00
Ventilation - Exhaust Hood Sensor Control	Ventilation	0%	0%	1%	20%	$0.04	10	-
Fans - Energy-Efficient Motors	Ventilation	1%	1%	11%	100%	$0.14	10	0.01
Pumps - High-Efficiency Motors	Cooling	0%	0%	0%	0%	$1.36	-	-
Pumps - High-Efficiency Motors	Cooling/Heating	0%	0%	0%	0%	$1.36	-	-
Pumps - High-Efficiency Motors	Heating	0%	0%	0%	0%	$1.36	-	-
Pumps - Variable Speed Control	Cooling	8%	0%	0%	0%	$0.44	10	0.45
Pumps - Variable Speed Control	Cooling/Heating	0%	0%	0%	0%	$0.44	10	0.45
Pumps - Variable Speed Control	Heating	4%	4%	0%	0%	$0.44	10	0.45
Insulation - Ducting	Cooling	3%	3%	21%	100%	$0.41	20	0.37
Insulation - Ducting	Cooling/Heating	1%	3%	21%	100%	$0.41	20	0.37
Insulation - Ducting	Heating	3%	3%	21%	100%	$0.41	20	0.37
Insulation - Ceiling	Cooling	17%	44%	7%	25%	$0.64	20	1.35
Insulation - Ceiling	Cooling/Heating	33%	22%	7%	25%	$0.64	20	1.35
Insulation - Ceiling	Heating	22%	22%	7%	25%	$0.64	20	1.35
Insulation - Wall Cavity	Cooling	0%	0%	14%	75%	$0.34	20	3.84
Insulation - Wall Cavity	Cooling/Heating	48%	20%	14%	75%	$0.34	20	3.84
Insulation - Wall Cavity	Heating	82%	82%	14%	75%	$0.34	20	3.84
HVAC - Duct Repair and Sealing	Cooling	8%	4%	5%	50%	$0.38	18	0.94
HVAC - Duct Repair and Sealing	Cooling/Heating	9%	6%	5%	50%	$0.38	18	0.94
HVAC - Duct Repair and Sealing	Heating	9%	7%	5%	50%	$0.38	18	0.94
Roofs - Cool Roof	Cooling	4%	14%	58%	100%	$0.18	15	0.54
Roofs - Cool Roof	Cooling/Heating	0%	0%	58%	100%	$0.18	15	0.54
Roofs - Cool Roof	Heating	0%	0%	58%	100%	$0.18	15	0.54
Windows - High Efficiency	Cooling	5%	0%	45%	100%	$0.44	20	0.41
Windows - High Efficiency	Cooling/Heating	0%	0%	45%	100%	$0.44	20	0.41
Windows - High Efficiency	Heating	3%	3%	45%	100%	$0.44	20	0.41
Energy Management System	Cooling	8%	14%	8%	100%	$0.70	14	0.72
Energy Management System	Cooling/Heating	8%	6%	8%	100%	$0.70	14	0.72
Energy Management System	Heating	6%	6%	8%	100%	$0.70	14	0.72
Energy Management System	Interior Lighting	9%	9%	8%	100%	$0.70	14	0.72
Energy Management System	Exterior Lighting	9%	9%	8%	100%	$0.70	14	0.72
Thermostat - Clock/Programmable	Cooling	7%	0%	44%	50%	$0.13	11	4.58
Thermostat - Clock/Programmable	Cooling/Heating	0%	0%	44%	50%	$0.13	11	4.58
Thermostat - Clock/Programmable	Heating	41%	41%	44%	50%	$0.13	11	4.58
Interior Lighting - LED Exit Lighting	Interior Lighting	2%	2%	9%	90%	$0.00	16	47.6
Interior Lighting - Occupancy Sensors	Interior Lighting	10%	5%	4%	75%	$0.44	8	0.34
Interior Lighting - Task Lighting	Interior Lighting	1%	10%	12%	100%	$0.24	5	0.04
Interior Lighting - Time Clocks and Timers (lighting)	Interior Lighting	5%	3%	4%	75%	$0.20	8	0.37
Interior Lighting - Fluorescent Delamp and Install Reflectors	Interior Lighting	20%	8%	10%	60%	$0.55	11	0.68
Interior Fluorescent - Bi-Level Fixture w/Occupancy Sensor	Interior Lighting	10%	5%	10%	30%	$0.50	8	0.13

Measure	End Use	Energy Savings	Demand Savings	Base Satura-tion	Appl./ Feas.	Cost ($/sqft)	Life-time (yrs)	BC Ratio
Interior Fluorescent - Photocell-Controlled Dimming Ballasts	Interior Lighting	25%	13%	8%	60%	$0.50	8	0.33
Indoor Lighting - Daylighting Controls	Interior Lighting	10%	10%	14%	100%	$0.11	8	1.35
Lighting Retrocommissioning	Interior Lighting	6%	8%	32%	90%	$0.04	5	1.69
Lighting Retrocommissioning	Exterior Lighting	6%	3%	32%	90%	$0.04	5	1.69
Water Heating - Heat Trap	Water Heating	9%	9%	5%	25%	$2.36	-	-
Water Heating - Faucet Aerators and Low Flow Nozzles	Water Heating	4%	4%	23%	100%	$0.01	9	1.19
Water Heating - Pipe Insulation	Water Heating	6%	6%	10%	100%	$0.28	15	0.09
Water Heating - Tank Blanket	Water Heating	10%	3%	40%	100%	$0.02	10	1.61
Water Heating - Hot Water Saver	Water Heating	5%	1%	0%	100%	$0.04	5	0.22
Water Heating - High Efficiency Circulation Pump	Water Heating	0%	0%	0%	0%	$0.00	-	1.00
Water Heating - Install Timer	Water Heating	9%	9%	5%	25%	$0.04	-	-
Water Heating - Thermostat Setback	Water Heating	10%	10%	10%	100%	$0.11	10	0.29
Water Heating - Solar Water Heating System	Water Heating	70%	70%	1%	85%	$2.46	-	-
Refrigerator - Decommissioning and Recycling	Refrigeration	90%	90%	10%	50%	$0.13	8	2.41
Refrigerator - Anti-Sweat Heater	Refrigeration	5%	3%	0%	100%	$0.20	12	0.03
Refrigerator - Door Gasket Replacement	Refrigeration	4%	2%	5%	100%	$0.10	4	0.02
Display Case - LED Lighting	Refrigeration	0%	0%	0%	0%	$0.00	-	2.00
Open Display Case - Night Covers	Refrigeration	6%	3%	5%	100%	$0.05	8	0.05
Vending Machine - Controller	Refrigeration	15%	11%	2%	10%	$0.27	5	0.01
Office Electronics - Plug Load Occupancy Sensors	Office Equipment	10%	5%	7%	75%	$0.30	8	0.06
Office Electronics - ENERGY STAR Power Supplies	Office Equipment	1%	1%	10%	100%	$0.00	7	13.3
Non-HVAC Motors - Variable Speed Control	Miscellaneous	1%	0%	0%	75%	$0.10	10	0.00
Pool Pump - Timer	Miscellaneous	60%	15%	0%	45%	$0.36	10	-

Table C-44 Energy-Efficiency Measure Data—Small Retail, Existing Vintage

Measure	End Use	Energy Savings	Demand Savings	Base Satura-tion	Appl./ Feas.	Cost ($/sqft)	Life-time (yrs)	BC Ratio
Chiller - VSD	Cooling	27%	33%	0%	0%	$1.17	20	1.47
Chiller - Condenser Water Temperature Reset	Cooling	10%	7%	0%	0%	$0.87	4	0.09
Chiller - Economizer	Cooling	8%	0%	4%	65%	$0.15	10	2.37
Chiller - Thermal Energy Storage	Cooling	0%	25%	45%	65%	$0.15	15	4.54
Air-Cooled Chiller - High Efficiency Fans	Cooling	0%	0%	0%	0%	$0.04	10	0.02
Water-Cooled Chiller - Condenser Water Temperature Reset	Cooling	14%	7%	0%	0%	$0.86	4	0.13
Water-Cooled Chiller - Cooling Tower, High-Efficiency Fans	Cooling	0%	0%	0%	0%	$0.04	10	0.02
Heat Pump - Maintenance	Cooling/Heating	12%	14%	14%	100%	$0.03	4	4.98
RTU - Maintenance	Cooling	14%	15%	14%	100%	$0.08	4	1.45
Ventilation - Variable Speed Control	Ventilation	1%	1%	0%	0%	$0.34	10	0.02
Ventilation - CO2 Controlled	Ventilation	2%	13%	1%	20%	$1.60	10	0.01
Ventilation - Exhaust Hood Sensor Control	Ventilation	0%	0%	1%	20%	$0.04	10	-
Fans - Energy-Efficient Motors	Ventilation	1%	1%	11%	100%	$0.14	10	0.01
Pumps - High-Efficiency Motors	Cooling	0%	0%	0%	0%	$1.36	-	-
Pumps - High-Efficiency Motors	Cooling/Heating	0%	0%	0%	0%	$1.36	-	-
Pumps - High-Efficiency Motors	Heating	0%	0%	0%	0%	$1.36	-	-
Pumps - Variable Speed Control	Cooling	8%	0%	0%	0%	$0.44	10	0.47
Pumps - Variable Speed Control	Cooling/Heating	0%	0%	0%	0%	$0.44	10	0.47
Pumps - Variable Speed Control	Heating	4%	4%	0%	0%	$0.44	10	0.47
Insulation - Ducting	Cooling	3%	3%	21%	100%	$0.41	20	0.40
Insulation - Ducting	Cooling/Heating	1%	3%	21%	100%	$0.41	20	0.40
Insulation - Ducting	Heating	3%	3%	21%	100%	$0.41	20	0.40
Insulation - Ceiling	Cooling	17%	44%	7%	25%	$0.64	20	1.46
Insulation - Ceiling	Cooling/Heating	33%	22%	7%	25%	$0.64	20	1.46
Insulation - Ceiling	Heating	22%	22%	7%	25%	$0.64	20	1.46
Insulation - Wall Cavity	Cooling	0%	0%	14%	75%	$0.34	20	4.45
Insulation - Wall Cavity	Cooling/Heating	48%	20%	14%	75%	$0.34	20	4.45
Insulation - Wall Cavity	Heating	82%	82%	14%	75%	$0.34	20	4.45
HVAC - Duct Repair and Sealing	Cooling	8%	4%	5%	50%	$0.38	18	1.12
HVAC - Duct Repair and Sealing	Cooling/Heating	10%	9%	5%	50%	$0.38	18	1.12
HVAC - Duct Repair and Sealing	Heating	12%	14%	5%	50%	$0.38	18	1.12
Roofs - Cool Roof	Cooling	4%	14%	58%	100%	$0.18	15	0.55
Roofs - Cool Roof	Cooling/Heating	0%	0%	58%	100%	$0.18	15	0.55
Roofs - Cool Roof	Heating	0%	0%	58%	100%	$0.18	15	0.55
Windows - High Efficiency	Cooling	5%	0%	45%	100%	$0.44	20	0.43
Windows - High Efficiency	Cooling/Heating	0%	0%	45%	100%	$0.44	20	0.43
Windows - High Efficiency	Heating	3%	3%	45%	100%	$0.44	20	0.43
Energy Management System	Cooling	8%	14%	8%	85%	$0.70	14	0.75
Energy Management System	Cooling/Heating	8%	6%	8%	85%	$0.70	14	0.75
Energy Management System	Heating	6%	6%	8%	85%	$0.70	14	0.75
Energy Management System	Interior Lighting	9%	9%	8%	85%	$0.70	14	0.75
Energy Management System	Exterior Lighting	9%	9%	8%	85%	$0.70	14	0.75
Thermostat - Clock/Programmable	Cooling	7%	0%	44%	50%	$0.13	11	5.20
Thermostat - Clock/Programmable	Cooling/Heating	0%	0%	44%	50%	$0.13	11	5.20
Thermostat - Clock/Programmable	Heating	41%	41%	44%	50%	$0.13	11	5.20
Interior Lighting - LED Exit Lighting	Interior Lighting	2%	2%	9%	90%	$0.00	16	50.9
Interior Lighting - Occupancy Sensors	Interior Lighting	10%	5%	4%	75%	$0.44	8	0.36
Interior Lighting - Task Lighting	Interior Lighting	1%	10%	12%	100%	$0.24	5	0.04
Interior Lighting - Time Clocks and Timers (lighting)	Interior Lighting	5%	3%	4%	75%	$0.20	8	0.40
Interior Lighting - Fluorescent Delamp and Install Reflectors	Interior Lighting	20%	8%	10%	60%	$0.55	11	0.73
Interior Fluorescent - Bi-Level Fixture w/Occupancy Sensor	Interior Lighting	10%	5%	10%	30%	$0.50	8	0.14

Measure	End Use	Energy Savings	Demand Savings	Base Satura-tion	Appl./ Feas.	Cost ($/sqft)	Life-time (yrs)	BC Ratio
Interior Fluorescent - Photocell-Controlled Dimming Ballasts	Interior Lighting	25%	13%	8%	60%	$0.50	8	0.35
Indoor Lighting - Daylighting Controls	Interior Lighting	10%	10%	14%	100%	$0.11	8	1.44
Lighting Retrocommissioning	Interior Lighting	6%	8%	32%	90%	$0.04	5	1.75
Lighting Retrocommissioning	Exterior Lighting	6%	3%	32%	90%	$0.04	5	1.75
Water Heating - Heat Trap	Water Heating	9%	9%	5%	25%	$2.36	-	-
Water Heating - Faucet Aerators and Low Flow Nozzles	Water Heating	4%	4%	23%	100%	$0.01	9	1.23
Water Heating - Pipe Insulation	Water Heating	6%	6%	10%	100%	$0.28	15	0.09
Water Heating - Tank Blanket	Water Heating	10%	3%	40%	100%	$0.02	10	1.67
Water Heating - Hot Water Saver	Water Heating	5%	1%	0%	100%	$0.04	5	0.22
Water Heating - High Efficiency Circulation Pump	Water Heating	0%	0%	0%	0%	$0.00	-	1.00
Water Heating - Install Timer	Water Heating	9%	9%	5%	25%	$0.04	-	-
Water Heating - Thermostat Setback	Water Heating	10%	10%	10%	100%	$0.11	10	0.30
Water Heating - Solar Water Heating System	Water Heating	70%	70%	1%	85%	$2.46	-	-
Refrigerator - Decommissioning and Recycling	Refrigeration	90%	90%	10%	50%	$0.13	8	2.05
Refrigerator - Anti-Sweat Heater	Refrigeration	5%	3%	0%	100%	$0.20	12	0.05
Refrigerator - Door Gasket Replacement	Refrigeration	4%	2%	5%	100%	$0.10	4	0.04
Display Case - LED Lighting	Refrigeration	0%	0%	0%	0%	$0.00	-	2.00
Open Display Case - Night Covers	Refrigeration	6%	3%	5%	100%	$0.05	8	0.08
Vending Machine - Controller	Refrigeration	15%	11%	2%	10%	$0.27	5	0.01
Office Electronics - Plug Load Occupancy Sensors	Office Equipment	10%	5%	7%	75%	$0.30	8	0.05
Office Electronics - ENERGY STAR Power Supplies	Office Equipment	1%	1%	10%	100%	$0.00	7	10.8
Non-HVAC Motors - Variable Speed Control	Miscellaneous	1%	0%	0%	75%	$0.10	10	0.01
Pool Pump - Timer	Miscellaneous	60%	15%	0%	45%	$0.36	10	-

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

Measure	End Use	Energy Savings	Demand Savings	Base Satura-tion	Appl./ Feas.	Cost ($/sqft)	Life-time (yrs)	BC Ratio
Chiller - VSD	Cooling	32%	33%	15%	88%	$1.17	20	1.32
Chiller - Condenser Water Temperature Reset	Cooling	9%	7%	30%	100%	$0.52	4	0.12
Chiller - Economizer	Cooling	10%	0%	0%	65%	$0.15	10	2.03
Chiller - Thermal Energy Storage	Cooling	0%	25%	44%	65%	$0.15	15	1.47
Air-Cooled Chiller - High Efficiency Fans	Cooling	0%	0%	15%	44%	$0.04	10	0.01
Water-Cooled Chiller - Condenser Water Temperature Reset	Cooling	31%	7%	30%	100%	$0.57	4	0.31
Water-Cooled Chiller - Cooling Tower, High-Efficiency Fans	Cooling	0%	0%	15%	44%	$0.04	10	0.01
Heat Pump - Maintenance	Cooling/Heating	12%	14%	14%	100%	$0.06	4	2.34
RTU - Maintenance	Cooling	14%	15%	14%	100%	$0.06	4	1.24
Ventilation - Variable Speed Control	Ventilation	2%	2%	0%	0%	$0.34	10	0.01
Ventilation - CO2 Controlled	Ventilation	5%	7%	1%	10%	$0.21	10	0.02
Ventilation - Exhaust Hood Sensor Control	Ventilation	0%	0%	1%	10%	$0.03	10	-
Fans - Energy-Efficient Motors	Ventilation	1%	1%	11%	100%	$0.14	10	0.01
Pumps - High-Efficiency Motors	Cooling	0%	0%	0%	0%	$0.00	-	3.00
Pumps - High-Efficiency Motors	Cooling/Heating	0%	0%	0%	0%	$0.00	-	3.00
Pumps - High-Efficiency Motors	Heating	0%	0%	0%	0%	$0.00	-	3.00
Pumps - Variable Speed Control	Cooling	8%	0%	0%	0%	$0.13	10	1.39
Pumps - Variable Speed Control	Cooling/Heating	0%	0%	0%	0%	$0.13	10	1.39
Pumps - Variable Speed Control	Heating	5%	5%	0%	0%	$0.13	10	1.39
Insulation - Ducting	Cooling	2%	3%	15%	100%	$0.41	20	0.10
Insulation - Ducting	Cooling/Heating	1%	3%	15%	100%	$0.41	20	0.10
Insulation - Ducting	Heating	0%	0%	15%	100%	$0.41	20	0.10
Insulation - Ceiling	Cooling	11%	44%	7%	25%	$0.85	20	0.78
Insulation - Ceiling	Cooling/Heating	33%	22%	7%	25%	$0.85	20	0.78
Insulation - Ceiling	Heating	18%	18%	7%	25%	$0.85	20	0.78
Insulation - Wall Cavity	Cooling	0%	19%	10%	75%	$0.08	20	25.9
Insulation - Wall Cavity	Cooling/Heating	48%	20%	10%	75%	$0.08	20	25.9
Insulation - Wall Cavity	Heating	82%	82%	10%	75%	$0.08	20	25.9
HVAC - Duct Repair and Sealing	Cooling	8%	4%	5%	50%	$0.38	18	0.96
HVAC - Duct Repair and Sealing	Cooling/Heating	9%	6%	5%	50%	$0.38	18	0.96
HVAC - Duct Repair and Sealing	Heating	9%	7%	5%	50%	$0.38	18	0.96
Roofs - Cool Roof	Cooling	5%	14%	50%	100%	$0.08	15	0.98
Roofs - Cool Roof	Cooling/Heating	0%	0%	50%	100%	$0.08	15	0.98
Roofs - Cool Roof	Heating	0%	0%	50%	100%	$0.08	15	0.98
Windows - High Efficiency	Cooling	12%	0%	47%	100%	$0.88	20	0.58
Windows - High Efficiency	Cooling/Heating	0%	0%	47%	100%	$0.88	20	0.58
Windows - High Efficiency	Heating	11%	11%	47%	100%	$0.88	20	0.58
Energy Management System	Cooling	33%	14%	7%	85%	$0.70	14	1.71
Energy Management System	Cooling/Heating	24%	24%	7%	85%	$0.70	14	1.71
Energy Management System	Heating	28%	28%	7%	85%	$0.70	14	1.71
Energy Management System	Interior Lighting	9%	9%	7%	85%	$0.70	14	1.71
Energy Management System	Exterior Lighting	9%	9%	7%	85%	$0.70	14	1.71
Thermostat - Clock/Programmable	Cooling	7%	0%	32%	50%	$0.13	11	6.24
Thermostat - Clock/Programmable	Cooling/Heating	0%	0%	32%	50%	$0.13	11	6.24
Thermostat - Clock/Programmable	Heating	41%	41%	32%	50%	$0.13	11	6.24
Interior Lighting - LED Exit Lighting	Interior Lighting	2%	2%	9%	90%	$0.00	16	24.0
Interior Lighting - Occupancy Sensors	Interior Lighting	10%	5%	6%	75%	$0.44	8	0.17
Interior Lighting - Task Lighting	Interior Lighting	10%	10%	6%	100%	$0.24	5	0.21
Interior Lighting - Time Clocks and Timers (lighting)	Interior Lighting	5%	3%	3%	75%	$0.30	8	0.13
Interior Lighting - Fluorescent Delamp and Install Reflectors	Interior Lighting	30%	8%	18%	75%	$0.50	11	0.57
Interior Fluorescent - Bi-Level Fixture w/Occupancy Sensor	Interior Lighting	10%	5%	10%	30%	$0.20	8	0.29

Measure	End Use	Energy Savings	Demand Savings	Base Satura-tion	Appl./ Feas.	Cost ($/sqft)	Life-time (yrs)	BC Ratio
Interior Fluorescent - Photocell-Controlled Dimming Ballasts	Interior Lighting	25%	13%	12%	60%	$0.50	8	0.29
Indoor Lighting - Daylighting Controls	Interior Lighting	20%	20%	15%	41%	$0.29	8	0.53
Lighting Retrocommissioning	Interior Lighting	6%	8%	26%	80%	$0.05	5	0.69
Lighting Retrocommissioning	Exterior Lighting	6%	3%	26%	80%	$0.05	5	0.69
Water Heating - Heat Trap	Water Heating	0%	0%	5%	25%	$2.36	-	-
Water Heating - Faucet Aerators and Low Flow Nozzles	Water Heating	4%	4%	19%	100%	$0.03	9	0.12
Water Heating - Pipe Insulation	Water Heating	6%	6%	6%	22%	$0.28	15	0.03
Water Heating - Tank Blanket	Water Heating	10%	3%	0%	0%	$0.04	10	0.25
Water Heating - Hot Water Saver	Water Heating	5%	1%	0%	100%	$0.04	5	0.07
Water Heating - High Efficiency Circulation Pump	Water Heating	0%	0%	0%	0%	$0.00	-	1.00
Water Heating - Install Timer	Water Heating	0%	0%	5%	25%	$0.04	-	-
Water Heating - Thermostat Setback	Water Heating	10%	10%	5%	100%	$0.11	10	0.09
Water Heating - Solar Water Heating System	Water Heating	0%	70%	1%	85%	$2.46	-	-
Refrigerator - Decommissioning and Recycling	Refrigeration	90%	90%	10%	50%	$0.13	8	1.91
Refrigerator - Anti-Sweat Heater	Refrigeration	5%	3%	0%	100%	$0.20	12	-
Refrigerator - Door Gasket Replacement	Refrigeration	4%	2%	5%	100%	$0.10	4	-
Display Case - LED Lighting	Refrigeration	0%	0%	0%	0%	$0.00	-	2.00
Open Display Case - Night Covers	Refrigeration	6%	3%	5%	100%	$0.05	8	-
Vending Machine - Controller	Refrigeration	15%	11%	2%	10%	$0.27	5	0.05
Office Electronics - Plug Load Occupancy Sensors	Office Equipment	10%	5%	13%	75%	$0.28	8	0.03
Office Electronics - ENERGY STAR Power Supplies	Office Equipment	1%	1%	10%	100%	$0.00	7	6.88
Non-HVAC Motors - Variable Speed Control	Miscellaneous	1%	0%	0%	75%	$0.10	10	0.00
Pool Pump - Timer	Miscellaneous	60%	15%	0%	45%	$0.36	10	-

Table C-46 Energy-Efficiency Measure Data—Refrigerated Warehouse, Existing Vintage

Measure	End Use	Energy Savings	Demand Savings	Base Satura-tion	Appl./ Feas.	Cost ($/sqft)	Life-time (yrs)	BC Ratio
Chiller - VSD	Cooling	26%	32%	0%	0%	$1.17	20	2.91
Chiller - Condenser Water Temperature Reset	Cooling	10%	7%	0%	0%	$0.37	4	0.46
Chiller - Economizer	Cooling	9%	2%	0%	65%	$0.15	10	5.06
Chiller - Thermal Energy Storage	Cooling	0%	25%	45%	65%	$0.15	15	7.57
Air-Cooled Chiller - High Efficiency Fans	Cooling	0%	0%	0%	0%	$0.04	10	0.03
Water-Cooled Chiller - Condenser Water Temperature Reset	Cooling	14%	7%	0%	0%	$0.37	4	0.57
Water-Cooled Chiller - Cooling Tower, High-Efficiency Fans	Cooling	0%	0%	0%	0%	$0.04	10	0.03
Heat Pump - Maintenance	Cooling/Heating	14%	14%	14%	100%	$0.06	4	4.79
RTU - Maintenance	Cooling	14%	15%	14%	100%	$0.06	4	3.57
Ventilation - Variable Speed Control	Ventilation	4%	4%	0%	0%	$0.34	10	0.10
Ventilation - CO2 Controlled	Ventilation	1%	13%	1%	20%	$0.21	10	0.04
Ventilation - Exhaust Hood Sensor Control	Ventilation	15%	1%	1%	20%	$0.07	10	1.94
Fans - Energy-Efficient Motors	Ventilation	1%	1%	11%	100%	$0.05	10	0.24
Pumps - High-Efficiency Motors	Cooling	0%	0%	0%	0%	$0.00	-	3.00
Pumps - High-Efficiency Motors	Cooling/Heating	0%	0%	0%	0%	$0.00	-	3.00
Pumps - High-Efficiency Motors	Heating	0%	0%	0%	0%	$0.00	-	3.00
Pumps - Variable Speed Control	Cooling	8%	0%	0%	0%	$0.44	10	0.77
Pumps - Variable Speed Control	Cooling/Heating	0%	0%	0%	0%	$0.44	10	0.77
Pumps - Variable Speed Control	Heating	4%	4%	0%	0%	$0.44	10	0.77
Insulation - Ducting	Cooling	2%	2%	33%	100%	$0.41	20	0.28
Insulation - Ducting	Cooling/Heating	0%	0%	33%	100%	$0.41	20	0.28
Insulation - Ducting	Heating	0%	0%	33%	100%	$0.41	20	0.28
Insulation - Ceiling	Cooling	47%	31%	7%	25%	$0.85	20	3.43
Insulation - Ceiling	Cooling/Heating	9%	9%	7%	25%	$0.85	20	3.43
Insulation - Ceiling	Heating	15%	15%	7%	25%	$0.85	20	3.43
Insulation - Wall Cavity	Cooling	50%	51%	11%	75%	$0.08	20	36.5
Insulation - Wall Cavity	Cooling/Heating	10%	30%	11%	75%	$0.08	20	36.5
Insulation - Wall Cavity	Heating	6%	6%	11%	75%	$0.08	20	36.5
HVAC - Duct Repair and Sealing	Cooling	13%	14%	5%	50%	$0.38	18	2.11
HVAC - Duct Repair and Sealing	Cooling/Heating	10%	10%	5%	50%	$0.38	18	2.11
HVAC - Duct Repair and Sealing	Heating	7%	7%	5%	50%	$0.38	18	2.11
Roofs - Cool Roof	Cooling	10%	16%	67%	100%	$0.17	15	2.74
Roofs - Cool Roof	Cooling/Heating	0%	0%	67%	100%	$0.17	15	2.74
Roofs - Cool Roof	Heating	0%	0%	67%	100%	$0.17	15	2.74
Windows - High Efficiency	Cooling	14%	5%	33%	100%	$0.88	20	0.92
Windows - High Efficiency	Cooling/Heating	0%	0%	33%	100%	$0.88	20	0.92
Windows - High Efficiency	Heating	3%	3%	33%	100%	$0.88	20	0.92
Energy Management System	Cooling	8%	14%	0%	100%	$0.70	14	1.21
Energy Management System	Cooling/Heating	8%	6%	0%	100%	$0.70	14	1.21
Energy Management System	Heating	6%	6%	0%	100%	$0.70	14	1.21
Energy Management System	Interior Lighting	9%	9%	0%	100%	$0.70	14	1.21
Energy Management System	Exterior Lighting	9%	9%	0%	100%	$0.70	14	1.21
Thermostat - Clock/Programmable	Cooling	13%	0%	33%	50%	$0.13	11	4.56
Thermostat - Clock/Programmable	Cooling/Heating	0%	0%	33%	50%	$0.13	11	4.56
Thermostat - Clock/Programmable	Heating	7%	7%	33%	50%	$0.13	11	4.56
Interior Lighting - LED Exit Lighting	Interior Lighting	2%	2%	9%	90%	$0.00	16	24.0
Interior Lighting - Occupancy Sensors	Interior Lighting	10%	5%	6%	75%	$0.44	8	0.17
Interior Lighting - Task Lighting	Interior Lighting	10%	10%	6%	100%	$0.24	5	0.21
Interior Lighting - Time Clocks and Timers (lighting)	Interior Lighting	5%	3%	3%	75%	$0.30	8	0.13
Interior Lighting - Fluorescent Delamp and Install Reflectors	Interior Lighting	30%	8%	18%	75%	$0.50	11	0.57

Measure	End Use	Energy Savings	Demand Savings	Base Satura-tion	Appl./ Feas.	Cost ($/sqft)	Life-time (yrs)	BC Ratio
Interior Fluorescent - Bi-Level Fixture w/Occupancy Sensor	Interior Lighting	10%	5%	10%	30%	$0.20	8	0.29
Interior Fluorescent - Photocell-Controlled Dimming Ballasts	Interior Lighting	25%	13%	12%	60%	$0.50	8	0.29
Indoor Lighting - Daylighting Controls	Interior Lighting	20%	20%	15%	41%	$0.29	8	0.53
Lighting Retrocommissioning	Interior Lighting	6%	8%	26%	80%	$0.05	5	0.69
Lighting Retrocommissioning	Exterior Lighting	6%	3%	26%	80%	$0.05	5	0.69
Water Heating - Heat Trap	Water Heating	0%	0%	5%	25%	$2.36	-	-
Water Heating - Faucet Aerators and Low Flow Nozzles	Water Heating	4%	4%	22%	100%	$0.03	9	1.20
Water Heating - Pipe Insulation	Water Heating	6%	6%	22%	100%	$0.28	15	0.26
Water Heating - Tank Blanket	Water Heating	10%	3%	40%	100%	$0.04	10	2.44
Water Heating - Hot Water Saver	Water Heating	5%	1%	0%	100%	$0.04	5	0.66
Water Heating - High Efficiency Circulation Pump	Water Heating	0%	0%	0%	0%	$0.00	-	1.00
Water Heating - Install Timer	Water Heating	0%	0%	5%	25%	$0.04	-	-
Water Heating - Thermostat Setback	Water Heating	10%	10%	0%	100%	$0.11	10	0.89
Water Heating - Solar Water Heating System	Water Heating	0%	70%	1%	85%	$2.46	-	-
Refrigerator - Decommissioning and Recycling	Refrigeration	90%	90%	10%	50%	$0.13	8	44.2
Refrigerator - Anti-Sweat Heater	Refrigeration	20%	3%	0%	100%	$0.20	12	7.49
Refrigerator - Door Gasket Replacement	Refrigeration	4%	2%	5%	100%	$0.10	4	0.89
Display Case - LED Lighting	Refrigeration	38%	38%	0%	0%	$0.00	-	2.00
Open Display Case - Night Covers	Refrigeration	6%	3%	5%	100%	$0.05	8	2.33
Vending Machine - Controller	Refrigeration	15%	11%	2%	10%	$0.27	5	0.05
Office Electronics - Plug Load Occupancy Sensors	Office Equipment	10%	5%	13%	75%	$0.28	8	0.03
Office Electronics - ENERGY STAR Power Supplies	Office Equipment	1%	1%	10%	100%	$0.00	7	6.88
Non-HVAC Motors - Variable Speed Control	Miscellaneous	1%	0%	0%	75%	$0.10	10	0.00
Pool Pump - Timer	Miscellaneous	60%	15%	0%	45%	$0.36	10	-

Table C-47 Energy-Efficiency Measure Data—College, New Vintage

Measure	End Use	Energy Savings	Demand Savings	Base Satura-tion	Appl./ Feas.	Cost ($/sqft)	Life-time (yrs)	BC Ratio
Chiller - VSD	Cooling	28%	33%	3%	100%	$1.17	20	2.72
Chiller - Condenser Water Temperature Reset	Cooling	8%	7%	60%	100%	$0.09	4	1.30
Chiller - Economizer	Cooling	9%	0%	64%	90%	$0.15	10	4.30
Chiller - Thermal Energy Storage	Cooling	0%	25%	73%	90%	$0.15	15	7.37
Air-Cooled Chiller - High Efficiency Fans	Cooling	0%	0%	25%	74%	$0.04	10	0.04
Water-Cooled Chiller - Condenser Water Temperature Reset	Cooling	12%	7%	60%	100%	$0.09	4	2.04
Water-Cooled Chiller - Cooling Tower, High-Efficiency Fans	Cooling	0%	0%	25%	74%	$0.04	10	0.17
Heat Pump - Maintenance	Cooling/Heating	9%	14%	33%	100%	$0.06	4	2.52
RTU - Maintenance	Cooling	14%	14%	33%	100%	$0.06	4	2.25
Ventilation - Variable Speed Control	Ventilation	23%	13%	0%	0%	$0.34	10	0.42
Ventilation - CO2 Controlled	Ventilation	5%	7%	6%	10%	$0.80	10	0.04
Ventilation - Exhaust Hood Sensor Control	Ventilation	3%	1%	1%	10%	$0.04	10	0.38
Fans - Energy-Efficient Motors	Ventilation	1%	1%	11%	100%	$0.05	10	0.07
Pumps - High-Efficiency Motors	Cooling	0%	0%	0%	0%	$0.00	-	3.00
Pumps - High-Efficiency Motors	Cooling/Heating	0%	0%	0%	0%	$0.00	-	3.00
Pumps - High-Efficiency Motors	Heating	0%	0%	0%	0%	$0.00	-	3.00
Pumps - Variable Speed Control	Cooling	11%	0%	0%	0%	$0.44	10	0.61
Pumps - Variable Speed Control	Cooling/Heating	6%	6%	0%	0%	$0.44	10	0.61
Pumps - Variable Speed Control	Heating	0%	0%	0%	0%	$0.44	10	0.61
Insulation - Ducting	Cooling	4%	3%	56%	61%	$0.41	20	0.35
Insulation - Ducting	Cooling/Heating	0%	0%	56%	61%	$0.41	20	0.35
Insulation - Ducting	Heating	0%	0%	56%	61%	$0.41	20	0.35
Insulation - Ceiling	Cooling	12%	17%	2%	25%	$0.16	20	4.25
Insulation - Ceiling	Cooling/Heating	14%	4%	2%	25%	$0.16	20	4.25
Insulation - Ceiling	Heating	7%	7%	2%	25%	$0.16	20	4.25
Insulation - Wall Cavity	Cooling	0%	11%	44%	75%	$0.09	20	6.78
Insulation - Wall Cavity	Cooling/Heating	18%	11%	44%	75%	$0.09	20	6.78
Insulation - Wall Cavity	Heating	21%	21%	44%	75%	$0.09	20	6.78
HVAC - Duct Repair and Sealing	Cooling	8%	6%	25%	50%	$0.38	18	1.20
HVAC - Duct Repair and Sealing	Cooling/Heating	7%	6%	25%	50%	$0.38	18	1.20
HVAC - Duct Repair and Sealing	Heating	6%	7%	25%	50%	$0.38	18	1.20
Roofs - Cool Roof	Cooling	3%	4%	22%	100%	$0.18	15	0.57
Roofs - Cool Roof	Cooling/Heating	0%	0%	22%	100%	$0.18	15	0.57
Roofs - Cool Roof	Heating	0%	0%	22%	100%	$0.18	15	0.57
Windows - High Efficiency	Cooling	6%	4%	44%	100%	$1.69	20	0.17
Windows - High Efficiency	Cooling/Heating	0%	0%	44%	100%	$1.69	20	0.17
Windows - High Efficiency	Heating	2%	2%	44%	100%	$1.69	20	0.17
Energy Management System	Cooling	6%	14%	44%	100%	$0.70	14	0.76
Energy Management System	Cooling/Heating	6%	5%	44%	100%	$0.70	14	0.76
Energy Management System	Heating	5%	5%	44%	100%	$0.70	14	0.76
Energy Management System	Interior Lighting	9%	9%	44%	100%	$0.70	14	0.76
Energy Management System	Exterior Lighting	9%	9%	44%	100%	$0.70	14	0.76
Thermostat - Clock/Programmable	Cooling	6%	0%	50%	50%	$0.13	11	7.77
Thermostat - Clock/Programmable	Cooling/Heating	0%	0%	50%	50%	$0.13	11	7.77
Thermostat - Clock/Programmable	Heating	41%	41%	50%	50%	$0.13	11	7.77
Interior Lighting - LED Exit Lighting	Interior Lighting	2%	2%	86%	90%	$0.00	16	41.6
Interior Lighting - Occupancy Sensors	Interior Lighting	10%	5%	56%	75%	$0.44	8	0.29
Interior Lighting - Task Lighting	Interior Lighting	10%	10%	11%	100%	$0.24	5	0.35
Interior Lighting - Time Clocks and Timers (lighting)	Interior Lighting	5%	3%	56%	75%	$0.20	8	0.32
Interior Lighting - Fluorescent Delamp and Install Reflectors	Interior Lighting	0%	0%	56%	75%	$0.50	11	-
Interior Fluorescent - Bi-Level Fixture w/Occupancy Sensor	Interior Lighting	10%	5%	10%	30%	$0.20	8	0.42

Measure	End Use	Energy Savings	Demand Savings	Base Satura-tion	Appl./ Feas.	Cost ($/sqft)	Life-time (yrs)	BC Ratio
Interior Fluorescent - Photocell-Controlled Dimming Ballasts	Interior Lighting	25%	13%	33%	60%	$0.30	8	0.70
Indoor Lighting - Daylighting Controls	Interior Lighting	20%	20%	15%	20%	$0.34	8	0.75
Water Heating - Heat Trap	Water Heating	9%	9%	5%	25%	$2.36	-	-
Water Heating - Faucet Aerators and Low Flow Nozzles	Water Heating	4%	4%	56%	100%	$0.03	9	1.10
Water Heating - Pipe Insulation	Water Heating	4%	4%	49%	99%	$0.28	15	0.16
Water Heating - Tank Blanket	Water Heating	10%	10%	0%	0%	$0.04	10	2.24
Water Heating - Hot Water Saver	Water Heating	5%	1%	0%	100%	$0.04	5	0.61
Water Heating - High Efficiency Circulation Pump	Water Heating	0%	0%	0%	0%	$0.00	-	1.00
Water Heating - Install Timer	Water Heating	9%	9%	5%	25%	$0.04	-	-
Water Heating - Thermostat Setback	Water Heating	10%	10%	10%	100%	$0.11	10	0.82
Water Heating - Solar Water Heating System	Water Heating	70%	70%	1%	85%	$2.46	-	-
Refrigerator - Decommissioning and Recycling	Refrigeration	90%	90%	10%	50%	$0.13	8	1.12
Refrigerator - Anti-Sweat Heater	Refrigeration	5%	3%	0%	100%	$0.20	12	0.01
Refrigerator - Door Gasket Replacement	Refrigeration	4%	2%	5%	100%	$0.10	4	0.01
Display Case - LED Lighting	Refrigeration	0%	0%	0%	0%	$0.00	-	2.00
Open Display Case - Night Covers	Refrigeration	6%	3%	5%	100%	$0.05	8	0.02
Vending Machine - Controller	Refrigeration	15%	11%	2%	10%	$0.27	5	0.01
Office Electronics - Plug Load Occupancy Sensors	Office Equipment	10%	5%	42%	75%	$0.25	8	0.10
Office Electronics - ENERGY STAR Power Supplies	Office Equipment	1%	1%	10%	100%	$0.00	7	20.3
Non-HVAC Motors - Variable Speed Control	Miscellaneous	1%	0%	11%	75%	$0.10	10	0.00
Pool Pump - Timer	Miscellaneous	60%	15%	34%	45%	$0.36	10	0.00

Table C-48 Energy-Efficiency Measure Data—School, New Vintage

Measure	End Use	Energy Savings	Demand Savings	Base Satura-tion	Appl./ Feas.	Cost ($/sqft)	Life-time (yrs)	BC Ratio
Chiller - VSD	Cooling	28%	33%	15%	88%	$1.17	20	1.41
Chiller - Condenser Water Temperature Reset	Cooling	8%	7%	60%	100%	$0.09	4	0.67
Chiller - Economizer	Cooling	8%	0%	37%	65%	$0.15	10	2.06
Chiller - Thermal Energy Storage	Cooling	0%	25%	44%	65%	$0.15	15	7.37
Air-Cooled Chiller - High Efficiency Fans	Cooling	0%	0%	15%	44%	$0.04	10	0.02
Water-Cooled Chiller - Condenser Water Temperature Reset	Cooling	12%	7%	60%	100%	$0.09	4	1.06
Water-Cooled Chiller - Cooling Tower, High-Efficiency Fans	Cooling	0%	0%	15%	44%	$0.04	10	0.09
Heat Pump - Maintenance	Cooling/Heating	9%	14%	33%	100%	$0.06	4	1.51
RTU - Maintenance	Cooling	14%	14%	33%	100%	$0.06	4	1.16
Ventilation - Variable Speed Control	Ventilation	23%	13%	0%	0%	$0.34	10	0.21
Ventilation - CO2 Controlled	Ventilation	5%	7%	9%	15%	$0.80	10	0.02
Ventilation - Exhaust Hood Sensor Control	Ventilation	1%	1%	1%	15%	$0.04	10	0.10
Fans - Energy-Efficient Motors	Ventilation	1%	1%	11%	100%	$0.05	10	0.04
Pumps - High-Efficiency Motors	Cooling	0%	0%	0%	0%	$0.00	-	3.00
Pumps - High-Efficiency Motors	Cooling/Heating	0%	0%	0%	0%	$0.00	-	3.00
Pumps - High-Efficiency Motors	Heating	0%	0%	0%	0%	$0.00	-	3.00
Pumps - Variable Speed Control	Cooling	11%	0%	0%	0%	$0.44	10	0.31
Pumps - Variable Speed Control	Cooling/Heating	6%	6%	0%	0%	$0.44	10	0.31
Pumps - Variable Speed Control	Heating	0%	0%	0%	0%	$0.44	10	0.31
Insulation - Ducting	Cooling	4%	3%	34%	50%	$0.41	20	0.18
Insulation - Ducting	Cooling/Heating	0%	0%	34%	50%	$0.41	20	0.18
Insulation - Ducting	Heating	0%	0%	34%	50%	$0.41	20	0.18
Insulation - Ceiling	Cooling	12%	17%	7%	25%	$0.16	20	2.36
Insulation - Ceiling	Cooling/Heating	14%	4%	7%	25%	$0.16	20	2.36
Insulation - Ceiling	Heating	7%	7%	7%	25%	$0.16	20	2.36
Insulation - Wall Cavity	Cooling	0%	11%	34%	75%	$0.09	20	4.32
Insulation - Wall Cavity	Cooling/Heating	18%	11%	34%	75%	$0.09	20	4.32
Insulation - Wall Cavity	Heating	21%	21%	34%	75%	$0.09	20	4.32
HVAC - Duct Repair and Sealing	Cooling	6%	8%	25%	50%	$0.38	18	0.56
HVAC - Duct Repair and Sealing	Cooling/Heating	6%	9%	25%	50%	$0.38	18	0.56
HVAC - Duct Repair and Sealing	Heating	5%	9%	25%	50%	$0.38	18	0.56
Roofs - Cool Roof	Cooling	3%	4%	34%	100%	$0.18	15	0.29
Roofs - Cool Roof	Cooling/Heating	0%	0%	34%	100%	$0.18	15	0.29
Roofs - Cool Roof	Heating	0%	0%	34%	100%	$0.18	15	0.29
Windows - High Efficiency	Cooling	6%	4%	67%	100%	$1.69	20	0.09
Windows - High Efficiency	Cooling/Heating	0%	0%	67%	100%	$1.69	20	0.09
Windows - High Efficiency	Heating	2%	2%	67%	100%	$1.69	20	0.09
Energy Management System	Cooling	6%	14%	0%	100%	$0.70	14	0.55
Energy Management System	Cooling/Heating	6%	5%	0%	100%	$0.70	14	0.55
Energy Management System	Heating	5%	5%	0%	100%	$0.70	14	0.55
Energy Management System	Interior Lighting	9%	9%	0%	100%	$0.70	14	0.55
Energy Management System	Exterior Lighting	9%	9%	0%	100%	$0.70	14	0.55
Thermostat - Clock/Programmable	Cooling	6%	0%	72%	72%	$0.13	11	4.84
Thermostat - Clock/Programmable	Cooling/Heating	0%	0%	72%	72%	$0.13	11	4.84
Thermostat - Clock/Programmable	Heating	41%	41%	72%	72%	$0.13	11	4.84
Interior Lighting - LED Exit Lighting	Interior Lighting	2%	2%	86%	90%	$0.00	16	42.8
Interior Lighting - Occupancy Sensors	Interior Lighting	10%	5%	56%	75%	$0.44	8	0.30
Interior Lighting - Task Lighting	Interior Lighting	10%	10%	0%	100%	$0.24	5	0.36
Interior Lighting - Time Clocks and Timers (lighting)	Interior Lighting	5%	3%	56%	75%	$0.20	8	0.33
Interior Lighting - Fluorescent Delamp and Install Reflectors	Interior Lighting	0%	0%	67%	95%	$0.50	11	-
Interior Fluorescent - Bi-Level Fixture w/Occupancy Sensor	Interior Lighting	10%	5%	10%	30%	$0.40	8	0.13

Measure	End Use	Energy Savings	Demand Savings	Base Satura-tion	Appl./ Feas.	Cost ($/sqft)	Life-time (yrs)	BC Ratio
Interior Fluorescent - Photocell-Controlled Dimming Ballasts	Interior Lighting	25%	13%	0%	60%	$0.34	8	0.39
Indoor Lighting - Daylighting Controls	Interior Lighting	20%	20%	19%	25%	$0.34	8	0.78
Water Heating - Heat Trap	Water Heating	9%	9%	5%	25%	$2.36	-	-
Water Heating - Faucet Aerators and Low Flow Nozzles	Water Heating	4%	4%	34%	100%	$0.03	9	0.60
Water Heating - Pipe Insulation	Water Heating	4%	4%	0%	0%	$0.28	15	0.09
Water Heating - Tank Blanket	Water Heating	10%	10%	0%	0%	$0.04	10	1.22
Water Heating - Hot Water Saver	Water Heating	5%	1%	0%	100%	$0.04	5	0.33
Water Heating - High Efficiency Circulation Pump	Water Heating	0%	0%	0%	0%	$0.00	-	1.00
Water Heating - Install Timer	Water Heating	9%	9%	5%	25%	$0.04	-	-
Water Heating - Thermostat Setback	Water Heating	10%	10%	10%	100%	$0.11	10	0.44
Water Heating - Solar Water Heating System	Water Heating	70%	70%	1%	85%	$2.46	-	-
Refrigerator - Decommissioning and Recycling	Refrigeration	90%	90%	10%	50%	$0.13	8	1.22
Refrigerator - Anti-Sweat Heater	Refrigeration	5%	3%	0%	100%	$0.20	12	0.01
Refrigerator - Door Gasket Replacement	Refrigeration	4%	2%	5%	100%	$0.10	4	0.01
Display Case - LED Lighting	Refrigeration	0%	0%	0%	0%	$0.00	-	2.00
Open Display Case - Night Covers	Refrigeration	6%	3%	5%	100%	$0.05	8	0.02
Vending Machine - Controller	Refrigeration	15%	11%	2%	10%	$0.27	5	0.01
Office Electronics - Plug Load Occupancy Sensors	Office Equipment	10%	5%	13%	75%	$0.25	8	0.07
Office Electronics - ENERGY STAR Power Supplies	Office Equipment	1%	1%	10%	100%	$0.00	7	14.0
Non-HVAC Motors - Variable Speed Control	Miscellaneous	1%	0%	0%	75%	$0.10	10	0.00
Pool Pump - Timer	Miscellaneous	60%	15%	34%	45%	$0.36	10	0.00

Table C-49 Energy-Efficiency Measure Data—Large Grocery, New Vintage

Measure	End Use	Energy Savings	Demand Savings	Base Satura-tion	Appl./ Feas.	Cost ($/sqft)	Life-time (yrs)	BC Ratio
Chiller - VSD	Cooling	27%	32%	0%	0%	$1.17	20	3.10
Chiller - Condenser Water Temperature Reset	Cooling	8%	5%	0%	0%	$0.37	4	0.40
Chiller - Economizer	Cooling	9%	2%	37%	65%	$0.15	10	5.38
Chiller - Thermal Energy Storage	Cooling	0%	25%	45%	65%	$0.15	15	1.51
Air-Cooled Chiller - High Efficiency Fans	Cooling	0%	0%	0%	0%	$0.04	10	0.05
Water-Cooled Chiller - Condenser Water Temperature Reset	Cooling	11%	5%	0%	0%	$0.37	4	0.48
Water-Cooled Chiller - Cooling Tower, High-Efficiency Fans	Cooling	0%	0%	0%	0%	$0.04	10	0.04
Heat Pump - Maintenance	Cooling/Heating	14%	14%	14%	100%	$0.03	4	9.54
RTU - Maintenance	Cooling	14%	15%	14%	100%	$0.08	4	2.91
Ventilation - Variable Speed Control	Ventilation	6%	6%	0%	0%	$0.34	10	0.17
Ventilation - CO2 Controlled	Ventilation	1%	13%	12%	20%	$0.21	10	0.04
Ventilation - Exhaust Hood Sensor Control	Ventilation	15%	1%	1%	20%	$0.07	10	1.94
Fans - Energy-Efficient Motors	Ventilation	2%	2%	11%	100%	$0.05	10	0.27
Pumps - High-Efficiency Motors	Cooling	0%	0%	0%	0%	$0.00	-	3.00
Pumps - High-Efficiency Motors	Cooling/Heating	0%	0%	0%	0%	$0.00	-	3.00
Pumps - High-Efficiency Motors	Heating	0%	0%	0%	0%	$0.00	-	3.00
Pumps - Variable Speed Control	Cooling	12%	0%	0%	0%	$0.44	10	1.24
Pumps - Variable Speed Control	Cooling/Heating	0%	0%	0%	0%	$0.44	10	1.24
Pumps - Variable Speed Control	Heating	6%	6%	0%	0%	$0.44	10	1.24
Insulation - Ducting	Cooling	2%	0%	33%	50%	$0.41	20	0.36
Insulation - Ducting	Cooling/Heating	4%	4%	33%	50%	$0.41	20	0.36
Insulation - Ducting	Heating	0%	0%	33%	50%	$0.41	20	0.36
Insulation - Ceiling	Cooling	47%	31%	7%	25%	$0.88	20	3.77
Insulation - Ceiling	Cooling/Heating	14%	14%	7%	25%	$0.88	20	3.77
Insulation - Ceiling	Heating	17%	17%	7%	25%	$0.88	20	3.77
Insulation - Wall Cavity	Cooling	3%	58%	11%	75%	$0.29	20	0.98
Insulation - Wall Cavity	Cooling/Heating	9%	18%	11%	75%	$0.29	20	0.98
Insulation - Wall Cavity	Heating	6%	6%	11%	75%	$0.29	20	0.98
HVAC - Duct Repair and Sealing	Cooling	13%	14%	25%	50%	$0.38	18	2.37
HVAC - Duct Repair and Sealing	Cooling/Heating	10%	10%	25%	50%	$0.38	18	2.37
HVAC - Duct Repair and Sealing	Heating	7%	7%	25%	50%	$0.38	18	2.37
Roofs - Cool Roof	Cooling	10%	14%	67%	100%	$0.17	15	3.15
Roofs - Cool Roof	Cooling/Heating	0%	0%	67%	100%	$0.17	15	3.15
Roofs - Cool Roof	Heating	0%	0%	67%	100%	$0.17	15	3.15
Windows - High Efficiency	Cooling	14%	9%	33%	100%	$0.29	20	3.14
Windows - High Efficiency	Cooling/Heating	0%	0%	33%	100%	$0.29	20	3.14
Windows - High Efficiency	Heating	3%	3%	33%	100%	$0.29	20	3.14
Energy Management System	Cooling	6%	14%	0%	100%	$0.70	14	1.24
Energy Management System	Cooling/Heating	6%	5%	0%	100%	$0.70	14	1.24
Energy Management System	Heating	5%	5%	0%	100%	$0.70	14	1.24
Energy Management System	Interior Lighting	9%	9%	0%	100%	$0.70	14	1.24
Energy Management System	Exterior Lighting	9%	9%	0%	100%	$0.70	14	1.24
Thermostat - Clock/Programmable	Cooling	14%	0%	50%	50%	$0.13	11	5.24
Thermostat - Clock/Programmable	Cooling/Heating	0%	0%	50%	50%	$0.13	11	5.24
Thermostat - Clock/Programmable	Heating	7%	7%	50%	50%	$0.13	11	5.24
Interior Lighting - LED Exit Lighting	Interior Lighting	2%	2%	86%	90%	$0.00	16	97.1
Interior Lighting - Occupancy Sensors	Interior Lighting	5%	5%	56%	75%	$0.44	8	0.34
Interior Lighting - Task Lighting	Interior Lighting	1%	10%	0%	100%	$0.24	5	0.08
Interior Lighting - Time Clocks and Timers (lighting)	Interior Lighting	5%	3%	56%	75%	$0.20	8	0.75
Interior Lighting - Fluorescent Delamp and Install Reflectors	Interior Lighting	0%	0%	44%	60%	$0.40	11	-
Interior Fluorescent - Bi-Level Fixture w/Occupancy Sensor	Interior Lighting	10%	5%	10%	30%	$0.50	8	0.40

Measure	End Use	Energy Savings	Demand Savings	Base Satura-tion	Appl./ Feas.	Cost ($/sqft)	Life-time (yrs)	BC Ratio
Interior Fluorescent - Photocell-Controlled Dimming Ballasts	Interior Lighting	25%	13%	11%	60%	$0.38	8	1.30
Indoor Lighting - Daylighting Controls	Interior Lighting	10%	10%	75%	100%	$0.05	8	5.97
Water Heating - Heat Trap	Water Heating	9%	9%	5%	25%	$2.36	-	-
Water Heating - Faucet Aerators and Low Flow Nozzles	Water Heating	4%	4%	22%	100%	$0.03	9	1.22
Water Heating - Pipe Insulation	Water Heating	4%	4%	50%	100%	$0.28	15	0.17
Water Heating - Tank Blanket	Water Heating	10%	10%	40%	100%	$0.04	10	2.48
Water Heating - Hot Water Saver	Water Heating	5%	1%	0%	100%	$0.04	5	0.67
Water Heating - High Efficiency Circulation Pump	Water Heating	0%	0%	0%	0%	$0.00	-	1.00
Water Heating - Install Timer	Water Heating	9%	9%	5%	25%	$0.04	-	-
Water Heating - Thermostat Setback	Water Heating	10%	10%	0%	100%	$0.11	10	0.90
Water Heating - Solar Water Heating System	Water Heating	70%	70%	1%	85%	$2.46	-	-
Refrigerator - Decommissioning and Recycling	Refrigeration	90%	90%	10%	50%	$0.13	8	48.7
Refrigerator - Anti-Sweat Heater	Refrigeration	20%	3%	0%	100%	$0.20	12	5.38
Refrigerator - Door Gasket Replacement	Refrigeration	4%	2%	5%	100%	$0.10	4	0.68
Display Case - LED Lighting	Refrigeration	39%	0%	12%	56%	$0.02	8	59.6
Open Display Case - Night Covers	Refrigeration	6%	3%	5%	100%	$0.05	8	1.99
Vending Machine - Controller	Refrigeration	15%	11%	2%	10%	$0.27	5	0.03
Office Electronics - Plug Load Occupancy Sensors	Office Equipment	10%	5%	7%	75%	$0.25	8	0.05
Office Electronics - ENERGY STAR Power Supplies	Office Equipment	1%	1%	10%	100%	$0.00	7	10.7
Non-HVAC Motors - Variable Speed Control	Miscellaneous	1%	0%	0%	75%	$0.10	10	0.00
Pool Pump - Timer	Miscellaneous	60%	15%	34%	45%	$0.44	10	-

Table C-50 Energy-Efficiency Measure Data—Small Grocery, New Vintage

Measure	End Use	Energy Savings	Demand Savings	Base Satura-tion	Appl./ Feas.	Cost ($/sqft)	Life-time (yrs)	BC Ratio
Chiller - VSD	Cooling	27%	32%	0%	0%	$1.17	20	2.90
Chiller - Condenser Water Temperature Reset	Cooling	8%	5%	0%	0%	$0.37	4	0.37
Chiller - Economizer	Cooling	9%	2%	37%	65%	$0.15	10	5.03
Chiller - Thermal Energy Storage	Cooling	0%	25%	45%	65%	$0.15	15	1.51
Air-Cooled Chiller - High Efficiency Fans	Cooling	0%	0%	0%	0%	$0.04	10	0.04
Water-Cooled Chiller - Condenser Water Temperature Reset	Cooling	11%	5%	0%	0%	$0.37	4	0.45
Water-Cooled Chiller - Cooling Tower, High-Efficiency Fans	Cooling	0%	0%	0%	0%	$0.04	10	0.04
Heat Pump - Maintenance	Cooling/Heating	14%	14%	14%	100%	$0.03	4	8.98
RTU - Maintenance	Cooling	14%	15%	14%	100%	$0.08	4	2.73
Ventilation - Variable Speed Control	Ventilation	6%	6%	0%	0%	$0.34	10	0.15
Ventilation - CO2 Controlled	Ventilation	1%	13%	12%	20%	$0.21	10	0.04
Ventilation - Exhaust Hood Sensor Control	Ventilation	15%	1%	1%	20%	$0.07	10	1.74
Fans - Energy-Efficient Motors	Ventilation	2%	2%	11%	100%	$0.05	10	0.24
Pumps - High-Efficiency Motors	Cooling	0%	0%	0%	0%	$0.00	-	3.00
Pumps - High-Efficiency Motors	Cooling/Heating	0%	0%	0%	0%	$0.00	-	3.00
Pumps - High-Efficiency Motors	Heating	0%	0%	0%	0%	$0.00	-	3.00
Pumps - Variable Speed Control	Cooling	12%	0%	0%	0%	$0.44	10	1.12
Pumps - Variable Speed Control	Cooling/Heating	0%	0%	0%	0%	$0.44	10	1.12
Pumps - Variable Speed Control	Heating	6%	6%	0%	0%	$0.44	10	1.12
Insulation - Ducting	Cooling	2%	0%	33%	50%	$0.41	20	0.32
Insulation - Ducting	Cooling/Heating	4%	4%	33%	50%	$0.41	20	0.32
Insulation - Ducting	Heating	0%	0%	33%	50%	$0.41	20	0.32
Insulation - Ceiling	Cooling	47%	31%	7%	25%	$0.88	20	3.39
Insulation - Ceiling	Cooling/Heating	14%	14%	7%	25%	$0.88	20	3.39
Insulation - Ceiling	Heating	17%	17%	7%	25%	$0.88	20	3.39
Insulation - Wall Cavity	Cooling	3%	58%	11%	75%	$0.29	20	0.88
Insulation - Wall Cavity	Cooling/Heating	9%	18%	11%	75%	$0.29	20	0.88
Insulation - Wall Cavity	Heating	6%	6%	11%	75%	$0.29	20	0.88
HVAC - Duct Repair and Sealing	Cooling	13%	14%	25%	50%	$0.38	18	2.14
HVAC - Duct Repair and Sealing	Cooling/Heating	10%	10%	25%	50%	$0.38	18	2.14
HVAC - Duct Repair and Sealing	Heating	7%	7%	25%	50%	$0.38	18	2.14
Roofs - Cool Roof	Cooling	10%	14%	67%	100%	$0.17	15	2.84
Roofs - Cool Roof	Cooling/Heating	0%	0%	67%	100%	$0.17	15	2.84
Roofs - Cool Roof	Heating	0%	0%	67%	100%	$0.17	15	2.84
Windows - High Efficiency	Cooling	14%	9%	33%	100%	$0.29	20	2.82
Windows - High Efficiency	Cooling/Heating	0%	0%	33%	100%	$0.29	20	2.82
Windows - High Efficiency	Heating	3%	3%	33%	100%	$0.29	20	2.82
Energy Management System	Cooling	6%	14%	0%	100%	$0.70	14	1.10
Energy Management System	Cooling/Heating	6%	5%	0%	100%	$0.70	14	1.10
Energy Management System	Heating	5%	5%	0%	100%	$0.70	14	1.10
Energy Management System	Interior Lighting	9%	9%	0%	100%	$0.70	14	1.10
Energy Management System	Exterior Lighting	9%	9%	0%	100%	$0.70	14	1.10
Thermostat - Clock/Programmable	Cooling	14%	0%	50%	50%	$0.13	11	4.71
Thermostat - Clock/Programmable	Cooling/Heating	0%	0%	50%	50%	$0.13	11	4.71
Thermostat - Clock/Programmable	Heating	7%	7%	50%	50%	$0.13	11	4.71
Interior Lighting - LED Exit Lighting	Interior Lighting	2%	2%	86%	90%	$0.00	16	87.3
Interior Lighting - Occupancy Sensors	Interior Lighting	5%	5%	56%	75%	$0.44	8	0.31
Interior Lighting - Task Lighting	Interior Lighting	1%	10%	0%	100%	$0.24	5	0.07
Interior Lighting - Time Clocks and Timers (lighting)	Interior Lighting	5%	3%	56%	75%	$0.20	8	0.67
Interior Lighting - Fluorescent Delamp and Install Reflectors	Interior Lighting	0%	0%	44%	60%	$0.40	11	-
Interior Fluorescent - Bi-Level Fixture w/Occupancy Sensor	Interior Lighting	10%	5%	10%	30%	$0.50	8	0.36

Measure	End Use	Energy Savings	Demand Savings	Base Satura-tion	Appl./ Feas.	Cost ($/sqft)	Life-time (yrs)	BC Ratio
Interior Fluorescent - Photocell-Controlled Dimming Ballasts	Interior Lighting	25%	13%	11%	60%	$0.38	8	1.17
Indoor Lighting - Daylighting Controls	Interior Lighting	10%	10%	75%	100%	$0.05	8	5.37
Water Heating - Heat Trap	Water Heating	9%	9%	5%	25%	$2.36	-	-
Water Heating - Faucet Aerators and Low Flow Nozzles	Water Heating	4%	4%	22%	100%	$0.03	9	0.97
Water Heating - Pipe Insulation	Water Heating	4%	4%	50%	100%	$0.28	15	0.14
Water Heating - Tank Blanket	Water Heating	10%	10%	40%	100%	$0.04	10	1.98
Water Heating - Hot Water Saver	Water Heating	5%	1%	0%	100%	$0.04	5	0.53
Water Heating - High Efficiency Circulation Pump	Water Heating	0%	0%	0%	0%	$0.00	-	1.00
Water Heating - Install Timer	Water Heating	9%	9%	5%	25%	$0.04	-	-
Water Heating - Thermostat Setback	Water Heating	10%	10%	0%	100%	$0.11	10	0.72
Water Heating - Solar Water Heating System	Water Heating	70%	70%	1%	85%	$2.46	-	-
Refrigerator - Decommissioning and Recycling	Refrigeration	90%	90%	10%	50%	$0.13	8	38.8
Refrigerator - Anti-Sweat Heater	Refrigeration	20%	3%	0%	100%	$0.20	12	4.36
Refrigerator - Door Gasket Replacement	Refrigeration	4%	2%	5%	100%	$0.10	4	0.58
Display Case - LED Lighting	Refrigeration	39%	39%	12%	56%	$0.02	8	74.3
Open Display Case - Night Covers	Refrigeration	6%	3%	5%	100%	$0.05	8	1.61
Vending Machine - Controller	Refrigeration	15%	11%	2%	10%	$0.27	5	0.06
Office Electronics - Plug Load Occupancy Sensors	Office Equipment	10%	5%	7%	75%	$0.25	8	0.04
Office Electronics - ENERGY STAR Power Supplies	Office Equipment	1%	1%	10%	100%	$0.00	7	8.61
Non-HVAC Motors - Variable Speed Control	Miscellaneous	1%	0%	0%	75%	$0.10	10	0.01
Pool Pump - Timer	Miscellaneous	60%	15%	34%	45%	$0.44	10	-

Table C-51 Energy-Efficiency Measure Data—Health, New Vintage

Measure	End Use	Energy Savings	Demand Savings	Base Satura-tion	Appl./ Feas.	Cost ($/sqft)	Life-time (yrs)	BC Ratio
Chiller - VSD	Cooling	32%	33%	3%	100%	$1.17	20	6.45
Chiller - Condenser Water Temperature Reset	Cooling	8%	7%	60%	100%	$0.31	4	0.83
Chiller - Economizer	Cooling	13%	13%	61%	90%	$0.15	10	12.6
Chiller - Thermal Energy Storage	Cooling	0%	25%	73%	90%	$0.15	15	1.03
Air-Cooled Chiller - High Efficiency Fans	Cooling	0%	0%	25%	74%	$0.04	10	0.09
Water-Cooled Chiller - Condenser Water Temperature Reset	Cooling	9%	7%	60%	100%	$0.30	4	0.90
Water-Cooled Chiller - Cooling Tower, High-Efficiency Fans	Cooling	0%	0%	25%	74%	$0.04	10	0.09
Heat Pump - Maintenance	Cooling/Heating	12%	14%	33%	100%	$0.06	4	4.68
RTU - Maintenance	Cooling	14%	14%	33%	100%	$0.06	4	4.53
Ventilation - Variable Speed Control	Ventilation	3%	13%	0%	0%	$0.34	10	0.17
Ventilation - CO2 Controlled	Ventilation	3%	7%	6%	10%	$0.80	10	0.06
Ventilation - Exhaust Hood Sensor Control	Ventilation	3%	1%	1%	10%	$0.06	10	0.72
Fans - Energy-Efficient Motors	Ventilation	0%	0%	6%	100%	$0.14	10	0.03
Pumps - High-Efficiency Motors	Cooling	0%	0%	0%	0%	$0.00	-	3.00
Pumps - High-Efficiency Motors	Cooling/Heating	0%	0%	0%	0%	$0.00	-	3.00
Pumps - High-Efficiency Motors	Heating	0%	0%	0%	0%	$0.00	-	3.00
Pumps - Variable Speed Control	Cooling	8%	8%	0%	0%	$0.44	10	1.21
Pumps - Variable Speed Control	Cooling/Heating	0%	0%	0%	0%	$0.44	10	1.21
Pumps - Variable Speed Control	Heating	5%	5%	0%	0%	$0.44	10	1.21
Insulation - Ducting	Cooling	5%	3%	9%	50%	$0.41	20	0.91
Insulation - Ducting	Cooling/Heating	0%	0%	9%	50%	$0.41	20	0.91
Insulation - Ducting	Heating	0%	0%	9%	50%	$0.41	20	0.91
Insulation - Ceiling	Cooling	20%	17%	2%	25%	$0.08	20	23.7
Insulation - Ceiling	Cooling/Heating	10%	4%	2%	25%	$0.08	20	23.7
Insulation - Ceiling	Heating	7%	7%	2%	25%	$0.08	20	23.7
Insulation - Wall Cavity	Cooling	2%	11%	9%	75%	$0.16	20	5.21
Insulation - Wall Cavity	Cooling/Heating	58%	11%	9%	75%	$0.16	20	5.21
Insulation - Wall Cavity	Heating	18%	18%	9%	75%	$0.16	20	5.21
HVAC - Duct Repair and Sealing	Cooling	1%	1%	25%	50%	$0.38	18	0.19
HVAC - Duct Repair and Sealing	Cooling/Heating	1%	1%	25%	50%	$0.38	18	0.19
HVAC - Duct Repair and Sealing	Heating	1%	1%	25%	50%	$0.38	18	0.19
Roofs - Cool Roof	Cooling	5%	4%	45%	100%	$0.03	15	11.7
Roofs - Cool Roof	Cooling/Heating	0%	0%	45%	100%	$0.03	15	11.7
Roofs - Cool Roof	Heating	0%	0%	45%	100%	$0.03	15	11.7
Windows - High Efficiency	Cooling	6%	4%	91%	100%	$1.84	20	0.39
Windows - High Efficiency	Cooling/Heating	0%	0%	91%	100%	$1.84	20	0.39
Windows - High Efficiency	Heating	6%	6%	91%	100%	$1.84	20	0.39
Energy Management System	Cooling	15%	14%	0%	100%	$0.70	14	2.02
Energy Management System	Cooling/Heating	14%	13%	0%	100%	$0.70	14	2.02
Energy Management System	Heating	5%	5%	0%	100%	$0.70	14	2.02
Energy Management System	Interior Lighting	9%	9%	0%	100%	$0.70	14	2.02
Energy Management System	Exterior Lighting	9%	9%	0%	100%	$0.70	14	2.02
Thermostat - Clock/Programmable	Cooling	6%	6%	87%	87%	$0.13	11	10.8
Thermostat - Clock/Programmable	Cooling/Heating	0%	0%	87%	87%	$0.13	11	10.8
Thermostat - Clock/Programmable	Heating	41%	41%	87%	87%	$0.13	11	10.8
Interior Lighting - LED Exit Lighting	Interior Lighting	2%	2%	86%	90%	$0.00	16	61.6
Interior Lighting - Occupancy Sensors	Interior Lighting	5%	5%	56%	75%	$0.44	8	0.22
Interior Lighting - Task Lighting	Interior Lighting	3%	10%	27%	100%	$0.24	5	0.15
Interior Lighting - Time Clocks and Timers (lighting)	Interior Lighting	5%	3%	56%	75%	$0.30	8	0.32
Interior Lighting - Fluorescent Delamp and Install Reflectors	Interior Lighting	0%	0%	18%	50%	$0.50	11	-
Interior Fluorescent - Bi-Level Fixture w/Occupancy Sensor	Interior Lighting	10%	5%	10%	30%	$0.20	8	0.68

Measure	End Use	Energy Savings	Demand Savings	Base Satura-tion	Appl./ Feas.	Cost ($/sqft)	Life-time (yrs)	BC Ratio
Interior Fluorescent - Photocell-Controlled Dimming Ballasts	Interior Lighting	25%	13%	27%	60%	$0.30	8	1.14
Indoor Lighting - Daylighting Controls	Interior Lighting	10%	10%	32%	43%	$0.38	8	0.50
Water Heating - Heat Trap	Water Heating	9%	9%	5%	25%	$2.36	-	-
Water Heating - Faucet Aerators and Low Flow Nozzles	Water Heating	4%	4%	27%	100%	$0.03	9	1.82
Water Heating - Pipe Insulation	Water Heating	4%	4%	14%	28%	$0.28	15	0.26
Water Heating - Tank Blanket	Water Heating	10%	10%	0%	0%	$0.04	10	3.70
Water Heating - Hot Water Saver	Water Heating	5%	1%	0%	100%	$0.04	5	1.00
Water Heating - High Efficiency Circulation Pump	Water Heating	0%	0%	0%	0%	$0.00	-	1.00
Water Heating - Install Timer	Water Heating	9%	9%	5%	25%	$0.10	-	-
Water Heating - Thermostat Setback	Water Heating	10%	10%	0%	100%	$0.11	10	1.35
Water Heating - Solar Water Heating System	Water Heating	70%	70%	1%	85%	$2.46	-	-
Refrigerator - Decommissioning and Recycling	Refrigeration	90%	90%	10%	50%	$0.13	8	1.60
Refrigerator - Anti-Sweat Heater	Refrigeration	5%	3%	0%	100%	$0.20	12	0.01
Refrigerator - Door Gasket Replacement	Refrigeration	4%	2%	5%	100%	$0.10	4	0.01
Display Case - LED Lighting	Refrigeration	0%	0%	0%	0%	$0.00	-	2.00
Open Display Case - Night Covers	Refrigeration	6%	3%	5%	100%	$0.05	8	0.03
Vending Machine - Controller	Refrigeration	15%	11%	2%	10%	$0.27	5	0.01
Office Electronics - Plug Load Occupancy Sensors	Office Equipment	10%	5%	42%	75%	$0.25	8	0.12
Office Electronics - ENERGY STAR Power Supplies	Office Equipment	1%	1%	10%	100%	$0.00	7	24.3
Non-HVAC Motors - Variable Speed Control	Miscellaneous	1%	0%	0%	75%	$0.10	10	0.01
Pool Pump - Timer	Miscellaneous	60%	15%	34%	45%	$0.36	10	0.01

Table C-52 Energy-Efficiency Measure Data—Lodging, New Vintage

Measure	End Use	Energy Savings	Demand Savings	Base Satura-tion	Appl./ Feas.	Cost ($/sqft)	Life-time (yrs)	BC Ratio
Chiller - VSD	Cooling	24%	33%	15%	88%	$1.17	20	1.10
Chiller - Condenser Water Temperature Reset	Cooling	8%	7%	60%	100%	$0.05	4	1.37
Chiller - Economizer	Cooling	1%	1%	37%	65%	$0.15	10	0.30
Chiller - Thermal Energy Storage	Cooling	0%	25%	44%	65%	$0.15	15	0.74
Air-Cooled Chiller - High Efficiency Fans	Cooling	0%	0%	15%	44%	$0.04	10	0.02
Water-Cooled Chiller - Condenser Water Temperature Reset	Cooling	8%	7%	60%	100%	$0.05	4	0.95
Water-Cooled Chiller - Cooling Tower, High-Efficiency Fans	Cooling	0%	0%	15%	44%	$0.04	10	0.01
Heat Pump - Maintenance	Cooling/Heating	5%	5%	14%	100%	$0.06	4	1.11
RTU - Maintenance	Cooling	4%	5%	14%	100%	$0.06	4	0.80
Ventilation - Variable Speed Control	Ventilation	3%	3%	0%	0%	$0.34	10	0.05
Ventilation - CO2 Controlled	Ventilation	3%	13%	12%	20%	$0.80	10	0.02
Ventilation - Exhaust Hood Sensor Control	Ventilation	3%	1%	1%	20%	$0.01	10	1.57
Fans - Energy-Efficient Motors	Ventilation	0%	0%	11%	100%	$0.14	10	0.02
Pumps - High-Efficiency Motors	Cooling	0%	0%	0%	0%	$0.00	-	3.00
Pumps - High-Efficiency Motors	Cooling/Heating	0%	0%	0%	0%	$0.00	-	3.00
Pumps - High-Efficiency Motors	Heating	0%	0%	0%	0%	$0.00	-	3.00
Pumps - Variable Speed Control	Cooling	9%	9%	0%	0%	$0.44	10	0.68
Pumps - Variable Speed Control	Cooling/Heating	0%	0%	0%	0%	$0.44	10	0.68
Pumps - Variable Speed Control	Heating	6%	6%	0%	0%	$0.44	10	0.68
Insulation - Ducting	Cooling	3%	3%	0%	50%	$0.41	20	0.34
Insulation - Ducting	Cooling/Heating	0%	0%	0%	50%	$0.41	20	0.34
Insulation - Ducting	Heating	0%	0%	0%	50%	$0.41	20	0.34
Insulation - Ceiling	Cooling	5%	25%	7%	25%	$0.03	20	9.02
Insulation - Ceiling	Cooling/Heating	8%	13%	7%	25%	$0.03	20	9.02
Insulation - Ceiling	Heating	5%	5%	7%	25%	$0.03	20	9.02
Insulation - Wall Cavity	Cooling	3%	1%	0%	75%	$0.08	20	13.1
Insulation - Wall Cavity	Cooling/Heating	1%	1%	0%	75%	$0.08	20	13.1
Insulation - Wall Cavity	Heating	69%	69%	0%	75%	$0.08	20	13.1
HVAC - Duct Repair and Sealing	Cooling	2%	3%	25%	50%	$0.38	18	0.22
HVAC - Duct Repair and Sealing	Cooling/Heating	2%	3%	25%	50%	$0.38	18	0.22
HVAC - Duct Repair and Sealing	Heating	2%	3%	25%	50%	$0.38	18	0.22
Roofs - Cool Roof	Cooling	2%	4%	50%	100%	$0.04	15	1.29
Roofs - Cool Roof	Cooling/Heating	0%	0%	50%	100%	$0.04	15	1.29
Roofs - Cool Roof	Heating	0%	0%	50%	100%	$0.04	15	1.29
Windows - High Efficiency	Cooling	6%	7%	75%	100%	$0.73	20	0.44
Windows - High Efficiency	Cooling/Heating	0%	0%	75%	100%	$0.73	20	0.44
Windows - High Efficiency	Heating	6%	6%	75%	100%	$0.73	20	0.44
Energy Management System	Cooling	17%	14%	0%	100%	$0.70	14	1.35
Energy Management System	Cooling/Heating	16%	13%	0%	100%	$0.70	14	1.35
Energy Management System	Heating	10%	10%	0%	100%	$0.70	14	1.35
Energy Management System	Interior Lighting	10%	10%	0%	100%	$0.70	14	1.35
Energy Management System	Exterior Lighting	10%	10%	0%	100%	$0.70	14	1.35
Thermostat - Clock/Programmable	Cooling	6%	6%	100%	100%	$0.13	11	4.33
Thermostat - Clock/Programmable	Cooling/Heating	0%	0%	100%	100%	$0.13	11	4.33
Thermostat - Clock/Programmable	Heating	41%	41%	100%	100%	$0.13	11	4.33
Hotel - Guest Room Controls	Cooling	0%	0%	0%	0%	$0.14	8	1.21
Hotel - Guest Room Controls	Interior Lighting	15%	12%	0%	0%	$0.14	8	1.21
Interior Lighting - LED Exit Lighting	Interior Lighting	2%	2%	86%	90%	$0.00	16	52.6
Interior Lighting - Occupancy Sensors	Interior Lighting	3%	5%	56%	75%	$0.44	8	0.09
Interior Lighting - Task Lighting	Interior Lighting	2%	10%	0%	100%	$0.24	5	0.09
Interior Lighting - Time Clocks and Timers (lighting)	Interior Lighting	5%	3%	56%	75%	$0.20	8	0.41
Interior Lighting - Fluorescent Delamp and	Interior Lighting	0%	0%	0%	75%	$1.35	11	-

Measure	End Use	Energy Savings	Demand Savings	Base Satura-tion	Appl./ Feas.	Cost ($/sqft)	Life-time (yrs)	BC Ratio
Install Reflectors								
Interior Fluorescent - Bi-Level Fixture w/Occupancy Sensor	Interior Lighting	10%	5%	10%	30%	$0.50	8	0.04
Interior Fluorescent - Photocell-Controlled Dimming Ballasts	Interior Lighting	25%	13%	0%	60%	$0.38	8	0.14
Indoor Lighting - Daylighting Controls	Interior Lighting	5%	5%	19%	25%	$0.15	8	0.54
Water Heating - Heat Trap	Water Heating	9%	9%	5%	25%	$2.36	-	-
Water Heating - Faucet Aerators and Low Flow Nozzles	Water Heating	4%	4%	0%	100%	$0.03	9	2.76
Water Heating - Pipe Insulation	Water Heating	4%	4%	30%	60%	$0.28	15	0.39
Water Heating - Tank Blanket	Water Heating	10%	10%	0%	0%	$0.04	10	5.61
Water Heating - Hot Water Saver	Water Heating	5%	1%	0%	100%	$0.10	5	0.61
Water Heating - High Efficiency Circulation Pump	Water Heating	0%	0%	0%	0%	$0.00	-	1.00
Water Heating - Install Timer	Water Heating	9%	9%	5%	25%	$0.04	-	-
Water Heating - Thermostat Setback	Water Heating	10%	10%	0%	100%	$0.11	10	2.04
Water Heating - Solar Water Heating System	Water Heating	70%	70%	1%	85%	$2.46	-	-
Refrigerator - Decommissioning and Recycling	Refrigeration	90%	90%	10%	50%	$0.13	8	2.65
Refrigerator - Anti-Sweat Heater	Refrigeration	5%	3%	0%	100%	$0.20	12	0.03
Refrigerator - Door Gasket Replacement	Refrigeration	4%	2%	5%	100%	$0.10	4	0.02
Display Case - LED Lighting	Refrigeration	0%	0%	0%	0%	$0.00	-	2.00
Open Display Case - Night Covers	Refrigeration	6%	3%	5%	100%	$0.05	8	0.05
Vending Machine - Controller	Refrigeration	15%	11%	2%	10%	$0.27	5	0.02
Office Electronics - Plug Load Occupancy Sensors	Office Equipment	10%	5%	13%	75%	$0.25	8	0.02
Office Electronics - ENERGY STAR Power Supplies	Office Equipment	1%	1%	10%	100%	$0.00	7	4.99
Non-HVAC Motors - Variable Speed Control	Miscellaneous	1%	0%	0%	75%	$0.10	10	0.00
Pool Pump - Timer	Miscellaneous	1%	15%	55%	73%	$0.36	10	0.00

Table C-53 Energy-Efficiency Measure Data—Large Miscellaneous, New Vintage

Measure	End Use	Energy Savings	Demand Savings	Base Satura-tion	Appl./ Feas.	Cost ($/sqft)	Life-time (yrs)	BC Ratio
Chiller - VSD	Cooling	32%	34%	15%	88%	$1.17	20	1.94
Chiller - Condenser Water Temperature Reset	Cooling	8%	10%	60%	100%	$0.57	4	0.14
Chiller - Economizer	Cooling	10%	0%	38%	65%	$0.15	10	2.96
Chiller - Thermal Energy Storage	Cooling	0%	25%	44%	65%	$0.15	15	1.47
Air-Cooled Chiller - High Efficiency Fans	Cooling	0%	0%	15%	44%	$0.04	10	0.02
Water-Cooled Chiller - Condenser Water Temperature Reset	Cooling	10%	10%	60%	100%	$0.57	4	0.15
Water-Cooled Chiller - Cooling Tower, High-Efficiency Fans	Cooling	25%	0%	15%	44%	$0.04	10	12.9
Heat Pump - Maintenance	Cooling/Heating	10%	14%	33%	100%	$0.06	4	2.32
RTU - Maintenance	Cooling	14%	14%	33%	100%	$0.06	4	2.01
Ventilation - Variable Speed Control	Ventilation	3%	6%	0%	0%	$0.34	10	0.04
Ventilation - CO2 Controlled	Ventilation	5%	13%	12%	20%	$0.21	10	0.09
Ventilation - Exhaust Hood Sensor Control	Ventilation	0%	0%	1%	20%	$0.03	10	-
Fans - Energy-Efficient Motors	Ventilation	1%	1%	11%	100%	$0.14	10	0.02
Pumps - High-Efficiency Motors	Cooling	0%	0%	0%	0%	$0.00	-	3.00
Pumps - High-Efficiency Motors	Cooling/Heating	0%	0%	0%	0%	$0.00	-	3.00
Pumps - High-Efficiency Motors	Heating	0%	0%	0%	0%	$0.00	-	3.00
Pumps - Variable Speed Control	Cooling	11%	0%	0%	0%	$0.13	10	2.26
Pumps - Variable Speed Control	Cooling/Heating	0%	0%	0%	0%	$0.13	10	2.26
Pumps - Variable Speed Control	Heating	6%	6%	0%	0%	$0.13	10	2.26
Insulation - Ducting	Cooling	4%	1%	8%	50%	$0.41	20	0.32
Insulation - Ducting	Cooling/Heating	1%	1%	8%	50%	$0.41	20	0.32
Insulation - Ducting	Heating	0%	0%	8%	50%	$0.41	20	0.32
Insulation - Ceiling	Cooling	11%	38%	7%	25%	$0.35	20	1.95
Insulation - Ceiling	Cooling/Heating	21%	15%	7%	25%	$0.35	20	1.95
Insulation - Ceiling	Heating	18%	18%	7%	25%	$0.35	20	1.95
Insulation - Wall Cavity	Cooling	2%	4%	19%	75%	$0.78	20	0.51
Insulation - Wall Cavity	Cooling/Heating	26%	26%	19%	75%	$0.78	20	0.51
Insulation - Wall Cavity	Heating	18%	18%	19%	75%	$0.78	20	0.51
HVAC - Duct Repair and Sealing	Cooling	1%	1%	25%	50%	$0.38	18	0.10
HVAC - Duct Repair and Sealing	Cooling/Heating	0%	0%	25%	50%	$0.38	18	0.10
HVAC - Duct Repair and Sealing	Heating	0%	0%	25%	50%	$0.38	18	0.10
Roofs - Cool Roof	Cooling	5%	5%	33%	100%	$0.05	15	2.74
Roofs - Cool Roof	Cooling/Heating	0%	0%	33%	100%	$0.05	15	2.74
Roofs - Cool Roof	Heating	0%	0%	33%	100%	$0.05	15	2.74
Windows - High Efficiency	Cooling	12%	26%	78%	100%	$0.88	20	0.68
Windows - High Efficiency	Cooling/Heating	0%	0%	78%	100%	$0.88	20	0.68
Windows - High Efficiency	Heating	11%	11%	78%	100%	$0.88	20	0.68
Energy Management System	Cooling	26%	14%	14%	100%	$0.70	14	1.73
Energy Management System	Cooling/Heating	24%	20%	14%	100%	$0.70	14	1.73
Energy Management System	Heating	20%	20%	14%	100%	$0.70	14	1.73
Energy Management System	Interior Lighting	9%	9%	14%	100%	$0.70	14	1.73
Energy Management System	Exterior Lighting	9%	9%	14%	100%	$0.70	14	1.73
Thermostat - Clock/Programmable	Cooling	6%	0%	50%	50%	$0.13	11	3.69
Thermostat - Clock/Programmable	Cooling/Heating	0%	0%	50%	50%	$0.13	11	3.69
Thermostat - Clock/Programmable	Heating	27%	27%	50%	50%	$0.13	11	3.69
Interior Lighting - LED Exit Lighting	Interior Lighting	2%	2%	86%	90%	$0.00	16	45.2
Interior Lighting - Occupancy Sensors	Interior Lighting	10%	5%	56%	75%	$0.44	8	0.32
Interior Lighting - Task Lighting	Interior Lighting	10%	10%	17%	100%	$0.24	5	0.38
Interior Lighting - Time Clocks and Timers (lighting)	Interior Lighting	5%	3%	56%	75%	$0.30	8	0.23
Interior Lighting - Fluorescent Delamp and Install Reflectors	Interior Lighting	0%	0%	11%	90%	$0.50	11	-
Interior Fluorescent - Bi-Level Fixture w/Occupancy Sensor	Interior Lighting	10%	5%	10%	30%	$0.50	8	0.05

Measure	End Use	Energy Savings	Demand Savings	Base Satura-tion	Appl./ Feas.	Cost ($/sqft)	Life-time (yrs)	BC Ratio
Interior Fluorescent - Photocell-Controlled Dimming Ballasts	Interior Lighting	25%	13%	6%	60%	$0.38	8	0.17
Indoor Lighting - Daylighting Controls	Interior Lighting	20%	20%	19%	25%	$0.19	8	1.46
Water Heating - Heat Trap	Water Heating	9%	9%	5%	25%	$2.36	-	-
Water Heating - Faucet Aerators and Low Flow Nozzles	Water Heating	4%	4%	31%	100%	$0.03	9	0.87
Water Heating - Pipe Insulation	Water Heating	4%	4%	30%	60%	$0.28	15	0.12
Water Heating - Tank Blanket	Water Heating	10%	10%	0%	0%	$0.04	10	1.77
Water Heating - Hot Water Saver	Water Heating	5%	1%	0%	100%	$0.04	5	0.48
Water Heating - High Efficiency Circulation Pump	Water Heating	0%	0%	0%	0%	$0.00	-	1.00
Water Heating - Install Timer	Water Heating	9%	9%	5%	25%	$0.04	-	-
Water Heating - Thermostat Setback	Water Heating	10%	10%	5%	100%	$0.11	10	0.64
Water Heating - Solar Water Heating System	Water Heating	70%	70%	1%	85%	$2.46	-	-
Refrigerator - Decommissioning and Recycling	Refrigeration	90%	90%	10%	50%	$0.13	8	2.08
Refrigerator - Anti-Sweat Heater	Refrigeration	5%	3%	0%	100%	$0.20	12	0.02
Refrigerator - Door Gasket Replacement	Refrigeration	4%	2%	5%	100%	$0.10	4	0.02
Display Case - LED Lighting	Refrigeration	0%	0%	0%	0%	$0.00	-	2.00
Open Display Case - Night Covers	Refrigeration	6%	3%	5%	100%	$0.05	8	0.04
Vending Machine - Controller	Refrigeration	15%	11%	2%	10%	$0.27	5	0.01
Office Electronics - Plug Load Occupancy Sensors	Office Equipment	10%	5%	13%	75%	$0.25	8	0.05
Office Electronics - ENERGY STAR Power Supplies	Office Equipment	1%	1%	10%	100%	$0.00	7	10.3
Non-HVAC Motors - Variable Speed Control	Miscellaneous	1%	0%	0%	75%	$0.10	10	0.00
Pool Pump - Timer	Miscellaneous	60%	15%	34%	45%	$0.36	10	0.00

Table C-54 Energy-Efficiency Measure Data—Small Miscellaneous, New Vintage

Measure	End Use	Energy Savings	Demand Savings	Base Satura-tion	Appl./ Feas.	Cost ($/sqft)	Life-time (yrs)	BC Ratio
Chiller - VSD	Cooling	32%	34%	15%	88%	$1.17	20	1.30
Chiller - Condenser Water Temperature Reset	Cooling	8%	10%	60%	100%	$0.57	4	0.09
Chiller - Economizer	Cooling	10%	0%	38%	65%	$0.15	10	1.99
Chiller - Thermal Energy Storage	Cooling	0%	25%	44%	65%	$0.15	15	1.47
Air-Cooled Chiller - High Efficiency Fans	Cooling	0%	0%	15%	44%	$0.04	10	0.01
Water-Cooled Chiller - Condenser Water Temperature Reset	Cooling	25%	10%	60%	100%	$0.57	4	0.26
Water-Cooled Chiller - Cooling Tower, High-Efficiency Fans	Cooling	0%	0%	15%	44%	$0.04	10	0.01
Heat Pump - Maintenance	Cooling/Heating	10%	14%	14%	100%	$0.06	4	1.68
RTU - Maintenance	Cooling	14%	14%	14%	100%	$0.06	4	1.58
Ventilation - Variable Speed Control	Ventilation	3%	6%	0%	0%	$0.34	10	0.02
Ventilation - CO2 Controlled	Ventilation	5%	13%	12%	20%	$0.21	10	0.06
Ventilation - Exhaust Hood Sensor Control	Ventilation	0%	0%	1%	20%	$0.03	10	-
Fans - Energy-Efficient Motors	Ventilation	1%	1%	11%	100%	$0.14	10	0.01
Pumps - High-Efficiency Motors	Cooling	0%	0%	0%	0%	$0.00	-	3.00
Pumps - High-Efficiency Motors	Cooling/Heating	0%	0%	0%	0%	$0.00	-	3.00
Pumps - High-Efficiency Motors	Heating	0%	0%	0%	0%	$0.00	-	3.00
Pumps - Variable Speed Control	Cooling	11%	0%	0%	0%	$0.13	10	1.69
Pumps - Variable Speed Control	Cooling/Heating	0%	0%	0%	0%	$0.13	10	1.69
Pumps - Variable Speed Control	Heating	6%	6%	0%	0%	$0.13	10	1.69
Insulation - Ducting	Cooling	4%	1%	8%	50%	$0.41	20	0.25
Insulation - Ducting	Cooling/Heating	1%	1%	8%	50%	$0.41	20	0.25
Insulation - Ducting	Heating	0%	0%	8%	50%	$0.41	20	0.25
Insulation - Ceiling	Cooling	11%	38%	7%	25%	$0.35	20	1.42
Insulation - Ceiling	Cooling/Heating	21%	15%	7%	25%	$0.35	20	1.42
Insulation - Ceiling	Heating	18%	18%	7%	25%	$0.35	20	1.42
Insulation - Wall Cavity	Cooling	2%	4%	19%	75%	$0.78	20	0.35
Insulation - Wall Cavity	Cooling/Heating	26%	26%	19%	75%	$0.78	20	0.35
Insulation - Wall Cavity	Heating	18%	18%	19%	75%	$0.78	20	0.35
HVAC - Duct Repair and Sealing	Cooling	1%	1%	25%	50%	$0.38	18	0.08
HVAC - Duct Repair and Sealing	Cooling/Heating	0%	0%	25%	50%	$0.38	18	0.08
HVAC - Duct Repair and Sealing	Heating	0%	0%	25%	50%	$0.38	18	0.08
Roofs - Cool Roof	Cooling	5%	5%	33%	100%	$0.05	15	2.12
Roofs - Cool Roof	Cooling/Heating	0%	0%	33%	100%	$0.05	15	2.12
Roofs - Cool Roof	Heating	0%	0%	33%	100%	$0.05	15	2.12
Windows - High Efficiency	Cooling	12%	26%	78%	100%	$0.88	20	0.50
Windows - High Efficiency	Cooling/Heating	0%	0%	78%	100%	$0.88	20	0.50
Windows - High Efficiency	Heating	11%	11%	78%	100%	$0.88	20	0.50
Energy Management System	Cooling	26%	14%	14%	100%	$0.70	14	1.30
Energy Management System	Cooling/Heating	24%	20%	14%	100%	$0.70	14	1.30
Energy Management System	Heating	20%	20%	14%	100%	$0.70	14	1.30
Energy Management System	Interior Lighting	9%	9%	14%	100%	$0.70	14	1.30
Energy Management System	Exterior Lighting	9%	9%	14%	100%	$0.70	14	1.30
Thermostat - Clock/Programmable	Cooling	6%	0%	50%	50%	$0.13	11	2.61
Thermostat - Clock/Programmable	Cooling/Heating	0%	0%	50%	50%	$0.13	11	2.61
Thermostat - Clock/Programmable	Heating	27%	27%	50%	50%	$0.13	11	2.61
Interior Lighting - LED Exit Lighting	Interior Lighting	2%	2%	86%	90%	$0.00	16	35.0
Interior Lighting - Occupancy Sensors	Interior Lighting	10%	5%	56%	75%	$0.44	8	0.24
Interior Lighting - Task Lighting	Interior Lighting	10%	10%	17%	100%	$0.24	5	0.29
Interior Lighting - Time Clocks and Timers (lighting)	Interior Lighting	5%	3%	56%	75%	$0.30	8	0.18
Interior Lighting - Fluorescent Delamp and Install Reflectors	Interior Lighting	0%	0%	11%	90%	$0.50	11	-
Interior Fluorescent - Bi-Level Fixture w/Occupancy Sensor	Interior Lighting	10%	5%	10%	30%	$0.50	8	0.04

Measure	End Use	Energy Savings	Demand Savings	Base Satura-tion	Appl./ Feas.	Cost ($/sqft)	Life-time (yrs)	BC Ratio
Interior Fluorescent - Photocell-Controlled Dimming Ballasts	Interior Lighting	25%	13%	6%	60%	$0.38	8	0.13
Indoor Lighting - Daylighting Controls	Interior Lighting	20%	20%	19%	25%	$0.19	8	1.13
Water Heating - Heat Trap	Water Heating	9%	9%	5%	25%	$2.36	-	-
Water Heating - Faucet Aerators and Low Flow Nozzles	Water Heating	4%	4%	31%	100%	$0.03	9	0.60
Water Heating - Pipe Insulation	Water Heating	4%	4%	30%	60%	$0.28	15	0.09
Water Heating - Tank Blanket	Water Heating	10%	10%	0%	0%	$0.04	10	1.22
Water Heating - Hot Water Saver	Water Heating	5%	1%	0%	100%	$0.04	5	0.33
Water Heating - High Efficiency Circulation Pump	Water Heating	0%	0%	0%	0%	$0.00	-	1.00
Water Heating - Install Timer	Water Heating	9%	9%	5%	25%	$0.04	-	-
Water Heating - Thermostat Setback	Water Heating	10%	10%	5%	100%	$0.11	10	0.44
Water Heating - Solar Water Heating System	Water Heating	70%	70%	1%	85%	$2.46	-	-
Refrigerator - Decommissioning and Recycling	Refrigeration	90%	90%	10%	50%	$0.13	8	1.31
Refrigerator - Anti-Sweat Heater	Refrigeration	5%	3%	0%	100%	$0.20	12	0.02
Refrigerator - Door Gasket Replacement	Refrigeration	4%	2%	5%	100%	$0.10	4	0.02
Display Case - LED Lighting	Refrigeration	0%	0%	0%	0%	$0.00	-	2.00
Open Display Case - Night Covers	Refrigeration	6%	3%	5%	100%	$0.05	8	0.05
Vending Machine - Controller	Refrigeration	15%	11%	2%	10%	$0.27	5	0.01
Office Electronics - Plug Load Occupancy Sensors	Office Equipment	10%	5%	13%	75%	$0.25	8	0.05
Office Electronics - ENERGY STAR Power Supplies	Office Equipment	1%	1%	10%	100%	$0.00	7	10.3
Non-HVAC Motors - Variable Speed Control	Miscellaneous	1%	0%	0%	75%	$0.10	10	0.00
Pool Pump - Timer	Miscellaneous	60%	15%	34%	45%	$0.36	10	0.01

Table C-55 Energy-Efficiency Measure Data—Large Office, New Vintage

Measure	End Use	Energy Savings	Demand Savings	Base Satura-tion	Appl./ Feas.	Cost ($/sqft)	Life-time (yrs)	BC Ratio
Chiller - VSD	Cooling	32%	33%	15%	88%	$1.17	20	2.60
Chiller - Condenser Water Temperature Reset	Cooling	8%	9%	60%	100%	$0.57	4	0.19
Chiller - Economizer	Cooling	9%	9%	54%	73%	$0.15	10	3.76
Chiller - Thermal Energy Storage	Cooling	0%	25%	44%	65%	$0.15	15	5.16
Air-Cooled Chiller - High Efficiency Fans	Cooling	0%	0%	15%	44%	$0.04	10	0.03
Water-Cooled Chiller - Condenser Water Temperature Reset	Cooling	25%	9%	60%	100%	$0.57	4	0.56
Water-Cooled Chiller - Cooling Tower, High-Efficiency Fans	Cooling	0%	0%	15%	44%	$0.04	10	0.03
Heat Pump - Maintenance	Cooling/Heating	11%	14%	33%	100%	$0.06	4	2.61
RTU - Maintenance	Cooling	14%	14%	33%	100%	$0.06	4	3.26
Ventilation - Variable Speed Control	Ventilation	3%	11%	0%	0%	$0.34	10	0.12
Ventilation - CO2 Controlled	Ventilation	5%	7%	9%	15%	$0.21	10	0.29
Ventilation - Exhaust Hood Sensor Control	Ventilation	0%	0%	1%	15%	$0.03	10	-
Fans - Energy-Efficient Motors	Ventilation	1%	1%	11%	100%	$0.14	10	0.06
Pumps - High-Efficiency Motors	Cooling	0%	0%	0%	0%	$0.00	-	3.00
Pumps - High-Efficiency Motors	Cooling/Heating	0%	0%	0%	0%	$0.00	-	3.00
Pumps - High-Efficiency Motors	Heating	0%	0%	0%	0%	$0.00	-	3.00
Pumps - Variable Speed Control	Cooling	11%	11%	0%	0%	$0.13	10	3.10
Pumps - Variable Speed Control	Cooling/Heating	0%	0%	0%	0%	$0.13	10	3.10
Pumps - Variable Speed Control	Heating	6%	6%	0%	0%	$0.13	10	3.10
Insulation - Ducting	Cooling	4%	0%	0%	50%	$0.41	20	0.49
Insulation - Ducting	Cooling/Heating	0%	0%	0%	50%	$0.41	20	0.49
Insulation - Ducting	Heating	0%	0%	0%	50%	$0.41	20	0.49
Insulation - Ceiling	Cooling	11%	14%	7%	25%	$0.35	20	2.36
Insulation – Ceiling	Cooling/Heating	12%	7%	7%	25%	$0.35	20	2.36
Insulation - Ceiling	Heating	18%	18%	7%	25%	$0.35	20	2.36
Insulation - Wall Cavity	Cooling	2%	6%	50%	75%	$0.78	20	0.50
Insulation - Wall Cavity	Cooling/Heating	35%	6%	50%	75%	$0.78	20	0.50
Insulation - Wall Cavity	Heating	18%	18%	50%	75%	$0.78	20	0.50
HVAC - Duct Repair and Sealing	Cooling	13%	14%	25%	50%	$0.38	18	2.16
HVAC - Duct Repair and Sealing	Cooling/Heating	14%	14%	25%	50%	$0.38	18	2.16
HVAC - Duct Repair and Sealing	Heating	15%	14%	25%	50%	$0.38	18	2.16
Roofs - Cool Roof	Cooling	5%	2%	50%	100%	$0.05	15	4.16
Roofs - Cool Roof	Cooling/Heating	0%	0%	50%	100%	$0.05	15	4.16
Roofs - Cool Roof	Heating	0%	0%	50%	100%	$0.05	15	4.16
Windows - High Efficiency	Cooling	12%	20%	100%	100%	$0.88	20	0.88
Windows - High Efficiency	Cooling/Heating	0%	0%	100%	100%	$0.88	20	0.88
Windows - High Efficiency	Heating	11%	11%	100%	100%	$0.88	20	0.88
Energy Management System	Cooling	26%	14%	50%	100%	$0.70	14	2.18
Energy Management System	Cooling/Heating	25%	15%	50%	100%	$0.70	14	2.18
Energy Management System	Heating	20%	20%	50%	100%	$0.70	14	2.18
Energy Management System	Interior Lighting	9%	9%	50%	100%	$0.70	14	2.18
Energy Management System	Exterior Lighting	9%	9%	50%	100%	$0.70	14	2.18
Thermostat - Clock/Programmable	Cooling	6%	6%	50%	50%	$0.13	11	5.14
Thermostat - Clock/Programmable	Cooling/Heating	0%	0%	50%	50%	$0.13	11	5.14
Thermostat - Clock/Programmable	Heating	41%	41%	50%	50%	$0.13	11	5.14
Interior Lighting - LED Exit Lighting	Interior Lighting	2%	2%	86%	90%	$0.00	16	51.6
Interior Lighting - Occupancy Sensors	Interior Lighting	10%	5%	56%	75%	$0.05	8	3.18
Interior Lighting - Task Lighting	Interior Lighting	10%	10%	50%	100%	$0.24	5	0.43
Interior Lighting - Time Clocks and Timers (lighting)	Interior Lighting	5%	3%	56%	75%	$0.30	8	0.26
Interior Lighting - Fluorescent Delamp and Install Reflectors	Interior Lighting	0%	0%	100%	100%	$0.50	11	-
Interior Fluorescent - Bi-Level Fixture	Interior Lighting	10%	5%	10%	30%	$0.40	8	0.28

Measure	End Use	Energy Savings	Demand Savings	Base Satura-tion	Appl./ Feas.	Cost ($/sqft)	Life-time (yrs)	BC Ratio
w/Occupancy Sensor								
Interior Fluorescent - Photocell-Controlled Dimming Ballasts	Interior Lighting	25%	13%	50%	73%	$0.34	8	0.83
Indoor Lighting - Daylighting Controls	Interior Lighting	10%	10%	19%	25%	$0.19	8	0.84
Water Heating - Heat Trap	Water Heating	9%	9%	5%	25%	$2.36	-	-
Water Heating - Faucet Aerators and Low Flow Nozzles	Water Heating	4%	4%	50%	100%	$0.03	9	0.53
Water Heating - Pipe Insulation	Water Heating	4%	4%	100%	100%	$0.28	15	0.08
Water Heating - Tank Blanket	Water Heating	10%	10%	0%	0%	$0.04	10	1.07
Water Heating - Hot Water Saver	Water Heating	5%	1%	0%	100%	$0.04	5	0.29
Water Heating - High Efficiency Circulation Pump	Water Heating	0%	0%	0%	0%	$0.00	-	1.00
Water Heating - Install Timer	Water Heating	9%	9%	5%	25%	$0.04	-	-
Water Heating - Thermostat Setback	Water Heating	10%	10%	5%	100%	$0.11	10	0.39
Water Heating - Solar Water Heating System	Water Heating	70%	70%	1%	85%	$2.46	-	-
Refrigerator - Decommissioning and Recycling	Refrigeration	90%	90%	10%	50%	$0.13	8	1.00
Refrigerator - Anti-Sweat Heater	Refrigeration	5%	3%	0%	100%	$0.20	12	0.02
Refrigerator - Door Gasket Replacement	Refrigeration	4%	2%	5%	100%	$0.10	4	0.01
Display Case - LED Lighting	Refrigeration	0%	0%	0%	0%	$0.00	-	2.00
Open Display Case - Night Covers	Refrigeration	6%	3%	5%	100%	$0.05	8	0.03
Vending Machine - Controller	Refrigeration	15%	11%	2%	10%	$0.27	5	0.01
Office Electronics - Plug Load Occupancy Sensors	Office Equipment	10%	5%	13%	75%	$0.25	8	0.50
Office Electronics - ENERGY STAR Power Supplies	Office Equipment	1%	1%	10%	100%	$0.00	7	101
Non-HVAC Motors - Variable Speed Control	Miscellaneous	1%	0%	50%	75%	$0.10	10	0.00
Pool Pump - Timer	Miscellaneous	60%	15%	34%	45%	$0.36	10	-

Table C-56 Energy-Efficiency Measure Data—Small Office, New Vintage

Measure	End Use	Energy Savings	Demand Savings	Base Satura-tion	Appl./ Feas.	Cost ($/sqft)	Life-time (yrs)	BC Ratio
Chiller - VSD	Cooling	32%	34%	0%	0%	$1.17	20	2.33
Chiller - Condenser Water Temperature Reset	Cooling	8%	10%	0%	0%	$0.57	4	0.16
Chiller - Economizer	Cooling	11%	0%	37%	65%	$0.15	10	3.77
Chiller - Thermal Energy Storage	Cooling	0%	25%	45%	65%	$0.15	15	5.30
Air-Cooled Chiller - High Efficiency Fans	Cooling	0%	0%	0%	0%	$0.04	10	0.02
Water-Cooled Chiller - Condenser Water Temperature Reset	Cooling	25%	10%	0%	0%	$0.57	4	0.47
Water-Cooled Chiller - Cooling Tower, High-Efficiency Fans	Cooling	0%	0%	0%	0%	$0.04	10	0.02
Heat Pump - Maintenance	Cooling/Heating	10%	14%	14%	100%	$0.03	4	5.91
RTU - Maintenance	Cooling	14%	14%	14%	100%	$0.08	4	2.11
Ventilation - Variable Speed Control	Ventilation	3%	6%	0%	0%	$0.34	10	0.05
Ventilation - CO2 Controlled	Ventilation	5%	13%	12%	20%	$0.21	10	0.11
Ventilation - Exhaust Hood Sensor Control	Ventilation	0%	0%	1%	20%	$0.03	10	-
Fans - Energy-Efficient Motors	Ventilation	1%	1%	11%	100%	$0.14	10	0.02
Pumps - High-Efficiency Motors	Cooling	0%	0%	0%	0%	$0.00	-	3.00
Pumps - High-Efficiency Motors	Cooling/Heating	0%	0%	0%	0%	$0.00	-	3.00
Pumps - High-Efficiency Motors	Heating	0%	0%	0%	0%	$0.00	-	3.00
Pumps - Variable Speed Control	Cooling	11%	0%	0%	0%	$0.13	10	2.99
Pumps - Variable Speed Control	Cooling/Heating	0%	0%	0%	0%	$0.13	10	2.99
Pumps - Variable Speed Control	Heating	6%	6%	0%	0%	$0.13	10	2.99
Insulation - Ducting	Cooling	4%	1%	11%	50%	$0.41	20	0.45
Insulation - Ducting	Cooling/Heating	1%	1%	11%	50%	$0.41	20	0.45
Insulation - Ducting	Heating	0%	0%	11%	50%	$0.41	20	0.45
Insulation - Ceiling	Cooling	11%	38%	7%	25%	$0.35	20	2.44
Insulation - Ceiling	Cooling/Heating	21%	15%	7%	25%	$0.35	20	2.44
Insulation - Ceiling	Heating	18%	18%	7%	25%	$0.35	20	2.44
Insulation - Wall Cavity	Cooling	2%	4%	13%	75%	$0.78	20	0.58
Insulation - Wall Cavity	Cooling/Heating	26%	26%	13%	75%	$0.78	20	0.58
Insulation - Wall Cavity	Heating	18%	18%	13%	75%	$0.78	20	0.58
HVAC - Duct Repair and Sealing	Cooling	13%	14%	25%	50%	$0.38	18	2.30
HVAC - Duct Repair and Sealing	Cooling/Heating	15%	14%	25%	50%	$0.38	18	2.30
HVAC - Duct Repair and Sealing	Heating	17%	15%	25%	50%	$0.38	18	2.30
Roofs - Cool Roof	Cooling	5%	5%	41%	100%	$0.05	15	3.81
Roofs - Cool Roof	Cooling/Heating	0%	0%	41%	100%	$0.05	15	3.81
Roofs - Cool Roof	Heating	0%	0%	41%	100%	$0.05	15	3.81
Windows - High Efficiency	Cooling	12%	26%	78%	100%	$0.88	20	0.88
Windows - High Efficiency	Cooling/Heating	0%	0%	78%	100%	$0.88	20	0.88
Windows - High Efficiency	Heating	11%	11%	78%	100%	$0.88	20	0.88
Energy Management System	Cooling	26%	14%	6%	100%	$0.70	14	2.16
Energy Management System	Cooling/Heating	24%	20%	6%	100%	$0.70	14	2.16
Energy Management System	Heating	20%	20%	6%	100%	$0.70	14	2.16
Energy Management System	Interior Lighting	9%	9%	6%	100%	$0.70	14	2.16
Energy Management System	Exterior Lighting	9%	9%	6%	100%	$0.70	14	2.16
Thermostat - Clock/Programmable	Cooling	6%	0%	78%	78%	$0.13	11	4.38
Thermostat - Clock/Programmable	Cooling/Heating	0%	0%	78%	78%	$0.13	11	4.38
Thermostat - Clock/Programmable	Heating	27%	27%	78%	78%	$0.13	11	4.38
Interior Lighting - LED Exit Lighting	Interior Lighting	2%	2%	86%	90%	$0.00	16	49.5
Interior Lighting - Occupancy Sensors	Interior Lighting	10%	5%	56%	75%	$0.05	8	3.06
Interior Lighting - Task Lighting	Interior Lighting	10%	10%	14%	100%	$0.24	5	0.42
Interior Lighting - Time Clocks and Timers (lighting)	Interior Lighting	5%	3%	56%	75%	$0.30	8	0.25
Interior Lighting - Fluorescent Delamp and Install Reflectors	Interior Lighting	0%	0%	14%	90%	$0.50	11	-
Interior Fluorescent - Bi-Level Fixture w/Occupancy Sensor	Interior Lighting	10%	5%	10%	30%	$0.50	8	0.18

Measure	End Use	Energy Savings	Demand Savings	Base Satura-tion	Appl./ Feas.	Cost ($/sqft)	Life-time (yrs)	BC Ratio
Interior Fluorescent - Photocell-Controlled Dimming Ballasts	Interior Lighting	25%	13%	11%	60%	$0.38	8	0.59
Indoor Lighting - Daylighting Controls	Interior Lighting	10%	10%	75%	100%	$0.19	8	0.80
Water Heating - Heat Trap	Water Heating	9%	9%	5%	25%	$2.36	-	-
Water Heating - Faucet Aerators and Low Flow Nozzles	Water Heating	4%	4%	25%	100%	$0.03	9	0.45
Water Heating - Pipe Insulation	Water Heating	4%	4%	50%	100%	$0.28	15	0.06
Water Heating - Tank Blanket	Water Heating	10%	10%	40%	100%	$0.04	10	0.93
Water Heating - Hot Water Saver	Water Heating	5%	1%	0%	100%	$0.04	5	0.25
Water Heating - High Efficiency Circulation Pump	Water Heating	0%	0%	0%	0%	$0.00	-	1.00
Water Heating - Install Timer	Water Heating	9%	9%	5%	25%	$0.04	-	-
Water Heating - Thermostat Setback	Water Heating	10%	10%	5%	100%	$0.11	10	0.34
Water Heating - Solar Water Heating System	Water Heating	70%	70%	1%	85%	$2.46	-	-
Refrigerator - Decommissioning and Recycling	Refrigeration	90%	90%	10%	50%	$0.13	8	1.41
Refrigerator - Anti-Sweat Heater	Refrigeration	5%	3%	0%	100%	$0.20	12	-
Refrigerator - Door Gasket Replacement	Refrigeration	4%	2%	5%	100%	$0.10	4	0.01
Display Case - LED Lighting	Refrigeration	0%	0%	0%	0%	$0.00	-	2.00
Open Display Case - Night Covers	Refrigeration	6%	3%	5%	100%	$0.05	8	-
Vending Machine - Controller	Refrigeration	15%	11%	2%	10%	$0.27	5	0.02
Office Electronics - Plug Load Occupancy Sensors	Office Equipment	10%	5%	7%	75%	$0.20	8	0.40
Office Electronics - ENERGY STAR Power Supplies	Office Equipment	1%	1%	10%	100%	$0.00	7	63.3
Non-HVAC Motors - Variable Speed Control	Miscellaneous	1%	0%	2%	75%	$0.10	10	0.01
Pool Pump - Timer	Miscellaneous	60%	15%	34%	45%	$0.36	10	-

Table C-57 Energy-Efficiency Measure Data—Restaurant, New Vintage

Measure	End Use	Energy Savings	Demand Savings	Base Satura-tion	Appl./ Feas.	Cost ($/sqft)	Life-time (yrs)	BC Ratio
Chiller - VSD	Cooling	27%	32%	0%	0%	$1.17	20	5.65
Chiller - Condenser Water Temperature Reset	Cooling	8%	5%	0%	0%	$1.75	4	0.15
Chiller - Economizer	Cooling	10%	2%	37%	65%	$0.15	10	10.7
Chiller - Thermal Energy Storage	Cooling	0%	25%	45%	65%	$0.15	15	7.60
Air-Cooled Chiller - High Efficiency Fans	Cooling	0%	0%	0%	0%	$0.04	10	0.08
Water-Cooled Chiller - Condenser Water Temperature Reset	Cooling	11%	5%	0%	0%	$1.73	4	0.21
Water-Cooled Chiller - Cooling Tower, High-Efficiency Fans	Cooling	0%	0%	0%	0%	$0.04	10	0.08
Heat Pump - Maintenance	Cooling/Heating	14%	14%	14%	100%	$0.03	4	12.4
RTU - Maintenance	Cooling	14%	15%	14%	100%	$0.08	4	4.89
Ventilation - Variable Speed Control	Ventilation	3%	3%	0%	0%	$0.34	10	0.13
Ventilation - CO2 Controlled	Ventilation	1%	13%	12%	20%	$0.80	10	0.02
Ventilation - Exhaust Hood Sensor Control	Ventilation	25%	13%	1%	20%	$0.08	10	4.49
Fans - Energy-Efficient Motors	Ventilation	1%	1%	11%	100%	$0.14	10	0.06
Pumps - High-Efficiency Motors	Cooling	0%	0%	0%	0%	$0.00	-	3.00
Pumps - High-Efficiency Motors	Cooling/Heating	0%	0%	0%	0%	$0.00	-	3.00
Pumps - High-Efficiency Motors	Heating	0%	0%	0%	0%	$0.00	-	3.00
Pumps - Variable Speed Control	Cooling	12%	12%	0%	0%	$0.44	10	1.94
Pumps - Variable Speed Control	Cooling/Heating	0%	0%	0%	0%	$0.44	10	1.94
Pumps - Variable Speed Control	Heating	6%	6%	0%	0%	$0.44	10	1.94
Insulation - Ducting	Cooling	3%	2%	0%	50%	$0.41	20	0.81
Insulation - Ducting	Cooling/Heating	4%	5%	0%	50%	$0.41	20	0.81
Insulation - Ducting	Heating	0%	0%	0%	50%	$0.41	20	0.81
Insulation - Ceiling	Cooling	17%	31%	7%	25%	$0.11	20	19.5
Insulation - Ceiling	Cooling/Heating	14%	13%	7%	25%	$0.11	20	19.5
Insulation - Ceiling	Heating	17%	17%	7%	25%	$0.11	20	19.5
Insulation - Wall Cavity	Cooling	2%	5%	0%	75%	$0.08	20	18.4
Insulation - Wall Cavity	Cooling/Heating	3%	1%	0%	75%	$0.08	20	18.4
Insulation - Wall Cavity	Heating	52%	52%	0%	75%	$0.08	20	18.4
HVAC - Duct Repair and Sealing	Cooling	10%	11%	25%	50%	$0.38	18	3.06
HVAC - Duct Repair and Sealing	Cooling/Heating	10%	11%	25%	50%	$0.38	18	3.06
HVAC - Duct Repair and Sealing	Heating	10%	11%	25%	50%	$0.38	18	3.06
Roofs - Cool Roof	Cooling	4%	3%	50%	100%	$0.05	15	6.75
Roofs - Cool Roof	Cooling/Heating	0%	0%	50%	100%	$0.05	15	6.75
Roofs - Cool Roof	Heating	0%	0%	50%	100%	$0.05	15	6.75
Windows - High Efficiency	Cooling	9%	21%	0%	100%	$0.60	20	1.68
Windows - High Efficiency	Cooling/Heating	0%	0%	0%	100%	$0.60	20	1.68
Windows - High Efficiency	Heating	3%	3%	0%	100%	$0.60	20	1.68
Energy Management System	Cooling	6%	14%	0%	100%	$0.70	14	1.56
Energy Management System	Cooling/Heating	6%	12%	0%	100%	$0.70	14	1.56
Energy Management System	Heating	5%	5%	0%	100%	$0.70	14	1.56
Energy Management System	Interior Lighting	9%	9%	0%	100%	$0.70	14	1.56
Energy Management System	Exterior Lighting	9%	9%	0%	100%	$0.70	14	1.56
Thermostat - Clock/Programmable	Cooling	2%	2%	50%	50%	$0.13	11	2.14
Thermostat - Clock/Programmable	Cooling/Heating	0%	0%	50%	50%	$0.13	11	2.14
Thermostat - Clock/Programmable	Heating	7%	7%	50%	50%	$0.13	11	2.14
Interior Lighting - LED Exit Lighting	Interior Lighting	2%	2%	86%	90%	$0.00	16	87.5
Interior Lighting - Occupancy Sensors	Interior Lighting	10%	5%	56%	75%	$0.44	8	0.62
Interior Lighting - Task Lighting	Interior Lighting	1%	10%	0%	100%	$0.24	5	0.07
Interior Lighting - Time Clocks and Timers (lighting)	Interior Lighting	5%	3%	56%	75%	$0.20	8	0.68
Interior Lighting - Fluorescent Delamp and Install Reflectors	Interior Lighting	0%	0%	0%	75%	$0.55	11	-
Interior Fluorescent - Bi-Level Fixture w/Occupancy Sensor	Interior Lighting	10%	5%	10%	30%	$0.50	8	0.11

Measure	End Use	Energy Savings	Demand Savings	Base Satura-tion	Appl./ Feas.	Cost ($/sqft)	Life-time (yrs)	BC Ratio
Interior Fluorescent - Photocell-Controlled Dimming Ballasts	Interior Lighting	25%	13%	0%	60%	$0.38	8	0.35
Indoor Lighting - Daylighting Controls	Interior Lighting	5%	5%	75%	100%	$0.34	8	0.40
Water Heating - Heat Trap	Water Heating	9%	9%	5%	25%	$2.36	-	-
Water Heating - Faucet Aerators and Low Flow Nozzles	Water Heating	4%	4%	0%	100%	$0.03	9	6.32
Water Heating - Pipe Insulation	Water Heating	6%	6%	50%	100%	$0.28	15	1.39
Water Heating - Tank Blanket	Water Heating	10%	10%	40%	100%	$0.04	10	12.9
Water Heating - Hot Water Saver	Water Heating	5%	1%	0%	100%	$0.04	5	3.46
Water Heating - High Efficiency Circulation Pump	Water Heating	0%	0%	0%	0%	$0.00	-	1.00
Water Heating - Install Timer	Water Heating	9%	9%	5%	25%	$0.10	-	-
Water Heating - Thermostat Setback	Water Heating	10%	10%	5%	100%	$0.05	10	10.3
Water Heating - Solar Water Heating System	Water Heating	70%	70%	1%	85%	$2.46	-	-
Refrigerator - Decommissioning and Recycling	Refrigeration	90%	90%	10%	50%	$0.13	8	22.5
Refrigerator - Anti-Sweat Heater	Refrigeration	5%	3%	0%	100%	$0.20	12	0.24
Refrigerator - Door Gasket Replacement	Refrigeration	4%	2%	5%	100%	$0.10	4	0.21
Display Case - LED Lighting	Refrigeration	0%	0%	0%	0%	$0.00	-	2.00
Open Display Case - Night Covers	Refrigeration	6%	3%	5%	100%	$0.05	8	0.48
Vending Machine - Controller	Refrigeration	15%	11%	2%	10%	$0.27	5	0.07
Office Electronics - Plug Load Occupancy Sensors	Office Equipment	10%	5%	7%	75%	$0.25	8	0.09
Office Electronics - ENERGY STAR Power Supplies	Office Equipment	1%	1%	10%	100%	$0.00	7	18.3
Non-HVAC Motors - Variable Speed Control	Miscellaneous	1%	0%	0%	75%	$0.10	10	0.03
Pool Pump - Timer	Miscellaneous	60%	15%	34%	45%	$0.36	10	-

Table C-58 Energy-Efficiency Measure Data—Large Retail, New Vintage

Measure	End Use	Energy Savings	Demand Savings	Base Satura-tion	Appl./ Feas.	Cost ($/sqft)	Life-time (yrs)	BC Ratio
Chiller - VSD	Cooling	26%	34%	0%	0%	$1.17	20	1.65
Chiller - Condenser Water Temperature Reset	Cooling	8%	5%	0%	0%	$0.87	4	0.09
Chiller - Economizer	Cooling	10%	0%	37%	65%	$0.15	10	3.15
Chiller - Thermal Energy Storage	Cooling	0%	25%	45%	65%	$0.15	15	4.54
Air-Cooled Chiller - High Efficiency Fans	Cooling	0%	0%	0%	0%	$0.04	10	0.03
Water-Cooled Chiller - Condenser Water Temperature Reset	Cooling	11%	5%	0%	0%	$0.86	4	0.11
Water-Cooled Chiller - Cooling Tower, High-Efficiency Fans	Cooling	0%	0%	0%	0%	$0.04	10	0.02
Heat Pump - Maintenance	Cooling/Heating	12%	14%	33%	100%	$0.03	4	4.99
RTU - Maintenance	Cooling	14%	15%	33%	100%	$0.08	4	1.56
Ventilation - Variable Speed Control	Ventilation	3%	3%	0%	0%	$0.34	10	0.03
Ventilation - CO2 Controlled	Ventilation	2%	13%	12%	20%	$0.80	10	0.01
Ventilation - Exhaust Hood Sensor Control	Ventilation	0%	0%	1%	20%	$0.04	10	-
Fans - Energy-Efficient Motors	Ventilation	0%	0%	11%	100%	$0.14	10	0.01
Pumps - High-Efficiency Motors	Cooling	0%	0%	0%	0%	$0.00	-	3.00
Pumps - High-Efficiency Motors	Cooling/Heating	0%	0%	0%	0%	$0.00	-	3.00
Pumps - High-Efficiency Motors	Heating	0%	0%	0%	0%	$0.00	-	3.00
Pumps - Variable Speed Control	Cooling	12%	0%	0%	0%	$0.44	10	0.72
Pumps - Variable Speed Control	Cooling/Heating	0%	0%	0%	0%	$0.44	10	0.72
Pumps - Variable Speed Control	Heating	6%	6%	0%	0%	$0.44	10	0.72
Insulation - Ducting	Cooling	4%	5%	0%	50%	$0.41	20	0.32
Insulation - Ducting	Cooling/Heating	0%	0%	0%	50%	$0.41	20	0.32
Insulation - Ducting	Heating	0%	0%	0%	50%	$0.41	20	0.32
Insulation - Ceiling	Cooling	17%	42%	7%	25%	$0.16	20	5.66
Insulation - Ceiling	Cooling/Heating	36%	22%	7%	25%	$0.16	20	5.66
Insulation - Ceiling	Heating	20%	20%	7%	25%	$0.16	20	5.66
Insulation - Wall Cavity	Cooling	3%	28%	0%	75%	$0.34	20	3.78
Insulation - Wall Cavity	Cooling/Heating	63%	27%	0%	75%	$0.34	20	3.78
Insulation - Wall Cavity	Heating	75%	75%	0%	75%	$0.34	20	3.78
HVAC - Duct Repair and Sealing	Cooling	8%	4%	25%	50%	$0.38	18	1.03
HVAC - Duct Repair and Sealing	Cooling/Heating	9%	6%	25%	50%	$0.38	18	1.03
HVAC - Duct Repair and Sealing	Heating	9%	7%	25%	50%	$0.38	18	1.03
Roofs - Cool Roof	Cooling	4%	12%	64%	100%	$0.09	15	1.27
Roofs - Cool Roof	Cooling/Heating	0%	0%	64%	100%	$0.09	15	1.27
Roofs - Cool Roof	Heating	0%	0%	64%	100%	$0.09	15	1.27
Windows - High Efficiency	Cooling	5%	0%	73%	100%	$0.35	20	0.58
Windows - High Efficiency	Cooling/Heating	0%	0%	73%	100%	$0.35	20	0.58
Windows - High Efficiency	Heating	3%	3%	73%	100%	$0.35	20	0.58
Energy Management System	Cooling	6%	14%	0%	100%	$0.70	14	0.74
Energy Management System	Cooling/Heating	6%	5%	0%	100%	$0.70	14	0.74
Energy Management System	Heating	5%	5%	0%	100%	$0.70	14	0.74
Energy Management System	Interior Lighting	9%	9%	0%	100%	$0.70	14	0.74
Energy Management System	Exterior Lighting	9%	9%	0%	100%	$0.70	14	0.74
Thermostat - Clock/Programmable	Cooling	7%	0%	50%	50%	$0.13	11	4.08
Thermostat - Clock/Programmable	Cooling/Heating	0%	0%	50%	50%	$0.13	11	4.08
Thermostat - Clock/Programmable	Heating	34%	34%	50%	50%	$0.13	11	4.08
Interior Lighting - LED Exit Lighting	Interior Lighting	2%	2%	86%	90%	$0.00	16	56.7
Interior Lighting - Occupancy Sensors	Interior Lighting	10%	5%	56%	75%	$0.44	8	0.39
Interior Lighting - Task Lighting	Interior Lighting	1%	10%	18%	100%	$0.24	5	0.05
Interior Lighting - Time Clocks and Timers (lighting)	Interior Lighting	5%	3%	56%	75%	$0.20	8	0.43
Interior Lighting - Fluorescent Delamp and Install Reflectors	Interior Lighting	0%	0%	9%	60%	$0.55	11	-
Interior Fluorescent - Bi-Level Fixture w/Occupancy Sensor	Interior Lighting	10%	5%	10%	30%	$0.50	8	0.15

Measure	End Use	Energy Savings	Demand Savings	Base Satura-tion	Appl./ Feas.	Cost ($/sqft)	Life-time (yrs)	BC Ratio
Interior Fluorescent - Photocell-Controlled Dimming Ballasts	Interior Lighting	25%	13%	9%	60%	$0.38	8	0.48
Indoor Lighting - Daylighting Controls	Interior Lighting	10%	10%	75%	100%	$0.09	8	1.93
Water Heating - Heat Trap	Water Heating	9%	9%	5%	25%	$2.36	-	-
Water Heating - Faucet Aerators and Low Flow Nozzles	Water Heating	4%	4%	36%	100%	$0.01	9	1.21
Water Heating - Pipe Insulation	Water Heating	4%	4%	50%	100%	$0.28	15	0.06
Water Heating - Tank Blanket	Water Heating	10%	10%	40%	100%	$0.02	10	1.64
Water Heating - Hot Water Saver	Water Heating	5%	1%	0%	100%	$0.04	5	0.22
Water Heating - High Efficiency Circulation Pump	Water Heating	0%	0%	0%	0%	$0.00	-	1.00
Water Heating - Install Timer	Water Heating	9%	9%	5%	25%	$0.04	-	-
Water Heating - Thermostat Setback	Water Heating	10%	10%	10%	100%	$0.11	10	0.30
Water Heating - Solar Water Heating System	Water Heating	70%	70%	1%	85%	$2.46	-	-
Refrigerator - Decommissioning and Recycling	Refrigeration	90%	90%	10%	50%	$0.13	8	2.64
Refrigerator - Anti-Sweat Heater	Refrigeration	5%	3%	0%	100%	$0.20	12	0.02
Refrigerator - Door Gasket Replacement	Refrigeration	4%	2%	5%	100%	$0.10	4	0.02
Display Case - LED Lighting	Refrigeration	0%	0%	0%	0%	$0.00	-	2.00
Open Display Case - Night Covers	Refrigeration	6%	3%	5%	100%	$0.05	8	0.05
Vending Machine - Controller	Refrigeration	15%	11%	2%	10%	$0.27	5	0.02
Office Electronics - Plug Load Occupancy Sensors	Office Equipment	10%	5%	7%	75%	$0.25	8	0.07
Office Electronics - ENERGY STAR Power Supplies	Office Equipment	1%	1%	10%	100%	$0.00	7	13.6
Non-HVAC Motors - Variable Speed Control	Miscellaneous	1%	0%	0%	75%	$0.10	10	0.00
Pool Pump - Timer	Miscellaneous	60%	15%	34%	45%	$0.36	10	-

Table C-59 Energy-Efficiency Measure Data—Small Retail, New Vintage

Measure	End Use	Energy Savings	Demand Savings	Base Satura-tion	Appl./ Feas.	Cost ($/sqft)	Life-time (yrs)	BC Ratio
Chiller - VSD	Cooling	26%	34%	0%	0%	$1.17	20	1.44
Chiller - Condenser Water Temperature Reset	Cooling	8%	5%	0%	0%	$0.87	4	0.07
Chiller - Economizer	Cooling	8%	0%	37%	65%	$0.15	10	2.33
Chiller - Thermal Energy Storage	Cooling	0%	25%	45%	65%	$0.15	15	4.54
Air-Cooled Chiller - High Efficiency Fans	Cooling	0%	0%	0%	0%	$0.04	10	0.02
Water-Cooled Chiller - Condenser Water Temperature Reset	Cooling	11%	5%	0%	0%	$0.86	4	0.10
Water-Cooled Chiller - Cooling Tower, High-Efficiency Fans	Cooling	0%	0%	0%	0%	$0.04	10	0.02
Heat Pump - Maintenance	Cooling/Heating	12%	14%	14%	100%	$0.03	4	5.22
RTU - Maintenance	Cooling	14%	15%	14%	100%	$0.08	4	1.59
Ventilation - Variable Speed Control	Ventilation	3%	3%	0%	0%	$0.34	10	0.03
Ventilation - CO2 Controlled	Ventilation	2%	13%	12%	20%	$0.80	10	0.01
Ventilation - Exhaust Hood Sensor Control	Ventilation	0%	0%	1%	20%	$0.04	10	-
Fans - Energy-Efficient Motors	Ventilation	0%	0%	11%	100%	$0.14	10	0.01
Pumps - High-Efficiency Motors	Cooling	0%	0%	0%	0%	$0.00	-	3.00
Pumps - High-Efficiency Motors	Cooling/Heating	0%	0%	0%	0%	$0.00	-	3.00
Pumps - High-Efficiency Motors	Heating	0%	0%	0%	0%	$0.00	-	3.00
Pumps - Variable Speed Control	Cooling	12%	0%	0%	0%	$0.44	10	0.74
Pumps - Variable Speed Control	Cooling/Heating	0%	0%	0%	0%	$0.44	10	0.74
Pumps - Variable Speed Control	Heating	6%	6%	0%	0%	$0.44	10	0.74
Insulation - Ducting	Cooling	4%	5%	0%	50%	$0.41	20	0.32
Insulation - Ducting	Cooling/Heating	0%	0%	0%	50%	$0.41	20	0.32
Insulation - Ducting	Heating	0%	0%	0%	50%	$0.41	20	0.32
Insulation - Ceiling	Cooling	17%	42%	7%	25%	$0.16	20	5.97
Insulation - Ceiling	Cooling/Heating	36%	22%	7%	25%	$0.16	20	5.97
Insulation - Ceiling	Heating	20%	20%	7%	25%	$0.16	20	5.97
Insulation - Wall Cavity	Cooling	3%	28%	0%	75%	$0.34	20	4.34
Insulation - Wall Cavity	Cooling/Heating	63%	27%	0%	75%	$0.34	20	4.34
Insulation - Wall Cavity	Heating	75%	75%	0%	75%	$0.34	20	4.34
HVAC - Duct Repair and Sealing	Cooling	8%	4%	25%	50%	$0.38	18	1.21
HVAC - Duct Repair and Sealing	Cooling/Heating	8%	4%	25%	50%	$0.38	18	1.21
HVAC - Duct Repair and Sealing	Heating	12%	14%	25%	50%	$0.38	18	1.21
Roofs - Cool Roof	Cooling	4%	12%	64%	100%	$0.09	15	1.27
Roofs - Cool Roof	Cooling/Heating	0%	0%	64%	100%	$0.09	15	1.27
Roofs - Cool Roof	Heating	0%	0%	64%	100%	$0.09	15	1.27
Windows - High Efficiency	Cooling	5%	0%	73%	100%	$0.35	20	0.60
Windows - High Efficiency	Cooling/Heating	0%	0%	73%	100%	$0.35	20	0.60
Windows - High Efficiency	Heating	3%	3%	73%	100%	$0.35	20	0.60
Energy Management System	Cooling	6%	14%	0%	100%	$0.70	14	0.76
Energy Management System	Cooling/Heating	6%	5%	0%	100%	$0.70	14	0.76
Energy Management System	Heating	5%	5%	0%	100%	$0.70	14	0.76
Energy Management System	Interior Lighting	9%	9%	0%	100%	$0.70	14	0.76
Energy Management System	Exterior Lighting	9%	9%	0%	100%	$0.70	14	0.76
Thermostat - Clock/Programmable	Cooling	7%	0%	50%	50%	$0.13	11	4.57
Thermostat - Clock/Programmable	Cooling/Heating	0%	0%	50%	50%	$0.13	11	4.57
Thermostat - Clock/Programmable	Heating	34%	34%	50%	50%	$0.13	11	4.57
Interior Lighting - LED Exit Lighting	Interior Lighting	2%	2%	86%	90%	$0.00	16	59.1
Interior Lighting - Occupancy Sensors	Interior Lighting	10%	5%	56%	75%	$0.44	8	0.41
Interior Lighting - Task Lighting	Interior Lighting	1%	10%	18%	100%	$0.24	5	0.05
Interior Lighting - Time Clocks and Timers (lighting)	Interior Lighting	5%	3%	56%	75%	$0.20	8	0.45
Interior Lighting - Fluorescent Delamp and Install Reflectors	Interior Lighting	0%	0%	9%	60%	$0.55	11	-
Interior Fluorescent - Bi-Level Fixture w/Occupancy Sensor	Interior Lighting	10%	5%	10%	30%	$0.50	8	0.15

Measure	End Use	Energy Savings	Demand Savings	Base Satura-tion	Appl./ Feas.	Cost ($/sqft)	Life-time (yrs)	BC Ratio
Interior Fluorescent - Photocell-Controlled Dimming Ballasts	Interior Lighting	25%	13%	9%	60%	$0.38	8	0.51
Indoor Lighting - Daylighting Controls	Interior Lighting	10%	10%	75%	100%	$0.09	8	2.02
Water Heating - Heat Trap	Water Heating	9%	9%	5%	25%	$2.36	-	-
Water Heating - Faucet Aerators and Low Flow Nozzles	Water Heating	4%	4%	36%	100%	$0.01	9	1.25
Water Heating - Pipe Insulation	Water Heating	4%	4%	50%	100%	$0.28	15	0.06
Water Heating - Tank Blanket	Water Heating	10%	10%	40%	100%	$0.02	10	1.70
Water Heating - Hot Water Saver	Water Heating	5%	1%	0%	100%	$0.04	5	0.23
Water Heating - High Efficiency Circulation Pump	Water Heating	0%	0%	0%	0%	$0.00	-	1.00
Water Heating - Install Timer	Water Heating	9%	9%	5%	25%	$0.04	-	-
Water Heating - Thermostat Setback	Water Heating	10%	10%	10%	100%	$0.11	10	0.31
Water Heating - Solar Water Heating System	Water Heating	70%	70%	1%	85%	$2.46	-	-
Refrigerator - Decommissioning and Recycling	Refrigeration	90%	90%	10%	50%	$0.13	8	1.98
Refrigerator - Anti-Sweat Heater	Refrigeration	5%	3%	0%	100%	$0.20	12	0.04
Refrigerator - Door Gasket Replacement	Refrigeration	4%	2%	5%	100%	$0.10	4	0.03
Display Case - LED Lighting	Refrigeration	0%	0%	0%	0%	$0.00	-	2.00
Open Display Case - Night Covers	Refrigeration	6%	3%	5%	100%	$0.05	8	0.07
Vending Machine - Controller	Refrigeration	15%	11%	2%	10%	$0.27	5	0.01
Office Electronics - Plug Load Occupancy Sensors	Office Equipment	10%	5%	7%	75%	$0.25	8	0.06
Office Electronics - ENERGY STAR Power Supplies	Office Equipment	1%	1%	10%	100%	$0.00	7	11.0
Non-HVAC Motors - Variable Speed Control	Miscellaneous	1%	0%	0%	75%	$0.10	10	0.01
Pool Pump - Timer	Miscellaneous	60%	15%	34%	45%	$0.36	10	-

Table C-60 Energy-Efficiency Measure Data—Warehouse, New Vintage

Measure	End Use	Energy Savings	Demand Savings	Base Satura-tion	Appl./ Feas.	Cost ($/sqft)	Life-time (yrs)	BC Ratio
Chiller - VSD	Cooling	32%	34%	15%	88%	$1.17	20	1.33
Chiller - Condenser Water Temperature Reset	Cooling	8%	5%	60%	100%	$0.57	4	0.10
Chiller - Economizer	Cooling	10%	0%	37%	65%	$0.15	10	2.03
Chiller - Thermal Energy Storage	Cooling	0%	25%	44%	65%	$0.15	15	1.47
Air-Cooled Chiller - High Efficiency Fans	Cooling	0%	0%	15%	44%	$0.04	10	0.01
Water-Cooled Chiller - Condenser Water Temperature Reset	Cooling	25%	5%	60%	100%	$0.57	4	0.26
Water-Cooled Chiller - Cooling Tower, High-Efficiency Fans	Cooling	0%	0%	15%	44%	$0.04	10	0.01
Heat Pump - Maintenance	Cooling/Heating	12%	14%	14%	100%	$0.06	4	2.39
RTU - Maintenance	Cooling	14%	15%	14%	100%	$0.06	4	1.34
Ventilation - Variable Speed Control	Ventilation	3%	3%	0%	0%	$0.34	10	0.01
Ventilation - CO2 Controlled	Ventilation	5%	7%	6%	10%	$0.21	10	0.02
Ventilation - Exhaust Hood Sensor Control	Ventilation	0%	0%	1%	10%	$0.03	10	-
Fans - Energy-Efficient Motors	Ventilation	1%	1%	11%	100%	$0.14	10	0.00
Pumps - High-Efficiency Motors	Cooling	0%	0%	0%	0%	$0.00	-	3.00
Pumps - High-Efficiency Motors	Cooling/Heating	0%	0%	0%	0%	$0.00	-	3.00
Pumps - High-Efficiency Motors	Heating	0%	0%	0%	0%	$0.00	-	3.00
Pumps - Variable Speed Control	Cooling	11%	0%	0%	0%	$0.13	10	1.90
Pumps - Variable Speed Control	Cooling/Heating	0%	0%	0%	0%	$0.13	10	1.90
Pumps - Variable Speed Control	Heating	6%	6%	0%	0%	$0.13	10	1.90
Insulation - Ducting	Cooling	4%	5%	0%	50%	$0.41	20	0.22
Insulation - Ducting	Cooling/Heating	0%	0%	0%	50%	$0.41	20	0.22
Insulation - Ducting	Heating	0%	0%	0%	50%	$0.41	20	0.22
Insulation - Ceiling	Cooling	11%	42%	7%	25%	$0.35	20	1.98
Insulation - Ceiling	Cooling/Heating	36%	22%	7%	25%	$0.35	20	1.98
Insulation - Ceiling	Heating	18%	18%	7%	25%	$0.35	20	1.98
Insulation - Wall Cavity	Cooling	2%	28%	26%	75%	$0.78	20	0.65
Insulation - Wall Cavity	Cooling/Heating	63%	27%	26%	75%	$0.78	20	0.65
Insulation - Wall Cavity	Heating	18%	18%	26%	75%	$0.78	20	0.65
HVAC - Duct Repair and Sealing	Cooling	1%	2%	25%	50%	$0.38	18	0.10
HVAC - Duct Repair and Sealing	Cooling/Heating	0%	0%	25%	50%	$0.38	18	0.10
HVAC - Duct Repair and Sealing	Heating	1%	1%	25%	50%	$0.38	18	0.10
Roofs - Cool Roof	Cooling	5%	12%	56%	100%	$0.05	15	1.82
Roofs - Cool Roof	Cooling/Heating	0%	0%	56%	100%	$0.05	15	1.82
Roofs - Cool Roof	Heating	0%	0%	56%	100%	$0.05	15	1.82
Windows - High Efficiency	Cooling	12%	0%	100%	100%	$0.88	20	0.62
Windows - High Efficiency	Cooling/Heating	0%	0%	100%	100%	$0.88	20	0.62
Windows - High Efficiency	Heating	11%	11%	100%	100%	$0.88	20	0.62
Energy Management System	Cooling	26%	14%	0%	100%	$0.70	14	1.42
Energy Management System	Cooling/Heating	23%	20%	0%	100%	$0.70	14	1.42
Energy Management System	Heating	20%	20%	0%	100%	$0.70	14	1.42
Energy Management System	Interior Lighting	9%	9%	0%	100%	$0.70	14	1.42
Energy Management System	Exterior Lighting	9%	9%	0%	100%	$0.70	14	1.42
Thermostat - Clock/Programmable	Cooling	7%	0%	86%	86%	$0.13	11	5.35
Thermostat - Clock/Programmable	Cooling/Heating	0%	0%	86%	86%	$0.13	11	5.35
Thermostat - Clock/Programmable	Heating	34%	34%	86%	86%	$0.13	11	5.35
Interior Lighting - LED Exit Lighting	Interior Lighting	2%	2%	86%	90%	$0.00	16	28.8
Interior Lighting - Occupancy Sensors	Interior Lighting	10%	5%	56%	75%	$0.44	8	0.20
Interior Lighting - Task Lighting	Interior Lighting	10%	10%	0%	100%	$0.24	5	0.24
Interior Lighting - Time Clocks and Timers (lighting)	Interior Lighting	5%	3%	56%	75%	$0.30	8	0.15
Interior Lighting - Fluorescent Delamp and Install Reflectors	Interior Lighting	0%	0%	19%	75%	$0.50	11	-
Interior Fluorescent - Bi-Level Fixture w/Occupancy Sensor	Interior Lighting	10%	5%	10%	30%	$0.20	8	0.32

Measure	End Use	Energy Savings	Demand Savings	Base Satura-tion	Appl./ Feas.	Cost ($/sqft)	Life-time (yrs)	BC Ratio
Interior Fluorescent - Photocell-Controlled Dimming Ballasts	Interior Lighting	25%	13%	0%	60%	$0.38	8	0.42
Indoor Lighting - Daylighting Controls	Interior Lighting	20%	20%	42%	56%	$0.19	8	0.93
Water Heating - Heat Trap	Water Heating	0%	0%	5%	25%	$2.36	-	-
Water Heating - Faucet Aerators and Low Flow Nozzles	Water Heating	4%	4%	0%	100%	$0.03	9	0.12
Water Heating - Pipe Insulation	Water Heating	4%	4%	0%	0%	$0.28	15	0.02
Water Heating - Tank Blanket	Water Heating	10%	10%	0%	0%	$0.04	10	0.25
Water Heating - Hot Water Saver	Water Heating	5%	1%	0%	100%	$0.04	5	0.07
Water Heating - High Efficiency Circulation Pump	Water Heating	0%	0%	0%	0%	$0.00	-	1.00
Water Heating - Install Timer	Water Heating	0%	0%	5%	25%	$0.04	-	-
Water Heating - Thermostat Setback	Water Heating	10%	10%	5%	100%	$0.11	10	0.09
Water Heating - Solar Water Heating System	Water Heating	0%	70%	1%	85%	$2.46	-	-
Refrigerator - Decommissioning and Recycling	Refrigeration	90%	90%	10%	50%	$0.13	8	2.21
Refrigerator - Anti-Sweat Heater	Refrigeration	5%	3%	0%	100%	$0.20	12	-
Refrigerator - Door Gasket Replacement	Refrigeration	4%	2%	5%	100%	$0.10	4	-
Display Case - LED Lighting	Refrigeration	0%	0%	0%	0%	$0.00	-	2.00
Open Display Case - Night Covers	Refrigeration	6%	3%	5%	100%	$0.05	8	-
Vending Machine - Controller	Refrigeration	15%	11%	2%	10%	$0.27	5	0.05
Office Electronics - Plug Load Occupancy Sensors	Office Equipment	10%	5%	13%	75%	$0.25	8	0.03
Office Electronics - ENERGY STAR Power Supplies	Office Equipment	1%	1%	10%	100%	$0.00	7	6.85
Non-HVAC Motors - Variable Speed Control	Miscellaneous	1%	0%	0%	75%	$0.10	10	0.00
Pool Pump - Timer	Miscellaneous	60%	15%	34%	45%	$0.36	10	-

Table C-61 Energy-Efficiency Measure Data—Refrigerated Warehouse, New Vintage

Measure	End Use	Energy Savings	Demand Savings	Base Satura-tion	Appl./ Feas.	Cost ($/sqft)	Life-time (yrs)	BC Ratio
Chiller - VSD	Cooling	27%	32%	0%	0%	$1.17	20	3.09
Chiller - Condenser Water Temperature Reset	Cooling	8%	5%	0%	0%	$0.37	4	0.40
Chiller - Economizer	Cooling	9%	2%	37%	65%	$0.15	10	5.36
Chiller - Thermal Energy Storage	Cooling	0%	25%	45%	65%	$0.15	15	7.57
Air-Cooled Chiller - High Efficiency Fans	Cooling	0%	0%	0%	0%	$0.04	10	0.05
Water-Cooled Chiller - Condenser Water Temperature Reset	Cooling	11%	5%	0%	0%	$0.37	4	0.48
Water-Cooled Chiller - Cooling Tower, High-Efficiency Fans	Cooling	0%	0%	0%	0%	$0.04	10	0.04
Heat Pump - Maintenance	Cooling/Heating	14%	14%	14%	100%	$0.03	4	9.54
RTU - Maintenance	Cooling	14%	15%	14%	100%	$0.08	4	2.91
Ventilation - Variable Speed Control	Ventilation	6%	6%	0%	0%	$0.34	10	0.17
Ventilation - CO2 Controlled	Ventilation	1%	13%	12%	20%	$0.21	10	0.04
Ventilation - Exhaust Hood Sensor Control	Ventilation	15%	1%	1%	20%	$0.07	10	1.94
Fans - Energy-Efficient Motors	Ventilation	2%	2%	11%	100%	$0.05	10	0.27
Pumps - High-Efficiency Motors	Cooling	0%	0%	0%	0%	$0.00	-	3.00
Pumps - High-Efficiency Motors	Cooling/Heating	0%	0%	0%	0%	$0.00	-	3.00
Pumps - High-Efficiency Motors	Heating	0%	0%	0%	0%	$0.00	-	3.00
Pumps - Variable Speed Control	Cooling	12%	0%	0%	0%	$0.44	10	1.24
Pumps - Variable Speed Control	Cooling/Heating	0%	0%	0%	0%	$0.44	10	1.24
Pumps - Variable Speed Control	Heating	6%	6%	0%	0%	$0.44	10	1.24
Insulation - Ducting	Cooling	2%	0%	33%	50%	$0.41	20	0.36
Insulation - Ducting	Cooling/Heating	4%	4%	33%	50%	$0.41	20	0.36
Insulation - Ducting	Heating	0%	0%	33%	50%	$0.41	20	0.36
Insulation - Ceiling	Cooling	47%	31%	7%	25%	$0.88	20	3.77
Insulation - Ceiling	Cooling/Heating	14%	14%	7%	25%	$0.88	20	3.77
Insulation - Ceiling	Heating	17%	17%	7%	25%	$0.88	20	3.77
Insulation - Wall Cavity	Cooling	3%	58%	11%	75%	$0.29	20	0.98
Insulation - Wall Cavity	Cooling/Heating	9%	18%	11%	75%	$0.29	20	0.98
Insulation - Wall Cavity	Heating	6%	6%	11%	75%	$0.29	20	0.98
HVAC - Duct Repair and Sealing	Cooling	13%	14%	25%	50%	$0.38	18	2.37
HVAC - Duct Repair and Sealing	Cooling/Heating	10%	10%	25%	50%	$0.38	18	2.37
HVAC - Duct Repair and Sealing	Heating	7%	7%	25%	50%	$0.38	18	2.37
Roofs - Cool Roof	Cooling	10%	14%	67%	100%	$0.17	15	3.15
Roofs - Cool Roof	Cooling/Heating	0%	0%	67%	100%	$0.17	15	3.15
Roofs - Cool Roof	Heating	0%	0%	67%	100%	$0.17	15	3.15
Windows - High Efficiency	Cooling	14%	9%	33%	100%	$0.29	20	3.14
Windows - High Efficiency	Cooling/Heating	0%	0%	33%	100%	$0.29	20	3.14
Windows - High Efficiency	Heating	3%	3%	33%	100%	$0.29	20	3.14
Energy Management System	Cooling	6%	14%	0%	100%	$0.70	14	1.24
Energy Management System	Cooling/Heating	6%	5%	0%	100%	$0.70	14	1.24
Energy Management System	Heating	5%	5%	0%	100%	$0.70	14	1.24
Energy Management System	Interior Lighting	9%	9%	0%	100%	$0.70	14	1.24
Energy Management System	Exterior Lighting	9%	9%	0%	100%	$0.70	14	1.24
Thermostat - Clock/Programmable	Cooling	14%	0%	50%	50%	$0.13	11	5.24
Thermostat - Clock/Programmable	Cooling/Heating	0%	0%	50%	50%	$0.13	11	5.24
Thermostat - Clock/Programmable	Heating	7%	7%	50%	50%	$0.13	11	5.24
Interior Lighting - LED Exit Lighting	Interior Lighting	2%	2%	86%	90%	$0.00	16	28.8
Interior Lighting - Occupancy Sensors	Interior Lighting	10%	5%	56%	75%	$0.44	8	0.20
Interior Lighting - Task Lighting	Interior Lighting	10%	10%	0%	100%	$0.24	5	0.24
Interior Lighting - Time Clocks and Timers (lighting)	Interior Lighting	5%	3%	56%	75%	$0.30	8	0.15
Interior Lighting - Fluorescent Delamp and Install Reflectors	Interior Lighting	0%	0%	19%	75%	$0.50	11	-
Interior Fluorescent - Bi-Level Fixture w/Occupancy Sensor	Interior Lighting	10%	5%	10%	30%	$0.20	8	0.32

Measure	End Use	Energy Savings	Demand Savings	Base Satura-tion	Appl./ Feas.	Cost ($/sqft)	Life-time (yrs)	BC Ratio
Interior Fluorescent - Photocell-Controlled Dimming Ballasts	Interior Lighting	25%	13%	0%	60%	$0.38	8	0.42
Indoor Lighting - Daylighting Controls	Interior Lighting	20%	20%	42%	56%	$0.19	8	0.93
Water Heating - Heat Trap	Water Heating	0%	0%	5%	25%	$2.36	-	-
Water Heating - Faucet Aerators and Low Flow Nozzles	Water Heating	4%	4%	22%	100%	$0.03	9	1.22
Water Heating - Pipe Insulation	Water Heating	4%	4%	50%	100%	$0.28	15	0.17
Water Heating - Tank Blanket	Water Heating	10%	10%	40%	100%	$0.04	10	2.48
Water Heating - Hot Water Saver	Water Heating	5%	1%	0%	100%	$0.04	5	0.67
Water Heating - High Efficiency Circulation Pump	Water Heating	0%	0%	0%	0%	$0.00	-	1.00
Water Heating - Install Timer	Water Heating	0%	0%	5%	25%	$0.04	-	-
Water Heating - Thermostat Setback	Water Heating	10%	10%	0%	100%	$0.11	10	0.90
Water Heating - Solar Water Heating System	Water Heating	0%	70%	1%	85%	$2.46	-	-
Refrigerator - Decommissioning and Recycling	Refrigeration	90%	90%	10%	50%	$0.13	8	61.1
Refrigerator - Anti-Sweat Heater	Refrigeration	20%	3%	0%	100%	$0.20	12	7.49
Refrigerator - Door Gasket Replacement	Refrigeration	4%	2%	5%	100%	$0.10	4	0.89
Display Case - LED Lighting	Refrigeration	39%	0%	0%	0%	$0.00	-	2.00
Open Display Case - Night Covers	Refrigeration	6%	3%	5%	100%	$0.05	8	2.33
Vending Machine - Controller	Refrigeration	15%	11%	2%	10%	$0.27	5	0.05
Office Electronics - Plug Load Occupancy Sensors	Office Equipment	10%	5%	13%	75%	$0.25	8	0.03
Office Electronics - ENERGY STAR Power Supplies	Office Equipment	1%	1%	10%	100%	$0.00	7	6.85
Non-HVAC Motors - Variable Speed Control	Miscellaneous	1%	0%	0%	75%	$0.10	10	0.00
Pool Pump - Timer	Miscellaneous	60%	15%	34%	45%	$0.36	10	-

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 provides brief narrative descriptions for the measures.[1]

Table D-2 through Table D-11 list the detailed unit-level data (including economic screen results) for industrial energy-efficiency equipment measures in existing and new buildings.

Table D-12 through Table D-21 list the detailed unit-level data (including economic screen results) for industrial energy-efficiency non-equipment measures in existing and new buildings.

[1] Measure Description Sources: Global internal databases. Also, for several measures: Northwest Power & Conservation Council, 6th Plan, "Systems Whole Plant Optimization Overview"

Table D-1 Industrial Energy-Efficiency Equipment/Measure Descriptions

End Use	Equipment/ Measure	Industrial Measure Description
Cooling	Roof Top AC	Rooftop cooling systems, such as rooftop units (RTUs), are simple to install and maintain. 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. Varying Energy Efficiency Ratios (EER) are modeled.
Cooling	Cooling Other, High Efficiency	This measure includes efficiency upgrades to other cooling systems in industrial buildings.
Combined Heating/Cooling	Roof Top Heat Pump	For heat pumps, units with increasing EER and COP levels are evaluated, as well as a ductless mini-split system and a geothermal system.
Cooling	Chiller, Variable Speed Drive	Variable speed drives, which reduce chiller energy use under part load, are modeled for both air-cooled and water-cooled chillers.
Cooling	Chiller, Condenser Water Temperature 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, High-Efficiency Fans	For air-cooled chillers, high-efficiency cooling fans utilize variable frequency drives that improve fan performance by adjusting fan speed and rotation as conditions change.
Cooling	Water-Cooled Chiller, Cooling Tower, High-Efficiency Fans	For water-cooled chillers, high-efficiency cooling tower fans utilize variable frequency drives in the cooling tower design. VFDs improve fan performance by adjusting fan speed and rotation as conditions change.
Cooling	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.
Cooling	Chiller, Economizer, Installation	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, Combined Heating/Cooling	Equip Maintenance (RTU, Heat Pump, Chiller)	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	Variable Air-Volume Systems	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.

End Use	Equipment/ Measure	Industrial Measure Description
Ventilation	Ventilation - Variable Speed Control	Variable speed controls adjust ventilation fans for part-load conditions to reduce energy use. This can be accomplished by using electronically commutated motors (ECM's).
Ventilation	Ventilation - CO2 Controlled	Carbon dioxide (CO2) levels indicate the level of occupancy in a space. This measure uses sensors to monitor CO2 levels and controls on the air handling system to adjust the amount of outside air accordingly. Ventilation rates are thereby controlled based on occupancy, rather than a fixed rate, thus saving HVAC energy use.
HVAC	Ducting, Insulation	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	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. This analysis assumes that the baseline air loss from ducts has doubled, and conducting repair and sealing of the ducts will restore leakage from ducts to the original baseline level.
HVAC	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	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	Roofs, Cool Roof	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.

End Use	Equipment/ Measure	Industrial Measure Description
HVAC, Lighting	Energy Management System	An energy management system (EMS) allows managers/owners to monitor and control the major energy-consuming systems within a 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	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	Screw-in: Halogen, CFL, Cold Cathode, LED	This measure evaluates higher-efficiency alternatives for screw-in interior lamps including halogen, CFL, Cold Cathode, 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-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.

End Use	Equipment/ Measure	Industrial Measure Description
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	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	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	Time Clocks and Timers (lighting)	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	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.
Interior Lighting	Interior Fluorescent - Bi-Level Fixture w/Occupancy Sensor	Bi-level fixtures with occupancy sensors detect when a space is unoccupied and reduce light output to a lower level.
Interior Lighting	Indoor Lighting - Daylighting Controls	Daylighting controls use a photosensor to detect ambient light and turn off interior lights accordingly.
Exterior Lighting	Screw-in: Halogen, CFL, Cold Cathode, LED	This measure evaluates higher-efficiency alternatives for screw-in exterior lamps including halogen, CFL, Cold Cathode, and LED.
Exterior Lighting	High Intensity Discharge (HID)	Alternatives modeled include mercury vapor, metal halides, T5 high output, high pressure sodium, and low pressure sodium.
Exterior Lighting	Linear Fluorescent	For linear fluorescent fixtures, alternatives include T12, T8, Super T8, T5, and LED.
Interior and Exterior Lighting	Lighting Retrocommissioning	Lighting retrocommissioning projects in existing commercial buildings do not require an event such as a tenant turnover, a major renovation, or an update to electrical circuits to drive its adoption. Rather, a decision-maker can decide at any time to perform a comprehensive audit of a facility's lighting systems, followed by an upgrade of equipment (lamps, ballasts, fixtures, reflectors), controls (occupancy sensors, daylighting controls, and central automation).

End Use	Equipment/ Measure	Industrial Measure Description
Motors	Motors, Premium Efficiency	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. Therefore, 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. 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. This analysis assumes 75% loading factor (for peak efficiency) for 1800 rpm motor. Hours of operation vary depending on horsepower size. In addition, improved drives and controls are assumed to be implemented along with the motors, resulting in savings as high as 10% of annual energy consumption
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 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.[2]
Motors	Motors, Variable Speed Control	The part-load efficiency of motor 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.

[2] Source: http://www.controldesign.com/articles/2011/Can-a-rewind-up-motor-efficiency.html

End Use	Equipment/ Measure	Industrial Measure Description
Motors	Integrated Plant Energy Management	This measure is based on the combination of best practices equipment improvements and a comprehensive plant management program including development and implementation of an energy management plan (policy, accountabilities, goals, department/system level targets and measurements, etc.) to support sustainable improvement of energy intensity and productivity, and independent verification of energy savings. The American National Standard for energy management, or equivalent standards, provides a point of reference for the level of management activity assumed by this measure bundle. This measure bundle could entail plant modernization in order to approximate the performance of higher performing plants currently competing in the international markets. In addition, the management practices increase the likelihood of best practices-based plant upgrades and the persistence of these savings over time. Therefore, the savings are derived from the effective application and operation of the high efficiency technologies, and this is enabled by the management practices.
Motors	Plant Energy Management	Includes low/no cost energy efficiency projects for multiple systems that are supported with comprehensive demand-side assessments and good preventative maintenance practices. Maintenance and operations are based on system-specific guidelines and supported by system operator training as noted in the system optimization measure descriptions. This measure also includes low/no cost equipment upgrades for some of the systems.
Motors	Energy Project Management	This measure is based on a package of optimized equipment improvements, but also includes the assignment of an energy engineer (or equivalent capability), tracking energy costs, identification and prioritization of capital projects, application of systems optimization tools and practices on the key systems in the facility. Energy waste is readily identified and mitigated by the energy engineer and his/her team, and the equipment installed under this measure is optimized. From a program perspective, the energy engineer function could be accomplished through other approaches including external support.
Motors	Synchronous Belts	Synchronous (also known as timing, positive drive, or high-torque) belts reduce slippage through the use of toothed-drive sprockets rather than relying solely on friction. At high torque loads, slippage can be reduced by 3%-5%. The belts require less maintenance and retensioning and are ideal for wet/oily environments. However, they are noisy and are unsuitable for shock loads.
Motors	Transformers-New & Retrofit	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.

End Use	Equipment/ Measure	Industrial Measure Description
Motors	Fan Energy Management	Quantifies low/no cost Energy Management as it relates to fans & blowers specifically. Measures include basic system maintenance including changing filters, tensioning belts, repairing duct leaks, and confirming damper actuation.
Motors	Fan Equipment Upgrade	Builds upon Fan Energy Management by including control measures such as variable speed drive controls.
Motors	Fan System Optimization	Builds upon Fan Energy Management and System Optimization by rolling them into a sustaining energy program with improved system design. A plant 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.
Motors	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.
Motors	Fan: Efficient Centrifugal Fan	Fans are widely used in industry for conveyance, drying and ventilation. Relatively inefficient centrifugal-radial fans, with efficiency as low as 22%, are commonly used in the wood products 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 often not chosen for industrial applications because of concerns about reliable operation in dirty environments.
Motors	Pump Energy Management	Quantifies low/no cost Energy Management as it relates to pumping systems specifically. Measures include coupling alignment, lubrication, seal maintenance, vibration analysis, motor conditioning, and others based on a comprehensive demand side assessment.
Motors	Pump Equipment Upgrade	Builds upon Pump Energy Management by including equipment replacement during times of major repair or shutdown such as proper pump sizing, impeller trimming, control valve replacement, and VSD control. Moreover, these improved systems would be assessed and managed in accordance with recognized standards such as ASME EA-2-2008.
Motors	Pump System Optimization	Builds upon Pump Energy Management and Equipment Upgrade by rolling their system analysis, equipment improvements, and operational improvements into a sustaining energy program. A plant in this tier 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. Plants will have a system for identifying, screening, and tracking capital projects in conjunction with procurement policies, system redesigning, and demand side management.
Motors	Pump 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.

End Use	Equipment/ Measure	Industrial Measure Description
Motors	Compressed Air Equipment Upgrade	This measure is the replacement of existing air compressor equipment with more efficient compressors and motors in order to improve energy efficiency.
Motors	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.
Motors	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.
Motors	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.
Motors	Cold Storage Retrofit	This measure involves the replacement of refrigeration compressors, lubricants, and refrigerants in order to boost overall system efficiency. By layering new improvements on top of existing equipment, energy savings can be realized without the expense of an entire new system.
Motors	Cold Storage Tune-up	Includes cleaning condenser coils, recharging refrigerant, and relubricating moving parts. This improves overall system efficiency by reducing energy wasted compressing, cooling, and moving the refrigerant through the system.
Motors	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.
Motors	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.
Motors	Refrigeration System Optimization	System optimization is a thorough overhaul of the refrigeration system which involves the resizing, sequencing, and controlling of compressors in order to optimize load. This measure may include those from Controls and Maintenance.
Motors	Paper: Efficient Pulp Screen	Pulp screens are used to remove contaminants from pulp. Inside the screen, a rotor spins the pulp, forcing it through the screen. Efficient screening solutions involving changes to the design of the rotor have been demonstrated in the pulp and paper industry. This technology, manufactured by Advanced Fiber Technologies, has gained some market penetration in the Northwest

End Use	Equipment/ Measure	Industrial Measure Description
Motors	Paper: Material Handling	Large conveyors often use gear boxes to isolate the motor and to provide better torque control. Most current gear boxes consist of transmissions with 90% to 92% efficiencies. Opportunities include using higher-efficiency drives, couplings, and gear/speed reducer alternatives. In older conveyor systems, or where process requirements have changed, it may be possible to resize a conveyor, upgrade the controls or re-engineer the system to improve layout and configuration, all of which will result in energy savings. On new conveyor installations, incorporating programmable logic controls (PLC) into the system will result in energy savings. PLC controls regulate conveyors based on load and shut down unloaded conveyors. Barriers to implementation include additional maintenance costs due to the increased number of components in the system. Downhill conveyors employ a braking system. Energy savings can be obtained by using a regenerative breaking system that utilizes the momentum of the belt, the material being conveyed and the pull of gravity converting the downhill force into electrical energy. Additional energy savings can be gained by installing product sensors to shut down unloaded conveyors. Barriers to system implementation include the additional cost of a motor/generator set and increased maintenance due to additional components in the system.
Motors	Paper: Material Handling, Variable Speed Drives	Variable speed drives are applicable for process equipment with variable or low loads. The installation of process drive VSDs is usually motivated primarily by process improvements. VSDs have the potential to speed up production by increasing the throughput of the process equipment and can also provide benefits to plant operators by affording greater and finer control.
Process Heating	Efficient Process Heating	Because of the customized nature of industrial heating applications, a variety of opportunities are summarized in a general improvement of process heating, focusing on electric resistance heating and the injection of RF waves as two electrotechnologies.

End Use	Equipment/ Measure	Industrial Measure Description
Process Heating	Metal: New Arc Furnace	While modern electric arc furnaces (EAFs) are generally more energy efficient, many technologies exist to improve energy efficiency in existing furnaces, such as process control, efficient transformers, oxy-fuel injection, bottom stirring, post-combustion, eccentric bottom-tapping and scrap preheating (Worrell et al. 1999). Several new EAF-designs are under development, which combine energy saving features like increased fuel and oxygen injection with scrap preheating (Greissel 2000, IISI 2000b). The aim is to produce a semi-continuous process with enhanced productivity through reduced resource use (e.g. refractories, electrodes) and reduced tap-to -tap times. At the same time increased product quality also demands increased feedstock flexibility (e.g. scrap, DRI or pig iron). Different developers are involved in new EAF-process design, the most important being the Twin Electrode DC (IHI, Japan), Comelt (Voest Alpine, Austria) and Contiarc and Conarc (SMS Demag, Germany). The production costs are expected to be $9-13 lower per ton steel produced (Reichelt and Hofman 1996; Mannesmann 1998), or up to a 20 percent reduction.[3]
Other	Custom Measures	Custom measures may be included in the analysis to serve as a "catch all" for unique measures for which costs and savings are not readily generalized. These measures could be part of a utility or program administrator's custom incentive program. Costs and energy savings were assumed such that the measures passed the economic screen and performance fell in line with the other measures.

[3] Source: CEE, Consortium for Energy Efficiency

Table D-2 Energy-Efficiency Equipment Data—Food Products, Existing Vintage

End Use	Technology	Efficiency Definition	Savings (kWh/ empl/yr)	Incremental Cost ($/empl)	Lifetime (yrs)	BC Ratio
Cooling	Roof Top AC	EER 9.2	-	$0	16	-
Cooling	Roof Top AC	EER 10.1	1,066	$520	16	1.10
Cooling	Roof Top AC	EER 11.2	2,136	$1,000	16	1.14
Cooling	Roof Top AC	EER 12.0	2,792	$1,920	16	0.78
Cooling	Roof Top AC	Ductless Minisplit	3,788	$6,301	16	0.32
Cooling	Other Cooling	EER 9.8	-	$0	14	-
Cooling	Other Cooling	EER 10.0	244	$418	14	0.28
Cooling	Other Cooling	EER 10.2	479	$495	14	0.46
Cooling	Other Cooling	EER 10.4	705	$571	14	0.59
Cooling	Other Cooling	EER 10.6	922	$648	14	0.68
Cooling	Other Cooling	EER 10.8	1,131	$724	14	0.74
Cooling	Other Cooling	EER 12.0	2,240	$3,733	14	0.29
Heating	Electric Heating	Standard	-	$0	25	-
Cooling/Heating	Roof Top Heat Pump	EER 9.3	-	$0	15	-
Cooling/Heating	Roof Top Heat Pump	EER 10.3	1,934	$1,080	15	0.88
Cooling/Heating	Roof Top Heat Pump	EER 11.0	3,079	$1,552	15	0.98
Cooling/Heating	Roof Top Heat Pump	EER 11.7	4,087	$3,981	15	0.51
Cooling/Heating	Roof Top Heat Pump	EER 12.0	4,483	$5,196	15	0.43
Cooling/Heating	Roof Top Heat Pump	Ductless Minisplit	6,838	$9,953	15	0.34
Cooling/Heating	Roof Top Heat Pump	Geothermal	10,758	$17,206	15	0.31
Ventilation	Ventilation	Constant Volume	-	$0	10	-
Ventilation	Ventilation	Constant Volume with ECM	63	$70	10	0.38
Ventilation	Ventilation	Variable Air Volume	157	-$29	10	1.00
Ventilation	Ventilation	Variable Air Volume with ECM	220	$42	10	2.23
Interior Lighting	Screw-in	Incandescent	-	$0	2	-
Interior Lighting	Screw-in	90W Halogen PAR-38	91	$3	3	3.86
Interior Lighting	Screw-in	70W HIR PAR-38	140	$5	3	4.28
Interior Lighting	Screw-in	CFL	261	$3	6	31.21
Interior Lighting	Screw-in	LED	283	$70	12	2.27
Interior Lighting	High-Bay Fixtures	Metal Halides	-	$0	3	-
Interior Lighting	High-Bay Fixtures	LED	949	$1,407	15	0.53
Interior Lighting	High-Bay Fixtures	T8	966	-$37	10	1.00
Interior Lighting	High-Bay Fixtures	High Pressure Sodium	1,028	$7	6	1.00
Interior Lighting	High-Bay Fixtures	T5	1,233	-$22	10	1.00
Interior Lighting	Linear Fluorescent	T12	-	$0	10	-
Interior Lighting	Linear Fluorescent	LED	122	$448	15	0.18
Interior Lighting	Linear Fluorescent	T8	127	$0	10	325.25
Interior Lighting	Linear Fluorescent	Super T8	177	$3	10	27.63
Exterior Lighting	Screw-in	Incandescent	-	$0	2	-
Exterior Lighting	Screw-in	90W Halogen PAR-38	0	$0	3	2.32
Exterior Lighting	Screw-in	70W HIR PAR-38	1	$0	3	2.57
Exterior Lighting	Screw-in	CFL	1	$0	6	19.43
Exterior Lighting	Screw-in	LED	1	$0	12	1.50
Exterior Lighting	HID	Metal Halides	-	$0	3	-
Exterior Lighting	HID	LED	150	$509	15	0.16
Exterior Lighting	HID	T8	156	-$4	10	1.00
Exterior Lighting	HID	High Pressure Sodium	241	$0	6	1.00
Exterior Lighting	HID	T5	252	$1	10	1.00
Exterior Lighting	Linear Fluorescent	T12	-	$0	10	-
Exterior Lighting	Linear Fluorescent	LED	0	$0	15	0.13
Exterior Lighting	Linear Fluorescent	T8	0	$0	10	229.51
Exterior Lighting	Linear Fluorescent	Super T8	0	$0	10	19.49
Exterior Lighting	Linear Fluorescent	T5	0	$0	10	14.02
Motors	1-5 HP	Standard (EPACT)	-	$0	10	-
Motors	1-5 HP	Standard (NEMA)	1,633	$1	10	558.31

End Use	Technology	Efficiency Definition	Savings (kWh/ empl/yr)	Incremental Cost ($/empl)	Lifetime (yrs)	BC Ratio
Motors	1-5 HP	High Efficiency	2,060	$149	10	6.29
Motors	1-5 HP	Premium	2,314	$238	10	4.42
Motors	6-20 HP	Standard (EPACT)	-	$0	10	-
Motors	6-20 HP	Standard (EISA)	8,239	$1	10	2,843.04
Motors	6-20 HP	High Efficiency	9,992	$225	10	20.16
Motors	6-20 HP	Premium	11,045	$359	10	13.96
Motors	21-50 HP	Standard (EPACT)	-	$0	10	-
Motors	21-50 HP	Standard (EISA)	22,560	$1	10	7,610.41
Motors	21-50 HP	High Efficiency	28,896	$619	10	21.18
Motors	21-50 HP	Premium	32,698	$990	10	14.99
Motors	51-100 HP	Standard (EPACT)	-	$0	10	-
Motors	51-100 HP	Standard (EISA)	72,416	$1	10	27,478.69
Motors	51-100 HP	High Efficiency	86,402	$723	10	54.25
Motors	51-100 HP	Premium	94,794	$1,156	10	37.23
Motors	101-200 HP	Standard (EPACT)	-	$0	10	-
Motors	101-200 HP	Standard (EISA)	132,903	$1	10	56,281.70
Motors	101-200 HP	High Efficiency	162,981	$1,436	10	51.53
Motors	101-200 HP	Premium	181,028	$2,296	10	35.78
Motors	201-500 HP	Standard (EPACT)	-	$0	10	-
Motors	201-500 HP	Standard (EISA)	188,166	$1	10	110,181.84
Motors	201-500 HP	High Efficiency	232,855	$5,352	10	19.75
Motors	201-500 HP	Premium	259,669	$8,563	10	13.76
Motors	501-1000 HP	Standard	-	$0	10	-
Motors	501-1000 HP	High Efficiency	260,489	$26,567	10	4.45
Motors	501-1000 HP	Premium	384,221	$42,507	10	4.10
Motors	1000+ HP	Standard	-	$0	10	-
Motors	1000+ HP	High Efficiency	514,897	$63,794	10	3.66
Motors	1000+ HP	Premium	759,474	$102,071	10	3.38
Process Heating	Process Heating	Standard	-	$0	15	-
Miscellaneous	Miscellaneous	Standard	-	$0	5	-

Table D-3 Energy-Efficiency Equipment Data—Paper Products, Existing Vintage

End Use	Technology	Efficiency Definition	Savings (kWh/ empl/yr)	Incremental Cost ($/empl)	Lifetime (yrs)	BC Ratio
Cooling	Roof Top AC	EER 9.2	-	$0	16	-
Cooling	Roof Top AC	EER 10.1	2,811	$1,371	16	1.10
Cooling	Roof Top AC	EER 11.2	5,634	$2,637	16	1.14
Cooling	Roof Top AC	EER 12.0	7,361	$5,064	16	0.78
Cooling	Roof Top AC	Ductless Minisplit	9,990	$16,615	16	0.32
Cooling	Other Cooling	EER 9.8	-	$0	14	-
Cooling	Other Cooling	EER 10.0	644	$1,102	14	0.28
Cooling	Other Cooling	EER 10.2	1,263	$1,304	14	0.46
Cooling	Other Cooling	EER 10.4	1,858	$1,506	14	0.59
Cooling	Other Cooling	EER 10.6	2,432	$1,708	14	0.68
Cooling	Other Cooling	EER 10.8	2,983	$1,910	14	0.74
Cooling	Other Cooling	EER 12.0	5,906	$9,844	14	0.29
Heating	Electric Heating	Standard	-	$0	25	-
Cooling/Heating	Roof Top Heat Pump	EER 9.3	-	$0	15	-
Cooling/Heating	Roof Top Heat Pump	EER 10.3	5,101	$2,847	15	0.88
Cooling/Heating	Roof Top Heat Pump	EER 11.0	8,120	$4,092	15	0.98
Cooling/Heating	Roof Top Heat Pump	EER 11.7	10,777	$10,498	15	0.51
Cooling/Heating	Roof Top Heat Pump	EER 12.0	11,821	$13,701	15	0.43
Cooling/Heating	Roof Top Heat Pump	Ductless Minisplit	18,031	$26,245	15	0.34
Cooling/Heating	Roof Top Heat Pump	Geothermal	28,368	$45,372	15	0.31
Ventilation	Ventilation	Constant Volume	-	$0	10	-
Ventilation	Ventilation	Constant Volume with ECM	166	$185	10	0.38
Ventilation	Ventilation	Variable Air Volume	415	-$75	10	1.00
Ventilation	Ventilation	Variable Air Volume with ECM	581	$110	10	2.24
Interior Lighting	Screw-in	Incandescent	-	$0	2	-
Interior Lighting	Screw-in	90W Halogen PAR-38	171	$6	3	3.86
Interior Lighting	Screw-in	70W HIR PAR-38	263	$9	3	4.28
Interior Lighting	Screw-in	CFL	493	$5	6	31.21
Interior Lighting	Screw-in	LED	534	$132	12	2.27
Interior Lighting	High-Bay Fixtures	Metal Halides	-	$0	3	-
Interior Lighting	High-Bay Fixtures	LED	1,792	$2,656	15	0.53
Interior Lighting	High-Bay Fixtures	T8	1,825	-$71	10	1.00
Interior Lighting	High-Bay Fixtures	High Pressure Sodium	1,941	$13	6	1.00
Interior Lighting	High-Bay Fixtures	T5	2,329	-$42	10	1.00
Interior Lighting	Linear Fluorescent	T12	-	$0	10	-
Interior Lighting	Linear Fluorescent	LED	231	$846	15	0.18
Interior Lighting	Linear Fluorescent	T8	240	$0	10	325.25
Interior Lighting	Linear Fluorescent	Super T8	333	$6	10	27.63
Exterior Lighting	Screw-in	Incandescent	-	$0	2	-
Exterior Lighting	Screw-in	90W Halogen PAR-38	1	$0	3	2.32
Exterior Lighting	Screw-in	70W HIR PAR-38	1	$0	3	2.57
Exterior Lighting	Screw-in	CFL	2	$0	6	19.44
Exterior Lighting	Screw-in	LED	3	$1	12	1.50
Exterior Lighting	HID	Metal Halides	-	$0	3	-
Exterior Lighting	HID	LED	283	$961	15	0.16
Exterior Lighting	HID	T8	294	-$7	10	1.00
Exterior Lighting	HID	High Pressure Sodium	456	$0	6	1.00
Exterior Lighting	HID	T5	476	$3	10	1.00
Exterior Lighting	Linear Fluorescent	T12	-	$0	10	-
Exterior Lighting	Linear Fluorescent	LED	0	$0	15	0.13
Exterior Lighting	Linear Fluorescent	T8	0	$0	10	229.57
Exterior Lighting	Linear Fluorescent	Super T8	0	$0	10	19.50
Exterior Lighting	Linear Fluorescent	T5	0	$0	10	14.02
Motors	1-5 HP	Standard (EPACT)	-	$0	10	-
Motors	1-5 HP	Standard (NEMA)	1,475	$1	10	558.26

End Use	Technology	Efficiency Definition	Savings (kWh/ empl/yr)	Incremental Cost ($/empl)	Lifetime (yrs)	BC Ratio
Motors	1-5 HP	High Efficiency	1,860	$134	10	6.29
Motors	1-5 HP	Premium	2,090	$215	10	4.42
Motors	6-20 HP	Standard (EPACT)	-	$0	10	-
Motors	6-20 HP	Standard (EISA)	8,365	$1	10	2,842.78
Motors	6-20 HP	High Efficiency	10,145	$228	10	20.16
Motors	6-20 HP	Premium	11,213	$365	10	13.96
Motors	21-50 HP	Standard (EPACT)	-	$0	10	-
Motors	21-50 HP	Standard (EISA)	21,713	$1	10	7,609.73
Motors	21-50 HP	High Efficiency	27,812	$596	10	21.17
Motors	21-50 HP	Premium	31,471	$953	10	14.99
Motors	51-100 HP	Standard (EPACT)	-	$0	10	-
Motors	51-100 HP	Standard (EISA)	76,456	$1	10	27,476.21
Motors	51-100 HP	High Efficiency	91,223	$763	10	54.25
Motors	51-100 HP	Premium	100,083	$1,220	10	37.22
Motors	101-200 HP	Standard (EPACT)	-	$0	10	-
Motors	101-200 HP	Standard (EISA)	151,699	$1	10	56,276.62
Motors	101-200 HP	High Efficiency	186,031	$1,639	10	51.52
Motors	101-200 HP	Premium	206,630	$2,621	10	35.78
Motors	201-500 HP	Standard (EPACT)	-	$0	10	-
Motors	201-500 HP	Standard (EISA)	305,986	$1	10	110,171.90
Motors	201-500 HP	High Efficiency	378,658	$8,703	10	19.75
Motors	201-500 HP	Premium	422,261	$13,924	10	13.76
Motors	501-1000 HP	Standard	-	$0	10	-
Motors	501-1000 HP	High Efficiency	310,848	$31,703	10	4.45
Motors	501-1000 HP	Premium	458,501	$50,725	10	4.10
Motors	1000+ HP	Standard	-	$0	10	-
Motors	1000+ HP	High Efficiency	592,117	$73,362	10	3.66
Motors	1000+ HP	Premium	873,373	$117,379	10	3.38
Process Heating	Process Heating	Standard	-	$0	15	-
Miscellaneous	Miscellaneous	Standard	-	$0	5	-

Table D-4 Energy-Efficiency Equipment Data—Chemical Products, Existing Vintage

End Use	Technology	Efficiency Definition	Savings (kWh/ empl/yr)	Incremental Cost ($/empl)	Lifetime (yrs)	BC Ratio
Cooling	Roof Top AC	EER 9.2	-	$0	16	-
Cooling	Roof Top AC	EER 10.1	4,223	$2,060	16	1.10
Cooling	Roof Top AC	EER 11.2	8,462	$3,961	16	1.14
Cooling	Roof Top AC	EER 12.0	11,057	$7,606	16	0.78
Cooling	Roof Top AC	Ductless Minisplit	15,005	$24,956	16	0.32
Cooling	Other Cooling	EER 9.8	-	$0	14	-
Cooling	Other Cooling	EER 10.0	967	$1,655	14	0.28
Cooling	Other Cooling	EER 10.2	1,898	$1,959	14	0.46
Cooling	Other Cooling	EER 10.4	2,791	$2,262	14	0.59
Cooling	Other Cooling	EER 10.6	3,652	$2,566	14	0.68
Cooling	Other Cooling	EER 10.8	4,481	$2,869	14	0.74
Cooling	Other Cooling	EER 12.0	8,871	$14,786	14	0.29
Heating	Electric Heating	Standard	-	$0	25	-
Cooling/Heating	Roof Top Heat Pump	EER 9.3	-	$0	15	-
Cooling/Heating	Roof Top Heat Pump	EER 10.3	7,662	$4,276	15	0.88
Cooling/Heating	Roof Top Heat Pump	EER 11.0	12,196	$6,147	15	0.98
Cooling/Heating	Roof Top Heat Pump	EER 11.7	16,187	$15,768	15	0.51
Cooling/Heating	Roof Top Heat Pump	EER 12.0	17,755	$20,578	15	0.43
Cooling/Heating	Roof Top Heat Pump	Ductless Minisplit	27,082	$39,419	15	0.34
Cooling/Heating	Roof Top Heat Pump	Geothermal	42,608	$68,149	15	0.31
Ventilation	Ventilation	Constant Volume	-	$0	10	-
Ventilation	Ventilation	Constant Volume with ECM	249	$278	10	0.38
Ventilation	Ventilation	Variable Air Volume	623	-$113	10	1.00
Ventilation	Ventilation	Variable Air Volume with ECM	872	$165	10	2.24
Interior Lighting	Screw-in	Incandescent	-	$0	2	-
Interior Lighting	Screw-in	90W Halogen PAR-38	253	$9	3	3.86
Interior Lighting	Screw-in	70W HIR PAR-38	388	$13	3	4.28
Interior Lighting	Screw-in	CFL	727	$7	6	31.21
Interior Lighting	Screw-in	LED	787	$194	12	2.27
Interior Lighting	High-Bay Fixtures	Metal Halides	-	$0	3	-
Interior Lighting	High-Bay Fixtures	LED	2,641	$3,914	15	0.53
Interior Lighting	High-Bay Fixtures	T8	2,689	-$104	10	1.00
Interior Lighting	High-Bay Fixtures	High Pressure Sodium	2,861	$19	6	1.00
Interior Lighting	High-Bay Fixtures	T5	3,432	-$62	10	1.00
Interior Lighting	Linear Fluorescent	T12	-	$0	10	-
Interior Lighting	Linear Fluorescent	LED	340	$1,247	15	0.18
Interior Lighting	Linear Fluorescent	T8	354	$1	10	325.25
Interior Lighting	Linear Fluorescent	Super T8	491	$8	10	27.63
Exterior Lighting	Screw-in	Incandescent	-	$0	2	-
Exterior Lighting	Screw-in	90W Halogen PAR-38	1	$0	3	2.32
Exterior Lighting	Screw-in	70W HIR PAR-38	2	$0	3	2.57
Exterior Lighting	Screw-in	CFL	4	$0	6	19.44
Exterior Lighting	Screw-in	LED	4	$1	12	1.50
Exterior Lighting	HID	Metal Halides	-	$0	3	-
Exterior Lighting	HID	LED	416	$1,416	15	0.16
Exterior Lighting	HID	T8	434	-$11	10	1.00
Exterior Lighting	HID	High Pressure Sodium	672	-$1	6	1.00
Exterior Lighting	HID	T5	702	$4	10	1.00
Exterior Lighting	Linear Fluorescent	T12	-	$0	10	-
Exterior Lighting	Linear Fluorescent	LED	0	$0	15	0.13
Exterior Lighting	Linear Fluorescent	T8	0	$0	10	229.57
Exterior Lighting	Linear Fluorescent	Super T8	0	$0	10	19.50
Exterior Lighting	Linear Fluorescent	T5	0	$0	10	14.02
Motors	1-5 HP	Standard (EPACT)	-	$0	10	-
Motors	1-5 HP	Standard (NEMA)	1,460	$1	10	558.26

End Use	Technology	Efficiency Definition	Savings (kWh/ empl/yr)	Incremental Cost ($/empl)	Lifetime (yrs)	BC Ratio
Motors	1-5 HP	High Efficiency	1,841	$133	10	6.29
Motors	1-5 HP	Premium	2,069	$212	10	4.42
Motors	6-20 HP	Standard (EPACT)	-	$0	10	-
Motors	6-20 HP	Standard (EISA)	8,591	$1	10	2,842.78
Motors	6-20 HP	High Efficiency	10,418	$235	10	20.16
Motors	6-20 HP	Premium	11,516	$374	10	13.96
Motors	21-50 HP	Standard (EPACT)	-	$0	10	-
Motors	21-50 HP	Standard (EISA)	18,711	$1	10	7,609.73
Motors	21-50 HP	High Efficiency	23,966	$514	10	21.17
Motors	21-50 HP	Premium	27,120	$821	10	14.99
Motors	51-100 HP	Standard (EPACT)	-	$0	10	-
Motors	51-100 HP	Standard (EISA)	64,343	$1	10	27,476.21
Motors	51-100 HP	High Efficiency	76,770	$642	10	54.25
Motors	51-100 HP	Premium	84,226	$1,027	10	37.22
Motors	101-200 HP	Standard (EPACT)	-	$0	10	-
Motors	101-200 HP	Standard (EISA)	129,374	$1	10	56,276.62
Motors	101-200 HP	High Efficiency	158,653	$1,398	10	51.52
Motors	101-200 HP	Premium	176,221	$2,236	10	35.78
Motors	201-500 HP	Standard (EPACT)	-	$0	10	-
Motors	201-500 HP	Standard (EISA)	275,274	$1	10	110,171.90
Motors	201-500 HP	High Efficiency	340,652	$7,830	10	19.75
Motors	201-500 HP	Premium	379,878	$12,527	10	13.76
Motors	501-1000 HP	Standard	-	$0	10	-
Motors	501-1000 HP	High Efficiency	311,256	$31,745	10	4.45
Motors	501-1000 HP	Premium	459,103	$50,792	10	4.10
Motors	1000+ HP	Standard	-	$0	10	-
Motors	1000+ HP	High Efficiency	532,322	$65,953	10	3.66
Motors	1000+ HP	Premium	785,176	$105,525	10	3.38
Process Heating	Process Heating	Standard	-	$0	15	-
Miscellaneous	Miscellaneous	Standard	-	$0	5	-

Table D-5 Energy-Efficiency Equipment Data—Primary Metals, Existing Vintage

End Use	Technology	Efficiency Definition	Savings (kWh/ empl/yr)	Incremental Cost ($/empl)	Lifetime (yrs)	BC Ratio
Cooling	Roof Top AC	EER 9.2	-	$0	16	-
Cooling	Roof Top AC	EER 10.1	5,007	$2,442	16	1.10
Cooling	Roof Top AC	EER 11.2	10,033	$4,697	16	1.14
Cooling	Roof Top AC	EER 12.0	13,109	$9,018	16	0.78
Cooling	Roof Top AC	Ductless Minisplit	17,791	$29,589	16	0.32
Cooling	Other Cooling	EER 9.8	-	$0	14	-
Cooling	Other Cooling	EER 10.0	1,147	$1,963	14	0.28
Cooling	Other Cooling	EER 10.2	2,250	$2,322	14	0.46
Cooling	Other Cooling	EER 10.4	3,309	$2,682	14	0.59
Cooling	Other Cooling	EER 10.6	4,330	$3,042	14	0.68
Cooling	Other Cooling	EER 10.8	5,313	$3,402	14	0.74
Cooling	Other Cooling	EER 12.0	10,518	$17,532	14	0.29
Heating	Electric Heating	Standard	-	$0	25	-
Cooling/Heating	Roof Top Heat Pump	EER 9.3	-	$0	15	-
Cooling/Heating	Roof Top Heat Pump	EER 10.3	9,085	$5,070	15	0.88
Cooling/Heating	Roof Top Heat Pump	EER 11.0	14,460	$7,288	15	0.98
Cooling/Heating	Roof Top Heat Pump	EER 11.7	19,192	$18,695	15	0.51
Cooling/Heating	Roof Top Heat Pump	EER 12.0	21,051	$24,399	15	0.43
Cooling/Heating	Roof Top Heat Pump	Ductless Minisplit	32,110	$46,738	15	0.34
Cooling/Heating	Roof Top Heat Pump	Geothermal	50,520	$80,802	15	0.31
Ventilation	Ventilation	Constant Volume	-	$0	10	-
Ventilation	Ventilation	Constant Volume with ECM	296	$330	10	0.38
Ventilation	Ventilation	Variable Air Volume	739	-$134	10	1.00
Ventilation	Ventilation	Variable Air Volume with ECM	1,034	$196	10	2.24
Interior Lighting	Screw-in	Incandescent	-	$0	2	-
Interior Lighting	Screw-in	90W Halogen PAR-38	291	$11	3	3.86
Interior Lighting	Screw-in	70W HIR PAR-38	447	$15	3	4.28
Interior Lighting	Screw-in	CFL	837	$8	6	31.21
Interior Lighting	Screw-in	LED	907	$224	12	2.27
Interior Lighting	High-Bay Fixtures	Metal Halides	-	$0	3	-
Interior Lighting	High-Bay Fixtures	LED	3,043	$4,509	15	0.53
Interior Lighting	High-Bay Fixtures	T8	3,098	-$120	10	1.00
Interior Lighting	High-Bay Fixtures	High Pressure Sodium	3,296	$21	6	1.00
Interior Lighting	High-Bay Fixtures	T5	3,954	-$72	10	1.00
Interior Lighting	Linear Fluorescent	T12	-	$0	10	-
Interior Lighting	Linear Fluorescent	LED	392	$1,436	15	0.18
Interior Lighting	Linear Fluorescent	T8	408	$1	10	325.25
Interior Lighting	Linear Fluorescent	Super T8	566	$10	10	27.63
Exterior Lighting	Screw-in	Incandescent	-	$0	2	-
Exterior Lighting	Screw-in	90W Halogen PAR-38	1	$0	3	2.32
Exterior Lighting	Screw-in	70W HIR PAR-38	2	$0	3	2.57
Exterior Lighting	Screw-in	CFL	4	$0	6	19.44
Exterior Lighting	Screw-in	LED	4	$1	12	1.50
Exterior Lighting	HID	Metal Halides	-	$0	3	-
Exterior Lighting	HID	LED	480	$1,631	15	0.16
Exterior Lighting	HID	T8	499	-$12	10	1.00
Exterior Lighting	HID	High Pressure Sodium	774	-$1	6	1.00
Exterior Lighting	HID	T5	808	$5	10	1.00
Exterior Lighting	Linear Fluorescent	T12	-	$0	10	-
Exterior Lighting	Linear Fluorescent	LED	0	$1	15	0.13
Exterior Lighting	Linear Fluorescent	T8	0	$0	10	229.57
Exterior Lighting	Linear Fluorescent	Super T8	0	$0	10	19.50
Exterior Lighting	Linear Fluorescent	T5	0	$0	10	14.02
Motors	1-5 HP	Standard (EPACT)	-	$0	10	-
Motors	1-5 HP	Standard (NEMA)	1,749	$1	10	558.26

End Use	Technology	Efficiency Definition	Savings (kWh/ empl/yr)	Incremental Cost ($/empl)	Lifetime (yrs)	BC Ratio
Motors	1-5 HP	High Efficiency	2,205	$159	10	6.29
Motors	1-5 HP	Premium	2,478	$254	10	4.42
Motors	6-20 HP	Standard (EPACT)	-	$0	10	-
Motors	6-20 HP	Standard (EISA)	8,089	$1	10	2,842.78
Motors	6-20 HP	High Efficiency	9,811	$221	10	20.16
Motors	6-20 HP	Premium	10,844	$353	10	13.96
Motors	21-50 HP	Standard (EPACT)	-	$0	10	-
Motors	21-50 HP	Standard (EISA)	20,815	$1	10	7,609.73
Motors	21-50 HP	High Efficiency	26,661	$571	10	21.17
Motors	21-50 HP	Premium	30,169	$914	10	14.99
Motors	51-100 HP	Standard (EPACT)	-	$0	10	-
Motors	51-100 HP	Standard (EISA)	82,233	$1	10	27,476.21
Motors	51-100 HP	High Efficiency	98,115	$821	10	54.25
Motors	51-100 HP	Premium	107,645	$1,313	10	37.22
Motors	101-200 HP	Standard (EPACT)	-	$0	10	-
Motors	101-200 HP	Standard (EISA)	181,272	$1	10	56,276.62
Motors	101-200 HP	High Efficiency	222,297	$1,958	10	51.52
Motors	101-200 HP	Premium	246,912	$3,132	10	35.78
Motors	201-500 HP	Standard (EPACT)	-	$0	10	-
Motors	201-500 HP	Standard (EISA)	337,820	$1	10	110,171.90
Motors	201-500 HP	High Efficiency	418,052	$9,609	10	19.75
Motors	201-500 HP	Premium	466,191	$15,373	10	13.76
Motors	501-1000 HP	Standard	-	$0	10	-
Motors	501-1000 HP	High Efficiency	359,440	$36,659	10	4.45
Motors	501-1000 HP	Premium	530,174	$58,654	10	4.10
Motors	1000+ HP	Standard	-	$0	10	-
Motors	1000+ HP	High Efficiency	556,249	$68,918	10	3.66
Motors	1000+ HP	Premium	820,468	$110,269	10	3.38
Process Heating	Process Heating	Standard	-	$0	15	-
Miscellaneous	Miscellaneous	Standard	-	$0	5	-

Table D-6 Energy-Efficiency Equipment Data—Other Industrial, Existing Vintage

End Use	Technology	Efficiency Definition	Savings (kWh/ empl/yr)	Incremental Cost ($/empl)	Lifetime (yrs)	BC Ratio
Cooling	Roof Top AC	EER 9.2	-	$0	16	-
Cooling	Roof Top AC	EER 10.1	2,542	$1,240	16	1.10
Cooling	Roof Top AC	EER 11.2	5,093	$2,384	16	1.14
Cooling	Roof Top AC	EER 12.0	6,655	$4,578	16	0.78
Cooling	Roof Top AC	Ductless Minisplit	9,032	$15,022	16	0.32
Cooling	Other Cooling	EER 9.8	-	$0	14	-
Cooling	Other Cooling	EER 10.0	582	$996	14	0.28
Cooling	Other Cooling	EER 10.2	1,142	$1,179	14	0.46
Cooling	Other Cooling	EER 10.4	1,680	$1,362	14	0.59
Cooling	Other Cooling	EER 10.6	2,198	$1,544	14	0.68
Cooling	Other Cooling	EER 10.8	2,697	$1,727	14	0.74
Cooling	Other Cooling	EER 12.0	5,340	$8,900	14	0.29
Heating	Electric Heating	Standard	-	$0	25	-
Cooling/Heating	Roof Top Heat Pump	EER 9.3	-	$0	15	-
Cooling/Heating	Roof Top Heat Pump	EER 10.3	4,612	$2,574	15	0.88
Cooling/Heating	Roof Top Heat Pump	EER 11.0	7,341	$3,700	15	0.98
Cooling/Heating	Roof Top Heat Pump	EER 11.7	9,743	$9,491	15	0.51
Cooling/Heating	Roof Top Heat Pump	EER 12.0	10,687	$12,387	15	0.43
Cooling/Heating	Roof Top Heat Pump	Ductless Minisplit	16,302	$23,728	15	0.34
Cooling/Heating	Roof Top Heat Pump	Geothermal	25,648	$41,021	15	0.31
Ventilation	Ventilation	Constant Volume	-	$0	10	-
Ventilation	Ventilation	Constant Volume with ECM	150	$168	10	0.38
Ventilation	Ventilation	Variable Air Volume	375	-$68	10	1.00
Ventilation	Ventilation	Variable Air Volume with ECM	525	$99	10	2.24
Interior Lighting	Screw-in	Incandescent	-	$0	2	-
Interior Lighting	Screw-in	90W Halogen PAR-38	185	$7	3	3.86
Interior Lighting	Screw-in	70W HIR PAR-38	284	$9	3	4.28
Interior Lighting	Screw-in	CFL	531	$5	6	31.21
Interior Lighting	Screw-in	LED	575	$142	12	2.27
Interior Lighting	High-Bay Fixtures	Metal Halides	-	$0	3	-
Interior Lighting	High-Bay Fixtures	LED	1,929	$2,858	15	0.53
Interior Lighting	High-Bay Fixtures	T8	1,963	-$76	10	1.00
Interior Lighting	High-Bay Fixtures	High Pressure Sodium	2,089	$14	6	1.00
Interior Lighting	High-Bay Fixtures	T5	2,506	-$46	10	1.00
Interior Lighting	Linear Fluorescent	T12	-	$0	10	-
Interior Lighting	Linear Fluorescent	LED	249	$910	15	0.18
Interior Lighting	Linear Fluorescent	T8	259	$0	10	325.25
Interior Lighting	Linear Fluorescent	Super T8	359	$6	10	27.63
Exterior Lighting	Screw-in	Incandescent	-	$0	2	-
Exterior Lighting	Screw-in	90W Halogen PAR-38	1	$0	3	2.32
Exterior Lighting	Screw-in	70W HIR PAR-38	1	$0	3	2.57
Exterior Lighting	Screw-in	CFL	3	$0	6	19.44
Exterior Lighting	Screw-in	LED	3	$1	12	1.50
Exterior Lighting	HID	Metal Halides	-	$0	3	-
Exterior Lighting	HID	LED	304	$1,034	15	0.16
Exterior Lighting	HID	T8	317	-$8	10	1.00
Exterior Lighting	HID	High Pressure Sodium	491	$0	6	1.00
Exterior Lighting	HID	T5	512	$3	10	1.00
Exterior Lighting	Linear Fluorescent	T12	-	$0	10	-
Exterior Lighting	Linear Fluorescent	LED	0	$0	15	0.13
Exterior Lighting	Linear Fluorescent	T8	0	$0	10	229.57
Exterior Lighting	Linear Fluorescent	Super T8	0	$0	10	19.50
Exterior Lighting	Linear Fluorescent	T5	0	$0	10	14.02
Motors	1-5 HP	Standard (EPACT)	-	$0	10	-
Motors	1-5 HP	Standard (NEMA)	2,053	$2	10	558.26

End Use	Technology	Efficiency Definition	Savings (kWh/ empl/yr)	Incremental Cost ($/empl)	Lifetime (yrs)	BC Ratio
Motors	1-5 HP	High Efficiency	2,589	$187	10	6.29
Motors	1-5 HP	Premium	2,909	$299	10	4.42
Motors	6-20 HP	Standard (EPACT)	-	$0	10	-
Motors	6-20 HP	Standard (EISA)	13,384	$2	10	2,842.78
Motors	6-20 HP	High Efficiency	16,231	$365	10	20.16
Motors	6-20 HP	Premium	17,941	$583	10	13.96
Motors	21-50 HP	Standard (EPACT)	-	$0	10	-
Motors	21-50 HP	Standard (EISA)	34,073	$2	10	7,609.73
Motors	21-50 HP	High Efficiency	43,643	$935	10	21.17
Motors	21-50 HP	Premium	49,385	$1,496	10	14.99
Motors	51-100 HP	Standard (EPACT)	-	$0	10	-
Motors	51-100 HP	Standard (EISA)	130,769	$2	10	27,476.21
Motors	51-100 HP	High Efficiency	156,025	$1,305	10	54.25
Motors	51-100 HP	Premium	171,179	$2,087	10	37.22
Motors	101-200 HP	Standard (EPACT)	-	$0	10	-
Motors	101-200 HP	Standard (EISA)	231,337	$2	10	56,276.62
Motors	101-200 HP	High Efficiency	283,692	$2,499	10	51.52
Motors	101-200 HP	Premium	315,105	$3,997	10	35.78
Motors	201-500 HP	Standard (EPACT)	-	$0	10	-
Motors	201-500 HP	Standard (EISA)	576,766	$2	10	110,171.90
Motors	201-500 HP	High Efficiency	713,748	$16,405	10	19.75
Motors	201-500 HP	Premium	795,937	$26,247	10	13.76
Motors	501-1000 HP	Standard	-	$0	10	-
Motors	501-1000 HP	High Efficiency	851,553	$86,849	10	4.45
Motors	501-1000 HP	Premium	1,256,040	$138,959	10	4.10
Motors	1000+ HP	Standard	-	$0	10	-
Motors	1000+ HP	High Efficiency	452,433	$56,055	10	3.66
Motors	1000+ HP	Premium	667,339	$89,688	10	3.38
Process Heating	Process Heating	Standard	-	$0	15	-
Miscellaneous	Miscellaneous	Standard	-	$0	5	-

Table D-7 Energy-Efficiency Equipment Data—Food Products, New Vintage

End Use	Technology	Efficiency Definition	Savings (kWh/ empl/yr)	Incremental Cost ($/empl)	Lifetime (yrs)	BC Ratio
Cooling	Roof Top AC	EER 9.2	-	$0	16	-
Cooling	Roof Top AC	EER 10.1	889	$393	16	1.21
Cooling	Roof Top AC	EER 11.2	1,781	$755	16	1.26
Cooling	Roof Top AC	EER 12.0	2,327	$1,450	16	0.86
Cooling	Roof Top AC	Ductless Minisplit	3,320	$4,759	16	0.37
Cooling	Other Cooling	EER 9.8	-	$0	14	-
Cooling	Other Cooling	EER 10.0	303	$506	14	0.29
Cooling	Other Cooling	EER 10.2	593	$599	14	0.47
Cooling	Other Cooling	EER 10.4	873	$692	14	0.60
Cooling	Other Cooling	EER 10.6	1,142	$784	14	0.69
Cooling	Other Cooling	EER 10.8	1,401	$877	14	0.76
Cooling	Other Cooling	EER 12.0	2,775	$4,521	14	0.29
Heating	Electric Heating	Standard	-	$0	25	-
Cooling/Heating	Roof Top Heat Pump	EER 9.3	-	$0	15	-
Cooling/Heating	Roof Top Heat Pump	EER 10.3	1,676	$815	15	1.01
Cooling/Heating	Roof Top Heat Pump	EER 11.0	2,669	$1,172	15	1.12
Cooling/Heating	Roof Top Heat Pump	EER 11.7	3,543	$3,007	15	0.58
Cooling/Heating	Roof Top Heat Pump	EER 12.0	3,886	$3,924	15	0.49
Cooling/Heating	Roof Top Heat Pump	Ductless Minisplit	5,932	$7,517	15	0.39
Cooling/Heating	Roof Top Heat Pump	Geothermal	10,028	$12,995	15	0.38
Ventilation	Ventilation	Constant Volume	-	$0	10	-
Ventilation	Ventilation	Constant Volume with ECM	37	$58	10	0.27
Ventilation	Ventilation	Variable Air Volume	93	-$24	10	1.00
Ventilation	Ventilation	Variable Air Volume with ECM	130	$35	10	1.59
Interior Lighting	Screw-in	Incandescent	-	$0	2	-
Interior Lighting	Screw-in	90W Halogen PAR-38	90	$3	3	3.85
Interior Lighting	Screw-in	70W HIR PAR-38	139	$5	3	4.27
Interior Lighting	Screw-in	CFL	260	$3	6	31.09
Interior Lighting	Screw-in	LED	282	$70	12	2.26
Interior Lighting	High-Bay Fixtures	Metal Halides	-	$0	3	-
Interior Lighting	High-Bay Fixtures	LED	1,017	$1,407	15	0.57
Interior Lighting	High-Bay Fixtures	T8	1,036	-$37	10	1.00
Interior Lighting	High-Bay Fixtures	High Pressure Sodium	1,102	$7	6	1.00
Interior Lighting	High-Bay Fixtures	T5	1,322	-$22	10	1.00
Interior Lighting	Linear Fluorescent	T12	-	$0	10	-
Interior Lighting	Linear Fluorescent	LED	122	$448	15	0.18
Interior Lighting	Linear Fluorescent	T8	127	$0	10	325.25
Interior Lighting	Linear Fluorescent	Super T8	177	$3	10	27.63
Exterior Lighting	Screw-in	Incandescent	-	$0	2	-
Exterior Lighting	Screw-in	90W Halogen PAR-38	0	$0	3	2.28
Exterior Lighting	Screw-in	70W HIR PAR-38	1	$0	3	2.53
Exterior Lighting	Screw-in	CFL	1	$0	6	19.10
Exterior Lighting	Screw-in	LED	1	$0	12	1.47
Exterior Lighting	HID	Metal Halides	-	$0	3	-
Exterior Lighting	HID	LED	150	$509	15	0.16
Exterior Lighting	HID	T8	156	-$4	10	1.00
Exterior Lighting	HID	High Pressure Sodium	241	$0	6	1.00
Exterior Lighting	HID	T5	252	$1	10	1.00
Exterior Lighting	Linear Fluorescent	T12	-	$0	10	-
Exterior Lighting	Linear Fluorescent	LED	0	$0	15	0.13
Exterior Lighting	Linear Fluorescent	T8	0	$0	10	229.51
Exterior Lighting	Linear Fluorescent	Super T8	0	$0	10	19.49
Exterior Lighting	Linear Fluorescent	T5	0	$0	10	14.02
Motors	1-5 HP	Standard (EPACT)	-	$0	10	-
Motors	1-5 HP	Standard (NEMA)	1,633	$1	10	558.31

End Use	Technology	Efficiency Definition	Savings (kWh/ empl/yr)	Incremental Cost ($/empl)	Lifetime (yrs)	BC Ratio
Motors	1-5 HP	High Efficiency	2,060	$149	10	6.29
Motors	1-5 HP	Premium	2,314	$238	10	4.42
Motors	6-20 HP	Standard (EPACT)	-	$0	10	-
Motors	6-20 HP	Standard (EISA)	8,239	$1	10	2,843.04
Motors	6-20 HP	High Efficiency	9,992	$225	10	20.16
Motors	6-20 HP	Premium	11,045	$359	10	13.96
Motors	21-50 HP	Standard (EPACT)	-	$0	10	-
Motors	21-50 HP	Standard (EISA)	22,560	$1	10	7,610.41
Motors	21-50 HP	High Efficiency	28,896	$619	10	21.18
Motors	21-50 HP	Premium	32,698	$990	10	14.99
Motors	51-100 HP	Standard (EPACT)	-	$0	10	-
Motors	51-100 HP	Standard (EISA)	72,416	$1	10	27,478.69
Motors	51-100 HP	High Efficiency	86,402	$723	10	54.25
Motors	51-100 HP	Premium	94,794	$1,156	10	37.23
Motors	101-200 HP	Standard (EPACT)	-	$0	10	-
Motors	101-200 HP	Standard (EISA)	132,903	$1	10	56,281.70
Motors	101-200 HP	High Efficiency	162,981	$1,436	10	51.53
Motors	101-200 HP	Premium	181,028	$2,296	10	35.78
Motors	201-500 HP	Standard (EPACT)	-	$0	10	-
Motors	201-500 HP	Standard (EISA)	188,166	$1	10	110,181.84
Motors	201-500 HP	High Efficiency	232,855	$5,352	10	19.75
Motors	201-500 HP	Premium	259,669	$8,563	10	13.76
Motors	501-1000 HP	Standard	-	$0	10	-
Motors	501-1000 HP	High Efficiency	260,489	$26,567	10	4.45
Motors	501-1000 HP	Premium	384,221	$42,507	10	4.10
Motors	1000+ HP	Standard	-	$0	10	-
Motors	1000+ HP	High Efficiency	514,897	$63,794	10	3.66
Motors	1000+ HP	Premium	759,474	$102,071	10	3.38
Process Heating	Process Heating	Standard	-	$0	15	-
Miscellaneous	Miscellaneous	Standard	-	$0	5	-

Table D-8 Energy-Efficiency Equipment Data—Paper Products, New Vintage

End Use	Technology	Efficiency Definition	Savings (kWh/ empl/yr)	Incremental Cost ($/empl)	Lifetime (yrs)	BC Ratio
Cooling	Roof Top AC	EER 9.2	-	$0	16	-
Cooling	Roof Top AC	EER 10.1	2,343	$1,036	16	1.21
Cooling	Roof Top AC	EER 11.2	4,696	$1,992	16	1.26
Cooling	Roof Top AC	EER 12.0	6,136	$3,824	16	0.86
Cooling	Roof Top AC	Ductless Minisplit	8,756	$12,549	16	0.37
Cooling	Other Cooling	EER 9.8	-	$0	14	-
Cooling	Other Cooling	EER 10.0	799	$1,335	14	0.29
Cooling	Other Cooling	EER 10.2	1,565	$1,579	14	0.47
Cooling	Other Cooling	EER 10.4	2,303	$1,824	14	0.60
Cooling	Other Cooling	EER 10.6	3,012	$2,069	14	0.69
Cooling	Other Cooling	EER 10.8	3,695	$2,313	14	0.76
Cooling	Other Cooling	EER 12.0	7,317	$11,923	14	0.29
Heating	Electric Heating	Standard	-	$0	25	-
Cooling/Heating	Roof Top Heat Pump	EER 9.3	-	$0	15	-
Cooling/Heating	Roof Top Heat Pump	EER 10.3	4,420	$2,150	15	1.01
Cooling/Heating	Roof Top Heat Pump	EER 11.0	7,037	$3,091	15	1.12
Cooling/Heating	Roof Top Heat Pump	EER 11.7	9,342	$7,929	15	0.58
Cooling/Heating	Roof Top Heat Pump	EER 12.0	10,248	$10,347	15	0.49
Cooling/Heating	Roof Top Heat Pump	Ductless Minisplit	15,642	$19,821	15	0.39
Cooling/Heating	Roof Top Heat Pump	Geothermal	26,444	$34,268	15	0.38
Ventilation	Ventilation	Constant Volume	-	$0	10	-
Ventilation	Ventilation	Constant Volume with ECM	98	$154	10	0.27
Ventilation	Ventilation	Variable Air Volume	245	-$63	10	1.00
Ventilation	Ventilation	Variable Air Volume with ECM	343	$91	10	1.59
Interior Lighting	Screw-in	Incandescent	-	$0	2	-
Interior Lighting	Screw-in	90W Halogen PAR-38	171	$6	3	3.85
Interior Lighting	Screw-in	70W HIR PAR-38	262	$9	3	4.27
Interior Lighting	Screw-in	CFL	491	$5	6	31.09
Interior Lighting	Screw-in	LED	532	$132	12	2.26
Interior Lighting	High-Bay Fixtures	Metal Halides	-	$0	3	-
Interior Lighting	High-Bay Fixtures	LED	1,921	$2,656	15	0.57
Interior Lighting	High-Bay Fixtures	T8	1,955	-$71	10	1.00
Interior Lighting	High-Bay Fixtures	High Pressure Sodium	2,080	$13	6	1.00
Interior Lighting	High-Bay Fixtures	T5	2,496	-$42	10	1.00
Interior Lighting	Linear Fluorescent	T12	-	$0	10	-
Interior Lighting	Linear Fluorescent	LED	231	$846	15	0.18
Interior Lighting	Linear Fluorescent	T8	240	$0	10	325.25
Interior Lighting	Linear Fluorescent	Super T8	333	$6	10	27.63
Exterior Lighting	Screw-in	Incandescent	-	$0	2	-
Exterior Lighting	Screw-in	90W Halogen PAR-38	1	$0	3	2.28
Exterior Lighting	Screw-in	70W HIR PAR-38	1	$0	3	2.53
Exterior Lighting	Screw-in	CFL	2	$0	6	19.10
Exterior Lighting	Screw-in	LED	3	$1	12	1.47
Exterior Lighting	HID	Metal Halides	-	$0	3	-
Exterior Lighting	HID	LED	283	$961	15	0.16
Exterior Lighting	HID	T8	294	-$7	10	1.00
Exterior Lighting	HID	High Pressure Sodium	456	$0	6	1.00
Exterior Lighting	HID	T5	476	$3	10	1.00
Exterior Lighting	Linear Fluorescent	T12	-	$0	10	-
Exterior Lighting	Linear Fluorescent	LED	0	$0	15	0.13
Exterior Lighting	Linear Fluorescent	T8	0	$0	10	229.57
Exterior Lighting	Linear Fluorescent	Super T8	0	$0	10	19.50
Exterior Lighting	Linear Fluorescent	T5	0	$0	10	14.02
Motors	1-5 HP	Standard (EPACT)	-	$0	10	-
Motors	1-5 HP	Standard (NEMA)	1,475	$1	10	558.26

End Use	Technology	Efficiency Definition	Savings (kWh/ empl/yr)	Incremental Cost ($/empl)	Lifetime (yrs)	BC Ratio
Motors	1-5 HP	High Efficiency	1,860	$134	10	6.29
Motors	1-5 HP	Premium	2,090	$215	10	4.42
Motors	6-20 HP	Standard (EPACT)	-	$0	10	-
Motors	6-20 HP	Standard (EISA)	8,365	$1	10	2,842.78
Motors	6-20 HP	High Efficiency	10,145	$228	10	20.16
Motors	6-20 HP	Premium	11,213	$365	10	13.96
Motors	21-50 HP	Standard (EPACT)	-	$0	10	-
Motors	21-50 HP	Standard (EISA)	21,713	$1	10	7,609.73
Motors	21-50 HP	High Efficiency	27,812	$596	10	21.17
Motors	21-50 HP	Premium	31,471	$953	10	14.99
Motors	51-100 HP	Standard (EPACT)	-	$0	10	-
Motors	51-100 HP	Standard (EISA)	76,456	$1	10	27,476.21
Motors	51-100 HP	High Efficiency	91,223	$763	10	54.25
Motors	51-100 HP	Premium	100,083	$1,220	10	37.22
Motors	101-200 HP	Standard (EPACT)	-	$0	10	-
Motors	101-200 HP	Standard (EISA)	151,699	$1	10	56,276.62
Motors	101-200 HP	High Efficiency	186,031	$1,639	10	51.52
Motors	101-200 HP	Premium	206,630	$2,621	10	35.78
Motors	201-500 HP	Standard (EPACT)	-	$0	10	-
Motors	201-500 HP	Standard (EISA)	305,986	$1	10	110,171.90
Motors	201-500 HP	High Efficiency	378,658	$8,703	10	19.75
Motors	201-500 HP	Premium	422,261	$13,924	10	13.76
Motors	501-1000 HP	Standard	-	$0	10	-
Motors	501-1000 HP	High Efficiency	310,848	$31,703	10	4.45
Motors	501-1000 HP	Premium	458,501	$50,725	10	4.10
Motors	1000+ HP	Standard	-	$0	10	-
Motors	1000+ HP	High Efficiency	592,117	$73,362	10	3.66
Motors	1000+ HP	Premium	873,373	$117,379	10	3.38
Process Heating	Process Heating	Standard	-	$0	15	-
Miscellaneous	Miscellaneous	Standard	-	$0	5	-

Table D-9 Energy-Efficiency Equipment Data—Chemical Products, New Vintage

End Use	Technology	Efficiency Definition	Savings (kWh/ empl/yr)	Incremental Cost ($/empl)	Lifetime (yrs)	BC Ratio
Cooling	Roof Top AC	EER 9.2	-	$0	16	-
Cooling	Roof Top AC	EER 10.1	3,520	$1,556	16	1.21
Cooling	Roof Top AC	EER 11.2	7,053	$2,992	16	1.26
Cooling	Roof Top AC	EER 12.0	9,216	$5,744	16	0.86
Cooling	Roof Top AC	Ductless Minisplit	13,151	$18,848	16	0.37
Cooling	Other Cooling	EER 9.8	-	$0	14	-
Cooling	Other Cooling	EER 10.0	1,200	$2,005	14	0.29
Cooling	Other Cooling	EER 10.2	2,351	$2,372	14	0.47
Cooling	Other Cooling	EER 10.4	3,459	$2,740	14	0.60
Cooling	Other Cooling	EER 10.6	4,524	$3,107	14	0.69
Cooling	Other Cooling	EER 10.8	5,550	$3,475	14	0.76
Cooling	Other Cooling	EER 12.0	10,989	$17,908	14	0.29
Heating	Electric Heating	Standard	-	$0	25	-
Cooling/Heating	Roof Top Heat Pump	EER 9.3	-	$0	15	-
Cooling/Heating	Roof Top Heat Pump	EER 10.3	6,639	$3,229	15	1.01
Cooling/Heating	Roof Top Heat Pump	EER 11.0	10,570	$4,642	15	1.12
Cooling/Heating	Roof Top Heat Pump	EER 11.7	14,032	$11,909	15	0.58
Cooling/Heating	Roof Top Heat Pump	EER 12.0	15,392	$15,542	15	0.49
Cooling/Heating	Roof Top Heat Pump	Ductless Minisplit	23,494	$29,772	15	0.39
Cooling/Heating	Roof Top Heat Pump	Geothermal	39,718	$51,470	15	0.38
Ventilation	Ventilation	Constant Volume	-	$0	10	-
Ventilation	Ventilation	Constant Volume with ECM	147	$231	10	0.27
Ventilation	Ventilation	Variable Air Volume	368	-$94	10	1.00
Ventilation	Ventilation	Variable Air Volume with ECM	515	$137	10	1.59
Interior Lighting	Screw-in	Incandescent	-	$0	2	-
Interior Lighting	Screw-in	90W Halogen PAR-38	252	$9	3	3.85
Interior Lighting	Screw-in	70W HIR PAR-38	387	$13	3	4.27
Interior Lighting	Screw-in	CFL	724	$7	6	31.09
Interior Lighting	Screw-in	LED	784	$194	12	2.26
Interior Lighting	High-Bay Fixtures	Metal Halides	-	$0	3	-
Interior Lighting	High-Bay Fixtures	LED	2,830	$3,914	15	0.57
Interior Lighting	High-Bay Fixtures	T8	2,881	-$104	10	1.00
Interior Lighting	High-Bay Fixtures	High Pressure Sodium	3,066	$19	6	1.00
Interior Lighting	High-Bay Fixtures	T5	3,678	-$62	10	1.00
Interior Lighting	Linear Fluorescent	T12	-	$0	10	-
Interior Lighting	Linear Fluorescent	LED	340	$1,247	15	0.18
Interior Lighting	Linear Fluorescent	T8	354	$1	10	325.25
Interior Lighting	Linear Fluorescent	Super T8	491	$8	10	27.63
Exterior Lighting	Screw-in	Incandescent	-	$0	2	-
Exterior Lighting	Screw-in	90W Halogen PAR-38	1	$0	3	2.28
Exterior Lighting	Screw-in	70W HIR PAR-38	2	$0	3	2.53
Exterior Lighting	Screw-in	CFL	3	$0	6	19.10
Exterior Lighting	Screw-in	LED	4	$1	12	1.47
Exterior Lighting	HID	Metal Halides	-	$0	3	-
Exterior Lighting	HID	LED	416	$1,416	15	0.16
Exterior Lighting	HID	T8	434	-$11	10	1.00
Exterior Lighting	HID	High Pressure Sodium	672	-$1	6	1.00
Exterior Lighting	HID	T5	702	$4	10	1.00
Exterior Lighting	Linear Fluorescent	T12	-	$0	10	-
Exterior Lighting	Linear Fluorescent	LED	0	$0	15	0.13
Exterior Lighting	Linear Fluorescent	T8	0	$0	10	229.57
Exterior Lighting	Linear Fluorescent	Super T8	0	$0	10	19.50
Exterior Lighting	Linear Fluorescent	T5	0	$0	10	14.02
Motors	1-5 HP	Standard (EPACT)	-	$0	10	-
Motors	1-5 HP	Standard (NEMA)	1,460	$1	10	558.26

End Use	Technology	Efficiency Definition	Savings (kWh/ empl/yr)	Incremental Cost ($/empl)	Lifetime (yrs)	BC Ratio
Motors	1-5 HP	High Efficiency	1,841	$133	10	6.29
Motors	1-5 HP	Premium	2,069	$212	10	4.42
Motors	6-20 HP	Standard (EPACT)	-	$0	10	-
Motors	6-20 HP	Standard (EISA)	8,591	$1	10	2,842.78
Motors	6-20 HP	High Efficiency	10,418	$235	10	20.16
Motors	6-20 HP	Premium	11,516	$374	10	13.96
Motors	21-50 HP	Standard (EPACT)	-	$0	10	-
Motors	21-50 HP	Standard (EISA)	18,711	$1	10	7,609.73
Motors	21-50 HP	High Efficiency	23,966	$514	10	21.17
Motors	21-50 HP	Premium	27,120	$821	10	14.99
Motors	51-100 HP	Standard (EPACT)	-	$0	10	-
Motors	51-100 HP	Standard (EISA)	64,343	$1	10	27,476.21
Motors	51-100 HP	High Efficiency	76,770	$642	10	54.25
Motors	51-100 HP	Premium	84,226	$1,027	10	37.22
Motors	101-200 HP	Standard (EPACT)	-	$0	10	-
Motors	101-200 HP	Standard (EISA)	129,374	$1	10	56,276.62
Motors	101-200 HP	High Efficiency	158,653	$1,398	10	51.52
Motors	101-200 HP	Premium	176,221	$2,236	10	35.78
Motors	201-500 HP	Standard (EPACT)	-	$0	10	-
Motors	201-500 HP	Standard (EISA)	275,274	$1	10	110,171.90
Motors	201-500 HP	High Efficiency	340,652	$7,830	10	19.75
Motors	201-500 HP	Premium	379,878	$12,527	10	13.76
Motors	501-1000 HP	Standard	-	$0	10	-
Motors	501-1000 HP	High Efficiency	311,256	$31,745	10	4.45
Motors	501-1000 HP	Premium	459,103	$50,792	10	4.10
Motors	1000+ HP	Standard	-	$0	10	-
Motors	1000+ HP	High Efficiency	532,322	$65,953	10	3.66
Motors	1000+ HP	Premium	785,176	$105,525	10	3.38
Process Heating	Process Heating	Standard	-	$0	15	-
Miscellaneous	Miscellaneous	Standard	-	$0	5	-

Table D-10 Energy-Efficiency Equipment Data—Primary Metals, New Vintage

End Use	Technology	Efficiency Definition	Savings (kWh/ empl/yr)	Incremental Cost ($/empl)	Lifetime (yrs)	BC Ratio
Cooling	Roof Top AC	EER 9.2	-	$0	16	-
Cooling	Roof Top AC	EER 10.1	4,173	$1,845	16	1.21
Cooling	Roof Top AC	EER 11.2	8,363	$3,547	16	1.26
Cooling	Roof Top AC	EER 12.0	10,927	$6,811	16	0.86
Cooling	Roof Top AC	Ductless Minisplit	15,593	$22,347	16	0.37
Cooling	Other Cooling	EER 9.8	-	$0	14	-
Cooling	Other Cooling	EER 10.0	1,422	$2,377	14	0.29
Cooling	Other Cooling	EER 10.2	2,787	$2,813	14	0.47
Cooling	Other Cooling	EER 10.4	4,101	$3,248	14	0.60
Cooling	Other Cooling	EER 10.6	5,363	$3,684	14	0.69
Cooling	Other Cooling	EER 10.8	6,580	$4,120	14	0.76
Cooling	Other Cooling	EER 12.0	13,030	$21,233	14	0.29
Heating	Electric Heating	Standard	-	$0	25	-
Cooling/Heating	Roof Top Heat Pump	EER 9.3	-	$0	15	-
Cooling/Heating	Roof Top Heat Pump	EER 10.3	7,871	$3,829	15	1.01
Cooling/Heating	Roof Top Heat Pump	EER 11.0	12,532	$5,504	15	1.12
Cooling/Heating	Roof Top Heat Pump	EER 11.7	16,638	$14,120	15	0.58
Cooling/Heating	Roof Top Heat Pump	EER 12.0	18,250	$18,428	15	0.49
Cooling/Heating	Roof Top Heat Pump	Ductless Minisplit	27,856	$35,299	15	0.39
Cooling/Heating	Roof Top Heat Pump	Geothermal	47,093	$61,026	15	0.38
Ventilation	Ventilation	Constant Volume	-	$0	10	-
Ventilation	Ventilation	Constant Volume with ECM	174	$274	10	0.27
Ventilation	Ventilation	Variable Air Volume	436	-$112	10	1.00
Ventilation	Ventilation	Variable Air Volume with ECM	610	$162	10	1.59
Interior Lighting	Screw-in	Incandescent	-	$0	2	-
Interior Lighting	Screw-in	90W Halogen PAR-38	290	$11	3	3.85
Interior Lighting	Screw-in	70W HIR PAR-38	446	$15	3	4.27
Interior Lighting	Screw-in	CFL	834	$8	6	31.09
Interior Lighting	Screw-in	LED	903	$224	12	2.26
Interior Lighting	High-Bay Fixtures	Metal Halides	-	$0	3	-
Interior Lighting	High-Bay Fixtures	LED	3,261	$4,509	15	0.57
Interior Lighting	High-Bay Fixtures	T8	3,320	-$120	10	1.00
Interior Lighting	High-Bay Fixtures	High Pressure Sodium	3,532	$21	6	1.00
Interior Lighting	High-Bay Fixtures	T5	4,237	-$72	10	1.00
Interior Lighting	Linear Fluorescent	T12	-	$0	10	-
Interior Lighting	Linear Fluorescent	LED	392	$1,436	15	0.18
Interior Lighting	Linear Fluorescent	T8	408	$1	10	325.25
Interior Lighting	Linear Fluorescent	Super T8	566	$10	10	27.63
Exterior Lighting	Screw-in	Incandescent	-	$0	2	-
Exterior Lighting	Screw-in	90W Halogen PAR-38	1	$0	3	2.28
Exterior Lighting	Screw-in	70W HIR PAR-38	2	$0	3	2.53
Exterior Lighting	Screw-in	CFL	4	$0	6	19.10
Exterior Lighting	Screw-in	LED	4	$1	12	1.47
Exterior Lighting	HID	Metal Halides	-	$0	3	-
Exterior Lighting	HID	LED	480	$1,631	15	0.16
Exterior Lighting	HID	T8	499	-$12	10	1.00
Exterior Lighting	HID	High Pressure Sodium	774	-$1	6	1.00
Exterior Lighting	HID	T5	808	$5	10	1.00
Exterior Lighting	Linear Fluorescent	T12	-	$0	10	-
Exterior Lighting	Linear Fluorescent	LED	0	$1	15	0.13
Exterior Lighting	Linear Fluorescent	T8	0	$0	10	229.57
Exterior Lighting	Linear Fluorescent	Super T8	0	$0	10	19.50
Exterior Lighting	Linear Fluorescent	T5	0	$0	10	14.02
Motors	1-5 HP	Standard (EPACT)	-	$0	10	-
Motors	1-5 HP	Standard (NEMA)	1,749	$1	10	558.26

End Use	Technology	Efficiency Definition	Savings (kWh/ empl/yr)	Incremental Cost ($/empl)	Lifetime (yrs)	BC Ratio
Motors	1-5 HP	High Efficiency	2,205	$159	10	6.29
Motors	1-5 HP	Premium	2,478	$254	10	4.42
Motors	6-20 HP	Standard (EPACT)	-	$0	10	-
Motors	6-20 HP	Standard (EISA)	8,089	$1	10	2,842.78
Motors	6-20 HP	High Efficiency	9,811	$221	10	20.16
Motors	6-20 HP	Premium	10,844	$353	10	13.96
Motors	21-50 HP	Standard (EPACT)	-	$0	10	-
Motors	21-50 HP	Standard (EISA)	20,815	$1	10	7,609.73
Motors	21-50 HP	High Efficiency	26,661	$571	10	21.17
Motors	21-50 HP	Premium	30,169	$914	10	14.99
Motors	51-100 HP	Standard (EPACT)	-	$0	10	-
Motors	51-100 HP	Standard (EISA)	82,233	$1	10	27,476.21
Motors	51-100 HP	High Efficiency	98,115	$821	10	54.25
Motors	51-100 HP	Premium	107,645	$1,313	10	37.22
Motors	101-200 HP	Standard (EPACT)	-	$0	10	-
Motors	101-200 HP	Standard (EISA)	181,272	$1	10	56,276.62
Motors	101-200 HP	High Efficiency	222,297	$1,958	10	51.52
Motors	101-200 HP	Premium	246,912	$3,132	10	35.78
Motors	201-500 HP	Standard (EPACT)	-	$0	10	-
Motors	201-500 HP	Standard (EISA)	337,820	$1	10	110,171.90
Motors	201-500 HP	High Efficiency	418,052	$9,609	10	19.75
Motors	201-500 HP	Premium	466,191	$15,373	10	13.76
Motors	501-1000 HP	Standard	-	$0	10	-
Motors	501-1000 HP	High Efficiency	359,440	$36,659	10	4.45
Motors	501-1000 HP	Premium	530,174	$58,654	10	4.10
Motors	1000+ HP	Standard	-	$0	10	-
Motors	1000+ HP	High Efficiency	556,249	$68,918	10	3.66
Motors	1000+ HP	Premium	820,468	$110,269	10	3.38
Process Heating	Process Heating	Standard	-	$0	15	-
Miscellaneous	Miscellaneous	Standard	-	$0	5	-

Table D-11 Energy-Efficiency Equipment Data—Other Industrial, New Vintage

End Use	Technology	Efficiency Definition	Savings (kWh/ empl/yr)	Incremental Cost ($/empl)	Lifetime (yrs)	BC Ratio
Cooling	Roof Top AC	EER 9.2	-	$0	16	-
Cooling	Roof Top AC	EER 10.1	2,119	$936	16	1.21
Cooling	Roof Top AC	EER 11.2	4,245	$1,801	16	1.26
Cooling	Roof Top AC	EER 12.0	5,547	$3,458	16	0.86
Cooling	Roof Top AC	Ductless Minisplit	7,916	$11,345	16	0.37
Cooling	Other Cooling	EER 9.8	-	$0	14	-
Cooling	Other Cooling	EER 10.0	722	$1,207	14	0.29
Cooling	Other Cooling	EER 10.2	1,415	$1,428	14	0.47
Cooling	Other Cooling	EER 10.4	2,082	$1,649	14	0.60
Cooling	Other Cooling	EER 10.6	2,723	$1,870	14	0.69
Cooling	Other Cooling	EER 10.8	3,341	$2,092	14	0.76
Cooling	Other Cooling	EER 12.0	6,615	$10,779	14	0.29
Heating	Electric Heating	Standard	-	$0	25	-
Cooling/Heating	Roof Top Heat Pump	EER 9.3	-	$0	15	-
Cooling/Heating	Roof Top Heat Pump	EER 10.3	3,996	$1,944	15	1.01
Cooling/Heating	Roof Top Heat Pump	EER 11.0	6,362	$2,794	15	1.12
Cooling/Heating	Roof Top Heat Pump	EER 11.7	8,447	$7,168	15	0.58
Cooling/Heating	Roof Top Heat Pump	EER 12.0	9,265	$9,355	15	0.49
Cooling/Heating	Roof Top Heat Pump	Ductless Minisplit	14,142	$17,921	15	0.39
Cooling/Heating	Roof Top Heat Pump	Geothermal	23,908	$30,981	15	0.38
Ventilation	Ventilation	Constant Volume	-	$0	10	-
Ventilation	Ventilation	Constant Volume with ECM	89	$139	10	0.27
Ventilation	Ventilation	Variable Air Volume	221	-$57	10	1.00
Ventilation	Ventilation	Variable Air Volume with ECM	310	$82	10	1.59
Interior Lighting	Screw-in	Incandescent	-	$0	2	-
Interior Lighting	Screw-in	90W Halogen PAR-38	184	$7	3	3.85
Interior Lighting	Screw-in	70W HIR PAR-38	282	$9	3	4.27
Interior Lighting	Screw-in	CFL	529	$5	6	31.09
Interior Lighting	Screw-in	LED	572	$142	12	2.26
Interior Lighting	High-Bay Fixtures	Metal Halides	-	$0	3	-
Interior Lighting	High-Bay Fixtures	LED	2,067	$2,858	15	0.57
Interior Lighting	High-Bay Fixtures	T8	2,104	-$76	10	1.00
Interior Lighting	High-Bay Fixtures	High Pressure Sodium	2,239	$14	6	1.00
Interior Lighting	High-Bay Fixtures	T5	2,685	-$46	10	1.00
Interior Lighting	Linear Fluorescent	T12	-	$0	10	-
Interior Lighting	Linear Fluorescent	LED	249	$910	15	0.18
Interior Lighting	Linear Fluorescent	T8	259	$0	10	325.25
Interior Lighting	Linear Fluorescent	Super T8	359	$6	10	27.63
Exterior Lighting	Screw-in	Incandescent	-	$0	2	-
Exterior Lighting	Screw-in	90W Halogen PAR-38	1	$0	3	2.28
Exterior Lighting	Screw-in	70W HIR PAR-38	1	$0	3	2.53
Exterior Lighting	Screw-in	CFL	3	$0	6	19.10
Exterior Lighting	Screw-in	LED	3	$1	12	1.47
Exterior Lighting	HID	Metal Halides	-	$0	3	-
Exterior Lighting	HID	LED	304	$1,034	15	0.16
Exterior Lighting	HID	T8	317	-$8	10	1.00
Exterior Lighting	HID	High Pressure Sodium	491	$0	6	1.00
Exterior Lighting	HID	T5	512	$3	10	1.00
Exterior Lighting	Linear Fluorescent	T12	-	$0	10	-
Exterior Lighting	Linear Fluorescent	LED	0	$0	15	0.13
Exterior Lighting	Linear Fluorescent	T8	0	$0	10	229.57
Exterior Lighting	Linear Fluorescent	Super T8	0	$0	10	19.50
Exterior Lighting	Linear Fluorescent	T5	0	$0	10	14.02
Motors	1-5 HP	Standard (EPACT)	-	$0	10	-
Motors	1-5 HP	Standard (NEMA)	2,053	$2	10	558.26

End Use	Technology	Efficiency Definition	Savings (kWh/ empl/yr)	Incremental Cost ($/empl)	Lifetime (yrs)	BC Ratio
Motors	1-5 HP	High Efficiency	2,589	$187	10	6.29
Motors	1-5 HP	Premium	2,909	$299	10	4.42
Motors	6-20 HP	Standard (EPACT)	-	$0	10	-
Motors	6-20 HP	Standard (EISA)	13,384	$2	10	2,842.78
Motors	6-20 HP	High Efficiency	16,231	$365	10	20.16
Motors	6-20 HP	Premium	17,941	$583	10	13.96
Motors	21-50 HP	Standard (EPACT)	-	$0	10	-
Motors	21-50 HP	Standard (EISA)	34,073	$2	10	7,609.73
Motors	21-50 HP	High Efficiency	43,643	$935	10	21.17
Motors	21-50 HP	Premium	49,385	$1,496	10	14.99
Motors	51-100 HP	Standard (EPACT)	-	$0	10	-
Motors	51-100 HP	Standard (EISA)	130,769	$2	10	27,476.21
Motors	51-100 HP	High Efficiency	156,025	$1,305	10	54.25
Motors	51-100 HP	Premium	171,179	$2,087	10	37.22
Motors	101-200 HP	Standard (EPACT)	-	$0	10	-
Motors	101-200 HP	Standard (EISA)	231,337	$2	10	56,276.62
Motors	101-200 HP	High Efficiency	283,692	$2,499	10	51.52
Motors	101-200 HP	Premium	315,105	$3,997	10	35.78
Motors	201-500 HP	Standard (EPACT)	-	$0	10	-
Motors	201-500 HP	Standard (EISA)	576,766	$2	10	110,171.90
Motors	201-500 HP	High Efficiency	713,748	$16,405	10	19.75
Motors	201-500 HP	Premium	795,937	$26,247	10	13.76
Motors	501-1000 HP	Standard	-	$0	10	-
Motors	501-1000 HP	High Efficiency	851,553	$86,849	10	4.45
Motors	501-1000 HP	Premium	1,256,040	$138,959	10	4.10
Motors	1000+ HP	Standard	-	$0	10	-
Motors	1000+ HP	High Efficiency	452,433	$56,055	10	3.66
Motors	1000+ HP	Premium	667,339	$89,688	10	3.38
Process Heating	Process Heating	Standard	-	$0	15	-
Miscellaneous	Miscellaneous	Standard	-	$0	5	-

Table D-12 Energy-Efficiency Measure Data—Food Products, Existing Vintage

Measure	End Use	Energy Savings	Demand Savings	Base Satura-tion	Appl./ Feas.	Cost ($/ employee)	Life-time (yrs)	BC Ratio
Air Compressor Demand Reduction	Motors	20%	16%	3%	29%	$599,994	10	5.70
Cold Storage Retrofit	Motors	26%	20%	0%	39%	$32,297,145	10	1.59
Cold Storage Tune-up	Motors	10%	8%	1%	66%	$5,217,881	3	2.09
Energy Project Management	Motors	29%	23%	7%	34%	$15,502,773	11	3.68
Fan Energy Management	Motors	10%	8%	7%	34%	$0	10	1.00
Fan Equipment Upgrade	Motors	35%	28%	6%	29%	$3,151,559	10	5.21
Fan System Optimization	Motors	50%	40%	7%	30%	$16,788,790	10	3.76
Food: Refrig Storage Tune-up	Motors	8%	6%	0%	0%	$3,794,571	3	2.09
Groc Dist Retrofit	Motors	16%	13%	0%	17%	$9,209,880	10	1.52
Groc Dist Tune-up	Motors	10%	8%	0%	34%	$2,650,399	3	2.09
Integrated Plant Energy Management	Motors	50%	40%	6%	28%	$23,253,506	11	2.50
Lighting Controls	Interior Lighting	28%	23%	0%	0%	$1,357,192	10	1.18
Motors: Rewind 20-50 HP	Motors	1%	1%	1%	11%	$736,806	10	1.23
Motors: Rewind 51-100 HP	Motors	1%	0%	1%	9%	$305,102	10	1.44
Motors: Rewind 101-200 HP	Motors	1%	0%	1%	10%	$253,986	10	1.93
Motors: Rewind 201-500 HP	Motors	1%	0%	1%	8%	$132,151	10	3.07
Motors: Rewind 501-1000 HP	Motors	1%	0%	1%	10%	$115,262	10	4.12
Motors: Rewind 1000+ HP	Motors	1%	0%	1%	10%	$115,262	10	4.12
Plant Energy Management	Motors	12%	10%	7%	34%	$727,198	10	20.4
Pump Energy Management	Motors	8%	6%	8%	39%	$0	10	1.00
Pump Equipment Upgrade	Motors	20%	16%	8%	42%	$1,683,201	10	3.59
Pump System Optimization	Motors	50%	40%	4%	15%	$15,428,000	10	2.03
Synchronous Belts	Motors	2%	2%	9%	30%	$1,637,982	10	2.08
Transformers-New	Motors	0%	0%	1%	3%	$1,322,307	32	0.90
Transformers-Retrofit	Motors	2%	1%	16%	25%	$275,131	10	3.72
Process Heating	Motors	0%	0%	0%	0%	$0	-	1.00
Custom Utility Programs - Misc	Miscellaneous	25%	20%	10%	40%	$25,000	10	3.52
Custom Utility Programs - Motors	Motors	25%	20%	10%	40%	$25,000	10	2.85
Custom Utility Programs - Int Lighting	Interior Lighting	25%	20%	10%	40%	$25,000	10	2.92
Custom Utility Programs - Cooling	Cooling	25%	20%	10%	40%	$25,000	10	2.47
Bi-Level Fixture w/Occupancy Sensor	Interior Lighting	10%	5%	10%	23%	$500	8	0.06
Central Chiller - Chiller Water Reset	Cooling	15%	15%	30%	75%	$2,000	4	1.08
Central Chiller - Economizer	Cooling	25%	0%	0%	49%	$4,384	15	2.64
Central Chiller - High Efficiency Fans	Cooling	0%	0%	15%	41%	$10,000	10	0.01
Central Chiller - Maintenance	Cooling	4%	4%	62%	90%	$8,000	3	0.43
Central Chiller - Temperature Reset	Cooling	15%	7%	30%	75%	$4,500	4	0.48
Central Chiller - VSD	Cooling	33%	33%	15%	66%	$7,500	20	2.36
Clock/Programmable Thermostat	Cooling	7%	0%	32%	50%	$250	11	3.54
Clock/Programmable Thermostat	Heating	41%	0%	32%	50%	$250	11	3.54
Daylighting Controls - Photocell Controlled Dimming Ballasts	Interior Lighting	25%	13%	15%	20%	$200	8	0.35
Delamp and Install Reflectors	Interior Lighting	8%	8%	18%	56%	$120	11	0.27
Energy Management System	Cooling	25%	14%	5%	75%	$10,230	14	0.54
Energy Management System	Heating	28%	0%	5%	75%	$10,230	14	0.54
Energy Management System	Interior Lighting	9%	0%	5%	75%	$10,230	14	0.54
Energy Management System	Exterior Lighting	9%	0%	5%	75%	$10,230	14	0.54
Heat Pump - Maintenance	Cooling/Heating	4%	5%	3%	95%	$1,000	3	4.76
HVAC - Duct Insulation	Cooling	2%	3%	15%	50%	$11,983	20	0.03
HVAC - Duct Insulation	Cooling/Heating	1%	3%	15%	50%	$11,983	20	0.03
HVAC - Duct Insulation	Heating	0%	0%	15%	50%	$11,983	20	0.03
HVAC - Duct Repair and Sealing	Cooling	1%	2%	5%	25%	$11,106	15	0.01
HVAC - Duct Repair and Sealing	Heating	1%	0%	5%	25%	$11,106	15	0.01
Insulation - Ceiling	Cooling	13%	43%	5%	20%	$10,814	20	0.16
Insulation - Ceiling	Cooling/Heating	32%	21%	5%	20%	$10,814	20	0.16
Insulation - Ceiling	Heating	22%	0%	5%	20%	$10,814	20	0.16

Measure	End Use	Energy Savings	Demand Savings	Base Satura-tion	Appl./ Feas.	Cost ($/ employee)	Life-time (yrs)	BC Ratio
Insulation - Wall Cavity	Cooling	1%	18%	10%	68%	$22,797	20	0.04
Insulation - Wall Cavity	Cooling/Heating	46%	19%	10%	68%	$22,797	20	0.04
Insulation - Wall Cavity	Heating	78%	0%	10%	68%	$22,797	20	0.04
LED Exit Lighting	Interior Lighting	87%	87%	9%	90%	$60	12	0.67
Machine Drive - Pumping System Controls	Motors	10%	8%	0%	0%	$3,000	15	29.1
Machine Drive - Pumping System Maintenance	Motors	4%	3%	5%	34%	$500	3	5.99
Machine Drive - Pumping System Optimization	Motors	6%	5%	5%	34%	$1,000	15	48.3
Occupancy Sensors	Interior Lighting	10%	5%	6%	56%	$100	6	0.87
Process - Compressed Air System Controls	Process Heating	20%	15%	0%	0%	$5,000	15	51.8
Process - Compressed Air System Maintenance	Process Heating	4%	3%	0%	0%	$3,000	3	4.05
Process - Compressed Air System Optimization and Improvements	Process Heating	12%	9%	0%	0%	$9,000	15	17.3
Process - Fan System Controls	Process Heating	20%	15%	0%	0%	$3,000	15	45.0
Process - Fan System Maintenance	Process Heating	4%	3%	10%	38%	$500	3	12.7
Process - Fan System Optimization	Process Heating	12%	9%	10%	38%	$1,000	15	81.0
Refrigeration System Controls	Motors	12%	9%	0%	0%	$200,000	18	0.50
Refrigeration System Maintenance	Motors	4%	3%	25%	75%	$6,000	3	0.60
Refrigeration System Optimization	Motors	12%	9%	40%	56%	$22,601	15	4.01
Roofs - High Reflectivity	Cooling	17%	14%	50%	75%	$13,152	15	0.13
RTU - Maintenance	Cooling	14%	15%	62%	90%	$1,500	4	1.56
Task Lighting	Interior Lighting	10%	10%	6%	75%	$150	6	0.04
Time Clocks and Timers	Interior Lighting	5%	3%	3%	56%	$250	6	0.04
Ventilation - C02 Controls	Ventilation	13%	7%	1%	8%	$1,228	10	1.21

Table D-13 Energy-Efficiency Measure Data—Paper Products, Existing Vintage

Measure	End Use	Energy Savings	Demand Savings	Base Satura-tion	Appl./ Feas.	Cost ($/ employee)	Life-time (yrs)	BC Ratio
Air Compressor Demand Reduction	Motors	20%	16%	3%	29%	$532,831	10	5.70
Air Compressor Equipment2	Motors	35%	28%	1%	18%	$488,636	10	6.86
Efficient Centrifugal Fan	Motors	20%	16%	5%	15%	$974,156	10	2.40
Energy Project Management	Motors	29%	23%	7%	34%	$14,846,738	11	3.46
Fan Energy Management	Motors	10%	8%	7%	34%	$0	10	1.00
Fan Equipment Upgrade	Motors	35%	28%	6%	29%	$1,775,747	10	4.99
Fan System Optimization	Motors	50%	40%	7%	30%	$4,531,215	10	3.60
Integrated Plant Energy Management	Motors	50%	40%	6%	28%	$22,269,482	11	2.32
Lighting Controls	Interior Lighting	28%	23%	0%	0%	$336,380	10	1.16
Material Handling VFD2	Motors	19%	15%	0%	6%	$9,307,114	10	1.43
Motors: Rewind 20-50 HP	Motors	1%	1%	0%	6%	$358,616	10	1.27
Motors: Rewind 51-100 HP	Motors	1%	0%	1%	10%	$270,681	10	1.36
Motors: Rewind 101-200 HP	Motors	1%	0%	1%	9%	$182,742	10	1.84
Motors: Rewind 201-500 HP	Motors	1%	0%	1%	13%	$167,492	10	3.07
Motors: Rewind 501-1000 HP	Motors	1%	0%	4%	23%	$224,522	10	4.12
Motors: Rewind 1000+ HP	Motors	1%	0%	4%	23%	$224,522	10	4.12
Paper: Efficient Pulp Screen	Motors	15%	12%	1%	15%	$1,198,293	10	2.54
Paper: Large Material Handling	Motors	10%	8%	3%	5%	$3,412,869	10	0.38
Paper: Material Handling	Motors	13%	10%	3%	5%	$3,839,477	10	0.46
Paper: Premium Control Large Material	Motors	19%	15%	3%	5%	$3,754,155	10	0.89
Paper: Premium Fan	Motors	20%	16%	0%	25%	$2,319,418	10	2.53
Plant Energy Management	Motors	12%	10%	7%	34%	$696,425	10	19.3
Pump Energy Management	Motors	8%	6%	8%	39%	$0	10	1.00
Pump Equipment Upgrade	Motors	20%	16%	8%	42%	$3,975,296	10	3.59
Pump System Optimization	Motors	50%	40%	4%	15%	$9,286,717	12	2.27
Synchronous Belts	Motors	2%	2%	9%	30%	$1,568,668	10	2.10
Transformers-New	Motors	0%	0%	1%	3%	$2,022,106	32	0.85
Transformers-Retrofit	Motors	2%	1%	16%	25%	$254,681	10	3.57
Process Heating	Motors	0%	0%	0%	0%	$0	-	1.00
Custom Utility Programs - Misc	Miscellaneous	25%	20%	10%	40%	$25,000	10	3.52
Custom Utility Programs - Motors	Motors	25%	20%	10%	40%	$25,000	10	2.86
Custom Utility Programs - Int Lighting	Interior Lighting	25%	20%	10%	40%	$25,000	10	2.92
Custom Utility Programs - Cooling	Cooling	25%	20%	10%	40%	$25,000	10	2.45
Bi-Level Fixture w/Occupancy Sensor	Interior Lighting	10%	5%	10%	23%	$500	8	0.06
Central Chiller - Chiller Water Reset	Cooling	15%	15%	30%	75%	$2,000	4	1.08
Central Chiller - Economizer	Cooling	25%	0%	0%	49%	$4,384	15	2.64
Central Chiller - High Efficiency Fans	Cooling	0%	0%	15%	41%	$10,000	10	0.01
Central Chiller - Maintenance	Cooling	4%	4%	62%	90%	$8,000	3	0.42
Central Chiller - Temperature Reset	Cooling	15%	7%	30%	75%	$4,500	4	0.48
Central Chiller - VSD	Cooling	33%	33%	15%	66%	$7,500	20	2.36
Clock/Programmable Thermostat	Cooling	7%	0%	32%	50%	$250	11	3.53
Clock/Programmable Thermostat	Heating	41%	0%	32%	50%	$250	11	3.53
Daylighting Controls - Photocell Controlled Dimming Ballasts	Interior Lighting	25%	13%	15%	20%	$200	8	0.35
Delamp and Install Reflectors	Interior Lighting	8%	8%	18%	56%	$120	11	0.27
Energy Management System	Cooling	25%	14%	5%	75%	$10,230	14	0.54
Energy Management System	Heating	28%	0%	5%	75%	$10,230	14	0.54
Energy Management System	Interior Lighting	9%	0%	5%	75%	$10,230	14	0.54
Energy Management System	Exterior Lighting	9%	0%	5%	75%	$10,230	14	0.54
Heat Pump - Maintenance	Cooling/Heating	4%	5%	3%	95%	$1,000	3	4.74
HVAC - Duct Insulation	Cooling	2%	3%	15%	50%	$11,983	20	0.03
HVAC - Duct Insulation	Cooling/Heating	1%	3%	15%	50%	$11,983	20	0.03
HVAC - Duct Insulation	Heating	0%	0%	15%	50%	$11,983	20	0.03
HVAC - Duct Repair and Sealing	Cooling	1%	2%	5%	25%	$11,106	15	0.01
HVAC - Duct Repair and Sealing	Heating	1%	0%	5%	25%	$11,106	15	0.01

Measure	End Use	Energy Savings	Demand Savings	Base Satura-tion	Appl./ Feas.	Cost ($/ employee)	Life-time (yrs)	BC Ratio
Insulation - Ceiling	Cooling	13%	43%	5%	20%	$10,814	20	0.16
Insulation - Ceiling	Cooling/Heating	32%	21%	5%	20%	$10,814	20	0.16
Insulation - Ceiling	Heating	22%	0%	5%	20%	$10,814	20	0.16
Insulation - Wall Cavity	Cooling	1%	18%	10%	68%	$22,797	20	0.04
Insulation - Wall Cavity	Cooling/Heating	46%	19%	10%	68%	$22,797	20	0.04
Insulation - Wall Cavity	Heating	78%	0%	10%	68%	$22,797	20	0.04
LED Exit Lighting	Interior Lighting	87%	87%	9%	90%	$60	12	0.67
Machine Drive - Pumping System Controls	Motors	10%	8%	0%	0%	$3,000	15	29.3
Machine Drive - Pumping System Maintenance	Motors	4%	3%	5%	34%	$500	3	5.97
Machine Drive - Pumping System Optimization	Motors	6%	5%	5%	34%	$1,000	15	48.5
Occupancy Sensors	Interior Lighting	10%	5%	6%	56%	$100	6	0.87
Process - Compressed Air System Controls	Process Heating	20%	15%	0%	0%	$5,000	15	51.8
Process - Compressed Air System Maintenance	Process Heating	4%	3%	0%	0%	$3,000	3	4.05
Process - Compressed Air System Optimization and Improvements	Process Heating	12%	9%	0%	0%	$9,000	15	17.3
Process - Fan System Controls	Process Heating	20%	15%	0%	0%	$3,000	15	45.0
Process - Fan System Maintenance	Process Heating	4%	3%	10%	38%	$500	3	12.7
Process - Fan System Optimization	Process Heating	12%	9%	10%	38%	$1,000	15	81.0
Refrigeration System Controls	Motors	12%	9%	0%	0%	$200,000	18	0.50
Refrigeration System Maintenance	Motors	4%	3%	25%	75%	$6,000	3	0.60
Refrigeration System Optimization	Motors	12%	9%	40%	56%	$22,601	15	4.03
Roofs - High Reflectivity	Cooling	17%	14%	50%	75%	$13,152	15	0.12
RTU - Maintenance	Cooling	14%	15%	62%	90%	$1,500	4	1.54
Task Lighting	Interior Lighting	10%	10%	6%	75%	$150	6	0.04
Time Clocks and Timers	Interior Lighting	5%	3%	3%	56%	$250	6	0.04
Ventilation - C02 Controls	Ventilation	13%	7%	1%	8%	$1,228	10	1.21

Table D-14 Energy-Efficiency Measure Data—Chemical Products, Existing Vintage

Measure	End Use	Energy Savings	Demand Savings	Base Satura-tion	Appl./ Feas.	Cost ($/ employee)	Life-time (yrs)	BC Ratio
Air Compressor Demand Reduction	Motors	20%	16%	3%	29%	$2,409,244	10	5.71
Energy Project Management	Motors	29%	23%	7%	34%	$15,502,773	11	3.69
Fan Energy Management	Motors	10%	8%	7%	34%	$0	10	1.00
Fan Equipment Upgrade	Motors	35%	28%	6%	29%	$1,003,649	10	5.22
Fan System Optimization	Motors	50%	40%	7%	30%	$16,788,790	10	3.77
Integrated Plant Energy Management	Motors	50%	40%	6%	28%	$23,253,506	11	2.51
Lighting Controls	Interior Lighting	28%	23%	0%	0%	$2,661,701	10	1.17
Motors: Rewind 20-50 HP	Motors	1%	1%	0%	6%	$463,193	10	1.27
Motors: Rewind 51-100 HP	Motors	1%	0%	0%	6%	$225,824	10	1.48
Motors: Rewind 101-200 HP	Motors	1%	0%	1%	10%	$257,659	10	2.00
Motors: Rewind 201-500 HP	Motors	1%	0%	1%	11%	$193,938	10	3.07
Motors: Rewind 501-1000 HP	Motors	1%	0%	1%	8%	$98,680	10	4.12
Motors: Rewind 1000+ HP	Motors	1%	0%	1%	8%	$98,680	10	4.12
Plant Energy Management	Motors	12%	10%	7%	34%	$915,759	10	20.8
Pump Energy Management	Motors	8%	6%	8%	39%	$0	10	1.00
Pump Equipment Upgrade	Motors	20%	16%	8%	42%	$4,355,396	10	3.59
Pump System Optimization	Motors	50%	40%	4%	15%	$10,174,673	12	2.27
Synchronous Belts	Motors	2%	2%	9%	30%	$2,062,707	10	2.12
Transformers-New	Motors	0%	0%	1%	3%	$2,658,953	32	1.01
Transformers-Retrofit	Motors	2%	1%	16%	25%	$403,046	10	4.25
Process Heating	Process Heating	25%	20%	1%	9%	$25,000	10	4.23
Custom Utility Programs - Misc	Miscellaneous	25%	20%	10%	40%	$25,000	10	3.52
Custom Utility Programs - Motors	Motors	25%	20%	10%	40%	$25,000	10	2.86
Custom Utility Programs - Int Lighting	Interior Lighting	25%	20%	10%	40%	$25,000	10	2.93
Custom Utility Programs - Cooling	Cooling	25%	20%	10%	40%	$25,000	10	2.46
Bi-Level Fixture w/Occupancy Sensor	Interior Lighting	10%	5%	10%	23%	$500	8	0.06
Central Chiller - Chiller Water Reset	Cooling	15%	15%	30%	75%	$2,000	4	1.08
Central Chiller - Economizer	Cooling	25%	0%	0%	49%	$4,384	15	2.64
Central Chiller - High Efficiency Fans	Cooling	0%	0%	15%	41%	$10,000	10	0.01
Central Chiller - Maintenance	Cooling	4%	4%	62%	90%	$8,000	3	0.42
Central Chiller - Temperature Reset	Cooling	15%	7%	30%	75%	$4,500	4	0.48
Central Chiller - VSD	Cooling	33%	33%	15%	66%	$7,500	20	2.36
Clock/Programmable Thermostat	Cooling	7%	0%	32%	50%	$250	11	3.54
Clock/Programmable Thermostat	Heating	41%	0%	32%	50%	$250	11	3.54
Daylighting Controls - Photocell Controlled Dimming Ballasts	Interior Lighting	25%	13%	15%	20%	$200	8	0.35
Delamp and Install Reflectors	Interior Lighting	8%	8%	18%	56%	$120	11	0.27
Energy Management System	Cooling	25%	14%	5%	75%	$10,230	14	0.54
Energy Management System	Heating	28%	0%	5%	75%	$10,230	14	0.54
Energy Management System	Interior Lighting	9%	0%	5%	75%	$10,230	14	0.54
Energy Management System	Exterior Lighting	9%	0%	5%	75%	$10,230	14	0.54
Heat Pump - Maintenance	Cooling/Heating	4%	5%	3%	95%	$1,000	3	4.76
HVAC - Duct Insulation	Cooling	2%	3%	15%	50%	$11,983	20	0.03
HVAC - Duct Insulation	Cooling/Heating	1%	3%	15%	50%	$11,983	20	0.03
HVAC - Duct Insulation	Heating	0%	0%	15%	50%	$11,983	20	0.03
HVAC - Duct Repair and Sealing	Cooling	1%	2%	5%	25%	$11,106	15	0.01
HVAC - Duct Repair and Sealing	Heating	1%	0%	5%	25%	$11,106	15	0.01
Insulation - Ceiling	Cooling	13%	43%	5%	20%	$10,814	20	0.16
Insulation - Ceiling	Cooling/Heating	32%	21%	5%	20%	$10,814	20	0.16
Insulation - Ceiling	Heating	22%	0%	5%	20%	$10,814	20	0.16
Insulation - Wall Cavity	Cooling	1%	18%	10%	68%	$22,797	20	0.04
Insulation - Wall Cavity	Cooling/Heating	46%	19%	10%	68%	$22,797	20	0.04
Insulation - Wall Cavity	Heating	78%	0%	10%	68%	$22,797	20	0.04
LED Exit Lighting	Interior Lighting	87%	87%	9%	90%	$60	12	0.67
Machine Drive - Pumping System Controls	Motors	10%	8%	0%	0%	$3,000	15	29.3

Measure	End Use	Energy Savings	Demand Savings	Base Satura-tion	Appl./ Feas.	Cost ($/ employee)	Life-time (yrs)	BC Ratio
Machine Drive - Pumping System Maintenance	Motors	4%	3%	5%	34%	$500	3	5.98
Machine Drive - Pumping System Optimization	Motors	6%	5%	5%	34%	$1,000	15	48.6
Occupancy Sensors	Interior Lighting	10%	5%	6%	56%	$100	6	0.87
Process - Compressed Air System Controls	Process Heating	20%	15%	0%	0%	$5,000	15	51.8
Process - Compressed Air System Maintenance	Process Heating	4%	3%	0%	0%	$3,000	3	4.05
Process - Compressed Air System Optimization and Improvements	Process Heating	12%	9%	0%	0%	$9,000	15	17.3
Process - Fan System Controls	Process Heating	20%	15%	0%	0%	$3,000	15	45.0
Process - Fan System Maintenance	Process Heating	4%	3%	10%	38%	$500	3	12.7
Process - Fan System Optimization	Process Heating	12%	9%	10%	38%	$1,000	15	81.0
Refrigeration System Controls	Motors	12%	9%	0%	0%	$200,000	18	0.50
Refrigeration System Maintenance	Motors	4%	3%	25%	75%	$6,000	3	0.60
Refrigeration System Optimization	Motors	12%	9%	40%	56%	$22,601	15	4.03
Roofs - High Reflectivity	Cooling	17%	14%	50%	75%	$13,152	15	0.12
RTU - Maintenance	Cooling	14%	15%	62%	90%	$1,500	4	1.55
Task Lighting	Interior Lighting	10%	10%	6%	75%	$150	6	0.04
Time Clocks and Timers	Interior Lighting	5%	3%	3%	56%	$250	6	0.04
Ventilation - C02 Controls	Ventilation	13%	7%	1%	8%	$1,228	10	1.21

Table D-15 Energy-Efficiency Measure Data—Primary Metals, Existing Vintage

Measure	End Use	Energy Savings	Demand Savings	Base Satura-tion	Appl./ Feas.	Cost ($/ employee)	Life-time (yrs)	BC Ratio
Air Compressor Demand Reduction	Motors	20%	16%	3%	29%	$214,439	10	5.70
Air Compressor Equipment2	Motors	35%	28%	1%	18%	$196,653	10	6.85
Energy Project Management	Motors	29%	23%	7%	34%	$15,502,773	11	3.68
Fan Energy Management	Motors	10%	8%	7%	34%	$0	10	1.00
Fan Equipment Upgrade	Motors	35%	28%	6%	29%	$6,579,391	10	5.21
Fan System Optimization	Motors	50%	40%	7%	30%	$16,788,790	10	3.76
Integrated Plant Energy Management	Motors	50%	40%	6%	28%	$23,253,506	11	2.50
Lighting Controls	Interior Lighting	28%	23%	0%	0%	$284,291	10	1.17
Motors: Rewind 20-50 HP	Motors	1%	1%	0%	6%	$70,404	10	1.27
Motors: Rewind 51-100 HP	Motors	1%	0%	0%	6%	$34,917	10	1.48
Motors: Rewind 101-200 HP	Motors	1%	0%	1%	8%	$32,279	10	2.00
Motors: Rewind 201-500 HP	Motors	1%	0%	1%	11%	$30,068	10	3.07
Motors: Rewind 501-1000 HP	Motors	1%	0%	3%	21%	$39,654	10	4.12
Motors: Rewind 1000+ HP	Motors	1%	0%	3%	21%	$39,654	10	4.12
Metal: New Arc Furnace	Process Heating	45%	36%	90%	100%	$401,012	10	26.2
Plant Energy Management	Motors	12%	10%	7%	34%	$140,080	10	21.6
Pump Energy Management	Motors	8%	6%	8%	39%	$0	10	1.00
Pump Equipment Upgrade	Motors	20%	16%	8%	42%	$6,604,003	10	3.59
Pump System Optimization	Motors	50%	40%	4%	15%	$15,428,000	10	2.03
Synchronous Belts	Motors	2%	2%	9%	30%	$315,525	10	2.11
Transformers-New	Motors	0%	0%	1%	3%	$406,731	32	1.05
Transformers-Retrofit	Motors	2%	1%	16%	25%	$143,495	10	4.47
Process Heating	Process Heating	25%	20%	1%	9%	$25,000	10	4.23
Custom Utility Programs - Misc	Miscellaneous	25%	20%	10%	40%	$25,000	10	3.52
Custom Utility Programs - Motors	Motors	25%	20%	10%	40%	$25,000	10	2.85
Custom Utility Programs - Int Lighting	Interior Lighting	25%	20%	10%	40%	$25,000	10	2.93
Custom Utility Programs - Cooling	Cooling	25%	20%	10%	40%	$25,000	10	2.46
Bi-Level Fixture w/Occupancy Sensor	Interior Lighting	10%	5%	10%	23%	$500	8	0.06
Central Chiller - Chiller Water Reset	Cooling	15%	15%	30%	75%	$2,000	4	1.08
Central Chiller - Economizer	Cooling	25%	0%	0%	49%	$4,384	15	2.64
Central Chiller - High Efficiency Fans	Cooling	0%	0%	15%	41%	$10,000	10	0.01
Central Chiller - Maintenance	Cooling	4%	4%	62%	90%	$8,000	3	0.42
Central Chiller - Temperature Reset	Cooling	15%	7%	30%	75%	$4,500	4	0.48
Central Chiller - VSD	Cooling	33%	33%	15%	66%	$7,500	20	2.36
Clock/Programmable Thermostat	Cooling	7%	0%	32%	50%	$250	11	3.54
Clock/Programmable Thermostat	Heating	41%	0%	32%	50%	$250	11	3.54
Daylighting Controls - Photocell Controlled Dimming Ballasts	Interior Lighting	25%	13%	15%	20%	$200	8	0.35
Delamp and Install Reflectors	Interior Lighting	8%	8%	18%	56%	$120	11	0.27
Energy Management System	Cooling	25%	14%	5%	75%	$10,230	14	0.54
Energy Management System	Heating	28%	0%	5%	75%	$10,230	14	0.54
Energy Management System	Interior Lighting	9%	0%	5%	75%	$10,230	14	0.54
Energy Management System	Exterior Lighting	9%	0%	5%	75%	$10,230	14	0.54
Heat Pump - Maintenance	Cooling/Heating	4%	5%	3%	95%	$1,000	3	4.75
HVAC - Duct Insulation	Cooling	2%	3%	15%	50%	$11,983	20	0.03
HVAC - Duct Insulation	Cooling/Heating	1%	3%	15%	50%	$11,983	20	0.03
HVAC - Duct Insulation	Heating	0%	0%	15%	50%	$11,983	20	0.03
HVAC - Duct Repair and Sealing	Cooling	1%	2%	5%	25%	$11,106	15	0.01
HVAC - Duct Repair and Sealing	Heating	1%	0%	5%	25%	$11,106	15	0.01
Insulation - Ceiling	Cooling	13%	43%	5%	20%	$10,814	20	0.16
Insulation - Ceiling	Cooling/Heating	32%	21%	5%	20%	$10,814	20	0.16
Insulation - Ceiling	Heating	22%	0%	5%	20%	$10,814	20	0.16
Insulation - Wall Cavity	Cooling	1%	18%	10%	68%	$22,797	20	0.04
Insulation - Wall Cavity	Cooling/Heating	46%	19%	10%	68%	$22,797	20	0.04
Insulation - Wall Cavity	Heating	78%	0%	10%	68%	$22,797	20	0.04
LED Exit Lighting	Interior Lighting	87%	87%	9%	90%	$60	12	0.67

Measure	End Use	Energy Savings	Demand Savings	Base Satura-tion	Appl./ Feas.	Cost ($/ employee)	Life-time (yrs)	BC Ratio
Machine Drive - Pumping System Controls	Motors	10%	8%	0%	0%	$3,000	15	29.2
Machine Drive - Pumping System Maintenance	Motors	4%	3%	5%	34%	$500	3	5.98
Machine Drive - Pumping System Optimization	Motors	6%	5%	5%	34%	$1,000	15	48.4
Occupancy Sensors	Interior Lighting	10%	5%	6%	56%	$100	6	0.87
Process - Compressed Air System Controls	Process Heating	20%	15%	0%	0%	$5,000	15	51.8
Process - Compressed Air System Maintenance	Process Heating	4%	3%	0%	0%	$3,000	3	4.05
Process - Compressed Air System Optimization and Improvements	Process Heating	12%	9%	0%	0%	$9,000	15	17.3
Process - Fan System Controls	Process Heating	20%	15%	0%	0%	$3,000	15	45.0
Process - Fan System Maintenance	Process Heating	4%	3%	10%	38%	$500	3	12.7
Process - Fan System Optimization	Process Heating	12%	9%	10%	38%	$1,000	15	81.0
Refrigeration System Controls	Motors	12%	9%	0%	0%	$200,000	18	0.50
Refrigeration System Maintenance	Motors	4%	3%	25%	75%	$6,000	3	0.60
Refrigeration System Optimization	Motors	12%	9%	40%	56%	$22,601	15	4.02
Roofs - High Reflectivity	Cooling	17%	14%	50%	75%	$13,152	15	0.12
RTU - Maintenance	Cooling	14%	15%	62%	90%	$1,500	4	1.55
Task Lighting	Interior Lighting	10%	10%	6%	75%	$150	6	0.04
Time Clocks and Timers	Interior Lighting	5%	3%	3%	56%	$250	6	0.04
Ventilation - C02 Controls	Ventilation	13%	7%	1%	8%	$1,228	10	1.21

Table D-16 Energy-Efficiency Measure Data—Other Industrial, Existing Vintage

Measure	End Use	Energy Savings	Demand Savings	Base Satura-tion	Appl./ Feas.	Cost ($/ employee)	Life-time (yrs)	BC Ratio
Air Compressor Demand Reduction	Motors	20%	16%	3%	29%	$3,192,653	10	5.70
Energy Project Management	Motors	29%	23%	7%	34%	$15,502,773	11	3.68
Fan Energy Management	Motors	10%	8%	7%	34%	$0	10	1.00
Fan Equipment Upgrade	Motors	35%	28%	6%	29%	$6,579,391	10	5.21
Fan System Optimization	Motors	50%	40%	7%	30%	$16,788,790	10	3.76
Integrated Plant Energy Management	Motors	50%	40%	6%	28%	$23,253,506	11	2.50
Lighting Controls	Interior Lighting	28%	23%	0%	0%	$4,894,651	10	1.17
Motors: Rewind 20-50 HP	Motors	1%	1%	1%	11%	$1,666,004	10	1.27
Motors: Rewind 51-100 HP	Motors	1%	0%	0%	0%	$13,800	10	1.48
Motors: Rewind 101-200 HP	Motors	1%	0%	3%	17%	$906,117	10	2.00
Motors: Rewind 201-500 HP	Motors	1%	0%	0%	0%	$0	10	1.00
Motors: Rewind 501-1000 HP	Motors	1%	0%	0%	0%	$0	10	1.00
Motors: Rewind 1000+ HP	Motors	1%	0%	0%	0%	$0	10	1.00
Plant Energy Management	Motors	12%	10%	7%	34%	$1,801,930	10	20.4
Pump Energy Management	Motors	8%	6%	8%	39%	$0	10	1.00
Pump Equipment Upgrade	Motors	20%	16%	8%	42%	$6,604,003	10	3.59
Pump System Optimization	Motors	50%	40%	4%	15%	$15,428,000	10	2.03
Synchronous Belts	Motors	2%	2%	9%	30%	$4,058,767	10	2.13
Transformers-New	Motors	0%	0%	1%	3%	$5,231,995	32	0.99
Transformers-Retrofit	Motors	2%	1%	16%	25%	$912,284	10	4.22
Process Heating	Process Heating	25%	20%	1%	9%	$25,000	10	4.23
Custom Utility Programs - Misc	Miscellaneous	25%	20%	10%	40%	$25,000	10	3.52
Custom Utility Programs - Motors	Motors	25%	20%	10%	40%	$25,000	10	2.85
Custom Utility Programs - Int Lighting	Interior Lighting	25%	20%	10%	40%	$25,000	10	2.92
Custom Utility Programs - Cooling	Cooling	25%	20%	10%	40%	$25,000	10	2.47
Bi-Level Fixture w/Occupancy Sensor	Interior Lighting	10%	5%	10%	23%	$500	8	0.06
Central Chiller - Chiller Water Reset	Cooling	15%	15%	30%	75%	$2,000	4	1.08
Central Chiller - Economizer	Cooling	25%	0%	0%	49%	$4,384	15	2.64
Central Chiller - High Efficiency Fans	Cooling	0%	0%	15%	41%	$10,000	10	0.01
Central Chiller - Maintenance	Cooling	4%	4%	62%	90%	$8,000	3	0.43
Central Chiller - Temperature Reset	Cooling	15%	7%	30%	75%	$4,500	4	0.48
Central Chiller - VSD	Cooling	33%	33%	15%	66%	$7,500	20	2.36
Clock/Programmable Thermostat	Cooling	7%	0%	32%	50%	$250	11	3.54
Clock/Programmable Thermostat	Heating	41%	0%	32%	50%	$250	11	3.54
Daylighting Controls - Photocell Controlled Dimming Ballasts	Interior Lighting	25%	13%	15%	20%	$200	8	0.35
Delamp and Install Reflectors	Interior Lighting	8%	8%	18%	56%	$120	11	0.27
Energy Management System	Cooling	25%	14%	5%	75%	$10,230	14	0.54
Energy Management System	Heating	28%	0%	5%	75%	$10,230	14	0.54
Energy Management System	Interior Lighting	9%	0%	5%	75%	$10,230	14	0.54
Energy Management System	Exterior Lighting	9%	0%	5%	75%	$10,230	14	0.54
Heat Pump - Maintenance	Cooling/Heating	4%	5%	3%	95%	$1,000	3	4.76
HVAC - Duct Insulation	Cooling	2%	3%	15%	50%	$11,983	20	0.03
HVAC - Duct Insulation	Cooling/Heating	1%	3%	15%	50%	$11,983	20	0.03
HVAC - Duct Insulation	Heating	0%	0%	15%	50%	$11,983	20	0.03
HVAC - Duct Repair and Sealing	Cooling	1%	2%	5%	25%	$11,106	15	0.01
HVAC - Duct Repair and Sealing	Heating	1%	0%	5%	25%	$11,106	15	0.01
Insulation - Ceiling	Cooling	13%	43%	5%	20%	$10,814	20	0.16
Insulation - Ceiling	Cooling/Heating	32%	21%	5%	20%	$10,814	20	0.16
Insulation - Ceiling	Heating	22%	0%	5%	20%	$10,814	20	0.16
Insulation - Wall Cavity	Cooling	1%	18%	10%	68%	$22,797	20	0.04
Insulation - Wall Cavity	Cooling/Heating	46%	19%	10%	68%	$22,797	20	0.04
Insulation - Wall Cavity	Heating	78%	0%	10%	68%	$22,797	20	0.04
LED Exit Lighting	Interior Lighting	87%	87%	9%	90%	$60	12	0.67
Machine Drive - Pumping System Controls	Motors	10%	8%	0%	0%	$3,000	15	29.2

Measure	End Use	Energy Savings	Demand Savings	Base Satura-tion	Appl./ Feas.	Cost ($/ employee)	Life-time (yrs)	BC Ratio
Machine Drive - Pumping System Maintenance	Motors	4%	3%	5%	34%	$500	3	5.99
Machine Drive - Pumping System Optimization	Motors	6%	5%	5%	34%	$1,000	15	48.3
Occupancy Sensors	Interior Lighting	10%	5%	6%	56%	$100	6	0.87
Process - Compressed Air System Controls	Process Heating	20%	15%	0%	0%	$5,000	15	51.8
Process - Compressed Air System Maintenance	Process Heating	4%	3%	0%	0%	$3,000	3	4.05
Process - Compressed Air System Optimization and Improvements	Process Heating	12%	9%	0%	0%	$9,000	15	17.3
Process - Fan System Controls	Process Heating	20%	15%	0%	0%	$3,000	15	45.0
Process - Fan System Maintenance	Process Heating	4%	3%	10%	38%	$500	3	12.7
Process - Fan System Optimization	Process Heating	12%	9%	10%	38%	$1,000	15	81.0
Refrigeration System Controls	Motors	12%	9%	0%	0%	$200,000	18	0.50
Refrigeration System Maintenance	Motors	4%	3%	25%	75%	$6,000	3	0.60
Refrigeration System Optimization	Motors	12%	9%	40%	56%	$22,601	15	4.01
Roofs - High Reflectivity	Cooling	17%	14%	50%	75%	$13,152	15	0.13
RTU - Maintenance	Cooling	14%	15%	62%	90%	$1,500	4	1.56
Task Lighting	Interior Lighting	10%	10%	6%	75%	$150	6	0.04
Time Clocks and Timers	Interior Lighting	5%	3%	3%	56%	$250	6	0.04
Ventilation - C02 Controls	Ventilation	13%	7%	1%	8%	$1,228	10	1.21

Table D-17 Energy-Efficiency Measure Data—Food Products, New Vintage

Measure	End Use	Energy Savings	Demand Savings	Base Satura-tion	Appl./ Feas.	Cost ($/ employee)	Life-time (yrs)	BC Ratio
Air Compressor Demand Reduction	Motors	20%	17%	3%	29%	$599,994	10	5.25
Cold Storage Retrofit	Motors	26%	22%	0%	39%	$32,297,145	10	1.46
Cold Storage Tune-up	Motors	10%	9%	1%	66%	$5,217,881	3	1.94
Energy Project Management	Motors	29%	25%	7%	34%	$15,502,773	11	3.39
Fan Energy Management	Motors	10%	9%	7%	34%	$0	10	1.00
Fan Equipment Upgrade	Motors	35%	30%	6%	29%	$3,151,559	10	4.80
Fan System Optimization	Motors	50%	43%	7%	30%	$16,788,790	10	3.49
Food: Refrig Storage Tune-up	Motors	8%	6%	0%	0%	$3,794,571	3	1.94
Groc Dist Retrofit	Motors	16%	14%	0%	17%	$9,209,880	10	1.40
Groc Dist Tune-up	Motors	10%	9%	0%	34%	$2,650,399	3	1.94
Integrated Plant Energy Management	Motors	50%	43%	6%	28%	$23,253,506	11	2.33
Lighting Controls	Interior Lighting	28%	24%	0%	0%	$1,357,192	10	1.58
Motors: Rewind 20-50 HP	Motors	1%	1%	1%	11%	$736,806	10	1.15
Motors: Rewind 51-100 HP	Motors	1%	0%	1%	9%	$305,102	10	1.30
Motors: Rewind 101-200 HP	Motors	1%	0%	1%	10%	$253,986	10	1.77
Motors: Rewind 201-500 HP	Motors	1%	0%	1%	8%	$132,151	10	2.83
Motors: Rewind 501-1000 HP	Motors	1%	0%	1%	10%	$115,262	10	4.17
Motors: Rewind 1000+ HP	Motors	1%	0%	1%	10%	$115,262	10	4.17
Plant Energy Management	Motors	12%	10%	7%	34%	$727,198	10	18.8
Pump Energy Management	Motors	8%	6%	8%	39%	$0	10	1.00
Pump Equipment Upgrade	Motors	20%	17%	8%	42%	$1,683,201	10	3.30
Pump System Optimization	Motors	50%	43%	4%	15%	$15,428,000	10	1.90
Synchronous Belts	Motors	2%	2%	9%	30%	$1,637,982	10	1.91
Transformers-New	Motors	0%	0%	1%	3%	$1,322,307	32	0.83
Transformers-Retrofit	Motors	2%	1%	16%	25%	$275,131	10	3.42
Process Heating	Motors	0%	0%	0%	0%	$0	-	1.00
Custom Utility Programs - Misc	Miscellaneous	25%	20%	10%	40%	$25,000	10	3.52
Custom Utility Programs - Motors	Motors	25%	20%	10%	40%	$25,000	10	2.59
Custom Utility Programs - Int Lighting	Interior Lighting	25%	20%	10%	40%	$25,000	10	3.82
Custom Utility Programs - Cooling	Cooling	25%	20%	10%	40%	$25,000	10	2.59
Bi-Level Fixture w/Occupancy Sensor	Interior Lighting	10%	5%	10%	23%	$500	8	0.08
Central Chiller - Chiller Water Reset	Cooling	15%	15%	30%	75%	$2,000	4	1.09
Central Chiller - Economizer	Cooling	25%	0%	0%	49%	$4,384	15	2.68
Central Chiller - High Efficiency Fans	Cooling	0%	0%	15%	41%	$10,000	10	0.01
Central Chiller - Maintenance	Cooling	4%	4%	62%	90%	$8,000	3	0.43
Central Chiller - Temperature Reset	Cooling	15%	6%	30%	75%	$4,500	4	0.48
Central Chiller - VSD	Cooling	33%	34%	15%	66%	$7,500	20	2.39
Clock/Programmable Thermostat	Cooling	7%	0%	32%	50%	$250	11	3.91
Clock/Programmable Thermostat	Heating	41%	0%	32%	50%	$250	11	3.91
Daylighting Controls - Photocell Controlled Dimming Ballasts	Interior Lighting	25%	13%	15%	20%	$200	8	0.45
Delamp and Install Reflectors	Interior Lighting	8%	8%	18%	56%	$120	11	0.34
Energy Management System	Cooling	25%	14%	5%	75%	$10,230	14	0.66
Energy Management System	Heating	28%	0%	5%	75%	$10,230	14	0.66
Energy Management System	Interior Lighting	9%	0%	5%	75%	$10,230	14	0.66
Energy Management System	Exterior Lighting	9%	0%	5%	75%	$10,230	14	0.66
Heat Pump - Maintenance	Cooling/Heating	4%	5%	3%	95%	$1,000	3	4.96
HVAC - Duct Insulation	Cooling	2%	3%	15%	50%	$11,983	20	0.03
HVAC - Duct Insulation	Cooling/Heating	1%	0%	15%	50%	$11,983	20	0.03
HVAC - Duct Insulation	Heating	0%	0%	15%	50%	$11,983	20	0.03
HVAC - Duct Repair and Sealing	Cooling	1%	2%	5%	25%	$11,106	15	0.01
HVAC - Duct Repair and Sealing	Heating	1%	0%	5%	25%	$11,106	15	0.01
Insulation - Ceiling	Cooling	13%	27%	5%	20%	$10,814	20	0.19
Insulation - Ceiling	Cooling/Heating	32%	20%	5%	20%	$10,814	20	0.19
Insulation - Ceiling	Heating	22%	0%	5%	20%	$10,814	20	0.19
Insulation - Wall Cavity	Cooling	1%	2%	10%	68%	$22,797	20	0.04

Measure	End Use	Energy Savings	Demand Savings	Base Satura-tion	Appl./ Feas.	Cost ($/ employee)	Life-time (yrs)	BC Ratio
Insulation - Wall Cavity	Cooling/Heating	46%	20%	10%	68%	$22,797	20	0.04
Insulation - Wall Cavity	Heating	78%	0%	10%	68%	$22,797	20	0.04
LED Exit Lighting	Interior Lighting	87%	87%	86%	90%	$60	12	0.72
Machine Drive - Pumping System Controls	Motors	10%	8%	0%	0%	$3,000	15	26.5
Machine Drive - Pumping System Maintenance	Motors	4%	3%	5%	34%	$500	3	5.47
Machine Drive - Pumping System Optimization	Motors	6%	5%	5%	34%	$1,000	15	44.0
Occupancy Sensors	Interior Lighting	10%	5%	6%	56%	$100	6	1.12
Process - Compressed Air System Controls	Process Heating	20%	15%	0%	0%	$5,000	15	51.8
Process - Compressed Air System Maintenance	Process Heating	4%	3%	0%	0%	$3,000	3	4.05
Process - Compressed Air System Optimization and Improvements	Process Heating	12%	9%	0%	0%	$9,000	15	17.3
Process - Fan System Controls	Process Heating	20%	15%	0%	0%	$3,000	15	45.0
Process - Fan System Maintenance	Process Heating	4%	3%	10%	38%	$500	3	12.7
Process - Fan System Optimization	Process Heating	12%	9%	10%	38%	$1,000	15	81.0
Refrigeration System Controls	Motors	12%	9%	0%	0%	$200,000	18	0.46
Refrigeration System Maintenance	Motors	4%	3%	25%	75%	$6,000	3	0.55
Refrigeration System Optimization	Motors	12%	9%	40%	56%	$22,601	15	3.65
Roofs - High Reflectivity	Cooling	17%	13%	50%	75%	$13,152	15	0.15
RTU - Maintenance	Cooling	14%	15%	62%	90%	$1,500	4	1.74
Task Lighting	Interior Lighting	10%	10%	6%	75%	$150	6	0.05
Time Clocks and Timers	Interior Lighting	5%	3%	3%	56%	$250	6	0.06
Ventilation - C02 Controls	Ventilation	13%	7%	1%	8%	$1,228	10	1.42

Table D-18 Energy-Efficiency Measure Data—Paper Products, New Vintage

Measure	End Use	Energy Savings	Demand Savings	Base Satura-tion	Appl./ Feas.	Cost ($/ employee)	Life-time (yrs)	BC Ratio
Air Compressor Demand Reduction	Motors	20%	16%	3%	29%	$532,831	10	5.22
Air Compressor Equipment2	Motors	35%	28%	1%	18%	$488,636	10	6.28
Efficient Centrifugal Fan	Motors	20%	16%	5%	15%	$974,156	10	2.20
Energy Project Management	Motors	29%	23%	7%	34%	$14,846,738	11	3.17
Fan Energy Management	Motors	10%	8%	7%	34%	$0	10	1.00
Fan Equipment Upgrade	Motors	35%	28%	6%	29%	$1,775,747	10	4.57
Fan System Optimization	Motors	50%	40%	7%	30%	$4,531,215	10	3.32
Integrated Plant Energy Management	Motors	50%	40%	6%	28%	$22,269,482	11	2.15
Lighting Controls	Interior Lighting	28%	23%	0%	0%	$336,380	10	1.53
Material Handling VFD2	Motors	19%	15%	0%	6%	$9,307,114	10	1.30
Motors: Rewind 20-50 HP	Motors	1%	1%	0%	6%	$358,616	10	1.17
Motors: Rewind 51-100 HP	Motors	1%	0%	1%	10%	$270,681	10	1.22
Motors: Rewind 101-200 HP	Motors	1%	0%	1%	9%	$182,742	10	1.67
Motors: Rewind 201-500 HP	Motors	1%	0%	1%	13%	$167,492	10	2.80
Motors: Rewind 501-1000 HP	Motors	1%	0%	4%	23%	$224,522	10	4.12
Motors: Rewind 1000+ HP	Motors	1%	0%	4%	23%	$224,522	10	4.12
Paper: Efficient Pulp Screen	Motors	15%	12%	1%	15%	$1,198,293	10	2.32
Paper: Large Material Handling	Motors	10%	8%	3%	5%	$3,412,869	10	0.35
Paper: Material Handling	Motors	13%	10%	3%	5%	$3,839,477	10	0.42
Paper: Premium Control Large Material	Motors	19%	15%	3%	5%	$3,754,155	10	0.81
Paper: Premium Fan	Motors	20%	16%	0%	25%	$2,319,418	10	2.31
Plant Energy Management	Motors	12%	10%	7%	34%	$696,425	10	17.6
Pump Energy Management	Motors	8%	6%	8%	39%	$0	10	1.00
Pump Equipment Upgrade	Motors	20%	16%	8%	42%	$3,975,296	10	3.28
Pump System Optimization	Motors	50%	40%	4%	15%	$9,286,717	12	2.11
Synchronous Belts	Motors	2%	2%	9%	30%	$1,568,668	10	1.92
Transformers-New	Motors	0%	0%	1%	3%	$2,022,106	32	0.78
Transformers-Retrofit	Motors	2%	1%	16%	25%	$254,681	10	3.27
Process Heating	Motors	0%	0%	0%	0%	$0	-	1.00
Custom Utility Programs - Misc	Miscellaneous	25%	20%	10%	40%	$25,000	10	3.52
Custom Utility Programs - Motors	Motors	25%	20%	10%	40%	$25,000	10	2.61
Custom Utility Programs - Int Lighting	Interior Lighting	25%	20%	10%	40%	$25,000	10	3.82
Custom Utility Programs - Cooling	Cooling	25%	20%	10%	40%	$25,000	10	2.59
Bi-Level Fixture w/Occupancy Sensor	Interior Lighting	10%	5%	10%	23%	$500	8	0.08
Central Chiller - Chiller Water Reset	Cooling	15%	15%	30%	75%	$2,000	4	1.09
Central Chiller - Economizer	Cooling	25%	0%	0%	49%	$4,384	15	2.68
Central Chiller - High Efficiency Fans	Cooling	0%	0%	15%	41%	$10,000	10	0.01
Central Chiller - Maintenance	Cooling	4%	4%	62%	90%	$8,000	3	0.43
Central Chiller - Temperature Reset	Cooling	15%	6%	30%	75%	$4,500	4	0.48
Central Chiller - VSD	Cooling	33%	34%	15%	66%	$7,500	20	2.39
Clock/Programmable Thermostat	Cooling	7%	0%	32%	50%	$250	11	3.91
Clock/Programmable Thermostat	Heating	41%	0%	32%	50%	$250	11	3.91
Daylighting Controls - Photocell Controlled Dimming Ballasts	Interior Lighting	25%	13%	15%	20%	$200	8	0.46
Delamp and Install Reflectors	Interior Lighting	8%	8%	18%	56%	$120	11	0.34
Energy Management System	Cooling	25%	14%	5%	75%	$10,230	14	0.66
Energy Management System	Heating	28%	0%	5%	75%	$10,230	14	0.66
Energy Management System	Interior Lighting	9%	0%	5%	75%	$10,230	14	0.66
Energy Management System	Exterior Lighting	9%	0%	5%	75%	$10,230	14	0.66
Heat Pump - Maintenance	Cooling/Heating	4%	5%	3%	95%	$1,000	3	4.96
HVAC - Duct Insulation	Cooling	2%	3%	15%	50%	$11,983	20	0.03
HVAC - Duct Insulation	Cooling/Heating	1%	0%	15%	50%	$11,983	20	0.03
HVAC - Duct Insulation	Heating	0%	0%	15%	50%	$11,983	20	0.03
HVAC - Duct Repair and Sealing	Cooling	1%	2%	5%	25%	$11,106	15	0.01
HVAC - Duct Repair and Sealing	Heating	1%	0%	5%	25%	$11,106	15	0.01

Measure	End Use	Energy Savings	Demand Savings	Base Satura-tion	Appl./ Feas.	Cost ($/ employee)	Life-time (yrs)	BC Ratio
Insulation - Ceiling	Cooling	13%	27%	5%	20%	$10,814	20	0.19
Insulation - Ceiling	Cooling/Heating	32%	20%	5%	20%	$10,814	20	0.19
Insulation - Ceiling	Heating	22%	0%	5%	20%	$10,814	20	0.19
Insulation - Wall Cavity	Cooling	1%	2%	10%	68%	$22,797	20	0.04
Insulation - Wall Cavity	Cooling/Heating	46%	20%	10%	68%	$22,797	20	0.04
Insulation - Wall Cavity	Heating	78%	0%	10%	68%	$22,797	20	0.04
LED Exit Lighting	Interior Lighting	87%	87%	86%	90%	$60	12	0.72
Machine Drive - Pumping System Controls	Motors	10%	8%	0%	0%	$3,000	15	26.8
Machine Drive - Pumping System Maintenance	Motors	4%	3%	5%	34%	$500	3	5.48
Machine Drive - Pumping System Optimization	Motors	6%	5%	5%	34%	$1,000	15	44.4
Occupancy Sensors	Interior Lighting	10%	5%	6%	56%	$100	6	1.12
Process - Compressed Air System Controls	Process Heating	20%	15%	0%	0%	$5,000	15	51.8
Process - Compressed Air System Maintenance	Process Heating	4%	3%	0%	0%	$3,000	3	4.05
Process - Compressed Air System Optimization and Improvements	Process Heating	12%	9%	0%	0%	$9,000	15	17.3
Process - Fan System Controls	Process Heating	20%	15%	0%	0%	$3,000	15	45.0
Process - Fan System Maintenance	Process Heating	4%	3%	10%	38%	$500	3	12.7
Process - Fan System Optimization	Process Heating	12%	9%	10%	38%	$1,000	15	81.0
Refrigeration System Controls	Motors	12%	9%	0%	0%	$200,000	18	0.46
Refrigeration System Maintenance	Motors	4%	3%	25%	75%	$6,000	3	0.55
Refrigeration System Optimization	Motors	12%	9%	40%	56%	$22,601	15	3.69
Roofs - High Reflectivity	Cooling	17%	13%	50%	75%	$13,152	15	0.15
RTU - Maintenance	Cooling	14%	15%	62%	90%	$1,500	4	1.74
Task Lighting	Interior Lighting	10%	10%	6%	75%	$150	6	0.05
Time Clocks and Timers	Interior Lighting	5%	3%	3%	56%	$250	6	0.06
Ventilation - C02 Controls	Ventilation	13%	7%	1%	8%	$1,228	10	1.42

Table D-19 Energy-Efficiency Measure Data—Chemical Products, New Vintage

Measure	End Use	Energy Savings	Demand Savings	Base Satura-tion	Appl./ Feas.	Cost ($/ employee)	Life-time (yrs)	BC Ratio
Air Compressor Demand Reduction	Motors	20%	16%	3%	29%	$2,409,244	10	5.23
Energy Project Management	Motors	29%	23%	7%	34%	$15,502,773	11	3.38
Fan Energy Management	Motors	10%	8%	7%	34%	$0	10	1.00
Fan Equipment Upgrade	Motors	35%	28%	6%	29%	$1,003,649	10	4.78
Fan System Optimization	Motors	50%	40%	7%	30%	$16,788,790	10	3.47
Integrated Plant Energy Management	Motors	50%	40%	6%	28%	$23,253,506	11	2.32
Lighting Controls	Interior Lighting	28%	23%	0%	0%	$2,661,701	10	1.53
Motors: Rewind 20-50 HP	Motors	1%	1%	0%	6%	$463,193	10	1.17
Motors: Rewind 51-100 HP	Motors	1%	0%	0%	6%	$225,824	10	1.33
Motors: Rewind 101-200 HP	Motors	1%	0%	1%	10%	$257,659	10	1.81
Motors: Rewind 201-500 HP	Motors	1%	0%	1%	11%	$193,938	10	2.80
Motors: Rewind 501-1000 HP	Motors	1%	0%	1%	8%	$98,680	10	4.12
Motors: Rewind 1000+ HP	Motors	1%	0%	1%	8%	$98,680	10	4.12
Plant Energy Management	Motors	12%	10%	7%	34%	$915,759	10	19.0
Pump Energy Management	Motors	8%	6%	8%	39%	$0	10	1.00
Pump Equipment Upgrade	Motors	20%	16%	8%	42%	$4,355,396	10	3.29
Pump System Optimization	Motors	50%	40%	4%	15%	$10,174,673	12	2.11
Synchronous Belts	Motors	2%	2%	9%	30%	$2,062,707	10	1.94
Transformers-New	Motors	0%	0%	1%	3%	$2,658,953	32	0.92
Transformers-Retrofit	Motors	2%	1%	16%	25%	$403,046	10	3.90
Process Heating	Process Heating	25%	20%	1%	9%	$25,000	10	4.23
Custom Utility Programs - Misc	Miscellaneous	25%	20%	10%	40%	$25,000	10	3.52
Custom Utility Programs - Motors	Motors	25%	20%	10%	40%	$25,000	10	2.62
Custom Utility Programs - Int Lighting	Interior Lighting	25%	20%	10%	40%	$25,000	10	3.82
Custom Utility Programs - Cooling	Cooling	25%	20%	10%	40%	$25,000	10	2.59
Bi-Level Fixture w/Occupancy Sensor	Interior Lighting	10%	5%	10%	23%	$500	8	0.08
Central Chiller - Chiller Water Reset	Cooling	15%	15%	30%	75%	$2,000	4	1.09
Central Chiller - Economizer	Cooling	25%	0%	0%	49%	$4,384	15	2.68
Central Chiller - High Efficiency Fans	Cooling	0%	0%	15%	41%	$10,000	10	0.01
Central Chiller - Maintenance	Cooling	4%	4%	62%	90%	$8,000	3	0.43
Central Chiller - Temperature Reset	Cooling	15%	6%	30%	75%	$4,500	4	0.48
Central Chiller - VSD	Cooling	33%	34%	15%	66%	$7,500	20	2.39
Clock/Programmable Thermostat	Cooling	7%	0%	32%	50%	$250	11	3.91
Clock/Programmable Thermostat	Heating	41%	0%	32%	50%	$250	11	3.91
Daylighting Controls - Photocell Controlled Dimming Ballasts	Interior Lighting	25%	13%	15%	20%	$200	8	0.46
Delamp and Install Reflectors	Interior Lighting	8%	8%	18%	56%	$120	11	0.34
Energy Management System	Cooling	25%	14%	5%	75%	$10,230	14	0.66
Energy Management System	Heating	28%	0%	5%	75%	$10,230	14	0.66
Energy Management System	Interior Lighting	9%	0%	5%	75%	$10,230	14	0.66
Energy Management System	Exterior Lighting	9%	0%	5%	75%	$10,230	14	0.66
Heat Pump - Maintenance	Cooling/Heating	4%	5%	3%	95%	$1,000	3	4.96
HVAC - Duct Insulation	Cooling	2%	3%	15%	50%	$11,983	20	0.03
HVAC - Duct Insulation	Cooling/Heating	1%	0%	15%	50%	$11,983	20	0.03
HVAC - Duct Insulation	Heating	0%	0%	15%	50%	$11,983	20	0.03
HVAC - Duct Repair and Sealing	Cooling	1%	2%	5%	25%	$11,106	15	0.01
HVAC - Duct Repair and Sealing	Heating	1%	0%	5%	25%	$11,106	15	0.01
Insulation - Ceiling	Cooling	13%	27%	5%	20%	$10,814	20	0.19
Insulation - Ceiling	Cooling/Heating	32%	20%	5%	20%	$10,814	20	0.19
Insulation - Ceiling	Heating	22%	0%	5%	20%	$10,814	20	0.19
Insulation - Wall Cavity	Cooling	1%	2%	10%	68%	$22,797	20	0.04
Insulation - Wall Cavity	Cooling/Heating	46%	20%	10%	68%	$22,797	20	0.04
Insulation - Wall Cavity	Heating	78%	0%	10%	68%	$22,797	20	0.04
LED Exit Lighting	Interior Lighting	87%	87%	86%	90%	$60	12	0.72
Machine Drive - Pumping System Controls	Motors	10%	8%	0%	0%	$3,000	15	26.9

Measure	End Use	Energy Savings	Demand Savings	Base Satura-tion	Appl./ Feas.	Cost ($/ employee)	Life-time (yrs)	BC Ratio
Machine Drive - Pumping System Maintenance	Motors	4%	3%	5%	34%	$500	3	5.49
Machine Drive - Pumping System Optimization	Motors	6%	5%	5%	34%	$1,000	15	44.5
Occupancy Sensors	Interior Lighting	10%	5%	6%	56%	$100	6	1.12
Process - Compressed Air System Controls	Process Heating	20%	15%	0%	0%	$5,000	15	51.8
Process - Compressed Air System Maintenance	Process Heating	4%	3%	0%	0%	$3,000	3	4.05
Process - Compressed Air System Optimization and Improvements	Process Heating	12%	9%	0%	0%	$9,000	15	17.3
Process - Fan System Controls	Process Heating	20%	15%	0%	0%	$3,000	15	45.0
Process - Fan System Maintenance	Process Heating	4%	3%	10%	38%	$500	3	12.7
Process - Fan System Optimization	Process Heating	12%	9%	10%	38%	$1,000	15	81.0
Refrigeration System Controls	Motors	12%	9%	0%	0%	$200,000	18	0.46
Refrigeration System Maintenance	Motors	4%	3%	25%	75%	$6,000	3	0.55
Refrigeration System Optimization	Motors	12%	9%	40%	56%	$22,601	15	3.70
Roofs - High Reflectivity	Cooling	17%	13%	50%	75%	$13,152	15	0.15
RTU - Maintenance	Cooling	14%	15%	62%	90%	$1,500	4	1.74
Task Lighting	Interior Lighting	10%	10%	6%	75%	$150	6	0.05
Time Clocks and Timers	Interior Lighting	5%	3%	3%	56%	$250	6	0.06
Ventilation - C02 Controls	Ventilation	13%	7%	1%	8%	$1,228	10	1.42

Table D-20 Energy-Efficiency Measure Data—Primary Metals, New Vintage

Measure	End Use	Energy Savings	Demand Savings	Base Satura-tion	Appl./ Feas.	Cost ($/ employee)	Life-time (yrs)	BC Ratio
Air Compressor Demand Reduction	Motors	20%	16%	3%	29%	$214,439	10	5.21
Air Compressor Equipment2	Motors	35%	28%	1%	18%	$196,653	10	6.26
Energy Project Management	Motors	29%	23%	7%	34%	$15,502,773	11	3.36
Fan Energy Management	Motors	10%	8%	7%	34%	$0	10	1.00
Fan Equipment Upgrade	Motors	35%	28%	6%	29%	$6,579,391	10	4.76
Fan System Optimization	Motors	50%	40%	7%	30%	$16,788,790	10	3.46
Integrated Plant Energy Management	Motors	50%	40%	6%	28%	$23,253,506	11	2.31
Lighting Controls	Interior Lighting	28%	23%	0%	0%	$284,291	10	1.53
Motors: Rewind 20-50 HP	Motors	1%	1%	0%	6%	$70,404	10	1.17
Motors: Rewind 51-100 HP	Motors	1%	0%	0%	6%	$34,917	10	1.33
Motors: Rewind 101-200 HP	Motors	1%	0%	1%	8%	$32,279	10	1.81
Motors: Rewind 201-500 HP	Motors	1%	0%	1%	11%	$30,068	10	2.80
Motors: Rewind 501-1000 HP	Motors	1%	0%	3%	21%	$39,654	10	4.12
Motors: Rewind 1000+ HP	Motors	1%	0%	3%	21%	$39,654	10	4.12
Metal: New Arc Furnace	Process Heating	45%	36%	90%	100%	$401,012	10	26.2
Plant Energy Management	Motors	12%	10%	7%	34%	$140,080	10	19.7
Pump Energy Management	Motors	8%	6%	8%	39%	$0	10	1.00
Pump Equipment Upgrade	Motors	20%	16%	8%	42%	$6,604,003	10	3.27
Pump System Optimization	Motors	50%	40%	4%	15%	$15,428,000	10	1.89
Synchronous Belts	Motors	2%	2%	9%	30%	$315,525	10	1.93
Transformers-New	Motors	0%	0%	1%	3%	$406,731	32	0.97
Transformers-Retrofit	Motors	2%	1%	16%	25%	$143,495	10	4.08
Process Heating	Process Heating	25%	20%	1%	9%	$25,000	10	4.23
Custom Utility Programs - Misc	Miscellaneous	25%	20%	10%	40%	$25,000	10	3.52
Custom Utility Programs - Motors	Motors	25%	20%	10%	40%	$25,000	10	2.61
Custom Utility Programs - Int Lighting	Interior Lighting	25%	20%	10%	40%	$25,000	10	3.82
Custom Utility Programs - Cooling	Cooling	25%	20%	10%	40%	$25,000	10	2.59
Bi-Level Fixture w/Occupancy Sensor	Interior Lighting	10%	5%	10%	23%	$500	8	0.08
Central Chiller - Chiller Water Reset	Cooling	15%	15%	30%	75%	$2,000	4	1.09
Central Chiller - Economizer	Cooling	25%	0%	0%	49%	$4,384	15	2.68
Central Chiller - High Efficiency Fans	Cooling	0%	0%	15%	41%	$10,000	10	0.01
Central Chiller - Maintenance	Cooling	4%	4%	62%	90%	$8,000	3	0.43
Central Chiller - Temperature Reset	Cooling	15%	6%	30%	75%	$4,500	4	0.48
Central Chiller - VSD	Cooling	33%	34%	15%	66%	$7,500	20	2.39
Clock/Programmable Thermostat	Cooling	7%	0%	32%	50%	$250	11	3.91
Clock/Programmable Thermostat	Heating	41%	0%	32%	50%	$250	11	3.91
Daylighting Controls - Photocell Controlled Dimming Ballasts	Interior Lighting	25%	13%	15%	20%	$200	8	0.46
Delamp and Install Reflectors	Interior Lighting	8%	8%	18%	56%	$120	11	0.34
Energy Management System	Cooling	25%	14%	5%	75%	$10,230	14	0.66
Energy Management System	Heating	28%	0%	5%	75%	$10,230	14	0.66
Energy Management System	Interior Lighting	9%	0%	5%	75%	$10,230	14	0.66
Energy Management System	Exterior Lighting	9%	0%	5%	75%	$10,230	14	0.66
Heat Pump - Maintenance	Cooling/Heating	4%	5%	3%	95%	$1,000	3	4.96
HVAC - Duct Insulation	Cooling	2%	3%	15%	50%	$11,983	20	0.03
HVAC - Duct Insulation	Cooling/Heating	1%	0%	15%	50%	$11,983	20	0.03
HVAC - Duct Insulation	Heating	0%	0%	15%	50%	$11,983	20	0.03
HVAC - Duct Repair and Sealing	Cooling	1%	2%	5%	25%	$11,106	15	0.01
HVAC - Duct Repair and Sealing	Heating	1%	0%	5%	25%	$11,106	15	0.01
Insulation - Ceiling	Cooling	13%	27%	5%	20%	$10,814	20	0.19
Insulation - Ceiling	Cooling/Heating	32%	20%	5%	20%	$10,814	20	0.19
Insulation - Ceiling	Heating	22%	0%	5%	20%	$10,814	20	0.19
Insulation - Wall Cavity	Cooling	1%	2%	10%	68%	$22,797	20	0.04
Insulation - Wall Cavity	Cooling/Heating	46%	20%	10%	68%	$22,797	20	0.04
Insulation - Wall Cavity	Heating	78%	0%	10%	68%	$22,797	20	0.04
LED Exit Lighting	Interior Lighting	87%	87%	86%	90%	$60	12	0.72

Measure	End Use	Energy Savings	Demand Savings	Base Satura-tion	Appl./ Feas.	Cost ($/ employee)	Life-time (yrs)	BC Ratio
Machine Drive - Pumping System Controls	Motors	10%	8%	0%	0%	$3,000	15	26.7
Machine Drive - Pumping System Maintenance	Motors	4%	3%	5%	34%	$500	3	5.48
Machine Drive - Pumping System Optimization	Motors	6%	5%	5%	34%	$1,000	15	44.3
Occupancy Sensors	Interior Lighting	10%	5%	6%	56%	$100	6	1.12
Process - Compressed Air System Controls	Process Heating	20%	15%	0%	0%	$5,000	15	51.8
Process - Compressed Air System Maintenance	Process Heating	4%	3%	0%	0%	$3,000	3	4.05
Process - Compressed Air System Optimization and Improvements	Process Heating	12%	9%	0%	0%	$9,000	15	17.3
Process - Fan System Controls	Process Heating	20%	15%	0%	0%	$3,000	15	45.0
Process - Fan System Maintenance	Process Heating	4%	3%	10%	38%	$500	3	12.7
Process - Fan System Optimization	Process Heating	12%	9%	10%	38%	$1,000	15	81.0
Refrigeration System Controls	Motors	12%	9%	0%	0%	$200,000	18	0.46
Refrigeration System Maintenance	Motors	4%	3%	25%	75%	$6,000	3	0.55
Refrigeration System Optimization	Motors	12%	9%	40%	56%	$22,601	15	3.67
Roofs - High Reflectivity	Cooling	17%	13%	50%	75%	$13,152	15	0.15
RTU - Maintenance	Cooling	14%	15%	62%	90%	$1,500	4	1.74
Task Lighting	Interior Lighting	10%	10%	6%	75%	$150	6	0.05
Time Clocks and Timers	Interior Lighting	5%	3%	3%	56%	$250	6	0.06
Ventilation - C02 Controls	Ventilation	13%	7%	1%	8%	$1,228	10	1.42

Table D-21 Energy-Efficiency Measure Data—Other Industrial, New Vintage

Measure	End Use	Energy Savings	Demand Savings	Base Satura-tion	Appl./ Feas.	Cost ($/ employee)	Life-time (yrs)	BC Ratio
Air Compressor Demand Reduction	Motors	20%	16%	3%	29%	$3,192,653	10	5.18
Energy Project Management	Motors	29%	23%	7%	34%	$15,502,773	11	3.34
Fan Energy Management	Motors	10%	8%	7%	34%	$0	10	1.00
Fan Equipment Upgrade	Motors	35%	28%	6%	29%	$6,579,391	10	4.74
Fan System Optimization	Motors	50%	40%	7%	30%	$16,788,790	10	3.44
Integrated Plant Energy Management	Motors	50%	40%	6%	28%	$23,253,506	11	2.30
Lighting Controls	Interior Lighting	28%	23%	0%	0%	$4,894,651	10	1.54
Motors: Rewind 20-50 HP	Motors	1%	1%	1%	11%	$1,666,004	10	1.17
Motors: Rewind 51-100 HP	Motors	1%	0%	0%	0%	$13,800	10	1.33
Motors: Rewind 101-200 HP	Motors	1%	0%	3%	17%	$906,117	10	1.81
Motors: Rewind 201-500 HP	Motors	1%	0%	0%	0%	$0	10	1.00
Motors: Rewind 501-1000 HP	Motors	1%	0%	0%	0%	$0	10	1.00
Motors: Rewind 1000+ HP	Motors	1%	0%	0%	0%	$0	10	1.00
Plant Energy Management	Motors	12%	10%	7%	34%	$1,801,930	10	18.5
Pump Energy Management	Motors	8%	6%	8%	39%	$0	10	1.00
Pump Equipment Upgrade	Motors	20%	16%	8%	42%	$6,604,003	10	3.26
Pump System Optimization	Motors	50%	40%	4%	15%	$15,428,000	10	1.88
Synchronous Belts	Motors	2%	2%	9%	30%	$4,058,767	10	1.93
Transformers-New	Motors	0%	0%	1%	3%	$5,231,995	32	0.90
Transformers-Retrofit	Motors	2%	1%	16%	25%	$912,284	10	3.83
Process Heating	Process Heating	25%	20%	1%	9%	$25,000	10	4.23
Custom Utility Programs - Misc	Miscellaneous	25%	20%	10%	40%	$25,000	10	3.52
Custom Utility Programs - Motors	Motors	25%	20%	10%	40%	$25,000	10	2.59
Custom Utility Programs - Int Lighting	Interior Lighting	25%	20%	10%	40%	$25,000	10	3.82
Custom Utility Programs - Cooling	Cooling	25%	20%	10%	40%	$25,000	10	2.59
Bi-Level Fixture w/Occupancy Sensor	Interior Lighting	10%	5%	10%	23%	$500	8	0.08
Central Chiller - Chiller Water Reset	Cooling	15%	15%	30%	75%	$2,000	4	1.09
Central Chiller - Economizer	Cooling	25%	0%	0%	49%	$4,384	15	2.68
Central Chiller - High Efficiency Fans	Cooling	0%	0%	15%	41%	$10,000	10	0.01
Central Chiller - Maintenance	Cooling	4%	4%	62%	90%	$8,000	3	0.43
Central Chiller - Temperature Reset	Cooling	15%	6%	30%	75%	$4,500	4	0.48
Central Chiller - VSD	Cooling	33%	34%	15%	66%	$7,500	20	2.39
Clock/Programmable Thermostat	Cooling	7%	0%	32%	50%	$250	11	3.91
Clock/Programmable Thermostat	Heating	41%	0%	32%	50%	$250	11	3.91
Daylighting Controls - Photocell Controlled Dimming Ballasts	Interior Lighting	25%	13%	15%	20%	$200	8	0.45
Delamp and Install Reflectors	Interior Lighting	8%	8%	18%	56%	$120	11	0.34
Energy Management System	Cooling	25%	14%	5%	75%	$10,230	14	0.66
Energy Management System	Heating	28%	0%	5%	75%	$10,230	14	0.66
Energy Management System	Interior Lighting	9%	0%	5%	75%	$10,230	14	0.66
Energy Management System	Exterior Lighting	9%	0%	5%	75%	$10,230	14	0.66
Heat Pump - Maintenance	Cooling/Heating	4%	5%	3%	95%	$1,000	3	4.96
HVAC - Duct Insulation	Cooling	2%	3%	15%	50%	$11,983	20	0.03
HVAC - Duct Insulation	Cooling/Heating	1%	0%	15%	50%	$11,983	20	0.03
HVAC - Duct Insulation	Heating	0%	0%	15%	50%	$11,983	20	0.03
HVAC - Duct Repair and Sealing	Cooling	1%	2%	5%	25%	$11,106	15	0.01
HVAC - Duct Repair and Sealing	Heating	1%	0%	5%	25%	$11,106	15	0.01
Insulation - Ceiling	Cooling	13%	27%	5%	20%	$10,814	20	0.19
Insulation - Ceiling	Cooling/Heating	32%	20%	5%	20%	$10,814	20	0.19
Insulation - Ceiling	Heating	22%	0%	5%	20%	$10,814	20	0.19
Insulation - Wall Cavity	Cooling	1%	2%	10%	68%	$22,797	20	0.04
Insulation - Wall Cavity	Cooling/Heating	46%	20%	10%	68%	$22,797	20	0.04
Insulation - Wall Cavity	Heating	78%	0%	10%	68%	$22,797	20	0.04
LED Exit Lighting	Interior Lighting	87%	87%	86%	90%	$60	12	0.72
Machine Drive - Pumping System Controls	Motors	10%	8%	0%	0%	$3,000	15	26.5

Measure	End Use	Energy Savings	Demand Savings	Base Satura-tion	Appl./ Feas.	Cost ($/ employee)	Life-time (yrs)	BC Ratio
Machine Drive - Pumping System Maintenance	Motors	4%	3%	5%	34%	$500	3	5.47
Machine Drive - Pumping System Optimization	Motors	6%	5%	5%	34%	$1,000	15	44.0
Occupancy Sensors	Interior Lighting	10%	5%	6%	56%	$100	6	1.12
Process - Compressed Air System Controls	Process Heating	20%	15%	0%	0%	$5,000	15	51.8
Process - Compressed Air System Maintenance	Process Heating	4%	3%	0%	0%	$3,000	3	4.05
Process - Compressed Air System Optimization and Improvements	Process Heating	12%	9%	0%	0%	$9,000	15	17.3
Process - Fan System Controls	Process Heating	20%	15%	0%	0%	$3,000	15	45.0
Process - Fan System Maintenance	Process Heating	4%	3%	10%	38%	$500	3	12.7
Process - Fan System Optimization	Process Heating	12%	9%	10%	38%	$1,000	15	81.0
Refrigeration System Controls	Motors	12%	9%	0%	0%	$200,000	18	0.46
Refrigeration System Maintenance	Motors	4%	3%	25%	75%	$6,000	3	0.55
Refrigeration System Optimization	Motors	12%	9%	40%	56%	$22,601	15	3.65
Roofs - High Reflectivity	Cooling	17%	13%	50%	75%	$13,152	15	0.15
RTU - Maintenance	Cooling	14%	15%	62%	90%	$1,500	4	1.74
Task Lighting	Interior Lighting	10%	10%	6%	75%	$150	6	0.05
Time Clocks and Timers	Interior Lighting	5%	3%	3%	56%	$250	6	0.06
Ventilation - C02 Controls	Ventilation	13%	7%	1%	8%	$1,228	10	1.42

MARKET AND PROGRAM ACCEPTANCE FACTORS

To calculate achievable potential, we apply a set of market acceptance rates and program implementation factors to economic potential. These parameters are described below, followed by a discussion of how they are applied to calculate achievable potential. Finally, we present the three sets of factors at the end of this section.

Market Acceptance Rates

The market acceptance rates (MARs) embody customer awareness and willingness to adopt energy-efficiency equipment and measures in light of perfect information about the technologies and measures and perfect implementation of programs by utilities. Stated differently the only barrier to customer adoption captured by the MARs is the customers' own preferences. The MARs increase over time, reflecting an increasing awareness and willingness to adopt energy-efficient measures.

The MARs are applied directly to economic potential to calculate the Achievable – High estimates.

Program Implementation Factors

Program implementation factors (PIFs) take into account existing market, financial, political, and regulatory barriers that are likely to limit the amount of savings that might be achieved through energy efficiency programs. For example, it considers more realistic incentives, defined marketing campaigns, and internal budget constraints. Political barriers often reflect differences in regional attitudes toward energy efficiency and its value as a resource. PIFs also take into account recent utility experience and reported savings as well as interviews with local, state and federal agencies, local energy efficiency contractors and consultants, and other interested parties. PIF values increase over time.

PIFs are applied directly to the Achievable – High estimates to calculate the Achievable – Low estimates. Stated differently, the MARs and PIFs are both applied to economic potential to calculate the Achievable – Low estimates.

Estimates of Achievable Potential

Table E-1 and Table E-3 present the MARs that represent how Economic potential is changed to reach Achievable – High potential for residential measures. Table E-2 and Table E-4 present the product of MARs and PIFs (MAR x PIF) to show how Economic potential is changed to reach Achievable – Low potential for residential equipment and measures. Table E-5 through Table E-8 present MARs and MARs x PIFs for commercial equipment and measures. Table E-9 through Table E-12 present the same for industrial equipment and measures.

Table E-1 Residential—Equipment Measures MARs

End Use	Technology	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
Cooling	Central AC	35%	40%	45%	50%	55%	60%	65%	70%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%
Cooling	Room AC	60%	65%	70%	75%	78%	81%	84%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%
Heating/Cooling	Air-Source Heat Pump	35%	40%	45%	50%	55%	60%	65%	70%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%
Heating/Cooling	Geothermal Heat Pump	35%	40%	45%	50%	55%	60%	65%	70%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%
Space Heating	Electric Resistance	35%	40%	45%	50%	55%	60%	65%	70%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%
Space Heating	Electric Furnace	35%	40%	45%	50%	55%	60%	65%	70%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%
Water Heating	Water Heater	35%	40%	45%	50%	55%	60%	65%	70%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%
Interior Lighting	Screw-in	55%	58%	60%	63%	65%	68%	70%	73%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%
Interior Lighting	Linear Fluorescent	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%
Exterior Lighting	Screw-in	55%	58%	60%	63%	65%	68%	70%	73%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%
Appliances	Clothes Washer	29%	31%	33%	35%	37%	39%	41%	43%	45%	46%	47%	48%	49%	50%	50%	50%	50%	50%	50%	50%	50%
Appliances	Clothes Dryer	60%	65%	70%	75%	78%	81%	84%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%
Appliances	Dishwasher	60%	65%	70%	75%	78%	81%	84%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%
Appliances	Refrigerator	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%
Appliances	Freezer	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%
Appliances	Second Refrigerator	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%
Appliances	Stove	60%	65%	70%	75%	78%	81%	84%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%
Appliances	Microwave	60%	65%	70%	75%	78%	81%	84%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%
Electronics	Personal Computer	55%	58%	60%	63%	65%	68%	70%	73%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%
Electronics	TV	55%	58%	60%	63%	65%	68%	70%	73%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%
Electronics	Printer/Fax/Copier	55%	58%	60%	63%	65%	68%	70%	73%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%
Electronics	Set-top Boxes/DVR/Audio	55%	58%	60%	63%	65%	68%	70%	73%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%
Electronics	Devices and Gadgets	55%	58%	60%	63%	65%	68%	70%	73%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%
Miscellaneous	Pool Pump	28%	30%	31%	33%	36%	40%	43%	47%	50%	53%	56%	59%	62%	65%	67%	69%	71%	73%	75%	77%	79%
Miscellaneous	Pool Heater	28%	30%	31%	33%	36%	40%	43%	47%	50%	53%	56%	59%	62%	65%	67%	69%	71%	73%	75%	77%	79%
Miscellaneous	Hot Tub / Spa	28%	30%	31%	33%	36%	40%	43%	47%	50%	53%	56%	59%	62%	65%	67%	69%	71%	73%	75%	77%	79%
Miscellaneous	Well Pump	28%	30%	31%	33%	36%	40%	43%	47%	50%	53%	56%	59%	62%	65%	67%	69%	71%	73%	75%	77%	79%
Miscellaneous	Furnace Fan	28%	30%	31%	33%	36%	40%	43%	47%	50%	53%	56%	59%	62%	65%	67%	69%	71%	73%	75%	77%	79%
Miscellaneous	Miscellaneous	28%	30%	31%	33%	36%	40%	43%	47%	50%	53%	56%	59%	62%	65%	67%	69%	71%	73%	75%	77%	79%

Table E-2 Residential—Equipment Measures MARs x PIFs

End Use	Technology	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
Cooling	Central AC	11%	15%	18%	23%	25%	28%	30%	33%	36%	36%	36%	36%	36%	36%	36%	36%	36%	36%	36%	36%	36%
Cooling	Room AC	21%	26%	31%	37%	39%	41%	43%	44%	45%	45%	45%	45%	45%	45%	45%	45%	45%	45%	45%	45%	45%
Heating/Cooling	Air-Source Heat Pump	13%	16%	21%	25%	28%	31%	34%	37%	41%	41%	41%	41%	41%	41%	41%	41%	41%	41%	41%	41%	41%
Heating/Cooling	Geothermal Heat Pump	13%	16%	21%	25%	28%	31%	34%	37%	41%	41%	41%	41%	41%	41%	41%	41%	41%	41%	41%	41%	41%
Space Heating	Electric Resistance	11%	15%	19%	23%	26%	28%	31%	34%	37%	37%	37%	37%	37%	37%	37%	37%	37%	37%	37%	37%	37%
Space Heating	Electric Furnace	11%	15%	19%	23%	26%	29%	31%	34%	38%	38%	38%	38%	38%	38%	38%	38%	38%	38%	38%	38%	38%
Water Heating	Water Heater	11%	14%	18%	22%	24%	27%	30%	32%	35%	35%	35%	35%	35%	35%	35%	35%	35%	35%	35%	35%	35%
Interior Lighting	Screw-in	19%	23%	27%	31%	33%	34%	36%	38%	40%	40%	40%	40%	40%	40%	40%	40%	40%	40%	40%	40%	40%
Interior Lighting	Linear Fluorescent	30%	33%	37%	41%	41%	42%	43%	44%	44%	44%	44%	44%	44%	44%	44%	44%	44%	44%	44%	44%	44%
Exterior Lighting	Screw-in	20%	24%	28%	32%	34%	36%	37%	39%	41%	41%	41%	41%	41%	41%	41%	41%	41%	41%	41%	41%	41%
Appliances	Clothes Washer	9%	11%	13%	15%	16%	17%	19%	20%	21%	22%	22%	23%	23%	24%	24%	24%	24%	24%	24%	24%	24%
Appliances	Clothes Dryer	20%	25%	30%	35%	37%	39%	41%	43%	43%	43%	43%	43%	43%	43%	43%	43%	43%	43%	43%	43%	43%
Appliances	Dishwasher	23%	28%	34%	41%	43%	45%	48%	49%	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%
Appliances	Refrigerator	30%	33%	37%	41%	41%	42%	42%	43%	43%	43%	43%	43%	43%	43%	43%	43%	43%	43%	43%	43%	43%
Appliances	Freezer	28%	32%	35%	39%	40%	40%	41%	42%	43%	43%	43%	43%	43%	43%	43%	43%	43%	43%	43%	43%	43%
Appliances	Second Refrigerator	29%	33%	38%	42%	42%	43%	44%	44%	45%	45%	45%	45%	45%	45%	45%	45%	45%	45%	45%	45%	45%
Appliances	Stove	19%	23%	27%	32%	34%	36%	38%	39%	40%	40%	40%	40%	40%	40%	40%	40%	40%	40%	40%	40%	40%
Appliances	Microwave	19%	23%	27%	32%	34%	36%	38%	39%	40%	40%	40%	40%	40%	40%	40%	40%	40%	40%	40%	40%	40%
Electronics	Personal Computer	21%	25%	29%	34%	36%	38%	40%	42%	44%	44%	44%	44%	44%	44%	44%	44%	44%	44%	44%	44%	44%
Electronics	TV	17%	20%	24%	27%	29%	30%	32%	34%	35%	35%	35%	35%	35%	35%	35%	35%	35%	35%	35%	35%	35%
Electronics	Printer/Fax/Copier	20%	24%	28%	32%	34%	36%	37%	39%	41%	41%	41%	41%	41%	41%	41%	41%	41%	41%	41%	41%	41%
Electronics	Set-top Boxes/DVR/Audio	20%	24%	28%	32%	34%	36%	37%	39%	41%	41%	41%	41%	41%	41%	41%	41%	41%	41%	41%	41%	41%
Electronics	Devices and Gadgets	20%	24%	28%	32%	34%	36%	37%	39%	41%	41%	41%	41%	41%	41%	41%	41%	41%	41%	41%	41%	41%
Miscellaneous	Pool Pump	11%	13%	16%	18%	20%	23%	25%	27%	30%	32%	34%	35%	37%	39%	40%	41%	43%	44%	45%	46%	47%
Miscellaneous	Pool Heater	11%	13%	16%	18%	20%	23%	25%	27%	30%	32%	34%	35%	37%	39%	40%	41%	43%	44%	45%	46%	47%
Miscellaneous	Hot Tub / Spa	11%	13%	16%	18%	20%	23%	25%	27%	30%	32%	34%	35%	37%	39%	40%	41%	43%	44%	45%	46%	47%
Miscellaneous	Well Pump	10%	12%	15%	17%	19%	21%	23%	25%	28%	29%	31%	32%	34%	36%	37%	38%	39%	40%	41%	42%	43%
Miscellaneous	Furnace Fan	9%	11%	13%	15%	17%	19%	21%	23%	25%	27%	28%	30%	31%	33%	34%	34%	36%	36%	38%	38%	40%
Miscellaneous	Miscellaneous	10%	12%	15%	17%	19%	21%	23%	25%	28%	29%	31%	32%	34%	36%	37%	38%	39%	40%	41%	42%	43%

Table E-3 Residential—Other Measures MARs

Technology	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
Central AC - Maintenance	28%	30%	31%	33%	36%	40%	43%	47%	50%	53%	56%	59%	62%	65%	67%	69%	71%	73%	75%	77%	79%
Attic Fan - Installation	35%	40%	45%	50%	55%	60%	65%	70%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%
Attic Fan - Photovoltaic	35%	40%	45%	50%	55%	60%	65%	70%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%
Ceiling Fan - Installation	35%	40%	45%	50%	55%	60%	65%	70%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%
Whole-House Fan - Installation	35%	40%	45%	50%	55%	60%	65%	70%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%
Dehumidifier	35%	40%	45%	50%	55%	60%	65%	70%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%
Central Heat Pump - Maintenance	28%	30%	31%	33%	36%	40%	43%	47%	50%	53%	56%	59%	62%	65%	67%	69%	71%	73%	75%	77%	79%
Insulation - Ducting	28%	30%	31%	33%	36%	40%	43%	47%	50%	53%	56%	59%	62%	65%	67%	69%	71%	73%	75%	77%	79%
Ducting - Repair and Sealing	28%	30%	31%	33%	36%	40%	43%	47%	50%	53%	56%	59%	62%	65%	67%	69%	71%	73%	75%	77%	79%
Insulation - Infiltration Control	28%	30%	31%	33%	36%	40%	43%	47%	50%	53%	56%	59%	62%	65%	67%	69%	71%	73%	75%	77%	79%
Insulation - Ceiling	40%	43%	47%	50%	54%	58%	62%	66%	70%	72%	74%	76%	78%	80%	82%	84%	85%	85%	85%	85%	85%
Doors - Storm and Thermal	28%	30%	31%	33%	36%	40%	43%	47%	50%	53%	56%	59%	62%	65%	67%	69%	71%	73%	75%	77%	79%
Windows - ENERGY STAR	28%	30%	31%	33%	36%	40%	43%	47%	50%	53%	56%	59%	62%	65%	67%	69%	71%	73%	75%	77%	79%
Windows - Install reflective film	28%	30%	31%	33%	36%	40%	43%	47%	50%	53%	56%	59%	62%	65%	67%	69%	71%	73%	75%	77%	79%
Roofs - High Reflectivity	40%	43%	47%	50%	54%	58%	62%	66%	70%	72%	74%	76%	78%	80%	82%	84%	85%	85%	85%	85%	85%
Thermostat - Clock/Programmable	40%	43%	47%	50%	55%	60%	65%	70%	75%	80%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%
Water Heater - Faucet Aerators	60%	65%	70%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%
Water Heater - Pipe Insulation	60%	65%	70%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%
Water Heater - Low-Flow Showerheads	60%	65%	70%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%
Water Heater - Tank Blanket/Insulation	60%	65%	70%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%
Water Heater - Thermostat Setback	46%	53%	59%	66%	69%	72%	74%	77%	80%	80%	80%	80%	80%	80%	80%	80%	80%	80%	80%	80%	80%
Water Heater - Timer	46%	53%	59%	66%	69%	72%	74%	77%	80%	80%	80%	80%	80%	80%	80%	80%	80%	80%	80%	80%	80%
Water Heater - Hot Water Saver	46%	53%	59%	66%	69%	72%	74%	77%	80%	80%	80%	80%	80%	80%	80%	80%	80%	80%	80%	80%	80%
Interior Lighting - Occupancy Sensor	40%	43%	47%	50%	55%	60%	65%	70%	75%	80%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%
Exterior Lighting - Photovoltaic - Installation	40%	43%	47%	50%	55%	60%	65%	70%	75%	80%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%
Exterior Lighting - Photosensor Control	40%	43%	47%	50%	55%	60%	65%	70%	75%	80%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%
Exterior Lighting - Timeclock Installation	40%	43%	47%	50%	55%	60%	65%	70%	75%	80%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%
Refrigerator - Remove Second Unit	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%
Refrigerator - Maintenance	28%	30%	31%	33%	36%	40%	43%	47%	50%	53%	56%	59%	62%	65%	67%	69%	71%	73%	75%	77%	79%
Freezer - Remove Second Unit	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%
Freezer - Maintenance	28%	30%	31%	33%	36%	40%	43%	47%	50%	53%	56%	59%	62%	65%	67%	69%	71%	73%	75%	77%	79%
Home Electronics - Reduce Standby Wattage	40%	43%	47%	50%	55%	60%	65%	70%	75%	80%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%
Pool - Pump Timer	40%	43%	47%	50%	55%	60%	65%	70%	75%	80%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%
Spa - Pump Timer	40%	43%	47%	50%	55%	60%	65%	70%	75%	80%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%
Home Energy Management System	40%	43%	47%	50%	55%	60%	65%	70%	75%	80%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%
Insulation - Foundation	40%	43%	47%	50%	54%	58%	62%	66%	70%	72%	74%	76%	78%	80%	82%	84%	85%	85%	85%	85%	85%
Insulation - Wall Cavity	40%	43%	47%	50%	54%	58%	62%	66%	70%	72%	74%	76%	78%	80%	82%	84%	85%	85%	85%	85%	85%
Insulation - Wall Sheathing	40%	43%	47%	50%	54%	58%	62%	66%	70%	72%	74%	76%	78%	80%	82%	84%	85%	85%	85%	85%	85%
Water Heater - Drainwater Heat Recovery	46%	53%	59%	66%	69%	72%	74%	77%	80%	80%	80%	80%	80%	80%	80%	80%	80%	80%	80%	80%	80%
Advanced New Construction Design	35%	40%	45%	50%	55%	60%	65%	70%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%
ENERGY STAR Homes	35%	40%	45%	50%	55%	60%	65%	70%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%

Table E-4 Residential—Other Measures MARs x PIFs

Technology	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
Central AC - Maintenance	11%	13%	15%	17%	20%	22%	24%	27%	29%	31%	32%	34%	36%	38%	39%	40%	41%	42%	44%	45%	46%
Attic Fan - Installation	11%	15%	18%	22%	25%	27%	30%	32%	35%	35%	35%	35%	35%	35%	35%	35%	35%	35%	35%	35%	35%
Attic Fan - Photovoltaic	11%	14%	17%	21%	23%	25%	27%	30%	32%	32%	32%	32%	32%	32%	32%	32%	32%	32%	32%	32%	32%
Ceiling Fan - Installation	11%	15%	18%	22%	25%	27%	30%	32%	35%	35%	35%	35%	35%	35%	35%	35%	35%	35%	35%	35%	35%
Whole-House Fan - Installation	11%	15%	18%	22%	25%	27%	30%	32%	35%	35%	35%	35%	35%	35%	35%	35%	35%	35%	35%	35%	35%
Dehumidifier	11%	14%	18%	22%	24%	27%	29%	32%	35%	35%	35%	35%	35%	35%	35%	35%	35%	35%	35%	35%	35%
Central Heat Pump - Maintenance	11%	13%	15%	17%	20%	22%	24%	27%	29%	31%	32%	34%	36%	38%	39%	40%	41%	42%	44%	45%	46%
Insulation - Ducting	9%	11%	12%	14%	16%	18%	19%	21%	23%	24%	26%	27%	29%	30%	31%	32%	33%	34%	35%	35%	36%
Ducting - Repair and Sealing	9%	11%	12%	14%	16%	18%	19%	21%	23%	24%	26%	27%	29%	30%	31%	32%	33%	34%	35%	35%	36%
Insulation - Infiltration Control	9%	11%	13%	15%	16%	18%	20%	22%	24%	25%	26%	28%	29%	31%	31%	32%	33%	34%	35%	36%	37%
Insulation - Ceiling	13%	16%	19%	22%	24%	26%	28%	31%	33%	34%	35%	36%	37%	38%	39%	39%	40%	40%	40%	40%	40%
Doors - Storm and Thermal	9%	10%	12%	14%	16%	18%	19%	21%	23%	24%	26%	27%	29%	30%	31%	32%	33%	34%	35%	35%	36%
Windows - ENERGY STAR	9%	10%	12%	14%	16%	18%	19%	21%	23%	24%	26%	27%	29%	30%	31%	32%	33%	34%	35%	35%	36%
Windows - Install reflective film	9%	11%	12%	14%	16%	18%	19%	21%	23%	24%	26%	27%	29%	30%	31%	32%	33%	34%	35%	35%	36%
Roofs - High Reflectivity	13%	15%	18%	22%	24%	26%	28%	30%	32%	33%	34%	35%	36%	37%	38%	39%	39%	39%	39%	39%	39%
Thermostat - Clock/Programmable	15%	18%	22%	26%	29%	32%	36%	39%	43%	46%	48%	48%	48%	48%	48%	48%	48%	48%	48%	48%	48%
Water Heater - Faucet Aerators	20%	24%	29%	35%	35%	35%	36%	36%	37%	37%	37%	37%	37%	37%	37%	37%	37%	37%	37%	37%	37%
Water Heater - Pipe Insulation	19%	23%	27%	32%	33%	33%	34%	34%	35%	35%	35%	35%	35%	35%	35%	35%	35%	35%	35%	35%	35%
Water Heater - Low-Flow Showerheads	20%	24%	29%	35%	35%	35%	36%	36%	37%	37%	37%	37%	37%	37%	37%	37%	37%	37%	37%	37%	37%
Water Heater - Tank Blanket/Insulation	20%	24%	29%	35%	35%	35%	36%	36%	37%	37%	37%	37%	37%	37%	37%	37%	37%	37%	37%	37%	37%
Water Heater - Thermostat Setback	17%	22%	28%	34%	36%	39%	41%	43%	46%	46%	46%	46%	46%	46%	46%	46%	46%	46%	46%	46%	46%
Water Heater - Timer	17%	22%	28%	34%	36%	39%	41%	43%	46%	46%	46%	46%	46%	46%	46%	46%	46%	46%	46%	46%	46%
Water Heater - Hot Water Saver	15%	19%	23%	28%	30%	32%	33%	35%	37%	37%	37%	37%	37%	37%	37%	37%	37%	37%	37%	37%	37%
Interior Lighting - Occupancy Sensor	14%	17%	20%	24%	27%	30%	33%	36%	39%	42%	44%	44%	44%	44%	44%	44%	44%	44%	44%	44%	44%
Exterior Lighting - Photovoltaic - Installation	14%	17%	20%	24%	27%	30%	33%	36%	39%	42%	44%	44%	44%	44%	44%	44%	44%	44%	44%	44%	44%
Exterior Lighting - Photosensor Control	14%	17%	20%	24%	27%	30%	33%	36%	39%	42%	44%	44%	44%	44%	44%	44%	44%	44%	44%	44%	44%
Exterior Lighting - Timeclock Installation	14%	17%	20%	24%	27%	30%	33%	36%	39%	42%	44%	44%	44%	44%	44%	44%	44%	44%	44%	44%	44%
Refrigerator - Remove Second Unit	29%	33%	38%	42%	42%	43%	44%	44%	45%	45%	45%	45%	45%	45%	45%	45%	45%	45%	45%	45%	45%
Refrigerator - Maintenance	11%	13%	15%	17%	20%	22%	24%	27%	29%	31%	32%	34%	36%	38%	39%	40%	41%	42%	44%	45%	46%
Freezer - Remove Second Unit	28%	32%	35%	39%	40%	40%	41%	42%	43%	43%	43%	43%	43%	43%	43%	43%	43%	43%	43%	43%	43%
Freezer - Maintenance	11%	13%	15%	17%	20%	22%	24%	27%	29%	31%	32%	34%	36%	38%	39%	40%	41%	42%	44%	45%	46%
Home Electronics - Reduce Standby Wattage	12%	15%	18%	22%	24%	27%	30%	32%	35%	38%	40%	40%	40%	40%	40%	40%	40%	40%	40%	40%	40%
Pool - Pump Timer	15%	18%	22%	26%	29%	32%	36%	39%	43%	46%	48%	48%	48%	48%	48%	48%	48%	48%	48%	48%	48%
Spa - Pump Timer	15%	18%	22%	26%	29%	32%	36%	39%	43%	46%	48%	48%	48%	48%	48%	48%	48%	48%	48%	48%	48%
Home Energy Management System	15%	18%	22%	26%	29%	32%	36%	39%	43%	46%	48%	48%	48%	48%	48%	48%	48%	48%	48%	48%	48%
Insulation - Foundation	13%	16%	19%	22%	24%	26%	28%	31%	33%	34%	35%	36%	37%	38%	39%	39%	40%	40%	40%	40%	40%
Insulation - Wall Cavity	13%	16%	19%	22%	24%	26%	28%	31%	33%	34%	35%	36%	37%	38%	39%	39%	40%	40%	40%	40%	40%
Insulation - Wall Sheathing	13%	16%	19%	22%	24%	26%	28%	31%	33%	34%	35%	36%	37%	38%	39%	39%	40%	40%	40%	40%	40%
Water Heater - Drainwater Heat Recovery	15%	20%	25%	30%	32%	34%	36%	37%	39%	39%	39%	39%	39%	39%	39%	39%	39%	39%	39%	39%	39%
Advanced New Construction Design	11%	14%	17%	21%	23%	25%	27%	30%	32%	32%	32%	32%	32%	32%	32%	32%	32%	32%	32%	32%	32%
ENERGY STAR Homes	11%	14%	17%	21%	23%	25%	27%	30%	32%	32%	32%	32%	32%	32%	32%	32%	32%	32%	32%	32%	32%

Table E-5 Commercial—Equipment Measures MARs

End Use	Technology	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
Cooling	Air-Cooled Chiller	42%	48%	54%	60%	65%	70%	75%	80%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%
Cooling	Water-Cooled Chiller	42%	48%	54%	60%	65%	70%	75%	80%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%
Cooling	Roof Top AC	35%	40%	45%	50%	55%	60%	65%	70%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%
Cooling	Other Cooling	35%	40%	45%	50%	55%	60%	65%	70%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%
Heating	Electric Heating	42%	48%	54%	60%	65%	70%	75%	80%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%
Cooling/Heating	Roof Top Heat Pump	35%	40%	45%	50%	55%	60%	65%	70%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%
Ventilation	Ventilation	35%	40%	45%	50%	55%	60%	65%	70%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%
Water Heating	Water Heating	37%	43%	49%	55%	60%	65%	70%	75%	80%	80%	80%	80%	80%	80%	80%	80%	80%	80%	80%	80%	80%
Interior Lighting	Screw-in	58%	62%	66%	70%	73%	76%	79%	82%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%
Interior Lighting	High-Bay Fixtures	58%	62%	66%	70%	73%	76%	79%	82%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%
Interior Lighting	Linear Fluorescent	58%	62%	66%	70%	73%	76%	79%	82%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%
Exterior Lighting	Screw-in	58%	62%	66%	70%	73%	76%	79%	82%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%
Exterior Lighting	HID	58%	62%	66%	70%	73%	76%	79%	82%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%
Exterior Lighting	Linear Fluorescent	58%	62%	66%	70%	73%	76%	79%	82%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%
Refrigeration	Walk-in Refrigerator	42%	48%	54%	60%	65%	70%	75%	80%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%
Refrigeration	Reach-in Refrigerator	42%	48%	54%	60%	65%	70%	75%	80%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%
Refrigeration	Glass Door Display	44%	51%	58%	65%	67%	69%	71%	73%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%
Refrigeration	Open Display Case	42%	48%	54%	60%	65%	70%	75%	80%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%
Refrigeration	Icemaker	42%	48%	54%	60%	65%	70%	75%	80%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%
Refrigeration	Vending Machine	35%	40%	45%	50%	55%	60%	65%	70%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%
Food Preparation	Oven	42%	48%	54%	60%	65%	70%	75%	80%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%
Food Preparation	Fryer	42%	48%	54%	60%	65%	70%	75%	80%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%
Food Preparation	Dishwasher	42%	48%	54%	60%	65%	70%	75%	80%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%
Food Preparation	Hot Food Container	42%	48%	54%	60%	65%	70%	75%	80%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%
Office Equipment	Desktop Computer	58%	62%	66%	70%	73%	76%	79%	82%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%
Office Equipment	Laptop	58%	62%	66%	70%	73%	76%	79%	82%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%
Office Equipment	Server	58%	62%	66%	70%	73%	76%	79%	82%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%
Office Equipment	Monitor	58%	62%	66%	70%	73%	76%	79%	82%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%
Office Equipment	Printer/Copier/Fax	58%	62%	66%	70%	73%	76%	79%	82%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%
Office Equipment	POS Terminal	58%	62%	66%	70%	73%	76%	79%	82%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%
Miscellaneous	Non-HVAC Motors	35%	40%	45%	50%	55%	60%	65%	70%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%
Miscellaneous	Pool Pump	35%	40%	45%	50%	55%	60%	65%	70%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%
Miscellaneous	Pool Heater	35%	40%	45%	50%	55%	60%	65%	70%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%
Miscellaneous	Miscellaneous	35%	40%	45%	50%	55%	60%	65%	70%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%

Table E-6 Commercial—Equipment Measures MARs x PIFs

End Use	Technology	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
Cooling	Air-Cooled Chiller	13%	17%	22%	28%	31%	34%	38%	41%	45%	45%	45%	45%	45%	45%	45%	45%	45%	45%	45%	45%	45%
Cooling	Water-Cooled Chiller	13%	17%	22%	28%	31%	34%	38%	41%	45%	45%	45%	45%	45%	45%	45%	45%	45%	45%	45%	45%	45%
Cooling	Roof Top AC	11%	15%	19%	23%	26%	29%	33%	36%	40%	40%	40%	40%	40%	40%	40%	40%	40%	40%	40%	40%	40%
Cooling	Other Cooling	11%	15%	19%	23%	26%	29%	33%	36%	40%	40%	40%	40%	40%	40%	40%	40%	40%	40%	40%	40%	40%
Heating	Electric Heating	13%	17%	22%	28%	31%	34%	38%	41%	45%	45%	45%	45%	45%	45%	45%	45%	45%	45%	45%	45%	45%
Cooling/Heating	Roof Top Heat Pump	11%	15%	19%	23%	26%	29%	33%	36%	40%	40%	40%	40%	40%	40%	40%	40%	40%	40%	40%	40%	40%
Ventilation	Ventilation	11%	14%	18%	23%	25%	28%	32%	35%	38%	38%	38%	38%	38%	38%	38%	38%	38%	38%	38%	38%	38%
Water Heating	Water Heating	12%	15%	20%	25%	28%	31%	34%	37%	41%	41%	41%	41%	41%	41%	41%	41%	41%	41%	41%	41%	41%
Interior Lighting	Screw-in	21%	26%	31%	36%	39%	42%	45%	48%	51%	51%	51%	51%	51%	51%	51%	51%	51%	51%	51%	51%	51%
Interior Lighting	High-Bay Fixtures	21%	26%	31%	36%	39%	42%	45%	48%	51%	51%	51%	51%	51%	51%	51%	51%	51%	51%	51%	51%	51%
Interior Lighting	Linear Fluorescent	21%	26%	31%	36%	39%	42%	45%	48%	51%	51%	51%	51%	51%	51%	51%	51%	51%	51%	51%	51%	51%
Exterior Lighting	Screw-in	21%	26%	31%	36%	39%	42%	45%	48%	51%	51%	51%	51%	51%	51%	51%	51%	51%	51%	51%	51%	51%
Exterior Lighting	HID	21%	26%	31%	36%	39%	42%	45%	48%	51%	51%	51%	51%	51%	51%	51%	51%	51%	51%	51%	51%	51%
Exterior Lighting	Linear Fluorescent	21%	26%	31%	36%	39%	42%	45%	48%	51%	51%	51%	51%	51%	51%	51%	51%	51%	51%	51%	51%	51%
Refrigeration	Walk-in Refrigerator	13%	17%	22%	27%	30%	33%	36%	40%	43%	43%	43%	43%	43%	43%	43%	43%	43%	43%	43%	43%	43%
Refrigeration	Reach-in Refrigerator	13%	17%	22%	27%	30%	33%	36%	40%	43%	43%	43%	43%	43%	43%	43%	43%	43%	43%	43%	43%	43%
Refrigeration	Glass Door Display	14%	18%	23%	29%	31%	33%	35%	36%	38%	38%	38%	38%	38%	38%	38%	38%	38%	38%	38%	38%	38%
Refrigeration	Open Display Case	13%	17%	22%	27%	30%	33%	36%	40%	43%	43%	43%	43%	43%	43%	43%	43%	43%	43%	43%	43%	43%
Refrigeration	Icemaker	13%	17%	22%	27%	30%	33%	36%	40%	43%	43%	43%	43%	43%	43%	43%	43%	43%	43%	43%	43%	43%
Refrigeration	Vending Machine	11%	14%	18%	23%	25%	28%	32%	35%	38%	38%	38%	38%	38%	38%	38%	38%	38%	38%	38%	38%	38%
Food Preparation	Oven	13%	17%	22%	27%	30%	33%	36%	40%	43%	43%	43%	43%	43%	43%	43%	43%	43%	43%	43%	43%	43%
Food Preparation	Fryer	13%	17%	22%	27%	30%	33%	36%	40%	43%	43%	43%	43%	43%	43%	43%	43%	43%	43%	43%	43%	43%
Food Preparation	Dishwasher	13%	17%	22%	27%	30%	33%	36%	40%	43%	43%	43%	43%	43%	43%	43%	43%	43%	43%	43%	43%	43%
Food Preparation	Hot Food Container	13%	17%	22%	27%	30%	33%	36%	40%	43%	43%	43%	43%	43%	43%	43%	43%	43%	43%	43%	43%	43%
Office Equipment	Desktop Computer	19%	23%	28%	33%	35%	38%	40%	42%	45%	45%	45%	45%	45%	45%	45%	45%	45%	45%	45%	45%	45%
Office Equipment	Laptop	19%	23%	28%	33%	35%	38%	40%	42%	45%	45%	45%	45%	45%	45%	45%	45%	45%	45%	45%	45%	45%
Office Equipment	Server	18%	22%	27%	32%	34%	36%	38%	41%	43%	43%	43%	43%	43%	43%	43%	43%	43%	43%	43%	43%	43%
Office Equipment	Monitor	19%	23%	28%	33%	35%	38%	40%	42%	45%	45%	45%	45%	45%	45%	45%	45%	45%	45%	45%	45%	45%
Office Equipment	Printer/Copier/Fax	18%	22%	27%	32%	34%	36%	39%	41%	44%	44%	44%	44%	44%	44%	44%	44%	44%	44%	44%	44%	44%
Office Equipment	POS Terminal	19%	23%	28%	33%	35%	38%	40%	42%	45%	45%	45%	45%	45%	45%	45%	45%	45%	45%	45%	45%	45%
Miscellaneous	Non-HVAC Motors	11%	14%	18%	23%	25%	28%	32%	35%	38%	38%	38%	38%	38%	38%	38%	38%	38%	38%	38%	38%	38%
Miscellaneous	Pool Pump	11%	14%	18%	23%	25%	28%	32%	35%	38%	38%	38%	38%	38%	38%	38%	38%	38%	38%	38%	38%	38%
Miscellaneous	Pool Heater	11%	14%	18%	23%	25%	28%	32%	35%	38%	38%	38%	38%	38%	38%	38%	38%	38%	38%	38%	38%	38%
Miscellaneous	Miscellaneous	11%	14%	18%	23%	25%	28%	32%	35%	38%	38%	38%	38%	38%	38%	38%	38%	38%	38%	38%	38%	38%

Table E-7 Commercial—Other Measures MARs

Technology	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
Chiller - VSD	35%	40%	45%	50%	55%	60%	65%	70%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%
Chiller - Condenser Water Temperature Reset	42%	48%	54%	60%	65%	70%	75%	80%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%
Chiller - Economizer	35%	40%	45%	50%	55%	60%	65%	70%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%
Chiller - Thermal Energy Storage	35%	40%	45%	50%	55%	60%	65%	70%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%
Air-Cooled Chiller - High Efficiency Fans	35%	40%	45%	50%	55%	60%	65%	70%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%
Water-Cooled Chiller - Cooling Tower, High-Efficiency Fans	35%	40%	45%	50%	55%	60%	65%	70%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%
Water-Cooled Chiller - Condenser Water Temperature Reset	42%	48%	54%	60%	65%	70%	75%	80%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%
Heat Pump - Maintenance	42%	48%	54%	60%	65%	70%	75%	80%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%
RTU - Maintenance	42%	48%	54%	60%	65%	70%	75%	80%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%
Ventilation - Variable Speed Control	35%	40%	45%	50%	55%	60%	65%	70%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%
Ventilation - CO2 Controlled	35%	40%	45%	50%	55%	60%	65%	70%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%
Ventilation - Exhaust Hood Sensor Control	35%	40%	45%	50%	55%	60%	65%	70%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%
Fans - Energy-Efficient Motors	35%	40%	45%	50%	55%	60%	65%	70%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%
Pumps - High-Efficiency Motors	35%	40%	45%	50%	55%	60%	65%	70%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%
Pumps - Variable Speed Control	35%	40%	45%	50%	55%	60%	65%	70%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%
Insulation - Ducting	42%	48%	54%	60%	65%	70%	75%	80%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%
Insulation - Ceiling	42%	48%	54%	60%	65%	70%	75%	80%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%
Insulation - Wall Cavity	42%	48%	54%	60%	65%	70%	75%	80%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%
HVAC - Duct Repair and Sealing	42%	48%	54%	60%	65%	70%	75%	80%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%
Roofs - Cool Roof	42%	48%	54%	60%	65%	70%	75%	80%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%
Windows - High Efficiency	42%	48%	54%	60%	65%	70%	75%	80%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%
Energy Management System	35%	40%	45%	50%	55%	60%	65%	70%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%
Thermostat - Clock/Programmable	35%	40%	45%	50%	55%	60%	65%	70%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%
Interior Lighting - LED Exit Lighting	60%	65%	70%	75%	79%	83%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%
Interior Lighting - Occupancy Sensors	56%	59%	62%	65%	67%	69%	71%	73%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%
Interior Lighting - Task Lighting	56%	59%	62%	65%	67%	69%	71%	73%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%
Interior Lighting - Time Clocks and Timers (lighting)	56%	59%	62%	65%	67%	69%	71%	73%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%
Interior Lighting - Fluorescent Delamp and Install Reflectors	42%	48%	54%	60%	65%	70%	75%	80%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%
Interior Fluorescent - Bi-Level Fixture w/Occupancy Sensor	56%	59%	62%	65%	67%	69%	71%	73%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%
Interior Fluorescent - Photocell-Controlled Dimming Ballasts	56%	59%	62%	65%	67%	69%	71%	73%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%
Indoor Lighting - Daylighting Controls	56%	59%	62%	65%	67%	69%	71%	73%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%
Lighting Retrocommissioning	42%	48%	54%	60%	65%	70%	75%	80%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%
Hotel - Guest Room Controls	56%	59%	62%	65%	67%	69%	71%	73%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%
Water Heating - Heat Trap	37%	43%	49%	55%	60%	65%	70%	75%	80%	80%	80%	80%	80%	80%	80%	80%	80%	80%	80%	80%	80%
Water Heating - Faucet Aerators and Low Flow Nozzles	37%	43%	49%	55%	60%	65%	70%	75%	80%	80%	80%	80%	80%	80%	80%	80%	80%	80%	80%	80%	80%
Water Heating - Pipe Insulation	37%	43%	49%	55%	60%	65%	70%	75%	80%	80%	80%	80%	80%	80%	80%	80%	80%	80%	80%	80%	80%

Water Heating - Tank Blanket	37%	43%	49%	55%	60%	65%	70%	75%	80%	80%	80%	80%	80%	80%	80%	80%	80%	80%	80%	80%	80%
Water Heating - Hot Water Saver	37%	43%	49%	55%	60%	65%	70%	75%	80%	80%	80%	80%	80%	80%	80%	80%	80%	80%	80%	80%	80%
Water Heating - High Efficiency Circulation Pump	37%	43%	49%	55%	60%	65%	70%	75%	80%	80%	80%	80%	80%	80%	80%	80%	80%	80%	80%	80%	80%
Water Heating - Install Timer	37%	43%	49%	55%	60%	65%	70%	75%	80%	80%	80%	80%	80%	80%	80%	80%	80%	80%	80%	80%	80%
Water Heating - Thermostat Setback	37%	43%	49%	55%	60%	65%	70%	75%	80%	80%	80%	80%	80%	80%	80%	80%	80%	80%	80%	80%	80%
Water Heating - Solar Water Heating System	37%	43%	49%	55%	60%	65%	70%	75%	80%	80%	80%	80%	80%	80%	80%	80%	80%	80%	80%	80%	80%
Refrigerator - Decommissioning and Recycling	42%	48%	54%	60%	65%	70%	75%	80%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%
Refrigerator - Anti-Sweat Heater	42%	48%	54%	60%	65%	70%	75%	80%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%
Refrigerator - Door Gasket Replacement	44%	51%	58%	65%	67%	69%	71%	73%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%
Open Display Case - Night Covers	44%	51%	58%	65%	67%	69%	71%	73%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%
Display Case - LED Lighting	44%	51%	58%	65%	67%	69%	71%	73%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%
Vending Machine - Controller	35%	40%	45%	50%	55%	60%	65%	70%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%
Office Electronics - Plug Load Occupancy Sensors	58%	62%	66%	70%	73%	76%	79%	82%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%
Office Electronics - ENERGY STAR Power Supplies	58%	62%	66%	70%	73%	76%	79%	82%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%
Non-HVAC Motors - Variable Speed Control	35%	40%	45%	50%	55%	60%	65%	70%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%
Pool Pump - Timer	35%	40%	45%	50%	55%	60%	65%	70%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%

Table E-8 Commercial—Other Measures MARs x PIFs

Technology	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
Chiller - VSD	8%	11%	14%	17%	19%	21%	24%	26%	29%	29%	29%	29%	29%	29%	29%	29%	29%	29%	29%	29%	29%
Chiller - Condenser Water Temperature Reset	13%	16%	21%	26%	29%	32%	35%	38%	42%	42%	42%	42%	42%	42%	42%	42%	42%	42%	42%	42%	42%
Chiller - Economizer	8%	11%	14%	17%	19%	21%	24%	26%	29%	29%	29%	29%	29%	29%	29%	29%	29%	29%	29%	29%	29%
Chiller - Thermal Energy Storage	7%	10%	12%	15%	17%	19%	21%	23%	25%	25%	25%	25%	25%	25%	25%	25%	25%	25%	25%	25%	25%
Air-Cooled Chiller - High Efficiency Fans	10%	13%	16%	20%	23%	25%	28%	31%	35%	35%	35%	35%	35%	35%	35%	35%	35%	35%	35%	35%	35%
Water-Cooled Chiller - Cooling Tower, High-Efficiency Fans	10%	13%	16%	20%	23%	25%	28%	31%	35%	35%	35%	35%	35%	35%	35%	35%	35%	35%	35%	35%	35%
Water-Cooled Chiller - Condenser Water Temperature Reset	13%	16%	21%	26%	29%	32%	35%	38%	42%	42%	42%	42%	42%	42%	42%	42%	42%	42%	42%	42%	42%
Heat Pump - Maintenance	13%	17%	21%	26%	29%	32%	36%	39%	43%	43%	43%	43%	43%	43%	43%	43%	43%	43%	43%	43%	43%
RTU - Maintenance	13%	17%	22%	28%	31%	34%	38%	41%	45%	45%	45%	45%	45%	45%	45%	45%	45%	45%	45%	45%	45%
Ventilation - Variable Speed Control	8%	11%	14%	17%	19%	21%	24%	26%	29%	29%	29%	29%	29%	29%	29%	29%	29%	29%	29%	29%	29%
Ventilation - CO2 Controlled	9%	12%	15%	18%	20%	23%	25%	27%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%
Ventilation - Exhaust Hood Sensor Control	9%	12%	15%	18%	20%	23%	25%	27%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%
Fans - Energy-Efficient Motors	10%	13%	16%	20%	23%	25%	28%	31%	35%	35%	35%	35%	35%	35%	35%	35%	35%	35%	35%	35%	35%
Pumps - High-Efficiency Motors	10%	13%	16%	20%	23%	25%	28%	31%	35%	35%	35%	35%	35%	35%	35%	35%	35%	35%	35%	35%	35%
Pumps - Variable Speed Control	9%	11%	14%	18%	20%	22%	24%	27%	29%	29%	29%	29%	29%	29%	29%	29%	29%	29%	29%	29%	29%
Insulation - Ducting	13%	17%	21%	26%	29%	32%	36%	39%	43%	43%	43%	43%	43%	43%	43%	43%	43%	43%	43%	43%	43%
Insulation - Ceiling	13%	17%	21%	26%	29%	32%	36%	39%	43%	43%	43%	43%	43%	43%	43%	43%	43%	43%	43%	43%	43%
Insulation - Wall Cavity	13%	17%	21%	26%	29%	32%	36%	39%	43%	43%	43%	43%	43%	43%	43%	43%	43%	43%	43%	43%	43%
HVAC - Duct Repair and Sealing	13%	17%	21%	26%	29%	32%	36%	39%	43%	43%	43%	43%	43%	43%	43%	43%	43%	43%	43%	43%	43%
Roofs - Cool Roof	12%	15%	19%	24%	27%	30%	33%	36%	39%	39%	39%	39%	39%	39%	39%	39%	39%	39%	39%	39%	39%
Windows - High Efficiency	12%	15%	19%	23%	26%	28%	31%	34%	37%	37%	37%	37%	37%	37%	37%	37%	37%	37%	37%	37%	37%
Energy Management System	7%	10%	12%	15%	17%	19%	21%	23%	25%	25%	25%	25%	25%	25%	25%	25%	25%	25%	25%	25%	25%
Thermostat - Clock/Programmable	7%	10%	12%	15%	17%	19%	21%	23%	25%	25%	25%	25%	25%	25%	25%	25%	25%	25%	25%	25%	25%
Interior Lighting - LED Exit Lighting	21%	27%	33%	39%	42%	46%	48%	50%	51%	51%	51%	51%	51%	51%	51%	51%	51%	51%	51%	51%	51%
Interior Lighting - Occupancy Sensors	15%	18%	21%	24%	25%	27%	28%	29%	31%	31%	31%	31%	31%	31%	31%	31%	31%	31%	31%	31%	31%
Interior Lighting - Task Lighting	17%	20%	24%	28%	30%	31%	33%	35%	37%	37%	37%	37%	37%	37%	37%	37%	37%	37%	37%	37%	37%
Interior Lighting - Time Clocks and Timers (lighting)	15%	18%	21%	24%	25%	27%	28%	29%	31%	31%	31%	31%	31%	31%	31%	31%	31%	31%	31%	31%	31%
Interior Lighting - Fluorescent Delamp and Install Reflectors	13%	16%	21%	26%	29%	32%	35%	38%	42%	42%	42%	42%	42%	42%	42%	42%	42%	42%	42%	42%	42%
Interior Fluorescent - Bi-Level Fixture w/Occupancy Sensor	17%	20%	24%	28%	30%	31%	33%	35%	37%	37%	37%	37%	37%	37%	37%	37%	37%	37%	37%	37%	37%
Interior Fluorescent - Photocell-Controlled Dimming Ballasts	17%	20%	24%	28%	30%	31%	33%	35%	37%	37%	37%	37%	37%	37%	37%	37%	37%	37%	37%	37%	37%
Indoor Lighting - Daylighting Controls	16%	19%	22%	26%	27%	29%	31%	32%	34%	34%	34%	34%	34%	34%	34%	34%	34%	34%	34%	34%	34%
Lighting Retrocommissioning	13%	16%	21%	26%	29%	32%	35%	38%	42%	42%	42%	42%	42%	42%	42%	42%	42%	42%	42%	42%	42%
Hotel - Guest Room Controls	12%	14%	17%	20%	21%	22%	23%	24%	25%	25%	25%	25%	25%	25%	25%	25%	25%	25%	25%	25%	25%
Water Heating - Heat Trap	10%	13%	16%	20%	22%	24%	26%	29%	31%	31%	31%	31%	31%	31%	31%	31%	31%	31%	31%	31%	31%
Water Heating - Faucet Aerators and Low Flow Nozzles	9%	12%	15%	19%	21%	23%	25%	28%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%
Water Heating - Pipe Insulation	11%	15%	19%	24%	27%	30%	33%	37%	40%	40%	40%	40%	40%	40%	40%	40%	40%	40%	40%	40%	40%

Water Heating - Tank Blanket	11%	15%	19%	24%	27%	30%	33%	37%	40%	40%	40%	40%	40%	40%	40%	40%	40%	40%	40%	40%	40%
Water Heating - Hot Water Saver	10%	13%	16%	20%	22%	24%	26%	29%	31%	31%	31%	31%	31%	31%	31%	31%	31%	31%	31%	31%	31%
Water Heating - High Efficiency Circulation Pump	9%	12%	15%	19%	21%	23%	25%	28%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%
Water Heating - Install Timer	11%	15%	19%	24%	27%	30%	33%	36%	39%	39%	39%	39%	39%	39%	39%	39%	39%	39%	39%	39%	39%
Water Heating - Thermostat Setback	11%	15%	19%	24%	27%	30%	33%	36%	39%	39%	39%	39%	39%	39%	39%	39%	39%	39%	39%	39%	39%
Water Heating - Solar Water Heating System	12%	15%	20%	25%	28%	31%	34%	37%	41%	41%	41%	41%	41%	41%	41%	41%	41%	41%	41%	41%	41%
Refrigerator - Decommissioning and Recycling	13%	17%	22%	27%	30%	33%	36%	40%	43%	43%	43%	43%	43%	43%	43%	43%	43%	43%	43%	43%	43%
Refrigerator - Anti-Sweat Heater	13%	17%	22%	27%	30%	33%	36%	40%	43%	43%	43%	43%	43%	43%	43%	43%	43%	43%	43%	43%	43%
Refrigerator - Door Gasket Replacement	14%	18%	23%	29%	31%	33%	35%	36%	38%	38%	38%	38%	38%	38%	38%	38%	38%	38%	38%	38%	38%
Open Display Case - Night Covers	14%	18%	23%	29%	31%	33%	35%	36%	38%	38%	38%	38%	38%	38%	38%	38%	38%	38%	38%	38%	38%
Display Case - LED Lighting	14%	18%	23%	29%	31%	33%	35%	36%	38%	38%	38%	38%	38%	38%	38%	38%	38%	38%	38%	38%	38%
Vending Machine - Controller	11%	14%	18%	23%	25%	28%	32%	35%	38%	38%	38%	38%	38%	38%	38%	38%	38%	38%	38%	38%	38%
Office Electronics - Plug Load Occupancy Sensors	19%	23%	28%	33%	35%	38%	40%	42%	45%	45%	45%	45%	45%	45%	45%	45%	45%	45%	45%	45%	45%
Office Electronics - ENERGY STAR Power Supplies	19%	23%	28%	33%	35%	38%	40%	42%	45%	45%	45%	45%	45%	45%	45%	45%	45%	45%	45%	45%	45%
Non-HVAC Motors - Variable Speed Control	9%	11%	14%	18%	20%	22%	24%	27%	29%	29%	29%	29%	29%	29%	29%	29%	29%	29%	29%	29%	29%
Pool Pump - Timer	9%	12%	15%	18%	20%	23%	25%	27%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%

Table E-9 Industrial—Equipment Measures MARs

End Use	Technology	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
Cooling	Roof Top AC	42%	48%	54%	60%	65%	70%	75%	80%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%
Cooling	Other Cooling	42%	48%	54%	60%	65%	70%	75%	80%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%
Heating	Electric Heating	42%	48%	54%	60%	65%	70%	75%	80%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%
Cooling/Heating	Roof Top Heat Pump	42%	48%	54%	60%	65%	70%	75%	80%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%
Ventilation	Ventilation	42%	48%	54%	60%	65%	70%	75%	80%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%
Interior Lighting	Screw-in	56%	59%	62%	65%	69%	73%	77%	81%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%
Interior Lighting	High-Bay Fixtures	56%	59%	62%	65%	69%	73%	77%	81%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%
Interior Lighting	Linear Fluorescent	56%	59%	62%	65%	69%	73%	77%	81%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%
Exterior Lighting	Screw-in	56%	59%	62%	65%	69%	73%	77%	81%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%
Exterior Lighting	HID	56%	59%	62%	65%	69%	73%	77%	81%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%
Exterior Lighting	Linear Fluorescent	56%	59%	62%	65%	69%	73%	77%	81%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%
Motors	1-5 HP	60%	65%	70%	75%	79%	83%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%
Motors	6-20 HP	60%	65%	70%	75%	79%	83%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%
Motors	21-50 HP	60%	65%	70%	75%	79%	83%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%
Motors	51-100 HP	60%	65%	70%	75%	79%	83%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%
Motors	101-200 HP	60%	65%	70%	75%	79%	83%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%
Motors	201-500 HP	60%	65%	70%	75%	79%	83%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%
Motors	501-1000 HP	60%	65%	70%	75%	79%	83%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%
Motors	1000+ HP	60%	65%	70%	75%	79%	83%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%
Process Heating	Process Heating	29%	31%	33%	35%	38%	41%	44%	47%	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%
Miscellaneous	Miscellaneous	29%	31%	33%	35%	38%	41%	44%	47%	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%

Table E-10 Industrial—Equipment Measures MARs x PIFs

End Use	Technology	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
Cooling	Roof Top AC	13%	17%	22%	28%	31%	34%	37%	41%	44%	44%	44%	44%	44%	44%	44%	44%	44%	44%	44%	44%	44%
Cooling	Other Cooling	13%	17%	22%	28%	31%	34%	37%	41%	44%	44%	44%	44%	44%	44%	44%	44%	44%	44%	44%	44%	44%
Heating	Electric Heating	13%	17%	22%	28%	31%	34%	37%	41%	44%	44%	44%	44%	44%	44%	44%	44%	44%	44%	44%	44%	44%
Cooling/Heating	Roof Top Heat Pump	13%	17%	22%	28%	31%	34%	37%	41%	44%	44%	44%	44%	44%	44%	44%	44%	44%	44%	44%	44%	44%
Ventilation	Ventilation	13%	17%	22%	28%	31%	34%	37%	41%	44%	44%	44%	44%	44%	44%	44%	44%	44%	44%	44%	44%	44%
Interior Lighting	Screw-in	19%	24%	28%	33%	36%	40%	43%	46%	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%
Interior Lighting	High-Bay Fixtures	19%	24%	28%	33%	36%	40%	43%	46%	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%
Interior Lighting	Linear Fluorescent	19%	24%	28%	33%	36%	40%	43%	46%	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%
Exterior Lighting	Screw-in	19%	24%	28%	33%	36%	40%	43%	46%	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%
Exterior Lighting	HID	19%	24%	28%	33%	36%	40%	43%	46%	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%
Exterior Lighting	Linear Fluorescent	19%	24%	28%	33%	36%	40%	43%	46%	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%
Motors	1-5 HP	20%	25%	30%	36%	39%	42%	44%	46%	47%	47%	47%	47%	47%	47%	47%	47%	47%	47%	47%	47%	47%
Motors	6-20 HP	20%	25%	30%	36%	39%	42%	44%	46%	47%	47%	47%	47%	47%	47%	47%	47%	47%	47%	47%	47%	47%
Motors	21-50 HP	20%	25%	30%	36%	39%	42%	44%	46%	47%	47%	47%	47%	47%	47%	47%	47%	47%	47%	47%	47%	47%
Motors	51-100 HP	20%	25%	30%	36%	39%	42%	44%	46%	47%	47%	47%	47%	47%	47%	47%	47%	47%	47%	47%	47%	47%
Motors	101-200 HP	20%	25%	30%	36%	39%	42%	44%	46%	47%	47%	47%	47%	47%	47%	47%	47%	47%	47%	47%	47%	47%
Motors	201-500 HP	20%	25%	30%	36%	39%	42%	44%	46%	47%	47%	47%	47%	47%	47%	47%	47%	47%	47%	47%	47%	47%
Motors	501-1000 HP	20%	25%	30%	36%	39%	42%	44%	46%	47%	47%	47%	47%	47%	47%	47%	47%	47%	47%	47%	47%	47%
Motors	1000+ HP	20%	25%	30%	36%	39%	42%	44%	46%	47%	47%	47%	47%	47%	47%	47%	47%	47%	47%	47%	47%	47%
Process Heating	Process Heating	9%	11%	14%	16%	18%	20%	22%	24%	26%	26%	26%	26%	26%	26%	26%	26%	26%	26%	26%	26%	26%
Miscellaneous	Miscellaneous	6%	8%	9%	11%	12%	13%	15%	16%	18%	18%	18%	18%	18%	18%	18%	18%	18%	18%	18%	18%	18%

Table E-11 Industrial—Other Measures MARs

Technology	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
Air Compressor Demand Reduction	60%	65%	70%	75%	79%	83%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%
Air Compressor Equipment2	60%	65%	70%	75%	79%	83%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%
Energy Project Management	29%	31%	33%	35%	38%	41%	44%	47%	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%
Fan Energy Management	60%	65%	70%	75%	79%	83%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%
Fan Equipment Upgrade	60%	65%	70%	75%	79%	83%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%
Fan System Optimization	60%	65%	70%	75%	79%	83%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%
Integrated Plant Energy Management	60%	65%	70%	75%	79%	83%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%
Lighting Controls	56%	59%	62%	65%	69%	73%	77%	81%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%
Motors: Rewind 20-50 HP	60%	65%	70%	75%	79%	83%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%
Motors: Rewind 51-100 HP	60%	65%	70%	75%	79%	83%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%
Motors: Rewind 101-200 HP	60%	65%	70%	75%	79%	83%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%
Motors: Rewind 201-500 HP	60%	65%	70%	75%	79%	83%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%
Motors: Rewind 501-1000 HP	60%	65%	70%	75%	79%	83%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%
Motors: Rewind 1000+ HP	60%	65%	70%	75%	79%	83%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%
Metal: New Arc Furnace	29%	31%	33%	35%	38%	41%	44%	47%	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%
Plant Energy Management	29%	31%	33%	35%	38%	41%	44%	47%	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%
Pump Energy Management	60%	65%	70%	75%	79%	83%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%
Pump Equipment Upgrade	60%	65%	70%	75%	79%	83%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%
Pump System Optimization	60%	65%	70%	75%	79%	83%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%
Synchronous Belts	60%	65%	70%	75%	79%	83%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%
Transformers-New	29%	31%	33%	35%	38%	41%	44%	47%	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%
Transformers-Retrofit	29%	31%	33%	35%	38%	41%	44%	47%	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%
Process Heating	29%	31%	33%	35%	38%	41%	44%	47%	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%
Custom Utility Programs - Misc	29%	31%	33%	35%	38%	41%	44%	47%	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%
Custom Utility Programs - Motors	60%	65%	70%	75%	79%	83%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%
Custom Utility Programs - Int Lighting	56%	59%	62%	65%	69%	73%	77%	81%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%
Custom Utility Programs - Cooling	42%	48%	54%	60%	65%	70%	75%	80%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%
Bi-Level Fixture w/Occupancy Sensor	56%	59%	62%	65%	69%	73%	77%	81%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%
Central Chiller - Chiller Water Reset	42%	48%	54%	60%	65%	70%	75%	80%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%
Central Chiller - Economizer	42%	48%	54%	60%	65%	70%	75%	80%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%
Central Chiller - High Efficiency Fans	42%	48%	54%	60%	65%	70%	75%	80%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%
Central Chiller - Maintenance	42%	48%	54%	60%	65%	70%	75%	80%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%
Central Chiller - Temperature Reset	42%	48%	54%	60%	65%	70%	75%	80%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%
Central Chiller - VSD	42%	48%	54%	60%	65%	70%	75%	80%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%
Clock/Programmable Thermostat	42%	48%	54%	60%	65%	70%	75%	80%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%
Daylighting Controls - Photocell Controlled Dimming Ballasts	56%	59%	62%	65%	69%	73%	77%	81%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%
Delamp and Install Reflectors	56%	59%	62%	65%	69%	73%	77%	81%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%
Energy Management System	42%	48%	54%	60%	65%	70%	75%	80%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%
Heat Pump - Maintenance	42%	48%	54%	60%	65%	70%	75%	80%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%
HVAC - Duct Insulation	42%	48%	54%	60%	65%	70%	75%	80%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%

Technology	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
HVAC - Duct Repair and Sealing	42%	48%	54%	60%	65%	70%	75%	80%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%
Insulation - Ceiling	42%	48%	54%	60%	65%	70%	75%	80%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%
Insulation - Wall Cavity	42%	48%	54%	60%	65%	70%	75%	80%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%
LED Exit Lighting	56%	59%	62%	65%	69%	73%	77%	81%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%
Machine Drive - Pumping System Controls	60%	65%	70%	75%	79%	83%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%
Machine Drive - Pumping System Maintenance	60%	65%	70%	75%	79%	83%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%
Machine Drive - Pumping System Optimization	60%	65%	70%	75%	79%	83%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%
Occupancy Sensors	56%	59%	62%	65%	69%	73%	77%	81%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%
Process - Compressed Air System Controls	60%	65%	70%	75%	79%	83%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%
Process - Compressed Air System Maintenance	60%	65%	70%	75%	79%	83%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%
Process - Compressed Air System Optimization and Improvements	60%	65%	70%	75%	79%	83%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%
Process - Fan System Controls	60%	65%	70%	75%	79%	83%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%
Process - Fan System Maintenance	60%	65%	70%	75%	79%	83%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%
Process - Fan System Optimization	60%	65%	70%	75%	79%	83%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%
Refrigeration System Controls	29%	31%	33%	35%	38%	41%	44%	47%	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%
Refrigeration System Maintenance	29%	31%	33%	35%	38%	41%	44%	47%	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%
Refrigeration System Optimization	29%	31%	33%	35%	38%	41%	44%	47%	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%
Roofs - High Reflectivity	42%	48%	54%	60%	65%	70%	75%	80%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%
RTU - Maintenance	42%	48%	54%	60%	65%	70%	75%	80%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%
Task Lighting	56%	59%	62%	65%	69%	73%	77%	81%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%
Time Clocks and Timers	56%	59%	62%	65%	69%	73%	77%	81%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%
Ventilation - C02 Controls	42%	48%	54%	60%	65%	70%	75%	80%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%

Table E-12 Industrial—Other Measures MARs x PIFs

Technology	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
Air Compressor Demand Reduction	13%	16%	20%	23%	25%	27%	28%	29%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%
Air Compressor Equipment2	13%	16%	20%	23%	25%	27%	28%	29%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%
Energy Project Management	9%	11%	14%	16%	18%	20%	22%	24%	26%	26%	26%	26%	26%	26%	26%	26%	26%	26%	26%	26%	26%
Fan Energy Management	13%	16%	20%	23%	25%	27%	28%	29%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%
Fan Equipment Upgrade	20%	25%	30%	36%	39%	42%	44%	46%	47%	47%	47%	47%	47%	47%	47%	47%	47%	47%	47%	47%	47%
Fan System Optimization	13%	16%	20%	23%	25%	27%	28%	29%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%
Integrated Plant Energy Management	19%	24%	29%	35%	37%	40%	42%	43%	44%	44%	44%	44%	44%	44%	44%	44%	44%	44%	44%	44%	44%
Lighting Controls	16%	19%	22%	26%	28%	31%	33%	36%	38%	38%	38%	38%	38%	38%	38%	38%	38%	38%	38%	38%	38%
Motors: Rewind 20-50 HP	20%	25%	30%	36%	39%	42%	44%	46%	47%	47%	47%	47%	47%	47%	47%	47%	47%	47%	47%	47%	47%
Motors: Rewind 51-100 HP	20%	25%	30%	36%	39%	42%	44%	46%	47%	47%	47%	47%	47%	47%	47%	47%	47%	47%	47%	47%	47%
Motors: Rewind 101-200 HP	20%	25%	30%	36%	39%	42%	44%	46%	47%	47%	47%	47%	47%	47%	47%	47%	47%	47%	47%	47%	47%
Motors: Rewind 201-500 HP	20%	25%	30%	36%	39%	42%	44%	46%	47%	47%	47%	47%	47%	47%	47%	47%	47%	47%	47%	47%	47%
Motors: Rewind 501-1000 HP	20%	25%	30%	36%	39%	42%	44%	46%	47%	47%	47%	47%	47%	47%	47%	47%	47%	47%	47%	47%	47%
Motors: Rewind 1000+ HP	20%	25%	30%	36%	39%	42%	44%	46%	47%	47%	47%	47%	47%	47%	47%	47%	47%	47%	47%	47%	47%
Metal: New Arc Furnace	6%	8%	9%	11%	12%	13%	15%	16%	18%	18%	18%	18%	18%	18%	18%	18%	18%	18%	18%	18%	18%
Plant Energy Management	9%	11%	14%	16%	18%	20%	22%	24%	26%	26%	26%	26%	26%	26%	26%	26%	26%	26%	26%	26%	26%
Pump Energy Management	13%	17%	20%	24%	26%	28%	29%	30%	31%	31%	31%	31%	31%	31%	31%	31%	31%	31%	31%	31%	31%
Pump Equipment Upgrade	20%	25%	30%	36%	39%	42%	44%	46%	47%	47%	47%	47%	47%	47%	47%	47%	47%	47%	47%	47%	47%
Pump System Optimization	13%	17%	20%	24%	26%	28%	29%	30%	31%	31%	31%	31%	31%	31%	31%	31%	31%	31%	31%	31%	31%
Synchronous Belts	13%	16%	20%	23%	25%	27%	28%	29%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%
Transformers-New	6%	8%	9%	11%	12%	13%	15%	16%	18%	18%	18%	18%	18%	18%	18%	18%	18%	18%	18%	18%	18%
Transformers-Retrofit	6%	8%	9%	11%	12%	13%	15%	16%	18%	18%	18%	18%	18%	18%	18%	18%	18%	18%	18%	18%	18%
Process Heating	6%	8%	10%	11%	12%	14%	15%	17%	18%	18%	18%	18%	18%	18%	18%	18%	18%	18%	18%	18%	18%
Custom Utility Programs - Misc	6%	8%	9%	11%	12%	13%	15%	16%	18%	18%	18%	18%	18%	18%	18%	18%	18%	18%	18%	18%	18%
Custom Utility Programs - Motors	20%	25%	30%	36%	39%	42%	44%	46%	47%	47%	47%	47%	47%	47%	47%	47%	47%	47%	47%	47%	47%
Custom Utility Programs - Int Lighting	19%	24%	28%	33%	36%	40%	43%	46%	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%
Custom Utility Programs - Cooling	13%	17%	22%	28%	31%	34%	37%	41%	44%	44%	44%	44%	44%	44%	44%	44%	44%	44%	44%	44%	44%
Bi-Level Fixture w/Occupancy Sensor	16%	19%	22%	26%	28%	31%	33%	36%	38%	38%	38%	38%	38%	38%	38%	38%	38%	38%	38%	38%	38%
Central Chiller - Chiller Water Reset	13%	17%	22%	28%	31%	34%	37%	41%	44%	44%	44%	44%	44%	44%	44%	44%	44%	44%	44%	44%	44%
Central Chiller - Economizer	10%	14%	17%	22%	24%	27%	29%	32%	35%	35%	35%	35%	35%	35%	35%	35%	35%	35%	35%	35%	35%
Central Chiller - High Efficiency Fans	13%	17%	21%	26%	29%	32%	36%	39%	43%	43%	43%	43%	43%	43%	43%	43%	43%	43%	43%	43%	43%
Central Chiller - Maintenance	13%	17%	21%	26%	29%	32%	36%	39%	43%	43%	43%	43%	43%	43%	43%	43%	43%	43%	43%	43%	43%
Central Chiller - Temperature Reset	12%	15%	19%	24%	27%	29%	32%	35%	38%	38%	38%	38%	38%	38%	38%	38%	38%	38%	38%	38%	38%
Central Chiller - VSD	9%	12%	15%	19%	21%	23%	25%	27%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%
Clock/Programmable Thermostat	13%	17%	22%	28%	31%	34%	37%	41%	44%	44%	44%	44%	44%	44%	44%	44%	44%	44%	44%	44%	44%
Daylighting Controls - Photocell Controlled Dimming Ballasts	16%	19%	22%	26%	28%	31%	33%	36%	38%	38%	38%	38%	38%	38%	38%	38%	38%	38%	38%	38%	38%
Delamp and Install Reflectors	16%	19%	22%	26%	28%	31%	33%	36%	38%	38%	38%	38%	38%	38%	38%	38%	38%	38%	38%	38%	38%
Energy Management System	13%	17%	22%	28%	31%	34%	37%	41%	44%	44%	44%	44%	44%	44%	44%	44%	44%	44%	44%	44%	44%
Heat Pump - Maintenance	13%	17%	21%	26%	29%	32%	36%	39%	43%	43%	43%	43%	43%	43%	43%	43%	43%	43%	43%	43%	43%
HVAC - Duct Insulation	12%	15%	19%	24%	27%	29%	32%	35%	38%	38%	38%	38%	38%	38%	38%	38%	38%	38%	38%	38%	38%

Technology	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
HVAC - Duct Repair and Sealing	12%	15%	19%	24%	27%	29%	32%	35%	38%	38%	38%	38%	38%	38%	38%	38%	38%	38%	38%	38%	38%
Insulation - Ceiling	12%	15%	19%	24%	27%	29%	32%	35%	38%	38%	38%	38%	38%	38%	38%	38%	38%	38%	38%	38%	38%
Insulation - Wall Cavity	12%	15%	19%	24%	27%	29%	32%	35%	38%	38%	38%	38%	38%	38%	38%	38%	38%	38%	38%	38%	38%
LED Exit Lighting	19%	24%	28%	33%	36%	40%	43%	46%	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%
Machine Drive - Pumping System Controls	13%	16%	20%	23%	25%	27%	28%	29%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%
Machine Drive - Pumping System Maintenance	18%	23%	28%	33%	36%	39%	40%	41%	43%	43%	43%	43%	43%	43%	43%	43%	43%	43%	43%	43%	43%
Machine Drive - Pumping System Optimization	13%	16%	20%	23%	25%	27%	28%	29%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%
Occupancy Sensors	16%	19%	22%	26%	28%	31%	33%	36%	38%	38%	38%	38%	38%	38%	38%	38%	38%	38%	38%	38%	38%
Process - Compressed Air System Controls	13%	16%	20%	23%	25%	27%	28%	29%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%
Process - Compressed Air System Maintenance	18%	23%	28%	33%	36%	39%	40%	41%	43%	43%	43%	43%	43%	43%	43%	43%	43%	43%	43%	43%	43%
Process - Compressed Air System Optimization and Improvements	13%	16%	20%	23%	25%	27%	28%	29%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%
Process - Fan System Controls	13%	16%	20%	23%	25%	27%	28%	29%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%
Process - Fan System Maintenance	18%	23%	28%	33%	36%	39%	40%	41%	43%	43%	43%	43%	43%	43%	43%	43%	43%	43%	43%	43%	43%
Process - Fan System Optimization	13%	16%	20%	23%	25%	27%	28%	29%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%
Refrigeration System Controls	6%	8%	9%	11%	12%	13%	15%	16%	18%	18%	18%	18%	18%	18%	18%	18%	18%	18%	18%	18%	18%
Refrigeration System Maintenance	9%	11%	13%	15%	17%	19%	21%	23%	25%	25%	25%	25%	25%	25%	25%	25%	25%	25%	25%	25%	25%
Refrigeration System Optimization	6%	8%	9%	11%	12%	13%	15%	16%	18%	18%	18%	18%	18%	18%	18%	18%	18%	18%	18%	18%	18%
Roofs - High Reflectivity	9%	12%	15%	19%	21%	23%	25%	27%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%
RTU - Maintenance	13%	17%	21%	26%	29%	32%	36%	39%	43%	43%	43%	43%	43%	43%	43%	43%	43%	43%	43%	43%	43%
Task Lighting	19%	24%	28%	33%	36%	40%	43%	46%	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%
Time Clocks and Timers	16%	19%	22%	26%	28%	31%	33%	36%	38%	38%	38%	38%	38%	38%	38%	38%	38%	38%	38%	38%	38%
Ventilation - C02 Controls	9%	12%	16%	19%	21%	24%	26%	28%	31%	31%	31%	31%	31%	31%	31%	31%	31%	31%	31%	31%	31%

APPENDIX | **F**

ANNUAL SAVINGS

This section presents the estimates of annual savings. Selected years are shown in Chapter 6 of the report. Table F-1 shows the overall annual savings, while Table F-2 through Table F-4 show the annual savings by sector.

Table F-1 Total Annual Savings

	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Baseline Forecast	146,118	149,336	145,637	146,505	147,211	148,446	148,692	149,412	150,636	152,982	154,584
Cumulative Savings (GWh)											
Achievable - Low	-	-	-	811	1,757	2,555	3,256	4,030	4,852	5,783	6,819
Achievable - High	-	-	-	2,417	4,756	6,432	7,494	8,637	9,972	11,566	13,369
Economic	-	-	-	4,481	8,550	11,224	12,418	13,530	15,008	17,000	19,338
Technical	-	-	-	5,349	10,182	13,587	15,347	17,026	19,103	21,719	24,525
Cumulative Savings (% of Baseline)											
Achievable - Low	0.0%	0.0%	0.0%	0.6%	1.2%	1.7%	2.2%	2.7%	3.2%	3.8%	4.4%
Achievable - High	0.0%	0.0%	0.0%	1.7%	3.2%	4.3%	5.0%	5.8%	6.6%	7.6%	8.6%
Economic	0.0%	0.0%	0.0%	3.1%	5.8%	7.6%	8.4%	9.1%	10.0%	11.1%	12.5%
Technical	0.0%	0.0%	0.0%	3.7%	6.9%	9.2%	10.3%	11.4%	12.7%	14.2%	15.9%
Incremental Savings (GWh)											
Achievable - Low	-	-	-	811	946	798	701	774	823	931	1,036
Achievable - High	-	-	-	2,417	2,339	1,676	1,062	1,143	1,335	1,594	1,803
Economic	-	-	-	4,481	4,069	2,673	1,195	1,112	1,477	1,993	2,338
Technical	-	-	-	5,349	4,833	3,405	1,759	1,679	2,077	2,617	2,806
Incremental Savings (% of Baseline)											
Achievable - Low	0.0%	0.0%	0.0%	0.6%	0.6%	0.5%	0.5%	0.5%	0.5%	0.6%	0.7%
Achievable - High	0.0%	0.0%	0.0%	1.7%	1.6%	1.1%	0.7%	0.8%	0.9%	1.0%	1.2%
Economic	0.0%	0.0%	0.0%	3.1%	2.8%	1.8%	0.8%	0.7%	1.0%	1.3%	1.5%
Technical	0.0%	0.0%	0.0%	3.7%	3.3%	2.3%	1.2%	1.1%	1.4%	1.7%	1.8%

	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Baseline Forecast	156,243	158,260	160,502	162,551	164,953	167,462	170,065	172,657	175,374	178,245	180,959
Cumulative Savings (GWh)											
Achievable - Low	7,963	9,071	10,157	11,197	12,283	13,420	14,548	15,708	16,842	17,986	19,093
Achievable - High	15,337	17,352	19,270	21,127	23,131	25,215	27,327	29,492	31,624	33,723	35,781
Economic	21,658	24,093	26,220	28,297	30,663	33,091	35,591	37,981	40,304	42,562	44,821
Technical	27,545	30,785	33,743	36,549	39,646	42,822	46,083	49,031	51,865	54,609	57,244
Cumulative Savings (% of Baseline)											
Achievable - Low	5.1%	5.7%	6.3%	6.9%	7.4%	8.0%	8.6%	9.1%	9.6%	10.1%	10.6%
Achievable - High	9.8%	11.0%	12.0%	13.0%	14.0%	15.1%	16.1%	17.1%	18.0%	18.9%	19.8%
Economic	13.9%	15.2%	16.3%	17.4%	18.6%	19.8%	20.9%	22.0%	23.0%	23.9%	24.8%
Technical	17.6%	19.5%	21.0%	22.5%	24.0%	25.6%	27.1%	28.4%	29.6%	30.6%	31.6%
Incremental Savings (GWh)											
Achievable - Low	1,145	1,108	1,085	1,041	1,086	1,136	1,128	1,160	1,134	1,144	1,107
Achievable - High	1,968	2,014	1,919	1,856	2,004	2,085	2,112	2,165	2,132	2,099	2,059
Economic	2,320	2,435	2,127	2,077	2,367	2,428	2,499	2,390	2,324	2,257	2,259
Technical	3,020	3,240	2,958	2,805	3,097	3,176	3,261	2,948	2,834	2,743	2,635
Incremental Savings (% of Baseline)											
Achievable - Low	0.7%	0.7%	0.7%	0.6%	0.7%	0.7%	0.7%	0.7%	0.6%	0.6%	0.6%
Achievable - High	1.3%	1.3%	1.2%	1.1%	1.2%	1.2%	1.2%	1.3%	1.2%	1.2%	1.1%
Economic	1.5%	1.5%	1.3%	1.3%	1.4%	1.5%	1.5%	1.4%	1.3%	1.3%	1.2%
Technical	1.9%	2.0%	1.8%	1.7%	1.9%	1.9%	1.9%	1.7%	1.6%	1.5%	1.5%

Table F-2 Residential Annual Savings

	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Baseline Forecast	62,246	63,888	61,140	61,936	62,400	63,109	62,932	63,106	63,565	64,807	65,682
Cumulative Savings (GWh)											
Achievable - Low	-	-	-	384	851	1,208	1,444	1,727	2,062	2,440	2,871
Achievable - High	-	-	-	1,107	2,263	3,054	3,356	3,719	4,254	4,942	5,788
Economic	-	-	-	2,045	4,174	5,616	5,955	6,288	6,945	7,971	9,287
Technical	-	-	-	2,562	5,233	7,144	7,795	8,431	9,419	10,799	12,322
Cumulative Savings (% of Baseline)											
Achievable - Low	0.0%	0.0%	0.0%	0.6%	1.4%	1.9%	2.3%	2.7%	3.2%	3.8%	4.4%
Achievable - High	0.0%	0.0%	0.0%	1.8%	3.6%	4.8%	5.3%	5.9%	6.7%	7.6%	8.8%
Economic	0.0%	0.0%	0.0%	3.3%	6.7%	8.9%	9.5%	10.0%	10.9%	12.3%	14.1%
Technical	0.0%	0.0%	0.0%	4.1%	8.4%	11.3%	12.4%	13.4%	14.8%	16.7%	18.8%
Incremental Savings (GWh)											
Achievable - Low				384	468	357	236	282	335	378	431
Achievable - High				1,107	1,156	791	301	363	535	688	847
Economic				2,045	2,130	1,441	339	333	657	1,026	1,316
Technical				2,562	2,671	1,911	651	636	988	1,380	1,523
Incremental Savings (% of Baseline)											
Achievable - Low	0.0%	0.0%	0.0%	0.6%	0.7%	0.6%	0.4%	0.4%	0.5%	0.6%	0.7%
Achievable - High	0.0%	0.0%	0.0%	1.8%	1.9%	1.3%	0.5%	0.6%	0.8%	1.1%	1.3%
Economic	0.0%	0.0%	0.0%	3.3%	3.4%	2.3%	0.5%	0.5%	1.0%	1.6%	2.0%
Technical	0.0%	0.0%	0.0%	4.1%	4.3%	3.0%	1.0%	1.0%	1.6%	2.1%	2.3%

	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Baseline Forecast	66,440	67,563	69,022	70,302	71,910	73,613	75,419	77,232	79,150	81,112	82,830
Cumulative Savings (GWh)											
Achievable - Low	3,216	3,623	4,111	4,554	5,089	5,652	6,185	6,746	7,277	7,813	8,307
Achievable - High	6,445	7,237	8,167	8,995	9,975	10,961	11,935	12,953	13,928	14,882	15,759
Economic	10,185	11,186	12,260	13,191	14,356	15,483	16,668	17,755	18,749	19,675	20,540
Technical	13,629	15,066	16,583	17,941	19,522	21,078	22,665	23,957	25,165	26,295	27,274
Cumulative Savings (% of Baseline)											
Achievable - Low	4.8%	5.4%	6.0%	6.5%	7.1%	7.7%	8.2%	8.7%	9.2%	9.6%	10.0%
Achievable - High	9.7%	10.7%	11.8%	12.8%	13.9%	14.9%	15.8%	16.8%	17.6%	18.3%	19.0%
Economic	15.3%	16.6%	17.8%	18.8%	20.0%	21.0%	22.1%	23.0%	23.7%	24.3%	24.8%
Technical	20.5%	22.3%	24.0%	25.5%	27.1%	28.6%	30.1%	31.0%	31.8%	32.4%	32.9%
Incremental Savings (GWh)											
Achievable - Low	345	407	488	443	534	564	532	561	531	536	494
Achievable - High	656	792	930	827	980	986	974	1,018	976	954	877
Economic	898	1,002	1,073	932	1,164	1,128	1,185	1,087	993	926	865
Technical	1,306	1,437	1,517	1,358	1,581	1,557	1,587	1,292	1,208	1,130	979
Incremental Savings (% of Baseline)											
Achievable - Low	0.5%	0.6%	0.7%	0.6%	0.7%	0.8%	0.7%	0.7%	0.7%	0.7%	0.6%
Achievable - High	1.0%	1.2%	1.3%	1.2%	1.4%	1.3%	1.3%	1.3%	1.2%	1.2%	1.1%
Economic	1.4%	1.5%	1.6%	1.3%	1.6%	1.5%	1.6%	1.4%	1.3%	1.1%	1.0%
Technical	2.0%	2.1%	2.2%	1.9%	2.2%	2.1%	2.1%	1.7%	1.5%	1.4%	1.2%

Table F-3 Commercial Annual Savings

	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Baseline Forecast	39,561	40,688	38,537	38,176	37,817	37,771	37,587	37,726	37,898	38,430	38,721
Cumulative Savings (GWh)											
Achievable - Low	-	-	-	228	515	749	985	1,265	1,519	1,829	2,188
Achievable - High	-	-	-	660	1,373	1,824	2,181	2,587	2,975	3,462	4,008
Economic	-	-	-	1,244	2,454	3,088	3,475	3,883	4,304	4,835	5,398
Technical	-	-	-	1,460	2,828	3,649	4,221	4,822	5,439	6,158	6,900
Cumulative Savings (% of Baseline)											
Achievable - Low	0.0%	0.0%	0.0%	0.6%	1.4%	2.0%	2.6%	3.4%	4.0%	4.8%	5.6%
Achievable - High	0.0%	0.0%	0.0%	1.7%	3.6%	4.8%	5.8%	6.9%	7.9%	9.0%	10.4%
Economic	0.0%	0.0%	0.0%	3.3%	6.5%	8.2%	9.2%	10.3%	11.4%	12.6%	13.9%
Technical	0.0%	0.0%	0.0%	3.8%	7.5%	9.7%	11.2%	12.8%	14.4%	16.0%	17.8%
Incremental Savings (GWh)											
Achievable - Low	-	-	-	228	287	234	236	280	254	310	358
Achievable - High	-	-	-	660	713	451	357	406	388	487	546
Economic	-	-	-	1,244	1,210	634	387	409	421	531	563
Technical	-	-	-	1,460	1,368	822	572	601	617	718	742
Incremental Savings (% of Baseline)											
Achievable - Low	0.0%	0.0%	0.0%	0.6%	0.8%	0.6%	0.6%	0.7%	0.7%	0.8%	0.9%
Achievable - High	0.0%	0.0%	0.0%	1.7%	1.9%	1.2%	1.0%	1.1%	1.0%	1.3%	1.4%
Economic	0.0%	0.0%	0.0%	3.3%	3.2%	1.7%	1.0%	1.1%	1.1%	1.4%	1.5%
Technical	0.0%	0.0%	0.0%	3.8%	3.6%	2.2%	1.5%	1.6%	1.6%	1.9%	1.9%

	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Baseline Forecast	39,026	39,343	39,802	40,307	40,881	41,485	42,096	42,734	43,376	44,034	44,718
Cumulative Savings (GWh)											
Achievable - Low	2,613	2,954	3,273	3,586	3,868	4,163	4,460	4,748	5,028	5,296	5,557
Achievable - High	4,693	5,271	5,791	6,326	6,851	7,419	7,997	8,556	9,104	9,618	10,130
Economic	6,106	6,767	7,302	7,877	8,483	9,145	9,792	10,395	10,994	11,563	12,142
Technical	7,795	8,717	9,539	10,332	11,157	12,033	12,921	13,764	14,559	15,312	16,053
Cumulative Savings (% of Baseline)											
Achievable - Low	6.7%	7.5%	8.2%	8.9%	9.5%	10.0%	10.6%	11.1%	11.6%	12.0%	12.4%
Achievable - High	12.0%	13.4%	14.5%	15.7%	16.8%	17.9%	19.0%	20.0%	21.0%	21.8%	22.7%
Economic	15.6%	17.2%	18.3%	19.5%	20.8%	22.0%	23.3%	24.3%	25.3%	26.3%	27.2%
Technical	20.0%	22.2%	24.0%	25.6%	27.3%	29.0%	30.7%	32.2%	33.6%	34.8%	35.9%
Incremental Savings (GWh)											
Achievable - Low	425	341	318	314	282	295	297	288	280	269	261
Achievable - High	685	578	520	535	525	569	577	560	548	514	512
Economic	708	661	535	575	606	662	647	603	599	569	580
Technical	895	922	822	793	825	876	888	843	795	752	741
Incremental Savings (% of Baseline)											
Achievable - Low	1.1%	0.9%	0.8%	0.8%	0.7%	0.7%	0.7%	0.7%	0.6%	0.6%	0.6%
Achievable - High	1.8%	1.5%	1.3%	1.3%	1.3%	1.4%	1.4%	1.3%	1.3%	1.2%	1.1%
Economic	1.8%	1.7%	1.3%	1.4%	1.5%	1.6%	1.5%	1.4%	1.4%	1.3%	1.3%
Technical	2.3%	2.3%	2.1%	2.0%	2.0%	2.1%	2.1%	2.0%	1.8%	1.7%	1.7%

Table F-4 Industrial Annual Savings

	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Baseline Forecast	44,311	44,760	45,960	46,394	46,994	47,565	48,173	48,580	49,173	49,745	50,182
Cumulative Savings (GWh)											
Achievable - Low	-	-	-	199	391	598	826	1,038	1,272	1,514	1,760
Achievable - High	-	-	-	651	1,120	1,553	1,957	2,331	2,742	3,162	3,573
Economic	-	-	-	1,192	1,922	2,520	2,989	3,359	3,759	4,195	4,653
Technical	-	-	-	1,327	2,121	2,794	3,330	3,773	4,244	4,763	5,303
Cumulative Savings (% of Baseline)											
Achievable - Low	0.0%	0.0%	0.0%	0.4%	0.8%	1.3%	1.7%	2.1%	2.6%	3.0%	3.5%
Achievable - High	0.0%	0.0%	0.0%	1.4%	2.4%	3.3%	4.1%	4.8%	5.6%	6.4%	7.1%
Economic	0.0%	0.0%	0.0%	2.6%	4.1%	5.3%	6.2%	6.9%	7.6%	8.4%	9.3%
Technical	0.0%	0.0%	0.0%	2.9%	4.5%	5.9%	6.9%	7.8%	8.6%	9.6%	10.6%
Incremental Savings (GWh)											
Achievable - Low	-	-	-	199	192	208	228	212	234	242	246
Achievable - High	-	-	-	651	469	433	404	374	411	420	410
Economic	-	-	-	1,192	730	598	469	370	400	436	458
Technical	-	-	-	1,327	794	672	536	442	472	518	541
Incremental Savings (% of Baseline)											
Achievable - Low	0.0%	0.0%	0.0%	0.4%	0.4%	0.4%	0.5%	0.4%	0.5%	0.5%	0.5%
Achievable - High	0.0%	0.0%	0.0%	1.4%	1.0%	0.9%	0.8%	0.8%	0.8%	0.8%	0.8%
Economic	0.0%	0.0%	0.0%	2.6%	1.6%	1.3%	1.0%	0.8%	0.8%	0.9%	0.9%
Technical	0.0%	0.0%	0.0%	2.9%	1.7%	1.4%	1.1%	0.9%	1.0%	1.0%	1.1%

	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Baseline Forecast	50,777	51,354	51,678	51,941	52,162	52,364	52,550	52,691	52,849	53,100	53,412
Cumulative Savings (GWh)											
Achievable - Low	2,134	2,494	2,773	3,057	3,327	3,604	3,902	4,214	4,537	4,877	5,229
Achievable - High	4,199	4,844	5,312	5,805	6,304	6,835	7,396	7,983	8,591	9,222	9,892
Economic	5,367	6,140	6,658	7,228	7,824	8,463	9,130	9,830	10,562	11,324	12,139
Technical	6,121	7,002	7,622	8,277	8,968	9,712	10,498	11,310	12,141	13,002	13,917
Cumulative Savings (% of Baseline)											
Achievable - Low	4.2%	4.9%	5.4%	5.9%	6.4%	6.9%	7.4%	8.0%	8.6%	9.2%	9.8%
Achievable - High	8.3%	9.4%	10.3%	11.2%	12.1%	13.1%	14.1%	15.2%	16.3%	17.4%	18.5%
Economic	10.6%	12.0%	12.9%	13.9%	15.0%	16.2%	17.4%	18.7%	20.0%	21.3%	22.7%
Technical	12.1%	13.6%	14.7%	15.9%	17.2%	18.5%	20.0%	21.5%	23.0%	24.5%	26.1%
Incremental Savings (GWh)											
Achievable - Low	374	360	279	284	270	277	298	311	324	339	353
Achievable - High	627	644	468	493	499	530	561	587	608	631	670
Economic	714	773	518	570	597	639	667	700	732	762	814
Technical	818	881	619	655	692	743	786	812	831	862	915
Incremental Savings (% of Baseline)											
Achievable - Low	0.7%	0.7%	0.5%	0.5%	0.5%	0.5%	0.6%	0.6%	0.6%	0.6%	0.7%
Achievable - High	1.2%	1.3%	0.9%	0.9%	1.0%	1.0%	1.1%	1.1%	1.2%	1.2%	1.3%
Economic	1.4%	1.5%	1.0%	1.1%	1.1%	1.2%	1.3%	1.3%	1.4%	1.4%	1.5%
Technical	1.6%	1.7%	1.2%	1.3%	1.3%	1.4%	1.5%	1.5%	1.6%	1.6%	1.7%

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Global Energy Partners,
500 Ygnacio Valley Road, Suite 450
Walnut Creek, CA 94596

P: 925.482.2000
F: 925.284.3147
E: globalhq@gepllc.com

TENNESSEE VALLEY AUTHORITY POTENTIAL STUDY

VOLUME 3: DEMAND RESPONSE POTENTIAL STUDY

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Global Energy Partners™
An EnerNOC Company

Global Energy Partners
An EnerNOC Company
500 Ygnacio Valley Road, Suite 450
Walnut Creek, CA 94596

P: 925.482.2000
F: 925.284.3147
E: gephq@gepllc.com

This report was prepared by

Global Energy Partners
An EnerNOC Company
500 Ygnacio Valley Blvd., Suite 450
Walnut Creek, CA 94596

Project Team:
I. Rohmund, Director
J. Borstein, Project Manager
D. Costenaro
A. Duer
D. Ghosh
K. Kolnowski
K. Marrin
F. Nguyen
A. Sanchez
S. Yoshida

Subcontractor*:*
The Brattle Group
353 Sacramento Street, Suite 1140
San Francisco, CA 94111

Dr. A. Faruqui
Dr. S. Sergici

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CHAPTER | 1

INTRODUCTION

Background

The Tennessee Valley Authority (TVA) has contracted with Global Energy Partners (Global) to conduct a potential study to assess 20-year potentials for energy efficiency (EE) and demand response (DR). TVA has an aspirational goal to lead the southeast in energy efficiency, and believes this leadership can be accomplished through the development and implementation of action plans for EE, DR, and end-use generation. This potential study will provide information to assist TVA in meeting that goal.

Toward this end, Global conducted a detailed, bottom-up assessment of the TVA market to deliver forecasts of energy use and peak demand, as well as forecasts of energy and peak-demand savings achievable through energy efficiency and demand response programs. The 20-year potentials study addresses the residential, small commercial, large commercial, and industrial sectors. Results of this task are discussed in two volumes, one for energy efficiency and one for demand response, as described below in the report organization.

Global also compared the results of the potential savings to those from existing regional potential studies that are specific to the Southeast and other select studies. This analysis, which appears in both the energy efficiency and demand response reports, also compares these potential studies with regard to methodology, assumptions, approaches, estimated baselines, technical performance, adoption, and program/regulatory context.

Objectives

Key objectives for the study include:

- Conduct a 20-year bottom-up energy efficiency potential study to determine the potential for specific energy efficiency measures to reduce the consumption and peak demand of electricity in the TVA service territory.
- Conduct a demand response potential study to determine the potential for reduction in peak demand through demand response programs.
- Compare the potential study results with other national and regional studies, including details regarding assumptions used to develop each of the studies.

Report Organization

This report is presented in 3 volumes as outlined below. This document is **Volume 3: Demand Response Potential Study**.

Volume 1, Executive Summary

Volume 2, Energy Efficiency Potential Study

Volume 3, Demand Response Potential Study

Abbreviations and Acronyms

Throughout the report we use several abbreviations and acronyms. Table 1-1 shows the abbreviation or acronym, along with what it stands for and a reference to the section in the report that defines the abbreviation or acronym.

Table 1-1 Explanation of Abbreviations and Acronyms

Acronym	Explanation
AMI	Advanced Metering Infrastructure
ARRA	American Recovery and Reinvestment Act
Auto-DR	Automated Demand Response
B/C Ratio	Benefit to Cost Ratio
C&I	Commercial and Industrial
CAC	Central Air Conditioning
CPP	Critical Peak Pricing
DLC	Direct Load Control
DOE	U.S. Department of Energy
DR	Demand Response
EBAU	Expanded Business as Usual
EE	Energy Efficiency
EM&V	Evaluation, Measurement and Verification
EMCS	Energy Management Control System
EUEA	Efficient Use of Energy Act
FERC	Federal Energy Regulatory Commission
ICAP	Installed Capacity
IOU	Investor Owned Utility
MW	Megawatt
NPV	Net Present Value
PCT	Programmable Communicating Thermostats
TRC	Total Resource Cost
WH	Water heater

CHAPTER | 2

ANALYSIS APPROACH AND DATA DEVELOPMENT

The analysis approach for estimating demand response potential is, by necessity, different from the approach used for energy efficiency. Energy efficiency can occur outside of utility programs to the extent that it is naturally occurring or technology driven; but can be enhanced and enabled by utility programs. Demand response, however, does not exist without a utility program. A program-by-program analysis is therefore at the core of a demand-response potential study. The basic steps used to perform this assessment are as follows:

1. ***Characterize the market.*** The first step is to segment the market into the relevant customer segments. The first level of segmentation is by sector: residential and C&I customers. Within residential customers, we further segment the population by describing housing types and presence of end uses (such as single family homes with central air conditioning (CAC) and electric water heating). For C&I customers, the next level of segmentation is based on the maximum demand values, typically following utility rate schedules.
2. ***Identify baseline forecast.*** The second step is to identify what the peak demand forecast will be, absent any DR programs, for both summer and winter in the TVA service territory.
3. ***Define relevant DR options.*** The next step is to identify applicable DR options for each customer segment. DR options include direct load control (DLC), curtailable, demand reduction, capacity reduction, load shifting, pricing, and voltage reduction programs. Each of these options is mapped to the applicable customer segments. For some options, such as DLC, specific end uses can be controlled and they are identified. Also, enabling technologies, such as programmable communicating thermostats (PCT) are identified by customer segment.
4. ***Outline DR program participation hierarchy.*** For each customer segment that has more than one DR option, the next step is to define the participation hierarchy. This accounts for program overlaps and ensures that cross-participation in DR events and double counting does not take place.
5. ***Develop program parameters.*** Program parameters include participation rates, number of participants equipped with enabling technology, unit load reduction impacts, attrition rates, and DR event participation rates. Cost data are also developed for the analysis, including program development costs, customer marketing and recruitment costs, technology costs, customer incentives, operation and maintenance (O&M) costs, and program administrative costs.
6. ***Estimate preliminary potential and assess cost-effectiveness.*** The final step is to estimate the load reduction potential associated with each of the DR options by customer segment, and also at the aggregate level across programs and segment. Utility-provided avoided capacity costs are used to assess benefits from DR programs.
7. ***Develop estimates of achievable potential.*** The final step is to estimate the load reduction potential associated with each of the DR options by customer segment, and also at the aggregate level across programs and segment. Achievable potential takes into account expected participation rates as well as cost-effectiveness of the program. For this study, we estimate a range of achievable potential:
    - Achievable – High assumes higher participation rates that result from application of industry best practices in program design, higher budget limits for implementation,

and does not incorporate the results of the cost effectiveness screen. Therefore, Achievable – High represents the upper bound of savings, regardless of cost.

- Achievable – Low assumes lower levels of participation as a result of limited budgets for program implementation and includes only those programs which pass the cost-effectiveness screen. Therefore the Achievable – Low represents a more realistic picture of DR potential given barriers to participation and cost constraints.

Unlike the energy-efficiency analysis, we do not consider "technical" or "economic" potential for demand response.

In the remainder of this chapter, we describe the analysis steps in more detail. We also present the key assumptions for estimating potential DR savings.

Market Characterization of Customer Segments

The market characterization is the first step in the potential assessment and provides insight into how TVA customers use energy. A variety of utility data is used to perform the market characterization including billing data, 8,760-hour load data by segment, energy consumption data, and recent appliance saturation survey data.

Before analyzing the customer load and energy data, billing data is used to segment the customers based on size and rate. The study divided the customers into residential and C&I segments with C&I customers further broken out into five subgroups:

1. Small C&I customers with a demand <= 50 kW
2. Medium C&I customers with a demand between 51 and 1,000 kW
3. Large C&I customers with a demand between 1,001 and 5,000 kW
4. Extra Large (X-Large) C&I customers with a demand greater than 5 MW
5. Direct serve customers (served directly by TVA) with a demand greater than 5 MW

The next step is to gain insight into the usage patterns of C&I customers by examining the 8,760-hour load data for 2009 provided by TVA for each of the six segments. Analyzing customer demand characteristics is important because customer demand at a given time determines how much load, on average, customers might be able to curtail. Table 2-1 presents total number of customers in each segment in 2009, the coincident demand for each customer segment (both summer and winter), and the average coincident demand per customer. Coincident demand refers to the MW (or kW) load for each segment (or customer) at the time of the seasonal peak. Residential customers have the greatest contribution to the system peak at 47% in the winter and 28% in the summer. Of the C&I customers medium C&I customers have the largest contribution with 22% in the summer and 16% in the winter. The X-large and direct serve customers combined also represent a significant proportion of coincident peak load concentrated in a relatively small number of customers. These initial observations indicate that the largest contributors to overall potential for DR will be among TVA's residential, medium C&I, and very large C&I customers.

Table 2-1 Customer Population by Entity (Number of Customers)

Customer Segment	Number of Customer Meters	Segment Peak (Summer MW)	Peak Per Customer Meter (Summer kW)	Segment Peak (Winter MW)	Peak Per Customer Meter (Winter kW)
Residential	3,857,699	12,954	3.4	17,017	4.4
Small C&I (<=50 kW)	636,496	2,147	3.4	1,596	2.5
Medium C&I (51-1,000 kW)	68,123	5,909	86.7	4,602	67.5
Large C&I (1,001-5,000 kW)	2,207	2,506	1,135	2,018	914
Extra Large C&I (> 5 MW)	442	1,947	4,406	2,235	5,057
Direct Serve (> 5 MW)	51	1,828	35,850	1,773	34,772
Total	**4,565,018**[1]	**27,292**		**29,241**	

Peak Demand Forecast

Global created a reference forecast for annual coincident peak demand, for each customer segment for the period 2010 through 2031. The reference forecast for peak demand is presented below in Table 2-2. Using the reference forecast as provided by TVA (below) and the 2009 base year values by segment (above in Table 2-1) we are able to create a reference forecast by customer segment.[2]

Table 2-2 TVA Peak Demand Forecast (MW)

	2012	2015	2020	2025	2030	% Increase 2012 to 2030
System Summer Peak	32,199	32,074	34,031	36,234	38,353	19%
System Winter Peak	32,886	31,252	33,145	35,284	37,390	14%

Customer Forecast

Global also created a reference forecast for the number of customers in each segment for the period 2010 through 2013. This forecast was then used to estimate participation rates in each segment, by program. The customer forecast was estimated by applying growth rates[3] to the 2009 base year customer counts in each segment. The base year values and selected forecast years are presented below in Table 2-3.

[1] Customer counts from TVPPA database for base year of 2009.

[2] The segment level peak demand forecast is created by calculating each classes contribution to the overall system peak in the base year as calculated from the 8760 load data provided by TVA and extending that ratio into the future applying it to the peak forecast in each subsequent year.

[3] Residential customer growth rates were provided by TVA. Non-residential customer growth rates were calculated as 80% of the growth in commercial square feet each year. This implies that increasing square footage by 1% results in a 0.8% increase in customer count. The growth rates were applied uniformly to all non-residential classes except X-large and Direct Serve. The growth rate for X-large and Direct serve customer is assumed to be half that of the Small, Medium, and Large customers.

Table 2-3 TVA Customer Forecast by Segment

	2009 Base Year	2012	2015	2020	2025	2030
Residential	3,857,699	3,897,654	4,061,899	4,333,480	4,596,330	4,854,904
Small C&I (<=50 kW)	636,496	637,635	653,150	691,757	733,184	774,155
Medium C&I (51-1,000 kW)	38,123	68,245	69,905	74,037	78,471	82,856
Large C&I (1,001-5,000 kW)	2,207	2,211	2,265	2,399	2,542	2,684
Extra Large C&I (> 5 MW)	442	442	448	461	474	488
Direct Serve (> 5 MW)	51	51	52	53	55	56

Demand Response Options

For this study, a broad set of demand response options that combines traditional and emerging approaches was identified. They fall into eight groups: direct load control programs, curtailable programs, demand and capacity reduction programs, dynamic pricing programs, aggregator managed programs, load shifting programs, voltage regulation programs, and fast-DR. Table 2-4 translates the eight groups into eleven specific options by customer segment and identifies the enabling technology options and targeted end uses for each.

Table 2-4 Relevant DR Options Matrix

Demand Response Option	Brief Description	Eligible Customer Segments	Targeted End Uses
Residential Direct Load Control	Traditional DLC program utilizing either load control switches or programmable thermostats	Single Family residential customers with CAC, Water Heating, or Space Heating	CAC, Water Heating, Space Heating
C&I Direct Load Control	Traditional DLC program utilizing either load control switches or programmable thermostats	Small C&I customers with CAC, Water Heating, or Space Heating	CAC, Water Heating, Space Heating
Capacity Reduction	Voluntary load nomination program with capacity credits and energy credits	Small C&I, Medium C&I, Large C&I, Extra Large C&I (except 5&60 MR, > 500kW), Direct Serve	Customer Specific
Demand Reduction	Voluntary load nomination program with energy credits	Extra Large C&I, Direct Serve	Customer Specific
Curtailable	Contractual commitment to reduce load to a pre-specified level; capacity credits and non-performance provisions apply	Extra Large C&I, Direct Serve	Customer Specific
Dynamic Pricing	Voluntary time-variant pricing tariff (i.e., CPP)	Residential, Small C&I, Medium C&I, Large C&I, Extra Large C&I, Direct Serve	All
Fast DR	Load reduction with response time less than 10 minutes, suitable for providing ancillary services.	All	Customer Specific
Third Party Aggregated	Represents primarily the existing TVA program	Medium C&I, Large C&I, Extra Large C&I	Customer Specific
Distributor Aggregated	Represents TVA's Distributor Aggregated Demand Response (DADR) Program	Residential, Small C&I, Medium C&I, Large C&I, Extra Large C&I	Customer Specific
Load Shifting	Represents TVA's 'Residential and Commercial Shift and Store Program'	Residential, Small C&I, Medium C&I	Customer Specific
Voltage Regulation	Represents TVA's Conservation Voltage Regulation (CVR) and Dispatchable Voltage Regulation (DVR) Programs	Residential, Small C&I, Medium C&I	Not applicable

The objective of these programs is to realize demand reductions from eligible customers during the highest load hours of each summer and winter season. Each program type provides demand response using different load reduction and incentive strategies designed to target different

types of customers. Dynamic pricing programs are voluntary both in participation and in load response. They offer customers the opportunity to save money on their energy bills by shifting usage away from high load hours. Demand and capacity reduction programs are also voluntary in nature and pay customers an incentive to reduce load during high need hours, but are targeted specifically toward the commercial and industrial class. In a DLC program, participation in an event is not usually voluntary, and offers a fixed payment in return for utility control of specific end uses. Curtailable, too, provides a firm load reduction through a contractual agreement between the customer and the utility.

From the utility perspective, each of the different program types can be called with different notification times. Having a good mix of programs provides load reduction that can be called under many different conditions from ancillary services, to economic dispatch. Table 2-5 shows the notification times typically associated with the options considered in our analysis. Load shifting is not included in the tables because it is not a dispatchable DR option.[4]

Table 2-5 Typical Notification Times for DR Options

DR Option	Target Market	Notification Timing			
		Day-ahead	Two to four hours	30 minutes to one hour	Instantaneous to 10 min
Direct Load Control	Residential Small C&I customers			X	X
Curtailable	Large C&I X-Large C&I Direct Serve		X	X	X
Demand /Capacity Reduction	Small, Medium, Large, X-Large C&I, and Direct Serve	X	X	X	
Aggregator Managed	All Classes	X	X	X	
Fast-DR	All Classes				X
Dynamic Pricing	All Classes	X	X	X	
Voltage Regulation	NA		X	X	?

Profiles of Demand Response Options

This section describes the nine demand-response options included in this study.

Direct Load Control (DLC)

In a DLC program, the program management team or system operator remotely shuts down or cycles a customer's CAC unit, water heater, or other smart appliance without advance notification. In exchange, the customer receives an incentive payment or bill credit. Operation of DLC typically occurs during times of high peak demand or supply-side constraints. During an event, participants' equipment is controlled either by a one-way remote switch or by a PCT.

- The one-way remote switch is connected to the condensing unit of CAC, and to the immersion element in a water heater. When activated by a control signal, the switch will not allow the equipment to operate for the duration of the event. For CAC, the compressor is shut down during an event while the fan continues to operate. This allows cool air to be circulated throughout the home while the compressor is disabled. The operation of the switch is usually controlled through a digital paging network. Most switches also contain multiple relays so that multiple end uses can be controlled by the same switch with independent control strategies for each relay.

[4] Load shifting represents a shift in load from the on-peak to the off-peak period that occurs either on all days all year, on all weekdays all year, or on all weekdays during a specific season depending on the applicable end-use.

- More recent DLC programs involve installation of a PCT or "smart thermostat" for customers. PCTs allow remote adjustment of temperature settings, so the utility can remotely adjust the temperature to reduce demand from CAC units. After an event, load control is released, allowing the thermostat to revert back to the original customer settings for temperature and schedule. Various re-set strategies are used across the country, ranging from 2°F to 8°F.[5]

Curtailable Rates

Under a Curtailable Rate option, participating customers agree to reduce demand by a specific amount or curtail their consumption to a pre-specified level. In return, they receive a fixed incentive payment in the form of capacity credits or reservation payments (typically expressed as $/kW-month or $/kW-year). Customers are paid to be on call even though actual load curtailments may not occur. The amount of the capacity payment typically varies with the load commitment level. In addition to the fixed capacity payment, participants typically receive a payment for energy reduction. Because it is a contractual arrangement for a specific level of load reduction, enrolled loads represent a firm resource and can be counted toward installed capacity (ICAP) requirements. Penalties are assessed for under-performance or non-performance.

This option is available to a utility's largest customers, typically large industrial customers who have flexibility in their operations. Those customers with 24x7 operations/continuous processes or with obligations to continue providing service (such as schools and hospitals) are generally not good candidates for the curtailable rate option. Participants need to have an interval meter in place in order to participate.

Capacity Reduction

A Capacity Reduction program offers participants the opportunity to receive a credit for voluntarily reducing load when an event is called. Customers do not pay a penalty if they are unable to meet their energy reduction bid, although they may be under contract for a specific quantity of load. Participants receive capacity credits for a pre-specified (usually seasonal) load reduction that the utility can expect when an event is called. The credit is paid in $/kW/month regardless of whether the utility calls an event. Participants in capacity reduction do not receive any additional compensation when an event is called. Events may be called on a day-of or day-ahead basis as conditions warrant.

Based on program experiences from other utilities, predefined and/or preprogrammed responses are likely to enhance customer response to capacity reduction events. Therefore this analysis includes an automated enablement element (Auto-DR) in the Capacity reduction program.

Demand Reduction

A Demand Reduction program offers participants the opportunity to receive a credit for voluntarily reducing load when an event is called. Customers do not pay a penalty if they are unable to meet their energy reduction bid and are usually not under contract for a specific quantity of load. Participants will generally place a bid online for the amount of load they are willing to reduce on a particular event day, and they usually enter bids daily during the peak season. Events may be called on a day-of or day-ahead basis as conditions warrant. Many utilities allow customers to enter a standing bid that is automatically entered for each event. Participants are paid a credit for each kWh they reduce during the event and they are not penalized if they do not meet their reduction bid.

Based on program experiences from other utilities, predefined and/or preprogrammed responses are likely to enhance customer response to demand reduction events. Therefore this analysis includes an automated enablement element (Auto-DR) in the Demand reduction program.

[5] Please note that for DLC programs with Programmable Communicating Thermostats, it is not necessary for Advanced Metering Infrastructure (AMI) to be in place.

Third Party Aggregated

Third party aggregated contracts are different from the other DR programs. A MW goal is established for the program and a third party Curtailment Service Provider (CSP) is contracted to meet that MW reduction goal. The third party provider is generally responsible for program implementation, recruitment, and technology enablement. The program itself could take the form of any of the DR program described in this section, however in our experience, demand reduction style programs are the most common. Third party aggregated programs provide the utility with a firm capacity reduction when called upon, but require the CSP to balance a portfolio of participants to achieve that reduction. In this way the program shifts the risk of non-performance from the utility to the CSP.

Distributor Aggregated

Distributor Aggregated demand response follows the same principals as the third party aggregated program except instead of a CSP, TVA is contracting with one of their distributors.

Fast DR

The Fast DR program is a technology overlay which can be applied to any of the dispatchable, customer based, demand response options. In order to be considered Fast DR the technology must be able to provide a load response within 10 minutes or less of the event notification. Loads participation in Fast DR programs can be nominated to serve as operating reserve and need to be shed within the response time specified (instantaneous to 10 minutes). The short timeframe of response necessitate loads to be equipped with advanced and automated control features, such as Auto-DR, along with extremely advanced metering and communication capabilities.

In our analysis, we consider Fast DR events separately from other traditional DR events. Traditional DR events can be called with advanced notice in response to forecasted high load or high prices. Fast-DR events, on the other hand, are called in response to immediate and severe system emergencies which could occur at any time. Therefore customers that participate in Fast-DR are actually a subset of participants in other DR options with enabling technology that allows for a response time of less than 10 minutes. Consequently, Fast DR potential is also considered separately and cannot be added to the total potential.

Dynamic Pricing

Dynamic pricing in this study refers to the critical peak pricing (CPP) option, which uses price signals in the form of high prices during relatively short critical peak periods to encourage customers to reduce their usage on event days. The customer incentive is a larger discount during off-peak hours throughout the year. Event days are dispatched on relatively short notice typically for a limited number of days during the year. Usually the timing is unknown. However, over time trigger criteria are well-established so that customers can expect events based on the weather or other factors. Events can also be called during times of system contingencies or emergencies. Notification of an event can either be day-ahead or day-of. For participation in this option, customers must have advanced meters, and customers are considered eligible for the CPP program after their AMI meter has been installed. This analysis assumes that all pricing program participants are equipped with enabling technology, which is PCT in the case of residential/small C&I customers and automated demand response (Auto-DR), implemented through energy management and control systems, in the case of medium/large C&I customers. PCTs allow automatic responses to critical peak prices. Auto-DR can be used in any pricing program by enabling automatic response to pricing signals through pre-programming of customer choice and preferences in the response strategy.

Load Shifting

The Load Shifting program includes a permanent technology enabled shifting of load from the on-peak to the off-peak period. This load shift could occur only during the summer months or,

might occur all year long depending on the end-use being shifted. The technology employed could be as simple as a timer used to shift pool pump load to the off-peak period. Or, it could be very complex, such as using ice or thermal storage to shift large commercial HVAC load. This program is not dispatchable therefore no event calling strategy is assumed. Compensation for a load shifting program is usually a combination of rebate based incentives and time-differentiated rates. The utility covers some portion (up to 100%) of the shift enabling technology, generally paid $/kW shifted, and customer benefits from lower off-peak energy rates.

Voltage Regulation

Voltage regulation is a program that produces energy and demand savings at the distribution level. The utility achieves savings by lowering service voltages at distribution feeders thereby reducing the real energy delivered to customers without compromising power quality. Some examples of measures include installation of shunt capacitors to improve power factor, installation of line regulators, implementation of line drop compensation voltage controls, and installation of voltage metering at feeders. In this study we consider two types of voltage regulation. Conservation Voltage Regulation (CVR) implies improvements that are always on, similar to energy efficiency, and Dispatchable Voltage Regulation (DVR), which could be turned on, in the case of a system emergency or forecasted high load conditions.

Program Participation Hierarchy

To avoid double counting of impacts, program-eligibility criteria were defined to ensure that customers cannot participate in multiple programs. For example, residential customers cannot participate in both an air conditioning DLC program and a dynamic pricing program, which both target the same load on the same days. Fast DR is the one exception; it is denoted as distinct from other DR programs, which means that customers can participate in both a traditional DR and a Fast DR option. We allow for dual participation in this particular option because Fast DR events are assumed to occur at different times than traditional DR events. Table 2-6 indicates the eligibility criteria by customer segment for the DR options applicable to each segment.

Table 2-6 Participation Hierarchy in DR Options by Customer Segments

Customer Segment	DR Option
Residential	Distributor Aggregated *(First Option Applied Within Segment)*
	Direct Load Control
	Load shifting
	Dynamic Pricing *(Last Option Applied Within Segment)*
	Fast DR (Distinct from other DR programs)
Small C&I	Direct Load Control
	Distributor Aggregated
	Dynamic Pricing
	Capacity Reduction
	Load Shifting
	Fast DR
Medium C&I	Third Party Aggregated
	Distributor Aggregated
	Dynamic Pricing
	Capacity Reduction
	Load Shifting
	Fast DR
Large C&I	Curtailable
	Third Party Aggregated
	Distributor Aggregated
	Capacity Reduction
	Dynamic Pricing
	Fast DR
Extra Large C&I	Curtailable
	Third Party Aggregated
	Distributor Aggregated
	Capacity Reduction
	Demand Reduction
	Dynamic Pricing
	Fast DR
Direct Serve	Curtailable
	Capacity Reduction
	Demand Reduction
	Dynamic Pricing
	Fast DR
Distributor	Voltage Regulation

Participation Rates

A key driver for the amount of DR potential is the participation rate for each program. In this study it was important to assess participation at two levels, both at the distributor level, and at the end-user level. End-user participation rates reflect the total number of customers that are likely to participant in a program within a specific distributor's territory. Distributor participation rates reflect the total percentage of distributors that we expect, on average, might choose to offer a particular DR option. Distributor participation rates were based on industry knowledge and collaborative discussions with TVA Staff.

End-user participation rates were developed as follows.

- ***Assumptions for 2012***. For existing DR programs of a particular type, end-user participation rate assumptions in 2012 are benchmarked to current levels of load reductions. That is, the existing program achievements fall within the range of Achievable potential.
- ***Achievable – High***. Where there are no existing programs in place, the participation rates under Achievable - High level are based on the FERC report's Expanded Business As Usual (EBAU) scenario for Tennessee.[6] The Expanded Business-As-Usual (EBAU) scenario assumes that existing programs continue into the future but are implemented such that "best practices" participation levels are achieved. In the FERC National Potential Study, the best practice participation rate was assumed to be equal to the 75th percentile of ranked participation rates of existing programs of the same type and customer class across all states. The AMI deployment schedule is also based on EBAU scenario values from the FERC study and we assume that 80% of the eligible customers with AMI participate in pricing programs.
- ***Achievable – Low***. Participation rates were adjusted to reflect a more moderate enrollment in specific DR options based on industry experience.

In all cases, participation rates ramp up until 2020 and remain steady thereafter.

Table 2-7 and Table 2-8 present participation rates for TVA's service territory by class and, program and both the distributor and end-user levels for the high and low case. The effective participation is calculated as the distributor participation multiplied by the end-user participation in both cases. Also note that the participation rates in Table 2-6 represent the percent of eligible customers and those in 2-7 represent the percent of eligible MW.[7]

[6] The FERC recently conducted a national study of demand response potential referenced in this report as the FERC National Demand Response Report or simply the FERC Report.
A National Assessment of Demand Response Potential, Prepared by: The Brattle Group, Freeman, Sullivan & Co, and Global Energy Partners for the Federal Energy Regulatory Commission, June 2009.

[7] For the X-large and Direct serve customers all the potential analysis was performed based on a market size of MW rather than customers. This approach was used due to the large variation is sizes among the largest customers and to easily benchmark both participation and potential to current participation. A similar approach was used in the FERC National Demand Response study to address the large C&I segments.

Table 2-7 DR Program Participation Rates (as % of eligible customers)

Sector	Program	Distributor Participation (2031 – High Case)	End-User Participation (2031 – High Case)	Effective Participation (2031 – High Case)	Distributor Participation (2031 – Low Case)	End-User Participation (2031 – Low Case)	Effective Participation (2031 – Low Case)
Residential	Dynamic Pricing	85%	5%	4.3%	75%	5%	3.8%
	DLC	85%	25%	21.3%	75%	15%	11.3%
	Fast DR [8]	25%	30%	7.5%	10%	30%	3.0%
	Load Shifting	15%	5%	0.8%	10%	5%	0.5%
	Dist. Aggregated	-	-	2.1%	-	-	2.1%
Small C&I	Dynamic Pricing	85%	5%	4.3%	75%	5%	3.8%
	DLC	85%	10%	8.5%	75%	10%	7.5%
	Load Shifting	50%	5%	2.5%	35%	5%	1.8%
	Capacity Reduction	65%	10%	6.5%	50%	10%	5.0%
	Fast DR [8]	25%	30%	7.5%	10%	30%	3.0%
	Dist. Aggregated	-	-	0.9%	-	-	0.9%
Medium C&I	Dynamic Pricing	85%	5%	4.3%	75%	5%	3.8%
	Capacity Reduction	75%	10%	7.5%	50%	10%	5.0%
	Load Shifting	50%	5%	2.5%	30%	5%	1.5%
	Fast DR [8]	25%	30%	7.5%	10%	30%	3.0%
	Dist. Aggregated	-	-	0.2%	-	-	0.2%
	3rd Party Aggregated	-	-	1.7%	-	-	1.7%
Large C&I	Curtailable	-	-	2.8%	-	-	2.8%
	Dynamic Pricing	85%	5%	4.3%	75%	5%	3.8%
	Capacity Reduction	95%	20%	19.0%	50%	20%	10.0%
	Fast DR [8]	25%	30%	7.5%	10%	30%	3.0%
	Dist. Aggregated	-	-	9.7%	-	-	9.7%
	3rd Party Aggregated	-	-	8.2%	-	-	8.2%

[8] Fast DR is distinct from other DR programs in that customers can participate in both a traditional DR and a Fast DR option. We allow for dual participation in this particular option because Fast DR events are assumed to occur at different times than traditional DR events.

Table 2-8 DR Program Participation Rates, Largest Customers (as % of eligible MW)

Sector	Program	Distributor Participation (2031 – High Case)	End-User Participation (2031 – High Case)	Effective Participation (2031 – High Case)	Distributor Participation (2031 – Low Case)	End-User Participation (2031 – Low Case)	Effective Participation (2031 – Low Case)
X-Large C&I	Curtailable	+	+	0.0%	+	+	0.0%
	Capacity Reduction	+	+	15.0%	+	+	15.0%
	Dynamic Pricing	50%	1%	0.5%	40%	1%	0.4%
	Demand Reduction	50%	6%	3.0%	50%	6%	3.0%
	Fast DR*	40%	30%	12.0%	25%	30%	7.5%
	Dist. Aggregated	-	-	1.2%	-	-	1.2%
	3rd Pty Aggregated	-	-	6%	-	-	6%
Direct Serve	Curtailable	+	+	20.8%	+	+	20.8%
	Capacity Reduction	+	+	36.6%	+	+	36.6%
	Dynamic Pricing	50%	1%	0.5%	40%	1%	0.4%
	Demand Reduction	50%	3%	1.5%	50%	3%	1.5%
	Fast DR*	+	+	27.8%	+	+	27.8%

Figure 2-1 and Table 2-9 present the AMI deployment schedule. TVA's AMI deployment schedule has been benchmarked to data provided by TVA estimating installed meters through 2020. AMI deployment never reaches 100% because about 15% of the meters, most likely residential and small commercial, are assumed never to achieve better than hourly resolution.

Figure 2-1 AMI Deployment Forecast (% of population with hourly data or better)

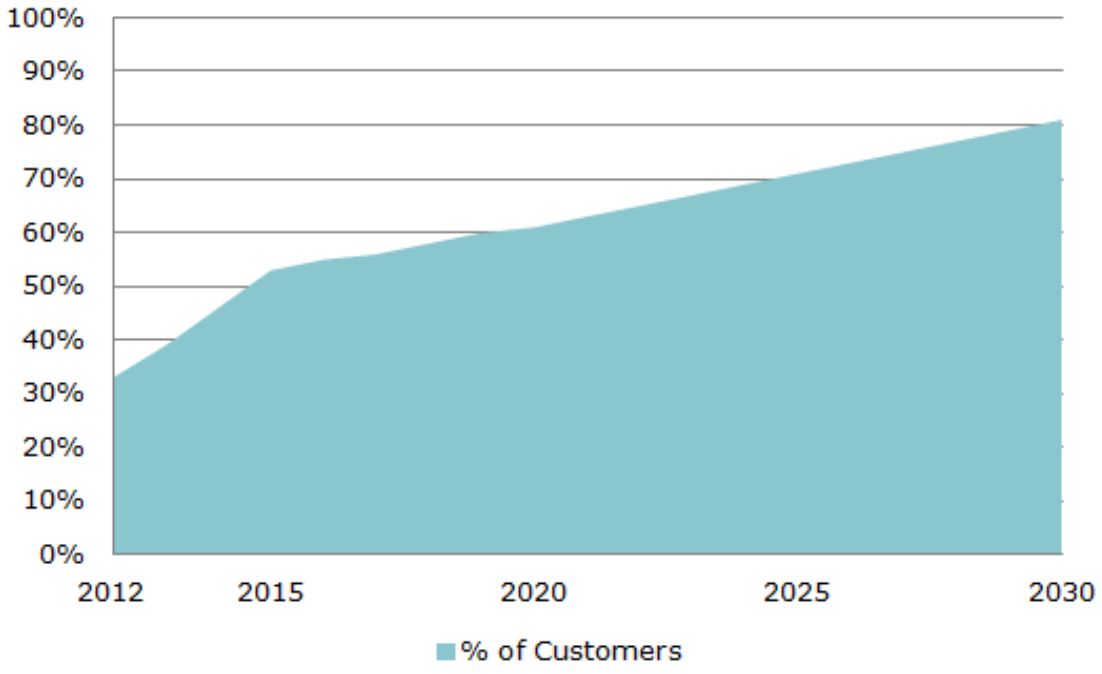


Table 2-9 AMI Deployment Forecast by Customer Segment (% of population with hourly data or better)

Customer Segment	2012	2015	2020	2025	2030
Residential, Small C&I, Medium C&I	33%	53%	61%	71%	81%
Large, X-Large, Direct Serve	100%	0%	4%	8%	13%

Load Impacts

Table 2-10 presents the load reductions per program participant (or unit impacts). Where current TVA DR programs exist, unit impacts are benchmarked to the values observed in those programs. Where there are no existing programs, unit impacts are based on the FERC study's EBAU scenario for Tennessee and values from Global's other recent potential studies.[9]

Table 2-10 Load Reduction Impact Assumptions [10]

DR Option	Unit of Impact	Residential	Small C&I	Medium C&I	Large C&I	X Large C&I	Direct Serve
AC DLC	kW load reduction per customer (summer)	1.0 kW	1.0 kW				
Space Heating DLC	kW load reduction per customer (winter)	1.0 kW	1.0 kW				
Water Heating DLC	kW load reduction per customer	0.5 kW	0.5 kW				
Capacity Reduction	Per Customer %Impact w/ tech		12%				
Capacity Reduction	Per Customer %Impact w/o tech		5%	12%	39%	100%*	100%*
Third Party Aggregated	Per Customer %Impact			40%	40%	40%	
Distributor Aggregated	Per Customer % Impact	30%	30%	40%	40%	40%	
Demand Reduction	Per Customer %Impact					100%*	100%*
Dynamic Pricing	Per Customer %Impact w/ tech	34%	15%	14%	14%	100%*	100%*
Dynamic Pricing	Per Customer %Impact w/o tech	17%	5%	9%	9%	100%*	100%*
Fast DR	Per Customer Summer %Impact w/ tech	30%	30%	39%	39%	100%*	100%*
Fast DR	Per Customer Winter %Impact w/ tech	30%	30%	39%			
Load Shifting	Per Customer %Impact	20%	25%	25%			
Curtailable	Per Customer %Impact					100%*	100%*

[9] Global has conducted numerous studies of DR potential in the last five years. We checked our input assumptions and analysis results against the results from these other studies which include AmerenUE, Los Angeles Department of Water and Power, and the State of New Mexico, and Avista Utilities.

[10] Gray shaded boxes indicate that a DR option is not applicable for that sector.
Xlarge and Direct serve % impacts are applied to eligible MW rather than eligible customers.
Impacts with asterisk (*) indicate existing TVA programs for which impacts were benchmarked to the expected interruptible load reduction during an event. In this case, a 100% impact represents a load drop of 100% of the expected load reduction not 100% of the peak load.

Framework for Cost-Effectiveness Assessment

The DR programs were assessed for cost-effectiveness drawing upon the California Standard Practice protocol for DSM economic assessment. For the purposes of this study, the Total Resource Cost (TRC) test was applied to assess the benefits and costs associated with the DR programs. The Total Resource Cost (TRC) test measures benefits and costs from the perspective of the utility and society as a whole. Since utilities customers are taken as a whole, changes in the dollar amounts that flow between them (transfer payments or in this case rebates) are ignored. Programs passing the TRC result in a decrease in the total cost of energy services to all electric ratepayers.

The benefits used in the TRC test for this analysis are made up solely of the avoided capacity benefits attributable to the impacts of the proposed programs from the high achievable case[11]. Energy benefits and external benefits were not considered in this analysis. The costs are made up of any customer incentives, costs attributable to the purchase and installation of enabling technologies, and, general administrative costs.

The cost-effectiveness analysis was performed at an aggregate level, representing the potential effects of each individual demand response program in the portfolio. A spreadsheet model was used as the primary tool for conducting the cost-effectiveness assessment. The detailed assumptions related to cost-effectiveness assessment are presented in Appendix A.

Economic Data Supporting DR Cost-Effectiveness Assessment

In our approach we estimate the Net Present Value (NPV) of costs and benefits associated with each of the DR programs from the Total Resource Cost test perspectives. All cost and benefit values were escalated for inflation at an annualized forecast GDP growth rate of 1.86%. Discount rates, line loss factors, avoided capacity, and avoided energy costs were provided by TVA and incorporated into the analysis to estimate net DR potential.

[11] We compute B/C ratios under the high case assumptions, which provide the best opportunity for programs to be cost-effective. Programs that pass the cost-effectiveness screen under the high scenario will not necessarily pass under the low scenario.

CHAPTER | 3

RESULTS OF DR POTENTIAL ANALYSIS

This chapter presents the estimates of DR potential for the service territory of the Tennessee Valley Authority.

Summary of Demand Response Potential

Demand response has the potential to reduce peak demand by 1,169 MW to 1,280 MW in 2012. The achievable potential increases to a range of 2,890 MW to 4,300 MW in 2030.[12]

Table 3-1 presents the overall summary of demand response potential for the two cases. Figure 3-1 presents this information graphically. The primary observations are:

- In summer of 2012, achievable potential reduces peak demand by approximately 4%. This starting point takes into account the achievements in 2011 from TVA's current DR program portfolio.
- By summer of 2030, the achievable potential reduces peak demand by 9% to 11%. This level of savings represents an offset in growth of between 49% and 59%.
- In winter of 2012, achievable potential reduces peak demand by approximately 4%.
- By winter of 2030, the achievable potential reduces peak demand by 8% in the low case and 9% in the high case which represents an offset in growth of between 48% and 55%.

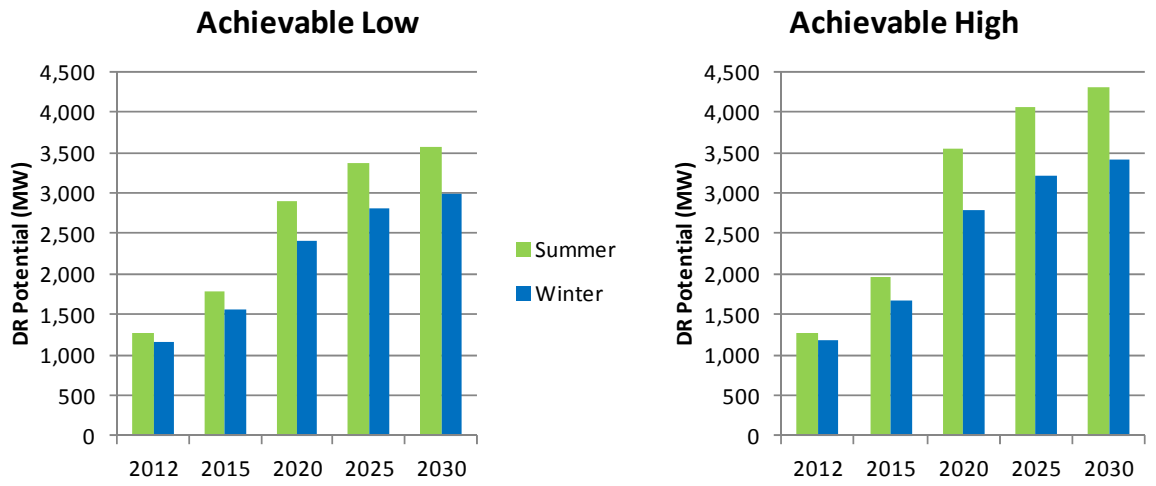
Detailed annual results of the potential analysis are provided in Appendix C.

Table 3-1 Summary of Demand Response Savings for TVA

		2012	2015	2020	2025	2030
Summer	Peak Forecast (MW)	31,036	32,074	34,031	36,234	38,353
	Achievable - Low (MW)	1,262	1,786	2,902	3,364	3,568
	Achievable - High (MW)	1,280	1,963	3,553	4,055	4,300
	Achievable - Low (% of baseline)	***4%***	***6%***	***9%***	***9%***	***9%***
	Achievable - High (% of baseline)	***4%***	***6%***	***10%***	***11%***	***11%***
Winter	Peak Forecast (MW)	31,145	31,252	33,145	35,284	37,390
	Achievable - Low (MW)	1,169	1,561	2,406	2,813	2,982
	Achievable - High (MW)	1,181	1,670	2,789	3,221	3,415
	Achievable - Low (% of baseline)	***4%***	***5%***	***7%***	***8%***	***8%***
	Achievable - High (% of baseline)	***4%***	***5%***	***8%***	***9%***	***9%***

[12] Fast DR is not included in the total potential estimates presented in Table 3-1 and Figure 3-1. As discussed in previous sections Fast-DR events are considered distinct from traditional DR events. Customers can dual enroll in Fast DR and any other customer based dispatchable DR program, therefore the impacts associated with DR cannot be added to the total potential and they will be discussed separately in a subsequent section.

Figure 3-1 Summary of Demand Response Potential for TVA



Potential Estimates by DR Program Type

Table 3-2, Table 3-3, Figure 3-2, and Figure 3-3 show the range of achievable potential for each program type in both summer and winter. The primary observations from the analysis are:

- Capacity reduction has, by far, the largest contribution to the overall potential from all DR programs, with a 37% share in the total achievable potential in the high case in 2030. The achievable potential for this program represents a migration from the curtailable program to the capacity reduction program by 2016.[13]
- The Curtailable program is phased out completely by the year 2016 as all participants migrate into the Capacity Reduction option. In our experience, this trend is common in the industry as many utilities move away from emergency response programs and toward programs that can be integrated into wholesale markets based on economic dispatch models.
- While the total potential attributable to DLC varies widely from 645 MW and 18% in the low case to 1,174 MW and 27% in the high case DLC remains the second largest contributor to overall potential. The key difference between estimates of potential in the high and low case is the participation rates. The high case assumes an effective participation of 23.1% while the low case assumes an effective participation of 11.3%. DLC potential also varies widely from summer to winter; this is a result of the saturation of central air conditioning in the Tennessee Valley being higher than the saturation of electric heat.
- The Voltage Reduction programs also contribute substantially to the overall potential with CVR contributing 13% and DVR contributing 5% to overall potential.
- Savings from the Third Party Aggregated program come in fourth with a 6% share of the total potential in 2030. When combined with the Distributor Aggregated Program, which is very similar to the Third Party Program, the two programs represent 9% of the total potential in 2030.
- Savings from the Dynamic Pricing program are moderate with a total contribution of about 5% in 2030. Under a voluntary scenario, we assume a very conservative participation rate which limits the potential of this program type.
- Load shifting and Demand Reduction have the smallest contributions to overall potential each with about a 2% contribution in 2030.

[13] This migration is representative of the migration of customers from TVA's current 5MR and 60MR programs to the new Reserve Preservation program which falls within the capacity reduction program option for this study.

Table 3-2 Summary of Summer MW Savings by Program for TVA

DR Program	Type	2012	2015	2020	2025	2030
Direct Load Control	Achievable - Low	11	136	575	610	645
	Achievable - High	19	249	1,048	1,111	1,174
Curtailable	Achievable - Low	530	37	0	0	0
	Achievable - High	530	37	0	0	0
Capacity Reduction	Achievable - Low	443	1,101	1,310	1,396	1,478
	Achievable - High	451	1,144	1,412	1,504	1,593
Third Party Aggregated	Achievable - Low	177	234	237	239	241
	Achievable - High	177	234	237	239	241
Distributor Aggregated	Achievable - Low	35	57	97	101	105
	Achievable - High	36	67	141	146	153
Demand Reduction	Achievable - Low	1	16	68	73	77
	Achievable - High	1	16	68	73	77
Dynamic Pricing	Achievable - Low	2	30	133	160	190
	Achievable - High	2	34	142	171	202
Conservation Voltage Regulation	Achievable - Low	46	121	320	543	576
	Achievable - High	46	121	320	543	576
Dispatchable Voltage Regulation	Achievable - Low	16	42	112	190	202
	Achievable - High	16	42	112	190	202
Load Shifting	Achievable - Low	1	12	49	52	55
	Achievable - High	2	19	74	77	82
All Programs	**Achievable - Low**	**1,262**	**1,786**	**2,902**	**3,364**	**3,568**
	Achievable - High	**1,280**	**1,963**	**3,553**	**4,055**	**4,300**

Table 3-3 Summary of Winter MW Savings by Program for TVA

DR Program	Type	2012	2015	2020	2025	2030
Direct Load Control	Achievable - Low	5	62	259	275	290
	Achievable - High	9	115	481	510	539
Curtailable	Achievable - Low	507	34	0	0	0
	Achievable - High	507	34	0	0	0
Capacity Reduction	Achievable - Low	412	1,010	1,190	1,268	1,344
	Achievable - High	418	1,041	1,264	1,346	1,428
Third Party Aggregated	Achievable - Low	147	190	192	194	197
	Achievable - High	147	190	192	194	197
Distributor Aggregated	Achievable - Low	29	53	108	113	118
	Achievable - High	31	67	168	176	185
Demand Reduction	Achievable - Low	1	16	68	73	77
	Achievable - High	1	16	68	73	77
Dynamic Pricing	Achievable - Low	2	32	141	170	202
	Achievable - High	2	36	149	179	213
Conservation Voltage Regulation	Achievable - Low	47	115	300	502	524
	Achievable - High	47	115	300	502	524
Dispatchable Voltage Regulation	Achievable - Low	17	40	105	176	183
	Achievable - High	17	40	105	176	183
Load Shifting	Achievable - Low	1	11	41	44	46
	Achievable - High	1	16	61	64	68
All Programs	**Achievable - Low**	**1,169**	**1,561**	**2,406**	**2,813**	**2,982**
	Achievable - High	**1,181**	**1,670**	**2,789**	**3,221**	**3,415**

Figure 3-2 Achievable – Low Potential by DR Option in 2020

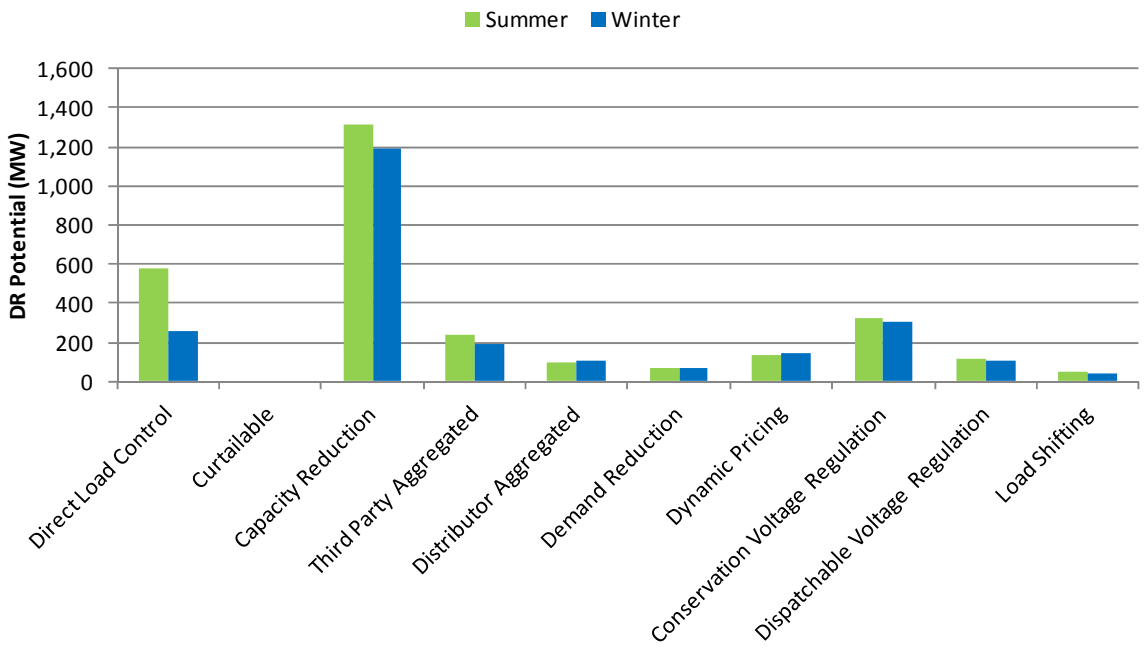


Figure 3-3 Achievable – High Potential by DR Option in 2020

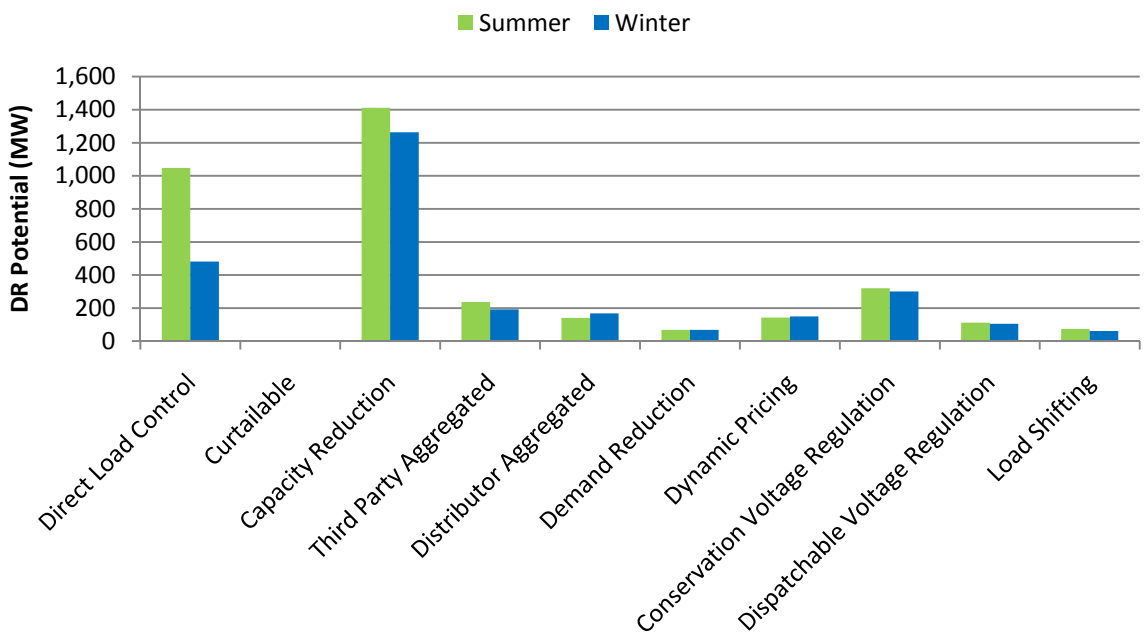


Figure 3-4 and Figure 3-5 show the range of achievable potential by customer class. The residential class has the largest contribution to overall potential at 43% in 2030 for the high achievable case. This is primarily due to participation in the DLC program option. Direct serve and X-large C&I and come in second and third in overall contribution to potential, with 22% and 13% respectively, with their contribution being concentrated heavily in the capacity reduction program. Large, Medium C&I contribute 8% and 10% to overall potential respectively. Small C&I has the smallest contribution with 4%.

Figure 3-4 Achievable – Low Potential by Customer Class

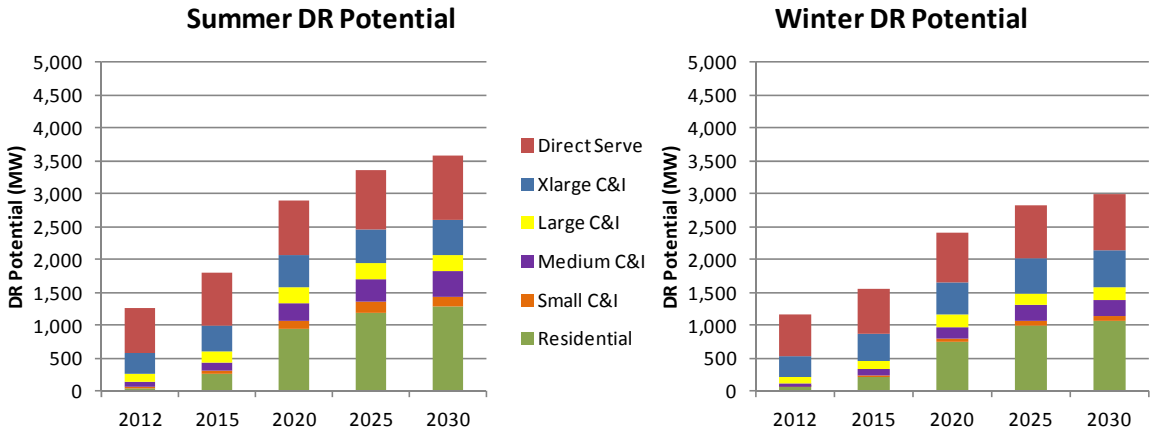
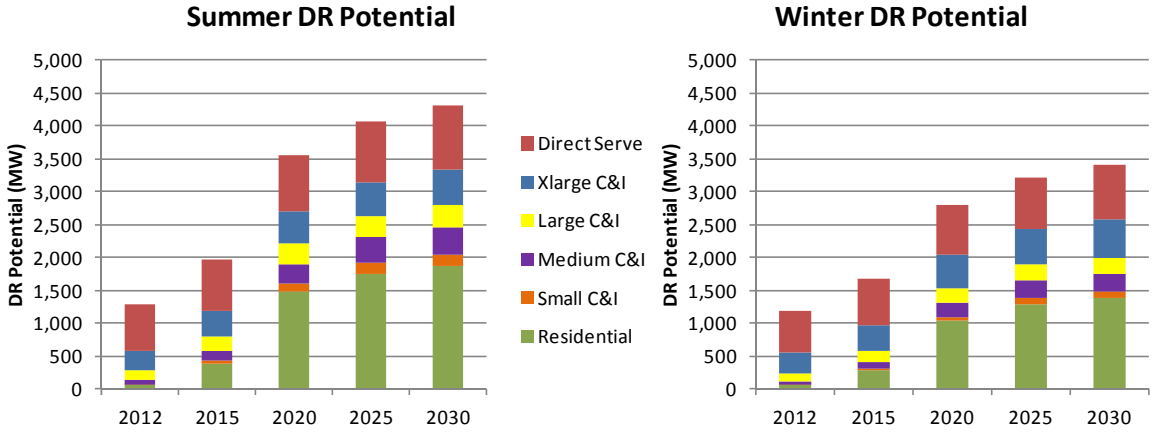


Figure 3-5 Achievable – High Potential by Customer Class



Potential Estimates for Fast DR

Because the Fast DR program is made up of a subset of participants from other DR programs the potential from this program cannot be added to the total potential and is therefore addressed separately in this section. Table 3-4, Table 3-5, Figure 3-6, and Figure 3-7 show the range of achievable potential for Fast DR by customer class for both summer and winter. The primary observations from the Fast DR analysis are:

- Direct Serve is the largest contributor to the total potential for Fast DR by a wide margin with 54% of the total potential reduction in 2030. This takes into account current participation in TVA's Instantaneous Response program which amounts to approximately 200 MW in 2011.
- Residential is the second largest contributor to the total potential with a contribution of 17% in 2030. Residential customers who participate in DLC are prime targets for Fast DR since they already have a significant portion of the necessary enabling technology installed.[14]

[14] The California Participating Load Pilot showed that residential and small commercial DLC participants can be used as a Fast DR resource suitable to be bid into the CAISO market as an ancillary service with minimal modification and investment. Customer Impact

Evaluation for the 2009 Southern California Edison Participating Load Pilot
Gifford, W., S. Bodmann and P. Young, KEMA; J. Eto, Lawrence Berkeley National Laboratory; J. Laundergan, Southern California Edison. LBNL-3550E. June 2010

- Small and X-large C&I each have similar contributions to Fast DR ranging from 10% to 8% of overall potential respectively in 2030.
- Medium and Large C&I have the smallest contributions to the overall potential at about 5% each.

Table 3-4 Summary of Summer MW Savings for Fast DR by Customer Class for TVA

DR Program	Type	2012	2015	2020	2025	2030
Residential	Achievable - Low	0	4	17	19	20
	Achievable - High	1	18	73	79	85
Small C&I	Achievable - Low	0	8	34	37	40
	Achievable - High	0	9	40	43	47
Medium C&I	Achievable - Low	2	3	7	7	8
	Achievable - High	4	9	22	24	26
Large C&I	Achievable - Low	4	6	8	8	8
	Achievable - High	11	17	25	26	28
X-large C&I	Achievable - Low	9	12	14	15	16
	Achievable - High	22	29	36	38	40
Direct Serve	Achievable - Low	223	249	234	249	264
	Achievable - High	223	249	234	249	264
All Classes	**Achievable - Low**	**238**	**281**	**314**	**335**	**356**
	Achievable - High	**262**	**331**	**431**	**460**	**489**

Table 3-5 Summary of Winter MW Savings for Fast DR by Customer Class for TVA

DR Program	Type	2012	2015	2020	2025	2030
Residential	Achievable - Low	0	6	24	26	28
	Achievable - High	2	21	88	94	101
Small C&I	Achievable - Low	0	9	37	40	43
	Achievable - High	0	6	27	29	32
Medium C&I	Achievable - Low	1	2	5	5	6
	Achievable - High	3	6	16	17	18
Large C&I	Achievable - Low	3	4	6	6	6
	Achievable - High	8	12	19	19	20
X-large C&I	Achievable - Low	10	12	15	16	17
	Achievable - High	24	30	38	40	42
Direct Serve	Achievable - Low	203	219	206	220	233
	Achievable - High	203	219	207	220	233
All Classes	**Achievable - Low**	**217**	**252**	**292**	**312**	**333**
	Achievable - High	**240**	**296**	**393**	**419**	**446**

Figure 3-6 Achievable – Low Potential for Fast DR by Customer Class

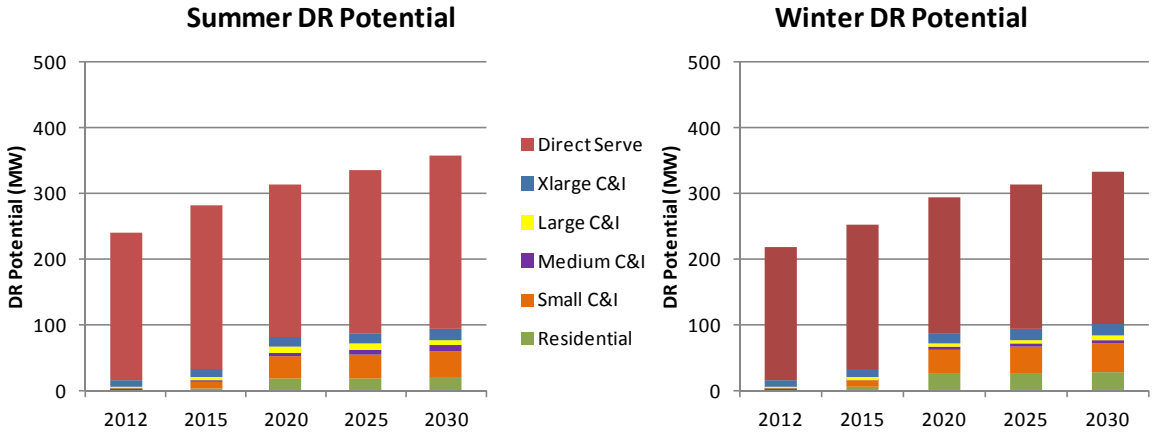
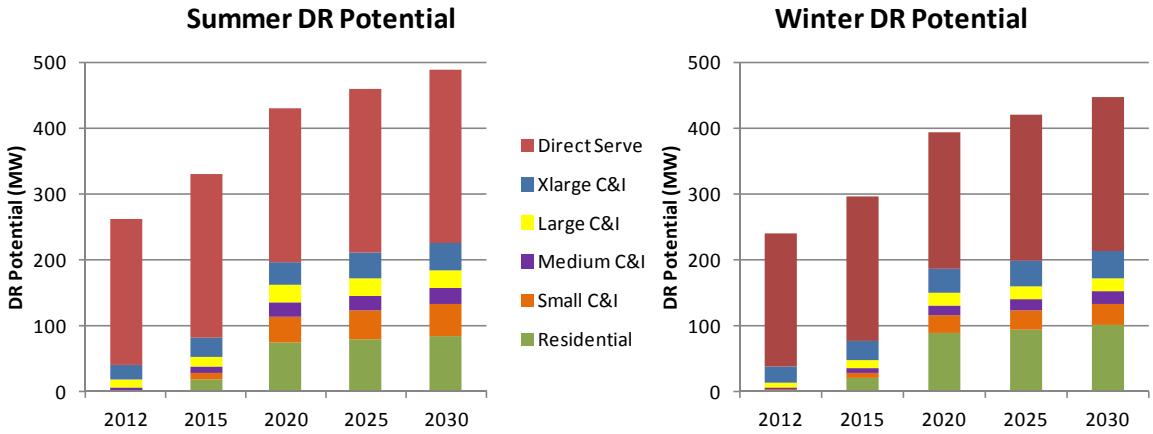


Figure 3-7 Achievable – High Potential for Fast DR by Customer Class



COST-EFFECTIVENESS ANALYSIS

Summary of Cost-Effectiveness Analysis Results

Table 4-1 presents a summary of the cost-effectiveness results based on the TRC test for all programs.[15] The cost effectiveness tests were performed using a bottom up approach that employs cost assumptions based on secondary information and industry best practices.[16] The analysis was performed in this manner in order to provide TVA with realistic annual costs that can be passed on to distributors including: equipment costs, incentive costs, administrative, and marketing costs[17]. The results of the TRC test analysis show that the overall portfolio of DR programs is cost-effective.[18] The cost-effectiveness assessment is done for the Achievable - High level.

The most cost effective programs are Curtailable, Capacity Reduction, Demand Reduction, Dynamic Pricing and Fast DR. Curtailable has the highest B/C ratio due to a shortened program life of three years. Demand Reduction, Capacity Reduction, and Dynamic Pricing are also highly cost effective. These programs have lower administrative costs, and fewer equipment costs than the other non-aggregated programs. The voltage regulation programs are also considered cost effective, however it is important to note that costs for these programs are based solely on the incentive payment that TVA pays to the distributors. All equipment and implementation costs are assumed to be covered by that incentive and additional external (rate-based) costs and benefits to the distributor are not captured. The remaining programs; DLC, Third Party and Distributor Aggregated, and Load Shifting, are all cost effective with B/C ratios ranging from 1.05 to 1.31.

Table 4-1 Results of Cost-Effectiveness Screening (B/C ratios)

DR Option	Summer	Winter
DLC	2.07	2.02
Curtailable	18.15	17.22
Capacity Reduction	5.89	5.29
Third Party Aggregated	1.24	1.24
Distributor Aggregated	1.05	1.05
Demand Reduction	3.94	3.93
Dynamic Pricing	3.23	3.40
Fast DR	4.19	3.80
Conservation Voltage Regulation	1.60	1.60
Dispatchable Voltage Regulation	1.60	1.60
Load Shifting	1.31	1.09

[15] Cost effectiveness results by program and customer segment are included in Appendix B.
[16] Cost effectiveness inputs and assumptions are included in Appendix A.
[17] While utility incentives are not included in the TRC test as costs, we provide estimates of incentives that could reasonably be assumed for each program in the appendix.
[18] The $/kW payment for the Distributor aggregated program was adjusted from the $63/kW year in the TVA provided program data sheet to $55/kW year in order for the program to pass the economic screen. The Distributor Aggregated program was not cost effective given our assumptions in the analysis at the higher incentive rate. Payments from the utility to aggregators for both the 3rd Party Aggregated and Distributor Aggregated programs are included as implementation costs in the TRC analysis.

We also provide a levelized cost per kW for each program in Table 4-2. Levelized costs represent the ratio of cumulative program costs to cumulative estimated kW impacts. These costs can be used to assist TVA in determining realistic incentive levels to offer distributors which will result in cost effective programs. The levelized cost results mirror the TRC test results with Curtailable having the lowest levelized cost at $3/kW and Distributor Aggregated having the highest levelized cost at $68/kW.

Table 4-2 Levelized Costs by Program ($/kW)

DR Option	Summer	Winter
DLC	$35.65	$36.41
Curtailable	$2.89	$3.05
Capacity Reduction	$11.81	$13.15
Third Party Aggregated	$53.81	$53.82
Distributor Aggregated	$67.50	$67.98
Demand Reduction	$18.74	$18.75
Dynamic Pricing	$23.17	$22.04
Fast DR	$16.28	$17.96
Conservation Voltage Regulation	$46.63	$43.43
Dispatchable Voltage Regulation	$46.63	$43.43
Load Shifting	$56.09	$67.53

PROGRAM RECOMMENDATIONS

The results of the DR assessment reveal that TVA has significant potential for demand response resources over the next two decades. Our analysis has shown that it is economically feasible for TVA to realize up to 11% reductions in summer peak and 9% reductions in winter peak by 2030 if it moves forward with the DR options represented in this report.

TVA's demand response programming efforts have a strong basis with large C&I customers in the field today. Moreover, a comprehensive suite of new programs is currently emerging from the planning phase and entering the implementation phase. In light of this study, Global provides the following recommendations to preserve and augment that momentum.

- ***Expand programs to include smaller customers:*** TVA's current DR programs total approximately 1,300 MW of DR, which indicates that the potential for future success with new DR programs is very high. The majority of the currently installed DR capacity is concentrated in the Large, X-Large, and Direct Serve customers. Targeting the largest customers first is an excellent strategy for utilities as they begin their DR efforts, however, as portfolios mature it becomes necessary to target other customer segments such as residential and small and medium C&I.
- ***Focus efforts on programs with the largest potential:*** DLC and Capacity Reduction are the DR programs with the largest opportunity for savings among end-users. DLC is a program that can be targeted to residential and small commercial customers and has been shown to be very successful given the right combination of technology and incentives.[19] Capacity reduction is gaining ground on the west coast as a highly favorable program with commercial and industrial customers. Customers particularly like the monthly capacity payments they receive all year long and the flexibility to determine their own reduction bid. Marketing efforts to expand DR program participation to the smaller customers should focus on DLC and capacity reduction.
- ***Voltage regulation programs need carefully designed incentives:*** Voltage reduction has significant potential to reduce demand on the distribution side. This is a unique program in that it involves infrastructure improvements to optimize and reduce voltage levels without affecting the power quality ultimately distributed to end users. Sufficient incentives will be needed to encourage distributors to participate in this program and therefore more information on the cost of specific voltage regulation technologies will need to be gathered.
- ***Coordinate distributor layer between TVA and end user:*** Because TVA is a wholesale provider, maintaining a cohesive DR message to end users may be challenging, especially as DR programs focus on residential and small C&I customers. We recommend dedicated resources to ensure that TVA programs are marketed and implemented consistently across distributors.
- ***Create internal DR targets:*** TVA should continue to evolve and formulate its specific objectives regarding demand response by creating targets and goals. Global recommends targets that fall within the range of achievable potentials identified in this study.
- ***Consider limiting the number of programs:*** TVA has a longer list of DR programs than many utilities do. TVA may consider limiting the number and type of DR programs to facilitate distributor and end-user understanding. Customers are often overwhelmed by too

[19] Southern California Edison, NV Energy, Florida Power & Light, and others all have very successful DLC programs with participation rates of 20% or more.

many options when it comes to utility programs, and many utilities with a large number of programs are now focused on reducing or bundling programs to make participation simpler for customers. We recommend focusing on those programs with the highest potential: capacity reduction in the C&I sectors, DLC in the residential sector, and voltage reduction for the distributors.

- ***Provide market-friendly customer incentives***: Most customers are willing to offer their loads for participation in demand response programs if the utility is willing to compensate them for any inconvenience that they may realize due to the temporary service interruption. While incentive strategies must be structured in a way that ensures economic viability for the program, we have found that there is significant room to expand customer incentives while still maintaining cost-effectiveness.
- ***Provide enabling technology incentives:*** Enabling technology has been shown to improve the reliability of DR resources and to maximize load reduction in DR programs. It is therefore crucial to provide incentives to customers for adopting enabling technology in order to automate response to DR events.

COMPARISON OF PREVIOUS POTENTIAL STUDIES

Previous studies of energy efficiency potential for the Valley and for the southeast region have produced a range of results. As part of this potential assessment, TVA requested that Global develop a comparison of several key recent studies to better understand how the studies differ in their approaches and thus why their results differ as well. Table 6-1 presents an *at-a-glance* comparison of this study with other relevant studies of the southeast and the nation as a whole.

Table 6-1 Demand Response Studies at a Glance

Source	Area	Year Released	Type of Potential	10-yr Savings Estimate	20-yr Savings Estimate
This Study: Global TVA	**TVA**	**2011**	**Achievable (High)**	**11%** ***3.8 GW***	**12%** ***4.6 GW***
			Achievable (Low)	**10%** ***3.2 GW***	**10%** ***3.9 GW***
FERC National Assessment of DR	U.S.	2009	Economic	20%	
			Achievable	14%	
			Expanded BAU	9%	
MISO Assessment	MISO	2010	Program potential	7.6%	7.6%
	Eastern Interconnection			11.1%	10.8%

This remainder of this section provides a more in-depth analysis of each of the studies and how it stacks up against the present study in terms of methodology, assumptions, approaches, estimated baselines, technical performance, adoption, and program/regulatory context.

Tennessee Valley Authority Energy Efficiency and Demand Response Potential Study — Global TVA (This Study)

We begin by briefly summarizing our own study in the same manner as we will summarize the comparison studies.

The Global TVA study was conducted and published in 2011. It estimated EE and DR savings specifically for the TVA service territory. The base year for the study was 2009 and the forecast horizon was 2009 through 2030, with program activity beginning in 2012. The contractors for the study were Global Energy Partners, LLC and The Brattle Group.

Analysis approach – The study used a detailed bottom-up analysis approach. Analysis was performed at the sector, segment, and DR option levels. TVA data, national data, and previous Global studies provided the inputs to the market characterization and analysis.

Baseline forecast – The peak demand forecast was taken directly from the TVA forecasting group and checked against the 2011 Annual Energy Outlook. It includes the affects of building codes and appliance standards in place in 2010, most notably the EISA lighting standard. The baseline does not include naturally occurring efficiency.

Levels of potential – A range of achievable potentials was developed: between Achievable – Low and Achievable High, based on a range of anticipated levels of customer adoption and incentive payments.

Study Findings – The table below summarizes the demand response savings for the different levels of potential relative to the baseline forecast.

Table 6-2 Summary of Demand Response Potential – Global TVA

		2012	2015	2020	2025	2030
Summer	Peak Forecast (MW)	31,036	32,074	34,031	36,234	38,353
	Achievable - Low (MW)	1,262	1,786	2,902	3,364	3,568
	Achievable - High (MW)	1,280	1,963	3,553	4,055	4,300
	Achievable - Low (% of baseline)	***4%***	***6%***	***9%***	***9%***	***9%***
	Achievable - High (% of baseline)	***4%***	***6%***	***10%***	***11%***	***11%***
Winter	Peak Forecast (MW)	31,145	31,252	33,145	35,284	37,390
	Achievable - Low (MW)	1,169	1,561	2,406	2,813	2,982
	Achievable - High (MW)	1,181	1,670	2,789	3,221	3,415
	Achievable - Low (% of baseline)	***4%***	***5%***	***7%***	***8%***	***8%***
	Achievable - High (% of baseline)	***4%***	***5%***	***8%***	***9%***	***9%***

A National Assessment of Demand Response — FERC

This study was commissioned by FERC and published in 2009. It presented the first nationwide assessment of demand response potential using a state-by-state approach along with a publicly available tool for updating the potential. The study estimated demand response potential within a 10-year timeframe, identified barriers to deployment of DR programs and provided specific recommendations for addressing those barriers. The contractors for the study were The Brattle Group, Freeman Sullivan and Company, and Global Energy Partners, LLC.

Analysis approach – The potential estimation was based on a detailed bottom-up analysis of demand reduction associated with DR programs at an individual state level. The aggregate of the state-level potentials represented the national potential. A state-by-state database was developed containing all inputs needed to do a detailed bottom-up assessment of DR potential. An excel-based tool was developed to estimate DR potential at four levels (discussed below) by state and by DR programs. Broadly, four types of DR programs were considered- Direct Load Control (DLC), Interruptible Tariffs, Dynamic Pricing, and Other DR programs (including Capacity, Demand Bidding, and other types of aggregator offerings). The analysis estimated potential by four customer classes- residential, small C&I, medium C&I, and large C&I classes based on rate definitions.

The timeframe of the study was from 2009 to 2019.

Baseline forecast – The baseline forecast, which excludes the effect of demand response but includes the effects of energy efficiency, was derived from NERC's data on total summer demand forecast, presented in the agency's 2008 Long Term Reliability Assessment Report.

Levels of potential – Four levels of potential were estimated:

- Business-as-Usual assumed the continuation of existing programs at their current levels of participation and included no increase in demand response.
- Expanded Business-as-Usual assumed that utilities would adopt "best practices" in existing demand response programs. In this case, the set of DR programs in 2019 was the same as in 2009.
- Achievable Potential expanded the set of DR programs to include dynamic pricing programs and assumed they would be implemented on an "opt-out" basis. Other programs and their participation were adjusted to account for the availability and adoption of dynamic pricing options. The level of

potential in each state varied according to the timeline for deployment of advanced metering infrastructure (AMI).

- Full Participation was similar to Achievable Potential but it assumed 100% participation in dynamic pricing programs when they became available to customers.

Study Findings – Study results are as follows:

Table 6-3 U.S. Savings Potential – FERC National

DR Potential Estimation Scenarios	Estimated Summer Peak Demand Savings by 2019 (GW)	Estimated Summer Peak Demand Savings by 2019 (% of baseline forecast)
Business-As-Usual	38	4%
Expanded Business-As-Usual	82	9%
Achievable Potential	138	14%
Full Potential	188	20%

Comparison to Global TVA Study – The results for this study are moderately comparable to the Global TVA study. They both use detailed, bottom-up analysis methods. They use different definitions of potential, however, but arrive at similar ranges of achievable peak demand savings.

Assessment of Demand Response and Energy Efficiency Potential for Midwest ISO and the Eastern Interconnection — MISO

This study was commissioned by Midwest ISO (MISO) and published in 2010. It addressed MISO's need to develop 20-year load forecasts that account for demand response (DR) and energy efficiency (EE) activities in the Midwest ISO region and for the Eastern Interconnection. The study presented demand and energy savings potential associated with a set of DR and energy efficiency programs over 2010-2030 for the MISO region as well as for the Eastern Interconnection. The contractor for the study was Global Energy Partners, LLC.

Analysis approach – For the MISO region, the study developed estimates of DR and EE savings over 2010-2030, using program information obtained from utilities within the region. For the Eastern Interconnection area, a variety of secondary resources were used to develop estimates of potential. For the Midwest ISO region, the study used a detailed bottom-up estimation framework, primarily based on survey data from utilities in the region. For the Eastern Interconnection analysis, the FERC National Assessment of DR Potential was used as the primary source of information to derive potential estimates. This was done by aggregating state-level potential data into the appropriate Eastern Interconnection planning areas. A total of five different DR program types were considered in the analysis to be in line with the Midwest ISO's planning model- residential DLC, residential pricing, C&I DLC, C&I Curtailable/Interruptible, and C&I Pricing. The timeframe of the study was from 2010 to 2030.

Baseline forecast – For the Midwest ISO region, the baseline forecast was developed based on forecast data provided by utilities in the region. For the Eastern Interconnection area, the baseline forecast was grounded to the FERC National Assessment of Demand Response Potential Report.

Levels of potential – The study developed estimates of achievable potential.

Study Findings- The savings from DR programs for the Midwest ISO region and Eastern Interconnection area are summarized in the table below.

Table 6-4 Savings Potential Summary – MISO

Geographic Area	Demand savings by 2020	Demand savings by 2030
MISO	8,139 MW (7.6%)	8,811 MW (7.6%)
Eastern Interconnection	42,399 MW (11.1%)	48,564 MW (10.8%)

Comparison to Global TVA Study – The results for this study are moderately comparable to the Global TVA study. They both use detailed, bottom-up analysis methods. The MISO study also has some limited regional specificity in that it looks at the Eastern Interconnection. Both studies arrive at similar ranges of achievable peak demand savings.

ABOUT GLOBAL

Global Energy Partners is a premier provider of energy and environmental engineering and technical services to utilities, energy companies, research organizations, government/regulatory agencies and private industry.

Global's offerings range from strategic planning to turn-key program design and implementation and technology applications.

Global is a wholly-owned subsidiary of EnerNOC, Inc committed to helping its clients achieve strategic business objectives with a staff of world-class experts, state of the art tools, and proven methodologies.

Global Energy Partners
An EnerNOC Company
500 Ygnacio Valley Road, Suite 450
Walnut Creek, CA 94596

P: 925.482.2000
F: 925.284.3147
E: gephq@gepllc.com

TENNESSEE VALLEY AUTHORITY POTENTIAL STUDY

VOLUME 3: DEMAND RESPONSE POTENTIAL STUDY

APPENDICES

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Global Energy Partners™
An EnerNOC Company

Global Energy Partners
An EnerNOC Company
500 Ygnacio Valley Road, Suite 450
Walnut Creek, CA 94596

P: 925.482.2000
F: 925.284.3147
E: gephq@gepllc.com

This report was prepared by

Global Energy Partners
An EnerNOC Company
500 Ygnacio Valley Blvd., Suite 450
Walnut Creek, CA 94596

Project Team:
I. Rohmund, Director
J. Borstein, Project Manager
D. Costenaro
A. Duer
D. Ghosh
K. Kolnowski
K. Marrin
F. Nguyen
A. Sanchez
S. Yoshida

Subcontractor*:*
The Brattle Group
353 Sacramento Street, Suite 1140
San Francisco, CA 94111

Dr. A. Faruqui
Dr. S. Sergici

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ASSUMPTIONS FOR COST EFFECTIVENESS ANALYSIS

Table A-1 Program Cost Assumptions

Program	Equipment Costs	Incentive Costs	Other
Direct Load Control	$170/participant for SH and WH, and $180/ participant for AC Source: PGE DR Potential Study (Cadmus), BPA Load Management Study (Global)	Res: $50/year for AC and SH, $25/year for WH Small C&I: $62/year for AC and SH, $31/year for WH Source: Based on low end of capacity payments in D7 program data sheet provided by TVA, also benchmarked against incentives in other studies	$400,000 program development cost; $50/new participant marketing cost; $10/kW-year administrative cost
Curtailable	Assume equipment cost of zero; contractual obligation between TVA and participant, enablement costs are not factored into analysis	$46.20/kW/year Source: Payment represents a weighted average (by load reduction) of the 5MR and 60MR capacity payments	$500/new participant marketing cost; $10/kW-year administrative cost
Capacity Reduction	Enabling tech costs - $270 small, $1000 medium, $2000 large, $13500/MW reduced for X-large, and Direct Serve Source: technology costs for small med and large from Avista Potential Study (Global), costs for X-large and DS from LADWP, HECO, Ameren potential studies (Global)	$48/kW/year, $0.25/kWh/year; Source: Benchmarked to the PSE potential study curtailable incentives	Marketing costs - $50/small medium, and large participants, $500 X-large and DS participants; $15/kW year administrative cost

Program	Equipment Costs	Incentive Costs	Other
Third Party Aggregated	Assume equipment cost of zero; contractual obligation between TVA and 3rd Party, 3rd Party incurs all costs	$44/kW /year, $2.00/kWh/year Source: TVA program description for EnerNOC; $2.00/kWh/year = $0.05kwh/month*40 hours	Assume other costs of zero; contractual obligation between TVA and 3rd Party, 3rd Party incurs all costs
Distributor Aggregated	Assume other costs of zero; contractual obligation between TVA and Distributors, Distributors incur all costs	$55/kW/year, $0.70/kWh/year; Source: capacity payment benchmarked to average aggregated DR $/kW; energy payment based on $0.035/kWh/month *20 hours from EnerNOC program description	Assume other costs of zero; contractual obligation between TVA and Distributors, Distributors incur all costs
Demand Reduction	$13,500/customer for X-large, and Direct Serve Source: costs for X-large and DS from LADWP, HECO, Ameren potential studies (Global)	$8/kWh/year Source: PG&E demand reduction payment of $200/MWH/month = $200/1000*40hours	Marketing costs $500/ participant; $15/kW-year administrative cost
Dynamic Pricing	Enabling tech costs - $180 Res, $270 Small, $1000 Medium, $2000 Large, $13,500/customer for X-large, and Direct Serve Source: technology costs for Res, Small, Med, and Large from Avista Potential Study (Global), costs for X-Large and Direct Serve from LADWP, HECO, Ameren potential studies (Global)	Incentives are assumed to be part of a revenue neutral tariff and are therefore not included in the analysis	$400,000 program development cost; marketing costs $50/participant; $5/kW-year administrative cost

Program	Equipment Costs	Incentive Costs	Other
Fast DR	Enabling tech costs - $180 Res, $270 Small, $0 for Medium, Large, X-large, and Direct Serve Source: technology costs for Res, Small, from Avista Potential Study (Global), costs for Medium, Large, X-large are assumed to be zero because these participants would be a subset of current DR participants with Auto-DR technology already in place	$36/year for Res and Small, $120/year for Medium, $3/kW/year for Large, X-Large and Direct Serve Source: Res, Small, Medium HECO potential study (Global); Large X-Large, Direct Serve from TVA IR description of $0.25/kW/month	$200,000 program development cost (for res, small); marketing costs of $50/participants; $10/kW-year administrative cost
Conservation Voltage Regulation **Dispatchable Voltage Regulation**	All costs are assumed to be covered by incentive payments.	$500/kW over 10 years	All costs are assumed to be covered by incentive payments.
Load Shifting	$500 Res, $1000 Small, $2000 Medium Source: CA and E-3 studies	Incentives are assumed to be part of a revenue neutral tariff and are therefore not included in the analysis	$200,000 program development cost; marketing costs of $50/participants; $5/kw-year administrative cost

SUMMARY OF COST EFFECTIVENESS RESULTS

Table B-1 Summer Cost Effectiveness Results

DR Option	Lifetime Benefits	Lifetime Costs	Net Benefits	B/C Ratio	Levelized Cost
Direct Load Control	**$514,678,911.45**	**$248,801,200.62**	**$265,877,710.83**	**2.07**	**$35.65**
Residential	$492,389,762.34	$238,104,064.38	$254,285,697.96	2.07	$35.66
Small C&I	$22,289,149.11	$10,697,136.24	$11,592,012.87	2.08	$35.32
Curtailable	**$91,766,484.40**	**$5,055,124.16**	**$86,711,360.24**	**18.15**	**$2.89**
Large C&I	$4,360,291.54	$250,257.49	$4,110,034.05	17.42	$3.02
X-Large C&I	$31,144,735.39	$1,712,077.41	$29,432,657.98	18.19	$2.89
Direct Serve	$56,261,457.47	$3,092,789.26	$53,168,668.21	18.19	$2.89
Capacity Reduction	**$857,816,207.84**	**$145,626,142.38**	**$712,190,065.46**	**5.89**	**$11.81**
Small C&I	$6,153,611.95	$7,041,539.00	-$887,927.05	0.87	$84.15
Medium C&I	$25,927,581.88	$8,615,197.17	$17,312,384.71	3.01	$24.47
Large C&I	$91,931,157.51	$23,349,648.20	$68,581,509.31	3.94	$18.34
X-Large C&I	$205,046,436.51	$53,633,625.98	$151,412,810.53	3.82	$18.42
Direct Serve	$528,757,419.99	$52,986,132.03	$475,771,287.96	9.98	$6.88
Third Party Aggregated	**$159,857,658.56**	**$128,731,621.67**	**$31,126,036.89**	**1.24**	**$53.81**
Medium C&I	$38,142,886.49	$30,769,950.15	$7,372,936.34	1.24	$53.67
Large C&I	$78,266,745.67	$63,073,352.80	$15,193,392.87	1.24	$53.75
X-Large C&I	$43,448,026.40	$34,888,318.72	$8,559,707.68	1.25	$54.03
Distributor Aggregated	**$77,274,582.87**	**$73,596,033.22**	**$3,678,549.65**	**1.05**	**$67.50**
Residential	$44,285,600.02	$41,531,987.73	$2,753,612.29	1.07	$69.16
Small C&I	$2,784,761.11	$2,614,123.96	$170,637.15	1.07	$69.06
Medium C&I	$7,486,021.26	$7,312,275.46	$173,745.80	1.02	$64.99
Large C&I	$14,253,241.91	$13,906,843.68	$346,398.23	1.02	$65.09
X-Large C&I	$8,464,958.57	$8,230,802.39	$234,156.18	1.03	$65.42
Demand Reduction	**$33,619,104.95**	**$8,540,687.83**	**$25,078,417.12**	**3.94**	**$18.74**
X-Large C&I	$24,676,140.45	$6,313,820.32	$18,362,320.13	3.91	$18.87
Direct Serve	$8,942,964.50	$2,226,867.51	$6,716,096.99	4.02	$18.37
Dynamic Pricing	**$76,913,917.29**	**$23,799,407.87**	**$53,114,509.42**	**3.23**	**$23.17**
Residential	$49,824,534.21	$17,045,919.43	$32,778,614.78	2.92	$25.69
Small C&I	$3,781,724.98	$3,508,698.90	$273,026.08	1.08	$69.81
Medium C&I	$10,043,877.78	$1,880,279.27	$8,163,598.51	5.34	$14.10
Large C&I	$4,974,924.38	$542,345.85	$4,432,578.53	9.17	$8.03
X-Large C&I	$4,781,574.24	$463,594.63	$4,317,979.61	10.31	$7.15
Direct Serve	$3,507,281.70	$358,569.79	$3,148,711.91	9.78	$7.54

DR Option	Lifetime Benefits	Lifetime Costs	Net Benefits	B/C Ratio	Levelized Cost
Fast DR	**$280,788,930.09**	**$67,056,383.74**	**$213,732,546.35**	**4.19**	**$16.28**
Residential	$36,535,366.99	$17,550,906.44	$18,984,460.55	2.08	$35.46
Small C&I	$19,955,586.42	$11,818,197.58	$8,137,388.84	1.69	$43.83
Medium C&I	$11,987,192.04	$2,466,149.51	$9,521,042.53	4.86	$14.78
Large C&I	$15,174,680.65	$2,516,097.54	$12,658,583.11	6.03	$11.48
X-Large C&I	$23,578,968.96	$3,919,514.38	$19,659,454.58	6.02	$11.29
Direct Serve	$173,557,135.03	$28,785,518.29	$144,771,616.74	6.03	$10.98
Conservation Voltage Regulation	**$213,026,158.70**	**$132,742,116.38**	**$80,284,042.32**	**1.60**	**$46.63**
Residential	$131,344,181.61	$81,843,961.07	$49,500,220.53	1.60	$46.63
Small C&I	$21,769,032.39	$13,564,847.85	$8,204,184.54	1.60	$46.63
Medium C&I	$59,912,944.71	$37,333,307.45	$22,579,637.25	1.60	$46.63
Dispatchable Voltage Regulation	**$74,559,155.54**	**$46,459,740.73**	**$28,099,414.81**	**1.60**	**$46.63**
Residential	$45,970,463.56	$28,645,386.38	$17,325,077.19	1.60	$46.63
Small C&I	$7,619,161.34	$4,747,696.75	$2,871,464.59	1.60	$46.63
Medium C&I	$20,969,530.65	$13,066,657.61	$7,902,873.04	1.60	$46.63
Load Shifting	**$36,408,961.39**	**$27,777,812.48**	**$8,631,148.91**	**1.31**	**$56.09**
Residential	$9,639,132.87	$11,583,656.15	-$1,944,523.28	0.83	$88.26
Small C&I	$6,940,094.50	$11,975,277.80	-$5,035,183.30	0.58	$126.77
Medium C&I	$19,829,734.02	$4,218,878.53	$15,610,855.49	4.70	$15.65

Table B-2 Winter Cost Effectiveness Results

DR Option	Lifetime Benefits	Lifetime Costs	Net Benefits	B/C Ratio	Levelized Cost
Direct Load Control	**$236,814,371.88**	**$116,985,300.19**	**$119,829,071.69**	**2.02**	**$36.41**
Residential	$233,658,128.41	$115,322,856.07	$118,335,272.34	2.03	$36.38
Small C&I	$3,156,243.47	$1,662,444.12	$1,493,799.35	1.90	$38.53
Curtailable	**$86,891,171.66**	**$5,045,015.04**	**$81,846,156.62**	**17.22**	**$3.05**
Large C&I	$3,251,430.33	$250,257.49	$3,001,172.84	12.99	$4.04
X-Large C&I	$33,105,732.89	$1,721,722.27	$31,384,010.62	19.23	$2.73
Direct Serve	$50,534,008.44	$3,073,035.28	$47,460,973.16	16.44	$3.19
Capacity Reduction	**$770,194,969.28**	**$145,591,427.90**	**$624,603,541.38**	**5.29**	**$13.15**
Small C&I	$4,157,765.05	$7,041,539.00	-$2,883,773.95	0.59	$124.57
Medium C&I	$18,357,953.82	$8,615,197.17	$9,742,756.65	2.13	$34.57
Large C&I	$67,259,658.16	$23,349,648.20	$43,910,009.96	2.88	$25.06
X-Large C&I	$213,856,883.32	$53,704,656.70	$160,152,226.62	3.98	$17.69
Direct Serve	$466,562,708.93	$52,880,386.83	$413,682,322.10	8.82	$7.77
Third Party Aggregated	**$129,782,501.82**	**$104,497,256.69**	**$25,285,245.13**	**1.24**	**$53.82**
Medium C&I	$27,047,248.20	$21,822,612.73	$5,224,635.47	1.24	$53.66
Large C&I	$57,354,874.10	$46,229,053.86	$11,125,820.24	1.24	$53.74
X-Large C&I	$45,380,379.52	$36,445,590.10	$8,934,789.42	1.25	$54.02
Distributor Aggregated	**$89,317,421.50**	**$84,674,593.64**	**$4,642,827.86**	**1.05**	**$67.98**
Residential	$61,711,015.78	$57,870,413.33	$3,840,602.45	1.07	$69.17
Small C&I	$3,010,424.79	$2,825,768.69	$184,656.10	1.07	$69.06
Medium C&I	$5,308,457.71	$5,186,102.55	$122,355.16	1.02	$64.97
Large C&I	$10,445,888.87	$10,193,904.89	$251,983.98	1.02	$65.08
X-Large C&I	$8,841,634.35	$8,598,404.18	$243,230.17	1.03	$65.40
Demand Reduction	**$33,620,053.87**	**$8,548,509.86**	**$25,071,544.01**	**3.93**	**$18.75**
X-Large C&I	$25,738,082.17	$6,323,486.63	$19,414,595.54	4.07	$18.12
Direct Serve	$7,881,971.70	$2,225,023.23	$5,656,948.47	3.54	$20.83
Dynamic Pricing	**$80,903,995.08**	**$23,799,392.43**	**$57,104,602.65**	**3.40**	**$22.04**
Residential	$59,517,291.85	$17,045,919.43	$42,471,372.42	3.49	$21.51
Small C&I	$2,555,566.32	$3,508,698.90	-$953,132.58	0.73	$103.33
Medium C&I	$7,112,629.90	$1,880,279.27	$5,232,350.63	3.78	$19.92
Large C&I	$3,639,990.55	$542,345.85	$3,097,644.70	6.71	$10.98
X-Large C&I	$4,987,341.18	$463,611.90	$4,523,729.28	10.76	$6.85
Direct Serve	$3,091,175.28	$358,537.08	$2,732,638.20	8.62	$8.55
Fast DR	**$254,768,952.54**	**$67,055,287.81**	**$187,713,664.73**	**3.80**	**$17.96**
Residential	$43,637,534.04	$17,550,906.44	$26,086,627.60	2.49	$29.69
Small C&I	$13,483,627.32	$11,818,197.58	$1,665,429.74	1.14	$64.88
Medium C&I	$8,491,294.55	$2,466,149.51	$6,025,145.04	3.44	$20.86
Large C&I	$11,114,643.97	$2,516,097.54	$8,598,546.43	4.42	$15.67
X-Large C&I	$24,644,321.47	$3,919,594.82	$20,724,726.65	6.29	$10.80
Direct Serve	$153,397,531.19	$28,784,341.92	$124,613,189.27	5.33	$12.41

DR Option	Lifetime Benefits	Lifetime Costs	Net Benefits	B/C Ratio	Levelized Cost
Conservation Voltage Regulation	**$197,826,298.42**	**$123,639,686.44**	**$74,186,611.98**	**1.60**	**$43.43**
Residential	$145,015,331.03	$90,633,299.01	$54,382,032.02	1.60	$51.63
Small C&I	$13,596,714.36	$8,497,826.19	$5,098,888.17	1.60	$29.21
Medium C&I	$39,214,253.03	$24,508,561.24	$14,705,691.80	1.60	$30.61
Dispatchable Voltage Regulation	**$69,239,204.45**	**$43,273,890.25**	**$25,965,314.19**	**1.60**	**$43.43**
Residential	$50,755,365.86	$31,721,654.66	$19,033,711.21	1.60	$51.63
Small C&I	$4,758,850.03	$2,974,239.17	$1,784,610.86	1.60	$29.21
Medium C&I	$13,724,988.56	$8,577,996.43	$5,146,992.13	1.60	$30.61
Load Shifting	**$30,242,026.32**	**$27,777,812.48**	**$2,464,213.84**	**1.09**	**$67.53**
Residential	$11,512,589.28	$11,583,656.15	-$71,066.87	0.99	$73.91
Small C&I	$4,689,135.62	$11,975,277.80	-$7,286,142.18	0.39	$187.66
Medium C&I	$14,040,301.42	$4,218,878.53	$9,821,422.89	3.33	$22.11

SUMMARY OF POTENTIAL RESULTS

This appendix presents the savings from demand response programs. All values shown are in MW.

Demand Response Potential Results—Summer

Table C-1 Direct Load Control–Central Air Conditioning (Summer)

Achievable Low

Customer Class	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
Residential	6.8	10.4	34.8	88.1	178.1	269.9	363.5	368.3	373.1	377.7	382.3	386.8	391.3	395.7	400.1	404.6	409.1	413.5	418.0	420.4	422.9
Small C&I	0.7	2.5	3.4	8.5	17.2	26.1	35.2	35.6	36.1	36.5	36.9	37.4	37.8	38.2	38.6	39.1	39.5	39.9	40.4	40.8	40.8
Total DR Potential	**7.4**	**13.0**	**38.2**	**96.6**	**195.3**	**296.0**	**398.8**	**404.0**	**409.2**	**414.2**	**419.2**	**424.2**	**429.1**	**434.0**	**438.8**	**443.7**	**448.6**	**453.5**	**458.4**	**461.2**	**463.7**

Achievable High

Customer Class	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
Residential	12.8	19.7	65.8	166.0	334.9	506.3	680.5	689.5	698.4	707.1	715.6	724.1	732.5	740.8	749.0	757.4	765.7	774.1	782.5	787.0	791.6
Small C&I	0.8	2.9	3.8	9.6	19.5	29.6	39.9	40.4	40.9	41.4	41.8	42.3	42.8	43.3	43.8	44.3	44.8	45.2	45.7	46.2	46.2
Total DR Potential	13.6	22.6	69.6	175.7	354.4	535.9	720.4	729.9	739.3	748.4	757.4	766.4	775.3	784.1	792.8	801.7	810.5	819.3	828.2	833.2	837.8

Table C-2 Direct Load Control–Water Heating (Summer)

Achievable Low

Customer Class	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
Residential	3.0	10.1	15.2	38.4	77.6	117.5	158.3	160.4	162.5	164.5	166.5	168.5	170.4	172.4	174.3	176.2	178.2	180.1	182.1	183.1	184.2
Small C&I	0.3	0.6	0.9	1.2	1.8	2.7	3.7	3.7	3.8	3.8	3.9	3.9	3.9	4.0	4.0	4.1	4.1	4.2	4.2	4.3	4.3
Total DR Potential	**3.2**	**10.7**	**16.1**	**39.6**	**79.4**	**120.3**	**162.0**	**164.1**	**166.3**	**168.3**	**170.3**	**172.4**	**174.4**	**176.3**	**178.3**	**180.3**	**182.3**	**184.3**	**186.3**	**187.4**	**188.4**

Achievable High

Customer Class	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
Residential	5.6	19.1	28.6	72.3	145.8	220.5	296.4	300.3	304.2	307.9	311.7	315.3	319.0	322.6	326.2	329.9	333.5	337.1	340.8	342.8	344.8
Small C&I	0.3	0.7	1.0	1.4	2.0	3.1	4.2	4.2	4.3	4.3	4.4	4.4	4.5	4.5	4.6	4.6	4.7	4.7	4.8	4.8	4.8
Total DR Potential	**5.9**	**19.7**	**29.6**	**73.7**	**147.9**	**223.6**	**300.5**	**304.5**	**308.4**	**312.3**	**316.0**	**319.8**	**323.5**	**327.2**	**330.8**	**334.5**	**338.2**	**341.9**	**345.6**	**347.6**	**349.6**

Table C-3 Curtailable (Summer)

Achievable Low and Achievable High

Customer Class	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
Large C&I	25.1	20.3	8.6	1.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
X-Large C&I	179.9	145.2	61.4	12.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Direct Serve	324.9	262.4	110.9	22.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total DR Potential	**529.9**	**427.8**	**180.9**	**36.5**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**

Table C-4 Capacity Reduction (Summer)

Achievable Low

Customer Class	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
Small C&I	0.2	0.5	1.0	2.5	4.9	7.2	9.6	9.7	9.7	9.8	9.9	10.0	10.1	10.2	10.3	10.4	10.5	10.6	10.8	10.9	11.0
Medium C&I	0.7	1.7	3.4	8.5	17.1	25.8	34.7	35.1	35.3	35.7	36.1	36.4	36.7	37.1	37.5	38.0	38.3	38.8	39.2	39.7	40.1
Large C&I	8.2	16.2	29.1	42.2	59.9	73.7	88.2	89.4	90.3	91.7	93.0	94.1	95.2	96.8	97.9	99.4	100.2	101.7	103.0	104.3	105.6
X-Large C&I	65.4	106.1	224.1	290.6	309.4	326.6	342.0	346.4	349.1	354.1	358.8	362.8	366.4	372.1	376.1	381.2	384.1	389.6	394.1	398.8	403.4
Direct Serve	368.6	443.2	634.4	756.9	796.6	798.1	809.5	819.8	826.1	837.8	848.6	857.9	866.4	879.6	889.1	900.9	907.5	920.3	931.0	941.8	952.7
Total DR Potential	**443**	**568**	**892**	**1,101**	**1,188**	**1,231**	**1,284**	**1,300**	**1,310**	**1,329**	**1,346**	**1,361**	**1,375**	**1,396**	**1,411**	**1,430**	**1,441**	**1,461**	**1,478**	**1,495**	**1,513**

Achievable High

Customer Class	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
Small C&I	0.3	0.6	1.3	3.2	6.3	9.3	12.3	12.4	12.5	12.6	12.8	12.9	13.0	13.1	13.2	13.4	13.5	13.7	13.8	14.0	14.1
Medium C&I	1.0	2.5	5.1	12.8	25.7	38.7	52.0	52.5	52.8	53.4	54.0	54.4	54.9	55.6	56.1	56.8	57.2	58.0	58.7	59.3	60.0
Large C&I	15.6	30.8	55.2	80.1	113.8	140.1	167.6	169.9	171.5	174.2	176.7	178.9	180.9	183.8	186.1	188.8	190.4	193.3	195.8	198.3	200.6
X-Large C&I	65.4	106.1	224.1	290.6	309.4	326.6	342.0	346.4	349.1	354.1	358.8	362.8	366.4	372.1	376.1	381.2	384.1	389.6	394.1	398.8	403.4
Direct Serve	368.6	443.2	634.4	756.9	796.6	798.1	809.5	819.8	826.1	837.8	848.6	857.9	866.4	879.6	889.1	900.9	907.5	920.3	931.0	941.8	952.7
Total DR Potential	**451**	**583**	**920**	**1,144**	**1,252**	**1,313**	**1,383**	**1,401**	**1,412**	**1,432**	**1,451**	**1,467**	**1,481**	**1,504**	**1,521**	**1,541**	**1,553**	**1,575**	**1,593**	**1,612**	**1,631**

Table C-5 Third Party Aggregated (Summer)

Achievable Low and Achievable High

Customer Class	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
Medium C&I	44.4	56.4	56.7	56.6	56.5	56.4	56.5	56.5	56.1	56.1	56.1	55.9	55.7	55.8	55.8	55.9	55.8	55.9	56.0	56.0	56.7
Large C&I	88.5	112.9	114.8	115.3	115.6	115.7	116.1	116.2	115.7	115.9	116.1	116.0	115.8	116.2	116.2	116.5	116.1	116.4	116.5	116.6	118.0
X-Large C&I	44.6	57.9	60.9	62.5	63.2	63.6	64.2	64.6	64.7	65.3	65.7	66.1	66.3	67.0	67.3	67.8	68.0	68.5	69.0	69.4	70.2
Total DR Potential	**177.5**	**227.1**	**232.3**	**234.3**	**235.3**	**235.7**	**236.8**	**237.3**	**236.6**	**237.4**	**237.9**	**237.9**	**237.8**	**239.0**	**239.3**	**240.3**	**239.8**	**240.9**	**241.4**	**242.0**	**244.8**

Table C-6 Distributor Aggregated (Summer)

Achievable Low

Customer Class	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
Residential	0.9	1.4	4.5	11.4	23.0	34.8	47.0	47.5	47.8	48.4	48.9	49.4	49.8	50.4	51.0	51.6	52.0	52.7	53.4	54.0	54.6
Small C&I	0.1	0.4	0.5	1.2	2.5	3.7	4.9	5.0	5.0	5.1	5.1	5.2	5.2	5.3	5.3	5.4	5.4	5.5	5.6	5.7	5.7
Medium C&I	8.7	11.0	11.1	11.1	11.1	11.1	11.1	11.1	11.0	11.0	11.0	11.0	10.9	11.0	11.0	11.0	11.0	11.0	11.0	11.0	11.1
Large C&I	16.3	20.3	20.7	20.8	20.9	20.9	21.0	21.1	21.0	21.1	21.1	21.1	21.1	21.2	21.2	21.3	21.3	21.3	21.4	21.4	21.7
X-Large C&I	8.7	11.3	11.8	12.2	12.3	12.4	12.5	12.6	12.6	12.7	12.8	12.9	12.9	13.0	13.1	13.2	13.2	13.4	13.4	13.5	13.7
Total DR Potential	**34.7**	**44.3**	**48.6**	**56.6**	**69.7**	**82.9**	**96.5**	**97.2**	**97.4**	**98.2**	**99.0**	**99.5**	**99.9**	**100.9**	**101.6**	**102.6**	**102.9**	**104.0**	**104.8**	**105.6**	**106.8**

Achievable High

Customer Class	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
Residential	1.7	2.6	8.5	21.5	43.4	65.7	88.8	89.8	90.3	91.4	92.4	93.2	94.0	95.2	96.3	97.5	98.3	99.6	100.8	102.0	103.1
Small C&I	0.1	0.4	0.6	1.4	2.8	4.2	5.5	5.6	5.6	5.7	5.8	5.8	5.9	5.9	6.0	6.1	6.1	6.2	6.3	6.4	6.4
Medium C&I	8.7	11.0	11.1	11.1	11.1	11.1	11.1	11.1	11.0	11.0	11.0	11.0	10.9	11.0	11.0	11.0	11.0	11.0	11.0	11.0	11.1
Large C&I	16.3	20.3	20.7	20.8	20.9	20.9	21.0	21.1	21.0	21.1	21.1	21.1	21.1	21.2	21.2	21.3	21.3	21.3	21.4	21.4	21.7
X-Large C&I	8.7	11.3	11.8	12.2	12.3	12.4	12.5	12.6	12.6	12.7	12.8	12.9	12.9	13.0	13.1	13.2	13.2	13.4	13.4	13.5	13.7
Total DR Potential	**35.5**	**45.6**	**52.7**	**66.9**	**90.4**	**114.3**	**139.0**	**140.1**	**140.5**	**141.9**	**143.1**	**144.0**	**144.8**	**146.4**	**147.6**	**149.1**	**149.8**	**151.5**	**152.9**	**154.3**	**156.1**

Table C-7 Demand Reduction (Summer)

Achievable Low and Achievable High

Customer Class	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
X-Large C&I	1.0	2.4	4.8	11.9	24.1	36.3	48.9	49.6	49.9	50.7	51.3	51.9	52.4	53.2	53.8	54.5	54.9	55.7	56.4	57.0	57.7
Direct Serve	0.3	0.9	1.7	4.3	8.6	13.1	17.8	18.0	18.1	18.4	18.6	18.8	19.0	19.3	19.5	19.8	19.9	20.2	20.4	20.7	20.9
Total DR Potential	**1.3**	**3.3**	**6.5**	**16.2**	**32.7**	**49.4**	**66.7**	**67.5**	**68.1**	**69.0**	**70.0**	**70.7**	**71.4**	**72.5**	**73.3**	**74.3**	**74.9**	**75.9**	**76.8**	**77.7**	**78.6**

Table C-8 Dynamic Pricing (Summer)

Achievable Low

Customer Class	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
Residential	1.0	2.9	6.9	19.7	40.3	60.5	82.4	86.2	88.1	92.1	96.1	99.9	103.7	108.1	112.4	117.0	121.0	125.9	130.6	135.4	140.2
Small C&I	0.1	0.2	0.5	1.3	2.7	4.2	5.7	6.0	6.1	6.4	6.7	7.0	7.2	7.5	7.8	8.2	8.4	8.8	9.1	9.4	9.8
Medium C&I	0.2	0.5	1.2	3.3	7.0	10.8	15.2	15.9	16.2	17.0	17.7	18.4	19.1	19.9	20.7	21.6	22.3	23.2	24.1	25.0	25.9
Large C&I	0.2	0.5	0.9	2.3	4.7	7.0	9.4	9.5	9.6	9.7	9.9	10.0	10.1	10.3	10.4	10.5	10.6	10.8	10.9	11.1	11.2
X-Large C&I	0.2	0.4	0.8	1.9	3.8	5.7	7.6	7.7	7.7	7.8	7.9	8.0	8.1	8.2	8.3	8.4	8.5	8.6	8.7	8.8	8.9
Direct Serve	0.1	0.3	0.5	1.4	2.7	4.1	5.6	5.6	5.7	5.8	5.8	5.9	6.0	6.1	6.1	6.2	6.2	6.3	6.4	6.5	6.6
Total DR Potential	**1.7**	**4.7**	**10.8**	**30.0**	**61.2**	**92.3**	**125.8**	**130.9**	**133.5**	**138.8**	**144.1**	**149.2**	**154.3**	**160.2**	**165.8**	**171.9**	**177.2**	**183.7**	**189.9**	**196.2**	**202.6**

Achievable High

Customer Class	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
Residential	1.1	3.3	7.8	21.9	43.6	63.8	84.5	88.4	90.3	94.4	98.5	102.5	106.4	110.9	115.2	120.0	124.1	129.1	133.9	138.8	143.8
Small C&I	0.1	0.2	0.5	1.5	3.1	4.7	6.5	6.8	6.9	7.2	7.5	7.8	8.1	8.5	8.8	9.2	9.5	9.9	10.2	10.6	11.0
Medium C&I	0.2	0.5	1.3	3.8	8.0	12.3	17.2	18.0	18.4	19.2	20.1	20.9	21.7	22.6	23.5	24.5	25.3	26.3	27.3	28.3	29.4
Large C&I	0.2	0.5	1.0	2.5	5.0	7.4	9.7	9.9	10.0	10.1	10.3	10.4	10.5	10.7	10.8	11.0	11.1	11.2	11.4	11.5	11.7
X-Large C&I	0.2	0.5	0.9	2.4	4.7	7.1	9.5	9.6	9.7	9.8	9.9	10.0	10.1	10.3	10.4	10.6	10.6	10.8	10.9	11.0	11.2
Direct Serve	0.1	0.3	0.7	1.7	3.4	5.2	7.0	7.1	7.1	7.2	7.3	7.4	7.5	7.6	7.6	7.8	7.8	7.9	8.0	8.1	8.2
Total DR Potential	**1.9**	**5.4**	**12.2**	**33.7**	**67.7**	**100.4**	**134.3**	**139.6**	**142.4**	**148.0**	**153.6**	**159.0**	**164.3**	**170.5**	**176.4**	**182.9**	**188.4**	**195.3**	**201.8**	**208.4**	**215.2**

Table C-9 Fast DR (Summer)

Achievable Low

Customer Class	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
Residential	0.3	0.8	1.6	4.1	8.2	12.4	16.7	17.0	17.1	17.4	17.7	18.0	18.2	18.6	18.9	19.2	19.5	19.8	20.2	20.5	20.9
Small C&I	0.3	1.3	2.7	7.9	16.3	24.5	33.0	33.5	33.8	34.4	35.0	35.5	36.0	36.7	37.3	38.0	38.5	39.2	39.9	40.6	41.3
Medium C&I	1.6	2.2	2.4	3.1	4.3	5.5	6.8	6.9	6.9	7.0	7.1	7.2	7.3	7.5	7.6	7.7	7.8	7.9	8.1	8.2	8.3
Large C&I	4.0	5.0	5.2	5.5	6.2	6.9	7.6	7.6	7.6	7.7	7.8	7.8	7.8	7.9	8.0	8.0	8.1	8.1	8.2	8.2	8.3
X-Large C&I	8.9	9.6	10.8	11.6	12.3	13.2	14.1	14.3	14.4	14.6	14.7	14.9	15.0	15.3	15.4	15.6	15.7	15.9	16.1	16.3	16.5
Direct Serve	223.3	223.9	236.9	248.6	255.9	250.2	247.4	242.2	233.9	237.2	240.3	242.9	245.3	249.1	251.7	255.1	257.0	260.6	263.6	266.7	269.8
Total DR Potential	**238.5**	**242.8**	**259.5**	**280.9**	**303.3**	**312.7**	**325.5**	**321.5**	**313.8**	**318.4**	**322.7**	**326.4**	**329.7**	**334.9**	**338.8**	**343.6**	**346.5**	**351.6**	**356.0**	**360.5**	**365.0**

Achievable High

Customer Class	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
Residential	1.3	3.8	7.0	17.8	35.6	53.5	71.8	72.8	73.3	74.5	75.5	76.5	77.3	78.6	79.7	81.0	81.9	83.3	84.6	85.8	87.1
Small C&I	0.4	1.5	3.2	9.4	19.4	29.0	39.0	39.6	39.9	40.6	41.3	41.9	42.4	43.2	43.9	44.7	45.3	46.2	46.9	47.7	48.5
Medium C&I	4.2	5.7	6.5	8.9	13.0	17.2	21.6	21.9	22.0	22.4	22.7	23.0	23.3	23.7	24.0	24.5	24.7	25.2	25.6	26.0	26.4
Large C&I	10.6	13.6	14.9	16.7	19.7	22.3	25.0	25.2	25.3	25.5	25.8	26.0	26.1	26.4	26.6	26.9	27.0	27.3	27.5	27.8	28.1
X-Large C&I	22.3	24.0	27.0	29.1	30.7	33.1	35.4	35.8	36.1	36.6	37.0	37.4	37.7	38.3	38.7	39.2	39.4	39.9	40.4	40.8	41.3
Direct Serve	223.3	223.9	236.9	248.8	256.2	250.5	247.8	242.6	234.3	237.6	240.7	243.3	245.7	249.5	252.2	255.5	257.4	261.0	264.1	267.1	270.2
Total DR Potential	**262.1**	**272.4**	**295.5**	**330.6**	**374.6**	**405.7**	**440.5**	**437.9**	**430.9**	**437.2**	**443.0**	**448.0**	**452.6**	**459.7**	**465.1**	**471.8**	**475.8**	**482.9**	**489.0**	**495.2**	**501.6**

Table C-10 Conservation Voltage Regulation (Summer)

Achievable Low and Achievable High

Customer Class	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
Residential	14	29	44	59	75	99	123	147	172	197	223	250	278	306	335	338	341	346	351	355	360	364
Small C&I	2	5	7	10	12	16	20	24	28	33	37	41	46	51	56	56	57	57	58	59	60	60
Medium C&I	6	13	20	27	34	45	56	67	78	90	102	114	127	140	153	154	156	158	160	162	164	166
Total DR Potential	**23**	**46**	**71**	**96**	**121**	**160**	**199**	**239**	**278**	**320**	**361**	**405**	**450**	**496**	**543**	**548**	**554**	**561**	**570**	**576**	**583**	**590**

Table C-11 Dispatchable Voltage Regulation (Summer)

Achievable Low and Achievable High

Customer Class	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
Residential	5	10	15	21	26	34	43	52	60	69	78	87	97	107	117	118	120	121	123	124	126	127
Small C&I	1	2	3	3	4	6	7	9	10	11	13	14	16	18	19	20	20	20	20	21	21	21
Medium C&I	2	5	7	9	12	16	20	24	27	31	36	40	44	49	53	54	55	55	56	57	57	58
Total DR Potential	**8**	**16**	**25**	**34**	**42**	**56**	**70**	**84**	**97**	**112**	**126**	**142**	**158**	**174**	**190**	**192**	**194**	**196**	**199**	**202**	**204**	**206**

Table C-12 Load Shifting (Summer)

Achievable Low

Customer Class	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
Residential	0.3	0.7	1.5	3.7	7.2	10.6	14.0	14.1	14.2	14.4	14.6	14.7	14.8	15.0	15.2	15.4	15.5	15.7	15.9	16.1	16.2
Small C&I	0.2	0.5	1.1	2.6	5.2	7.6	9.9	10.0	10.1	10.2	10.3	10.4	10.4	10.6	10.7	10.8	10.9	11.0	11.1	11.3	11.4
Medium C&I	0.5	1.2	2.5	6.2	12.3	18.3	24.3	24.6	24.7	25.0	25.3	25.5	25.7	26.0	26.3	26.6	26.8	27.2	27.5	27.8	28.1
Total DR Potential	**1.0**	**2.5**	**5.0**	**12.4**	**24.6**	**36.5**	**48.2**	**48.7**	**49.0**	**49.6**	**50.1**	**50.6**	**50.9**	**51.6**	**52.1**	**52.8**	**53.2**	**53.9**	**54.5**	**55.1**	**55.7**

Achievable High

Customer Class	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
Residential	0.4	1.1	2.2	5.4	10.3	14.9	19.0	19.2	19.4	19.6	19.8	20.0	20.1	20.4	20.6	20.9	21.1	21.4	21.6	21.9	22.1
Small C&I	0.3	0.8	1.5	3.7	7.3	10.6	13.8	14.0	14.0	14.2	14.3	14.5	14.6	14.7	14.9	15.1	15.2	15.4	15.5	15.7	15.9
Medium C&I	0.8	2.0	4.1	10.2	20.2	29.9	39.6	40.0	40.2	40.7	41.1	41.5	41.8	42.3	42.7	43.3	43.6	44.2	44.7	45.2	45.7
Total DR Potential	**1.5**	**3.9**	**7.8**	**19.3**	**37.8**	**55.4**	**72.4**	**73.2**	**73.6**	**74.5**	**75.3**	**75.9**	**76.5**	**77.5**	**78.3**	**79.3**	**79.8**	**80.9**	**81.8**	**82.7**	**83.6**

Demand Response Potential Results—Winter

Table C-13 Direct Load Control–Space Heating (Winter)

Achievable Low

Customer Class	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
Residential	1.7	4.2	8.5	21.5	43.5	66.0	88.9	90.1	91.2	92.4	93.5	94.6	95.7	96.8	97.8	98.9	100.0	101.1	102.2	102.8	103.4
Small C&I	0.0	0.1	0.2	0.4	0.8	1.3	1.7	1.8	1.8	1.8	1.8	1.8	1.9	1.9	1.9	1.9	1.9	2.0	2.0	2.0	2.0
Total DR Potential	**1.7**	**4.3**	**8.7**	**22.0**	**44.4**	**67.3**	**90.6**	**91.8**	**93.0**	**94.2**	**95.3**	**96.4**	**97.5**	**98.6**	**99.7**	**100.9**	**102.0**	**103.1**	**104.2**	**104.8**	**105.4**

Achievable High

Customer Class	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
Residential	3.1	7.9	16.1	40.6	81.9	123.8	166.4	168.6	170.8	172.9	175.0	177.0	179.1	181.1	183.2	185.2	187.2	189.3	191.3	192.4	193.6
Small C&I	0.0	0.1	0.2	0.5	1.0	1.5	2.0	2.0	2.0	2.0	2.1	2.1	2.1	2.1	2.2	2.2	2.2	2.2	2.2	2.3	2.3
Total DR Potential	**3.2**	**8.0**	**16.3**	**41.1**	**82.8**	**125.3**	**168.4**	**170.6**	**172.8**	**174.9**	**177.0**	**179.1**	**181.2**	**183.3**	**185.3**	**187.4**	**189.4**	**191.5**	**193.6**	**194.7**	**195.8**

Table C-14 Direct Load Control–Water Heating (Winter)

Achievable Low

Customer Class	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
Residential	3.0	10.1	15.2	38.4	77.6	117.5	158.3	160.4	162.5	164.5	166.5	168.5	170.4	172.4	174.3	176.2	178.2	180.1	182.1	183.1	184.2
Small C&I	0.3	0.6	0.9	1.2	1.8	2.7	3.7	3.7	3.8	3.8	3.9	3.9	3.9	4.0	4.0	4.1	4.1	4.2	4.2	4.3	4.3
Total DR Potential	**3.2**	**10.7**	**16.1**	**39.6**	**79.4**	**120.3**	**162.0**	**164.1**	**166.3**	**168.3**	**170.3**	**172.4**	**174.4**	**176.3**	**178.3**	**180.3**	**182.3**	**184.3**	**186.3**	**187.4**	**188.4**

Achievable High

Customer Class	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
Residential	5.6	19.1	28.6	72.3	145.8	220.5	296.4	300.3	304.2	307.9	311.7	315.3	319.0	322.6	326.2	329.9	333.5	337.1	340.8	342.8	344.8
Small C&I	0.3	0.7	1.0	1.4	2.0	3.1	4.2	4.2	4.3	4.3	4.4	4.4	4.5	4.5	4.6	4.6	4.7	4.7	4.8	4.8	4.8
Total DR Potential	**5.9**	**19.7**	**29.6**	**73.7**	**147.9**	**223.6**	**300.5**	**304.5**	**308.4**	**312.3**	**316.0**	**319.8**	**323.5**	**327.2**	**330.8**	**334.5**	**338.2**	**341.9**	**345.6**	**347.6**	**349.6**

Table C-15 Curtailable (Winter)

Achievable Low and Achievable High

Customer Class	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
Large C&I	18.9	14.6	6.2	1.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
X-Large C&I	193.4	149.6	63.7	12.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Direct Serve	295.2	228.4	97.3	19.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total DR Potential	**507.5**	**392.6**	**167.2**	**33.9**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**

Table C-16 Capacity Reduction (Winter)

Achievable Low

Customer Class	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
Small C&I	0.1	0.3	0.7	1.7	3.3	4.9	6.5	6.5	6.6	6.6	6.7	6.8	6.8	6.9	7.0	7.0	7.1	7.2	7.3	7.4	7.5
Medium C&I	0.5	1.2	2.4	6.0	12.1	18.3	24.6	24.9	25.0	25.2	25.5	25.8	26.0	26.3	26.6	26.9	27.1	27.5	27.8	28.2	28.6
Large C&I	6.2	11.7	21.2	30.9	43.7	53.9	64.5	65.5	66.1	66.9	67.9	68.8	69.6	70.8	71.8	72.5	73.3	74.4	75.5	76.6	77.6
X-Large C&I	70.3	109.3	232.5	303.4	322.0	340.5	356.6	361.9	364.3	368.5	373.4	378.2	382.0	388.1	392.9	396.7	400.4	406.1	411.7	417.3	423.0
Direct Serve	334.8	385.8	556.3	667.6	700.6	703.1	713.2	723.7	728.4	736.7	746.3	755.8	763.2	775.4	784.7	792.2	799.4	810.6	821.7	832.8	844.2
Total DR Potential	**412**	**508**	**813**	**1,010**	**1,082**	**1,121**	**1,165**	**1,183**	**1,190**	**1,204**	**1,220**	**1,235**	**1,248**	**1,268**	**1,283**	**1,295**	**1,307**	**1,326**	**1,344**	**1,362**	**1,381**

Achievable High

Customer Class	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
Small C&I	0.2	0.4	0.9	2.2	4.2	6.3	8.3	8.4	8.4	8.5	8.6	8.7	8.7	8.9	9.0	9.0	9.1	9.2	9.4	9.5	9.6
Medium C&I	0.7	1.8	3.6	9.0	18.1	27.4	36.8	37.2	37.4	37.7	38.1	38.5	38.8	39.3	39.8	40.2	40.5	41.1	41.6	42.1	42.7
Large C&I	11.7	22.2	40.2	58.7	83.1	102.4	122.6	124.5	125.5	127.1	129.0	130.8	132.3	134.5	136.3	137.8	139.2	141.3	143.4	145.5	147.5
X-Large C&I	70.3	109.3	232.5	303.4	322.0	340.5	356.6	361.9	364.3	368.5	373.4	378.2	382.0	388.1	392.9	396.7	400.4	406.1	411.7	417.3	423.0
Direct Serve	334.8	385.8	556.3	667.6	700.6	703.1	713.2	723.7	728.4	736.7	746.3	755.8	763.2	775.4	784.7	792.2	799.4	810.6	821.7	832.8	844.2
Total DR Potential	**418**	**519**	**833**	**1,041**	**1,128**	**1,180**	**1,237**	**1,256**	**1,264**	**1,279**	**1,295**	**1,312**	**1,325**	**1,346**	**1,363**	**1,376**	**1,389**	**1,408**	**1,428**	**1,447**	**1,467**

Table C-17 Third Party Aggregated (Winter)

Achievable Low and Achievable High

Customer Class	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
Medium C&I	32.4	39.4	39.9	40.1	39.9	39.9	40.0	40.0	39.7	39.7	39.6	39.6	39.4	39.5	39.6	39.5	39.5	39.6	39.7	39.8	40.3
Large C&I	66.7	81.6	83.5	84.5	84.4	84.6	84.9	85.1	84.7	84.6	84.7	84.8	84.7	85.1	85.1	85.0	84.9	85.1	85.4	85.6	86.8
X-Large C&I	48.0	59.6	63.1	65.2	65.8	66.3	66.9	67.5	67.6	67.9	68.4	68.9	69.1	69.9	70.3	70.6	70.8	71.5	72.0	72.6	73.6
Total DR Potential	**147.1**	**180.6**	**186.6**	**189.7**	**190.1**	**190.8**	**191.8**	**192.7**	**192.0**	**192.2**	**192.8**	**193.2**	**193.2**	**194.5**	**195.0**	**195.1**	**195.2**	**196.2**	**197.1**	**198.0**	**200.7**

Table C-18 Distributor Aggregated (Winter)

Achievable Low

Customer Class	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
Residential	1.3	1.9	6.3	15.9	31.9	48.5	65.5	66.3	66.6	67.3	68.0	68.8	69.3	70.3	71.1	71.8	72.5	73.5	74.5	75.5	76.5
Small C&I	0.1	0.4	0.5	1.3	2.7	4.0	5.3	5.4	5.4	5.5	5.5	5.6	5.6	5.7	5.8	5.8	5.9	6.0	6.1	6.1	6.2
Medium C&I	6.4	7.7	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.7	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.9
Large C&I	12.3	14.7	15.1	15.2	15.2	15.3	15.4	15.4	15.4	15.4	15.4	15.4	15.4	15.5	15.6	15.6	15.5	15.6	15.7	15.7	15.9
X-Large C&I	9.4	11.6	12.3	12.7	12.8	12.9	13.0	13.1	13.2	13.2	13.3	13.4	13.5	13.6	13.7	13.8	13.8	13.9	14.0	14.2	14.4
Total DR Potential	**29.4**	**36.2**	**41.9**	**53.0**	**70.5**	**88.5**	**107.1**	**108.1**	**108.4**	**109.1**	**110.1**	**111.0**	**111.6**	**112.9**	**113.9**	**114.7**	**115.4**	**116.8**	**118.0**	**119.3**	**120.9**

Achievable High

Customer Class	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
Residential	2.4	3.5	11.8	29.9	60.3	91.5	123.7	125.3	125.9	127.1	128.5	129.9	130.9	132.7	134.3	135.6	136.9	138.8	140.7	142.6	144.5
Small C&I	0.1	0.4	0.6	1.5	3.0	4.5	6.0	6.1	6.1	6.2	6.2	6.3	6.3	6.4	6.5	6.6	6.6	6.7	6.8	6.9	7.0
Medium C&I	6.4	7.7	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.7	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.9
Large C&I	12.3	14.7	15.1	15.2	15.2	15.3	15.4	15.4	15.4	15.4	15.4	15.4	15.4	15.5	15.6	15.6	15.5	15.6	15.7	15.7	15.9
X-Large C&I	9.4	11.6	12.3	12.7	12.8	12.9	13.0	13.1	13.2	13.2	13.3	13.4	13.5	13.6	13.7	13.8	13.8	13.9	14.0	14.2	14.4
Total DR Potential	**30.6**	**37.9**	**47.6**	**67.2**	**99.2**	**132.1**	**165.9**	**167.8**	**168.3**	**169.6**	**171.2**	**172.8**	**173.9**	**176.1**	**177.9**	**179.3**	**180.6**	**182.8**	**185.0**	**187.2**	**189.7**

Table C-19 Demand Reduction (Winter)

Achievable Low and Achievable High

Customer Class	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
X-Large C&I	1.0	2.5	4.9	12.4	25.1	37.9	51.0	51.8	52.1	52.7	53.4	54.1	54.6	55.5	56.2	56.8	57.3	58.1	58.9	59.7	60.5
Direct Serve	0.3	0.8	1.5	3.8	7.6	11.6	15.7	15.9	16.0	16.2	16.4	16.6	16.8	17.0	17.2	17.4	17.5	17.8	18.0	18.3	18.5
Total DR Potential	**1.3**	**3.2**	**6.5**	**16.2**	**32.6**	**49.4**	**66.7**	**67.7**	**68.1**	**68.9**	**69.8**	**70.7**	**71.4**	**72.5**	**73.4**	**74.1**	**74.8**	**75.9**	**76.9**	**78.0**	**79.0**

Table C-20 Dynamic Pricing (Winter)

Achievable Low

Customer Class	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
Residential	1.2	3.4	8.2	23.6	48.0	72.2	98.4	103.1	105.3	109.8	114.5	119.3	123.8	129.2	134.4	139.4	144.5	150.3	156.2	162.2	168.4
Small C&I	0.0	0.1	0.3	0.9	1.9	2.8	3.9	4.1	4.2	4.3	4.5	4.7	4.9	5.1	5.3	5.5	5.7	5.9	6.2	6.4	6.6
Medium C&I	0.1	0.3	0.8	2.4	5.0	7.7	10.7	11.3	11.5	12.0	12.5	13.0	13.5	14.1	14.7	15.3	15.8	16.5	17.1	17.8	18.4
Large C&I	0.1	0.3	0.7	1.7	3.4	5.1	6.8	7.0	7.0	7.1	7.2	7.3	7.4	7.5	7.6	7.7	7.8	7.9	8.0	8.1	8.2
X-Large C&I	0.2	0.4	0.8	2.0	3.9	5.9	7.9	8.0	8.1	8.2	8.3	8.4	8.5	8.6	8.7	8.8	8.9	9.0	9.1	9.2	9.4
Direct Serve	0.1	0.2	0.5	1.2	2.4	3.6	4.9	5.0	5.0	5.1	5.1	5.2	5.3	5.3	5.4	5.5	5.5	5.6	5.7	5.7	5.8
Total DR Potential	**1.8**	**4.8**	**11.3**	**31.7**	**64.5**	**97.4**	**132.6**	**138.3**	**141.0**	**146.4**	**152.1**	**157.9**	**163.3**	**169.9**	**176.2**	**182.1**	**188.1**	**195.2**	**202.3**	**209.5**	**216.9**

Achievable High

Customer Class	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
Residential	1.4	3.9	9.2	26.1	51.9	76.1	100.9	105.7	107.9	112.6	117.4	122.3	127.0	132.5	137.9	143.0	148.1	154.1	160.2	166.4	172.7
Small C&I	0.1	0.1	0.4	1.0	2.1	3.2	4.4	4.6	4.7	4.9	5.1	5.3	5.5	5.7	6.0	6.2	6.4	6.7	6.9	7.2	7.5
Medium C&I	0.1	0.4	0.9	2.7	5.6	8.7	12.2	12.8	13.0	13.6	14.2	14.8	15.3	16.0	16.7	17.3	17.9	18.6	19.4	20.1	20.9
Large C&I	0.2	0.4	0.7	1.9	3.6	5.4	7.1	7.2	7.3	7.4	7.5	7.6	7.7	7.8	7.9	8.0	8.1	8.2	8.3	8.5	8.6
X-Large C&I	0.2	0.5	1.0	2.5	4.9	7.4	9.9	10.0	10.1	10.2	10.3	10.5	10.6	10.7	10.9	11.0	11.1	11.2	11.4	11.6	11.7
Direct Serve	0.1	0.3	0.6	1.5	3.0	4.5	6.1	6.2	6.3	6.3	6.4	6.5	6.6	6.7	6.8	6.8	6.9	7.0	7.1	7.2	7.3
Total DR Potential	**2.0**	**5.5**	**12.8**	**35.6**	**71.2**	**105.3**	**140.5**	**146.5**	**149.3**	**154.9**	**160.9**	**167.0**	**172.6**	**179.5**	**186.1**	**192.3**	**198.5**	**205.9**	**213.3**	**220.9**	**228.6**

Table C-21 Fast DR (Winter)

Achievable Low

Customer Class	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
Residential	0.4	1.2	2.2	5.7	11.4	17.3	23.3	23.7	23.9	24.2	24.6	25.1	25.4	25.9	26.3	26.7	27.1	27.6	28.2	28.7	29.2
Small C&I	0.4	1.4	2.9	8.5	17.6	26.5	35.6	36.3	36.6	37.1	37.7	38.4	38.9	39.7	40.4	41.0	41.6	42.4	43.2	44.0	44.8
Medium C&I	1.2	1.5	1.7	2.2	3.0	3.9	4.8	4.9	4.9	5.0	5.0	5.1	5.2	5.3	5.4	5.4	5.5	5.6	5.7	5.8	5.9
Large C&I	3.0	3.6	3.8	4.0	4.6	5.0	5.5	5.6	5.6	5.6	5.7	5.7	5.7	5.8	5.8	5.9	5.9	5.9	6.0	6.1	6.1
X-Large C&I	9.6	9.9	11.2	12.1	12.8	13.8	14.7	14.9	15.0	15.2	15.3	15.5	15.7	15.9	16.1	16.2	16.4	16.6	16.8	17.0	17.3
Direct Serve	202.8	194.9	207.7	219.3	225.1	220.4	217.9	213.8	206.2	208.6	211.3	214.0	216.1	219.6	222.2	224.3	226.4	229.5	232.7	235.8	239.0
Total DR Potential	**217.4**	**212.4**	**229.5**	**251.9**	**274.5**	**286.9**	**301.9**	**299.1**	**292.2**	**295.7**	**299.8**	**303.8**	**307.0**	**312.1**	**316.2**	**319.6**	**322.8**	**327.7**	**332.5**	**337.4**	**342.4**

Achievable High

Customer Class	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
Residential	1.6	4.4	8.3	21.2	42.5	63.9	85.7	87.1	87.6	88.7	90.0	91.3	92.3	93.9	95.4	96.6	97.8	99.5	101.2	102.9	104.6
Small C&I	0.3	1.0	2.2	6.3	13.0	19.6	26.3	26.8	27.0	27.4	27.8	28.3	28.7	29.2	29.7	30.2	30.6	31.2	31.8	32.4	33.0
Medium C&I	3.0	4.0	4.6	6.3	9.2	12.2	15.3	15.5	15.6	15.8	16.0	16.3	16.5	16.8	17.0	17.3	17.5	17.8	18.1	18.5	18.8
Large C&I	8.0	9.8	10.8	12.2	14.4	16.3	18.3	18.5	18.5	18.6	18.8	19.0	19.1	19.3	19.5	19.6	19.8	20.0	20.2	20.4	20.7
X-Large C&I	23.9	24.7	28.0	30.4	32.0	34.5	36.9	37.4	37.7	38.1	38.5	39.0	39.3	39.9	40.4	40.7	41.1	41.6	42.2	42.7	43.3
Direct Serve	202.8	194.9	207.7	219.4	225.3	220.7	218.3	214.1	206.6	209.0	211.7	214.4	216.5	219.9	222.6	224.7	226.7	229.9	233.0	236.2	239.4
Total DR Potential	**239.8**	**238.8**	**261.6**	**295.9**	**336.4**	**367.2**	**400.7**	**399.4**	**392.9**	**397.6**	**402.9**	**408.2**	**412.4**	**419.1**	**424.6**	**429.1**	**433.4**	**440.0**	**446.5**	**453.0**	**459.8**

Table C-22 Conservation Voltage Regulation (Winter)

Achievable Low and Achievable High

Customer Class	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
Residential	17	35	50	67	84	111	137	164	192	220	248	278	307	337	368	371	374	378	381	384	387	390
Small C&I	2	3	5	6	8	10	13	15	18	21	23	26	29	32	34	35	35	35	36	36	36	37
Medium C&I	5	9	14	18	23	30	37	44	52	60	67	75	83	91	99	100	101	102	103	104	105	106
Total DR Potential	**23**	**47**	**68**	**92**	**115**	**151**	**187**	**224**	**262**	**300**	**339**	**379**	**419**	**460**	**502**	**506**	**510**	**516**	**520**	**524**	**528**	**533**

Table C-23 Dispatchable Voltage Regulation (Winter)

Achievable Low and Achievable High

Customer Class	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
Residential	6	12	18	24	29	39	48	57	67	77	87	97	107	118	129	130	131	132	133	134	136	137
Small C&I	1	1	2	2	3	4	5	5	6	7	8	9	10	11	12	12	12	12	13	13	13	13
Medium C&I	2	3	5	6	8	10	13	16	18	21	24	26	29	32	35	35	35	36	36	36	37	37
Total DR Potential	**8**	**17**	**24**	**32**	**40**	**53**	**66**	**78**	**92**	**105**	**119**	**133**	**147**	**161**	**176**	**177**	**179**	**181**	**182**	**183**	**185**	**186**

Table C-24 Load Shifting (Winter)

Achievable Low

Customer Class	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
Residential	0.4	0.9	1.7	4.4	8.6	12.7	16.7	16.9	17.0	17.2	17.3	17.5	17.7	17.9	18.1	18.3	18.5	18.7	19.0	19.3	19.5
Small C&I	0.1	0.4	0.7	1.8	3.5	5.1	6.7	6.8	6.8	6.9	6.9	7.0	7.1	7.1	7.2	7.3	7.4	7.4	7.5	7.6	7.7
Medium C&I	0.4	0.9	1.7	4.4	8.7	12.9	17.2	17.4	17.5	17.7	17.9	18.1	18.2	18.4	18.6	18.8	19.0	19.2	19.5	19.8	20.0
Total DR Potential	**0.9**	**2.1**	**4.2**	**10.5**	**20.7**	**30.7**	**40.6**	**41.1**	**41.3**	**41.7**	**42.1**	**42.6**	**42.9**	**43.5**	**44.0**	**44.4**	**44.8**	**45.4**	**46.0**	**46.6**	**47.3**

Achievable High

Customer Class	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
Residential	0.5	1.3	2.6	6.4	12.3	17.7	22.7	23.0	23.1	23.3	23.6	23.9	24.1	24.4	24.7	24.9	25.1	25.5	25.8	26.2	26.6
Small C&I	0.2	0.5	1.0	2.5	4.9	7.2	9.3	9.4	9.5	9.6	9.7	9.8	9.8	10.0	10.1	10.2	10.2	10.4	10.5	10.6	10.8
Medium C&I	0.6	1.4	2.9	7.2	14.3	21.2	28.0	28.4	28.5	28.7	29.0	29.3	29.6	30.0	30.3	30.6	30.9	31.3	31.7	32.1	32.5
Total DR Potential	**1.3**	**3.2**	**6.5**	**16.2**	**31.5**	**46.1**	**60.1**	**60.8**	**61.1**	**61.7**	**62.3**	**63.0**	**63.4**	**64.3**	**65.1**	**65.7**	**66.2**	**67.1**	**68.0**	**68.9**	**69.8**

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Global Energy Partners
An EnerNOC Company
500 Ygnacio Valley Road, Suite 450
Walnut Creek, CA 94596

P: 925.482.2000
F: 925.284.3147
E: gephq@gepllc.com