

aes Indiana
2022 Integrated
Resource Plan

(IRP)

Volume III

December 1, 2022



The logo for aes Indiana features the lowercase letters 'aes' in a stylized, rounded font. The 'a' is blue, the 'e' is purple, and the 's' is green. To the right of 'aes' is the word 'Indiana' in a black, sans-serif font.

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Attachment 5-1

(Test Year July 2016 through June 2017 Hourly Loads - MW)

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Attachment 5-2

(AES Indiana's 2022 Energy and Demand Forecast Report)

2022 Long-Term Energy and Demand Forecast Report

AES Indiana

Submitted to:

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Indianapolis, Indiana

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November 2022

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1 Overview

The 2022 IRP forecast provides sector and system energy and demand forecasts through 2042. The forecast is derived using a bottom-up approach where customer sector sales forecast for residential, commercial, and industrial sectors are translated that into long-term baseline energy and system demand requirements excluding future energy efficiency (EE) program impacts; for planning purposes, future EE savings are treated as a supply resource. The baseline forecast is adjusted for expected impact of behind-the-meter (BTM) solar market penetration and electric vehicle charging loads.

AES Indiana serves over 510,000 customers in the city of Indianapolis and surrounding area (primarily Marion County). In 2021, residential sales accounted for 40% of sales, commercial 39%, and industrial 21%. Figure 1 shows 2021 class-level sales distribution.

Figure 1: 2021 Class Sales (MWh) Distribution

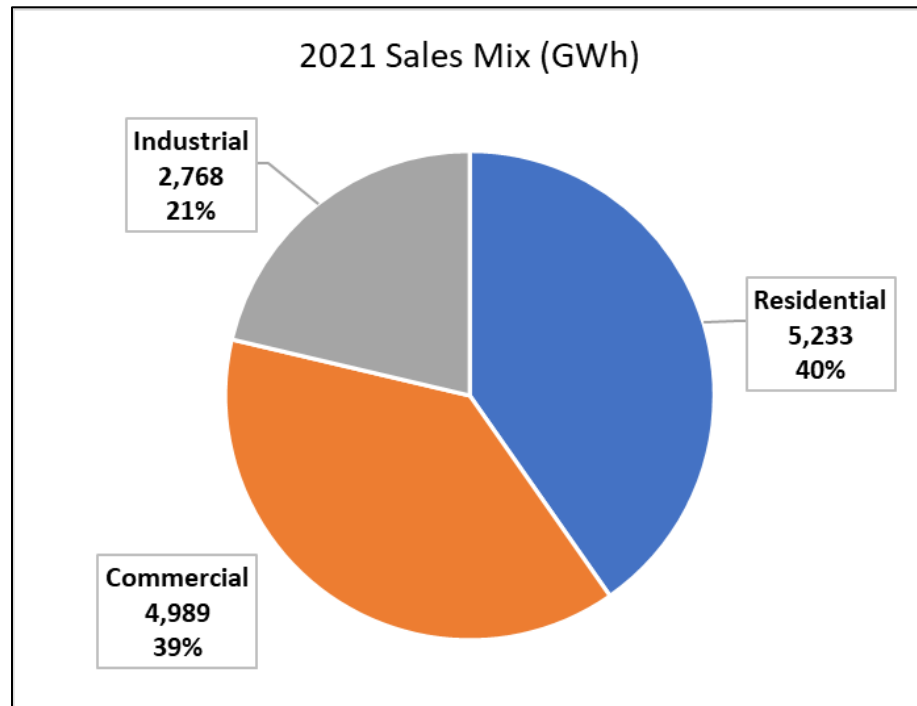
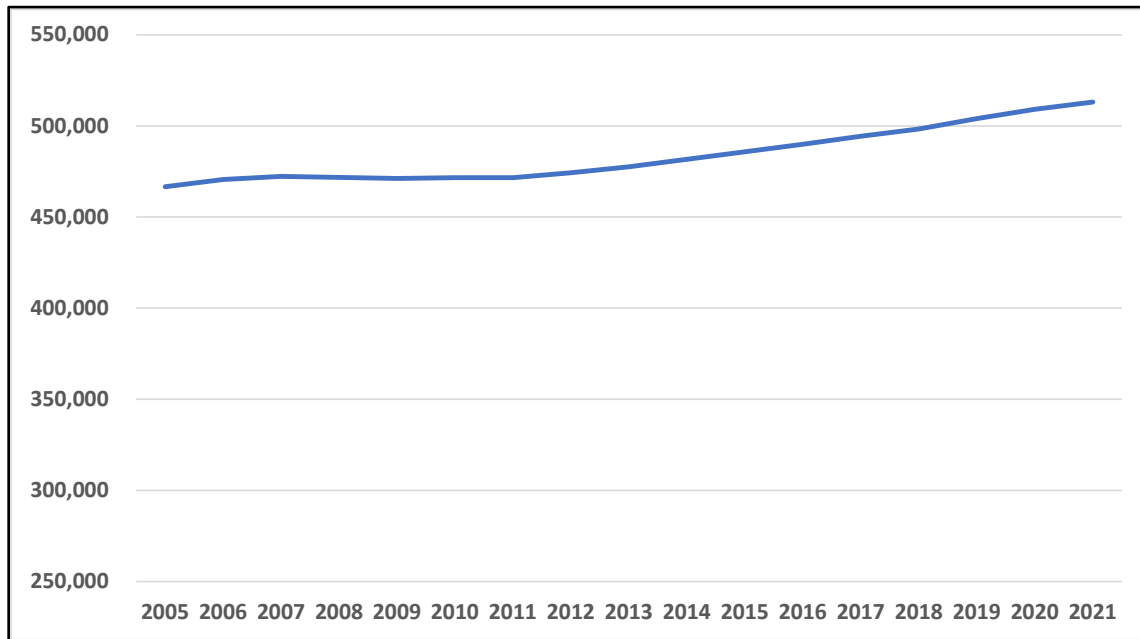


Figure 2 shows total number of customers since 2005.

Figure 2: AES Indiana Customers



Between 2005 and 2011 there was little customer growth. This all changed starting in 2011 with consistent customer growth averaging 0.8% per year. Residential customers are 88% of total customers and have been increasing 0.9% per year. Commercial customers have been averaging 0.6% annual growth while the number of industrial customers has declined from 224 customers in 2010 to 185 customers in 2021. AES Indiana is expected to see strong customer growth over the forecast horizon driven by a strong economy combined with relatively affordable housing. Indianapolis is the third most populous city in the Midwest after Chicago and Columbus. There are over 2 million people in the Indianapolis MSA with population is expected to increase by 26 percent over the next 30 years.

Despite relatively strong customer growth, the weather normalized system energy and peak demand has been declining. Largely as a result of strong energy efficiency gains, customer average use has been declining slightly faster than customer growth. Figure 3 and Figure 4 show the annual system energy and peak demand, actual and weather normalized from 2011 to 2021.

Figure 3: System Energy (MWh)

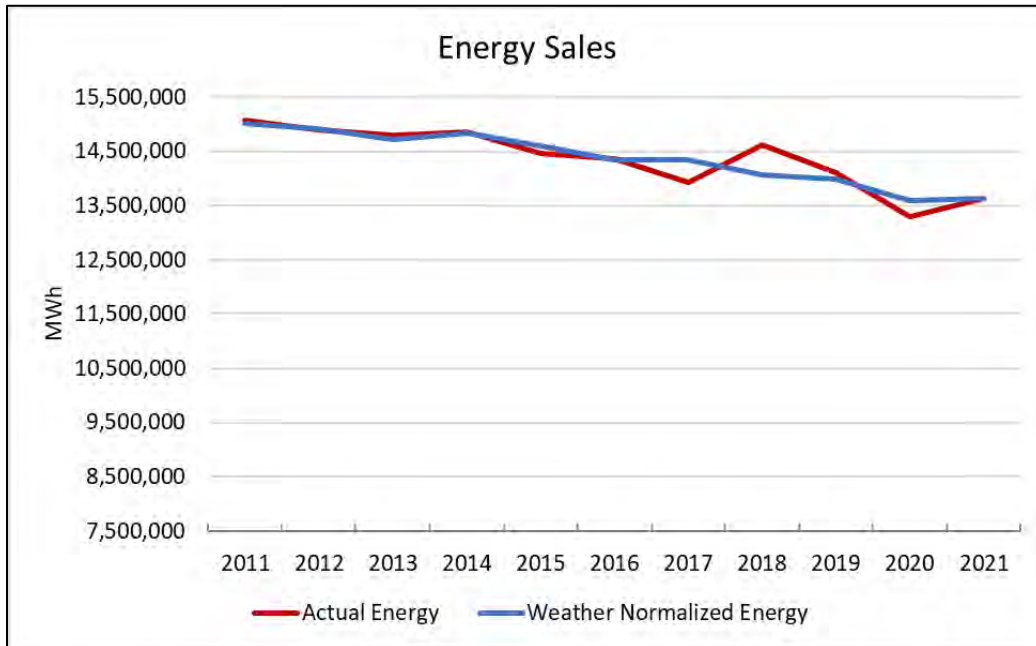
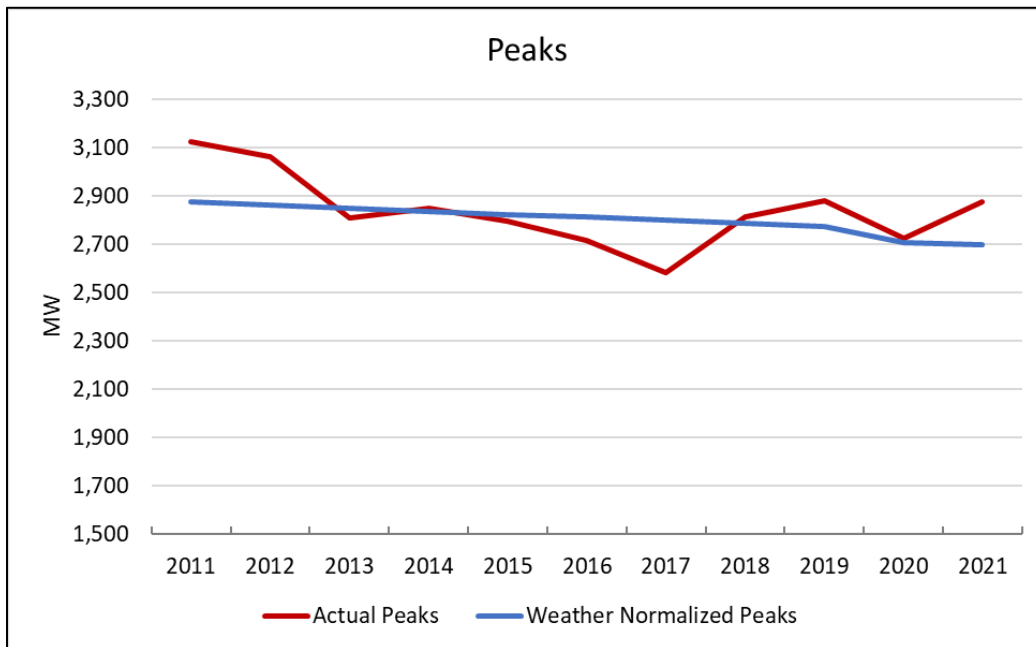


Figure 4: System Demand (MW)



Weather normalized system energy requirements in 2021 were 13,640 GWh compared with system energy requirements of 15,017 GWh in 2011. Energy requirements have, on average, declined 1.0% annually over this period. Normalized peak demand has fallen from roughly 2,900 MW in 2011 to 2,700 MW in 2021.

Part of the recent decline can be attributed to COVID-19 as *stay-at-home* orders in early 2020 had a significant impact on customer electricity use. The residential sector saw a significant increase in electricity sales, while commercial and industrial sales experienced a sharp decline. While residential sales gains partially offset C&I sales losses, given the relatively large commercial customer base, the net impact was a drop in sales and energy requirements. Excluding 2020 and 2021, energy requirements have averaged 0.9% annual decline.

The primary factor contributing to the decline in customer use is significant improvements in end-use energy efficiency. Efficiency improvements have largely been driven by federal end-use efficiency standards, AES Indiana EE programs, and market-driven efficiency gains as customer's replace old appliances and business equipment with new appliances and equipment that generally cost less for improved efficiency. With expected EE savings, system energy requirements will continue to decline through the forecast period.

For the purpose of resource planning, future EE program savings are excluded from the demand forecast and treated as a potential resource. Excluding EE, annual energy requirements average 0.5% and system peak demand 0.7% annual growth. The baseline forecast also excludes BTM solar projections and electric vehicles. Separate solar and EV forecasts technologies have been developed by GDS Associates and Brightline Group. Table 1-1 shows the annual baseline energy and demand forecast.

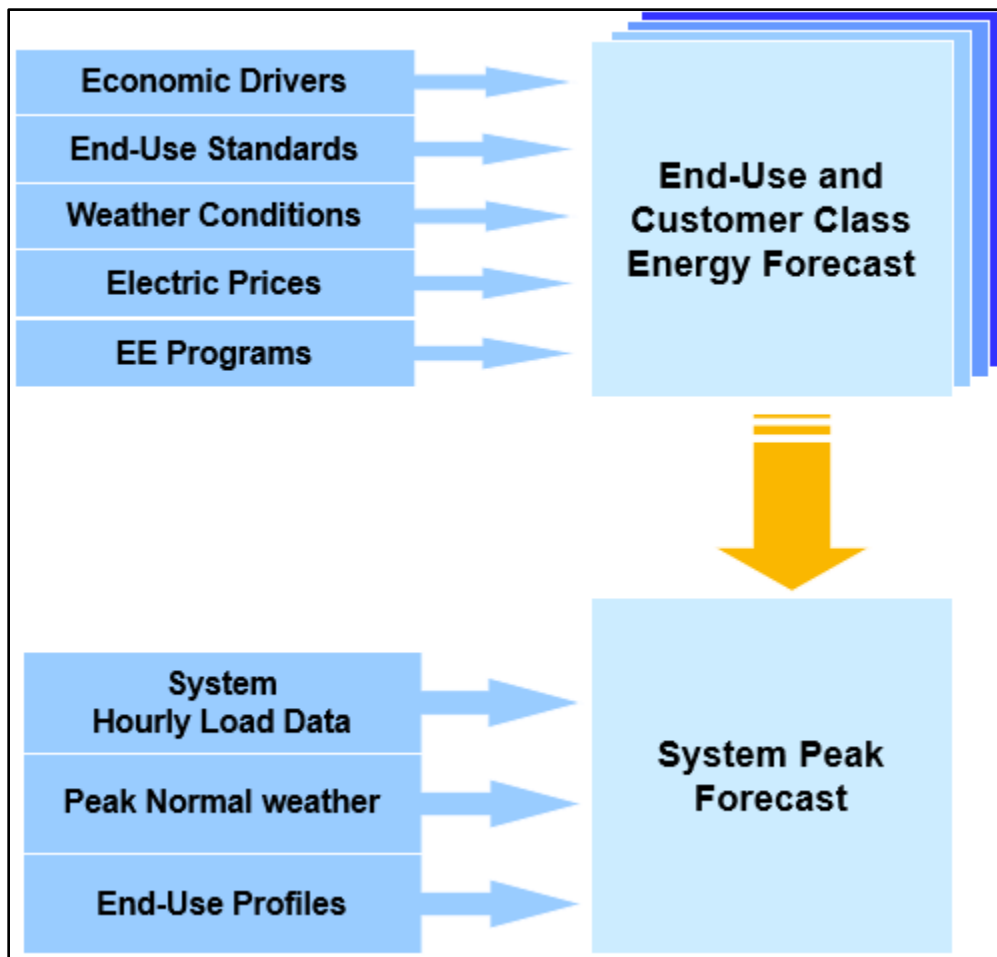
Table 1-1: Energy and Demand Forecast

Year	Energy (MWh)	Change	Peak (MW)	Change
2022	13,986,185		2,829	
2023	14,024,823	0.3%	2,852	0.8%
2024	14,133,336	0.8%	2,873	0.7%
2025	14,162,987	0.2%	2,878	0.2%
2026	14,182,532	0.1%	2,885	0.2%
2027	14,262,645	0.6%	2,905	0.7%
2028	14,373,450	0.8%	2,930	0.9%
2029	14,446,266	0.5%	2,950	0.7%
2030	14,496,004	0.3%	2,969	0.6%
2031	14,555,951	0.4%	2,988	0.6%
2032	14,619,528	0.4%	3,009	0.7%
2033	14,690,601	0.5%	3,031	0.7%
2034	14,775,368	0.6%	3,055	0.8%
2035	14,863,828	0.6%	3,080	0.8%
2036	14,957,410	0.6%	3,105	0.8%
2037	15,054,463	0.6%	3,132	0.9%
2038	15,153,931	0.7%	3,158	0.8%
2039	15,256,457	0.7%	3,186	0.9%
2040	15,352,201	0.6%	3,214	0.9%
2041	15,457,655	0.7%	3,244	0.9%
2042	15,567,503	0.7%	3,275	1.0%
2022-42		0.5%		0.7%

2 Forecast Approach

The system baseline energy and demand are derived using a bottom-up modeling framework. The process begins by estimating residential, commercial, and industrial rate class sales models and from these models isolating long-term cooling, heating, and base load energy requirements. End-use energy projections then drive system baseline energy requirements and peak demand. Figure 5 shows the general framework and model inputs.

Figure 5: Bottom-Up Modeling Framework



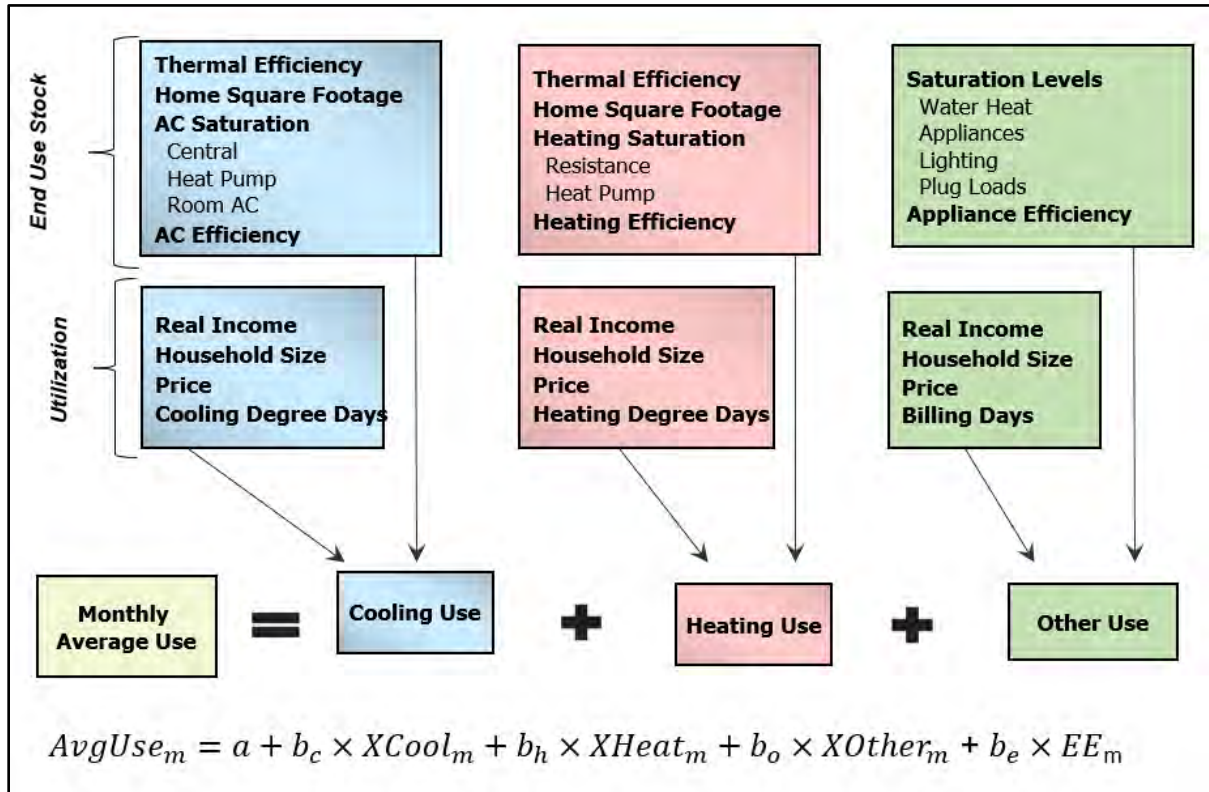
Monthly models are estimated at the rate schedule level and then aggregated to customer class. Table 2-1 shows the modeled rate-classes and associated customer class. By estimating models at the rate class model, we can use the same models for projecting near-term revenues for budget and financial planning as well as long-term resource needs.

Table 2-1: 2021 Customers and Sales

Sector	Rate Schedule	Definition	Customers	MWh
Residential	RS	General Service	252,980	2,394,397
Residential	RH	Electric Heat	165,547	2,396,800
Residential	RC	Electric Water Heat	35,274	433,725
Commercial	SS	General Service	50,761	1,242,488
Commercial	SH	GS All Electric	3,798	496,808
Commercial	SE	GS Electric Heat	24	15,117
Commercial	CB	GS Water Heat (Controlled)	87	386
Commercial	UW	GS Water Heat (Uncontrolled)	83	1,136
Commercial	APL	GS Security Lighting		28,648
Commercial	SL	Secondary Service	4,339	3,212,691
Industrial	PL	Primary Service	127	1,094,322
Industrial	HL1	High Load Factor 1	26	1,208,292
Industrial	HL2	High Load Factor 2	5	183,516
Industrial	HL3	High Load Factor 3	2	254,577
Industrial	APL	IND Security Light		4,415
Other	ST	Street Lighting		53,280
Total			513,052	13,020,598

Residential and commercial models are estimated using a Statistically Adjusted End-Use (SAE) model specification. This entails estimating monthly average use (residential) or sales models (commercial) that are defined as a function of monthly heating, cooling, and non-weather sensitive (base use) load requirements. Figure 6 show the residential SAE model.

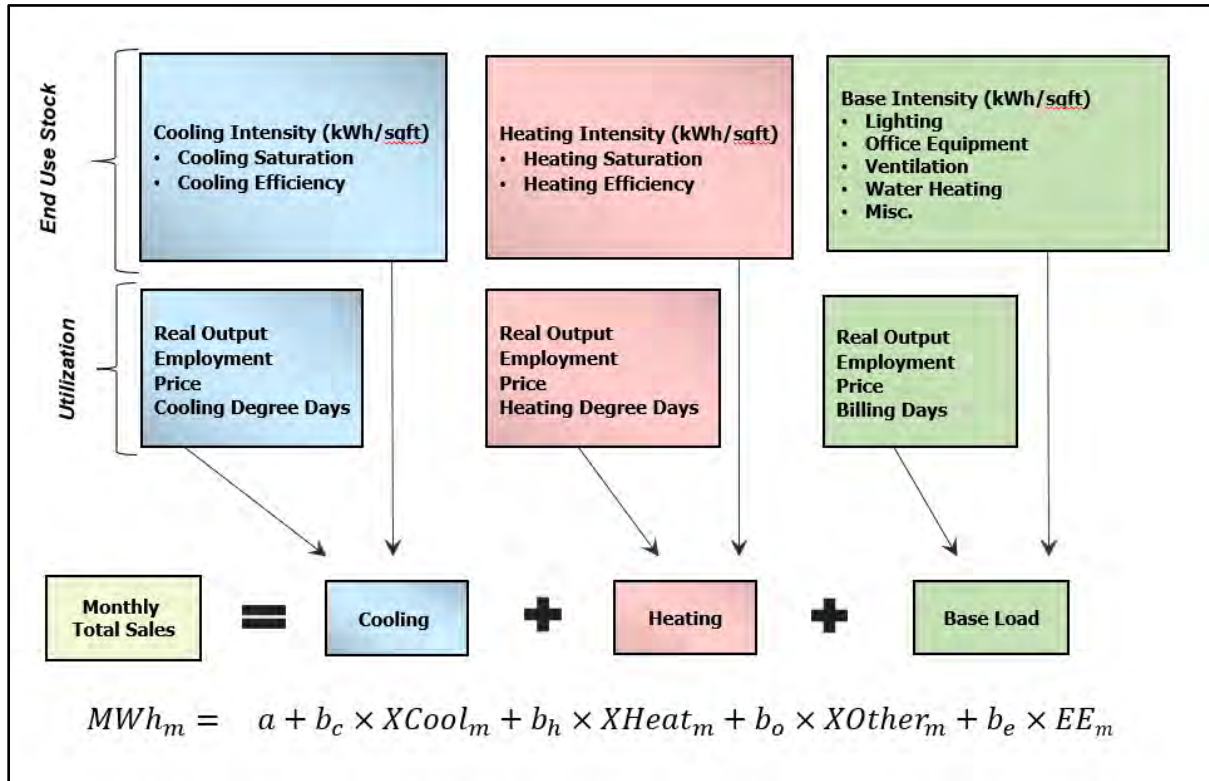
Figure 6: Residential Forecast Model Framework



Cooling (XCool), Heating (XHeat), and Base Use (XOther) are constructed by combining end-use stock variables (that include end-use saturation and efficiency) with monthly utilization variable (that includes cooling and heating degree-days, household size, household income, and price). The interaction of the annual end-use stock variable with monthly utilization variable gives initial estimates of monthly heating, cooling, and baseloads. Monthly models are estimated using linear regression; the estimation process results in a set of model coefficients b_c , b_h , and b_o that effectively *adjust* the end-use energy requirements to actual customer usage. Historical EE savings are also included to capture EE program savings not captured in the end-use intensity trends; the cumulative historical EE is held constant in the model with future EE treated as resource. The estimated models are used to forecast average use and sales based on projected economic activity, HDD and CDD trend projections, and end-use saturation and efficiency trends. A detail description of the model is included in Appendix B.

A similar model structure is used for forecasting commercial rate class sales as depicted in Figure 7.

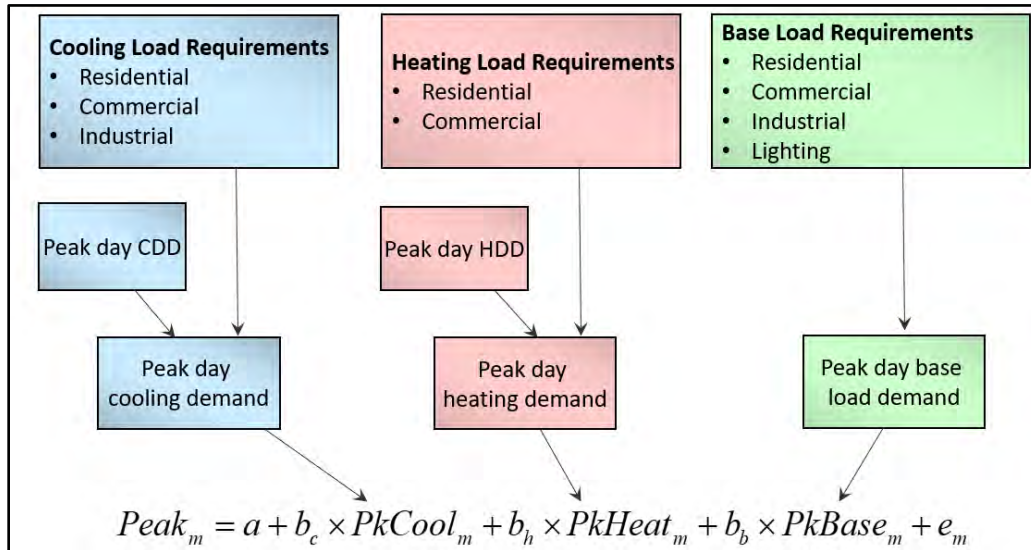
Figure 7: Commercial SAE Model



Commercial models are estimated using monthly sales rather than average use. End-use intensities are on a kWh per square foot basis and reflect both saturation (space impacted by the end-use) and end-use stock efficiency. The annual end-use indices are combined with monthly utilization variables that capture weather conditions (degree-days), economic activity and growth, and price. A cumulative EE variable is included to account for EE program savings that are not captured in the SAE XCool, XHeat, and XOther variables.

Energy and Peak. From a supply planning perspective, the most critical planning inputs are total system energy requirements and system peak demand. Heating, cooling, and base load energy requirements derived from the class sales models are used to drive system energy and peak demand. The energy forecast is calculated by applying a line loss forecast to the aggregated sales forecast. The peak forecast is based on a monthly peak regression model that relates maximum demand to peak-day cooling (PkCool) and heating (PkHeat), and base energy requirements estimated at time of peak (PkBase). Figure 8 shows the peak model framework.

Figure 8: Peak Model Framework



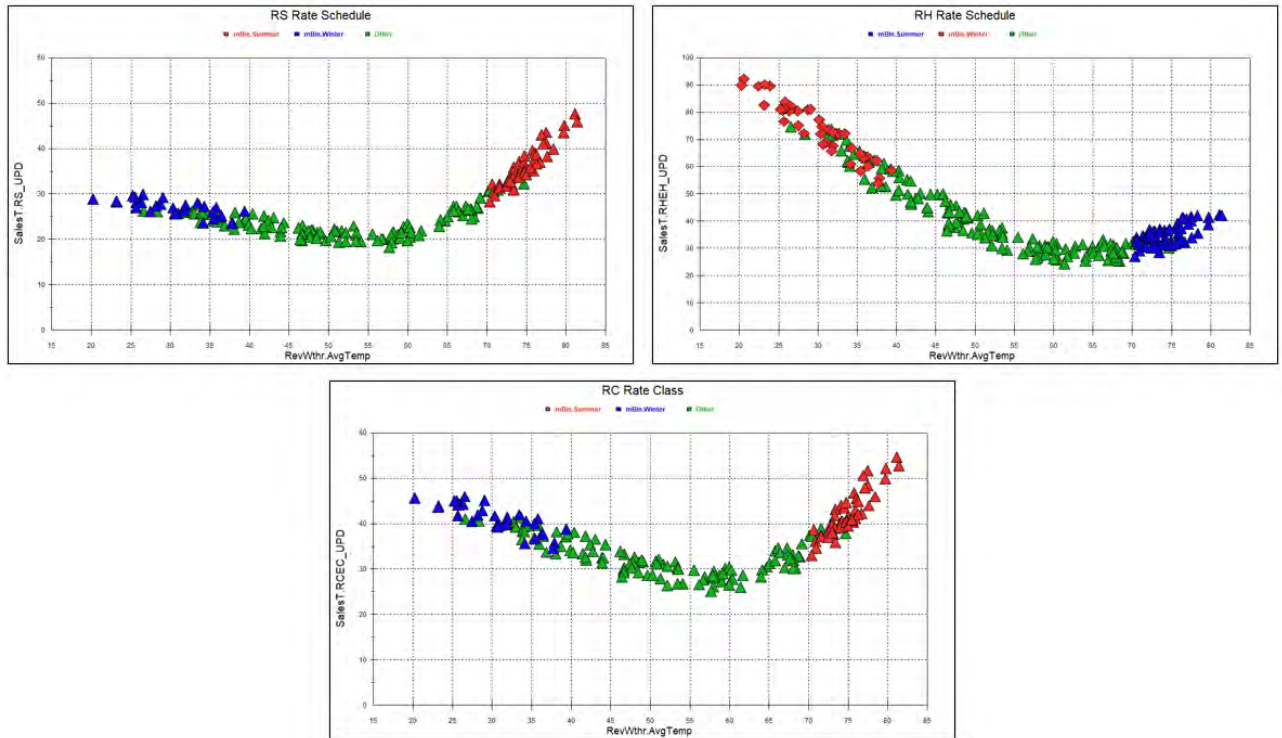
PkCool and PkHeat are derived by combining cooling and heating requirements with peak-day weather conditions. In this structure, the impact of peak-day temperatures on load will increase or decrease over time with changes in cooling and heating load requirements. Base loads at the time of peak are estimated by multiplying end-use energy estimates with end-use peak-day fractions estimated from Itron’s library of end-use load profiles.

The coefficients (b_c , b_h , b_b) are estimated using linear regression. The advantage of this approach when compared with a more traditional load factor model is that we can capture factors that may contribute to differences between energy and demand growth. For example, cooling requirements may be increasing faster than heating requirements and as a result the summer peak could potentially increase faster than overall sales and winter peak demand. While lighting sales are declining as a result of the new lighting standards, we can capture the fact that this will impact winter peaks more than summer peaks. As shown in the model section, the model explains historical sales variation well with a high adjusted R-Squared and statistically significant model coefficient.

2.1 Residential Models

Average Use. Residential average use is modeled for three rate schedules. Non-electric heat customers (RS), electric heat customers (RH) and electric water heat customers (RC). Each rate schedule has a very different load curve and sensitivity to heating and cooling conditions as result of differences in end-use mix. Figure 9 shows the sales/weather relationship for these classes.

Figure 9: Residential Weather Response Curves



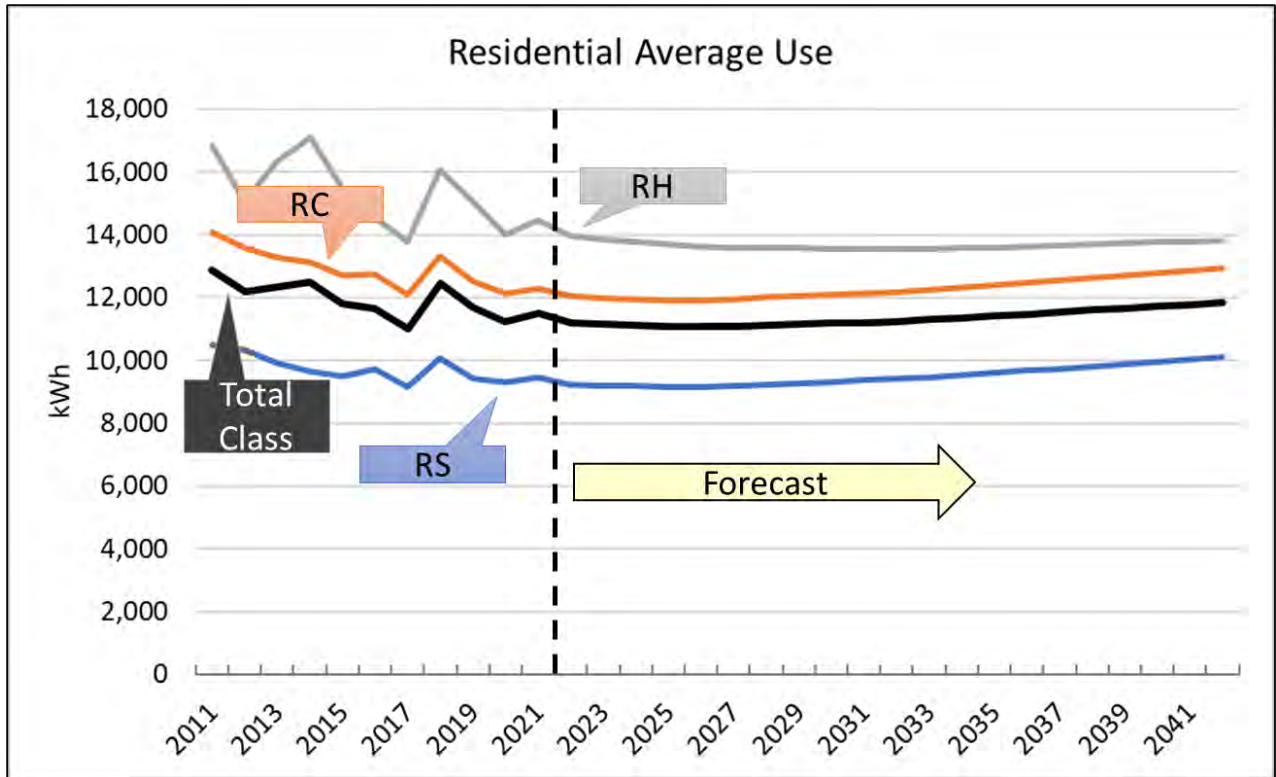
Each slide shows the relationship between average monthly temperature on the X axis and average class monthly use on a per billing-day basis. The curves are distinct with the RH rate schedule having a significantly steeper heating-side slope than either the RS or RC rate schedules. The base use for RC customers is higher reflecting the high electric water heating saturation.

As discussed earlier, the residential average use model relates customer average monthly use to a customer’s heating requirements (XHeat), cooling requirements (XCool), other use (XOther), and historical EE program savings:

- $$ResAvgUse_m = (B_1 \times XHeat_m) + (B_2 \times XCool_m) + (B_3 \times XOther_m) + (B_4 \times EE_m) + e_m$$

The model coefficients (B₁, B₂, B₃, B₄) are estimated using a linear regression model. Monthly average use data is derived from historical monthly billed sales and customer data from January 2011 to December 2021. Model statistics are included in Appendix A. Figure 10 shows historical and forecasted average use, excluding future EE.

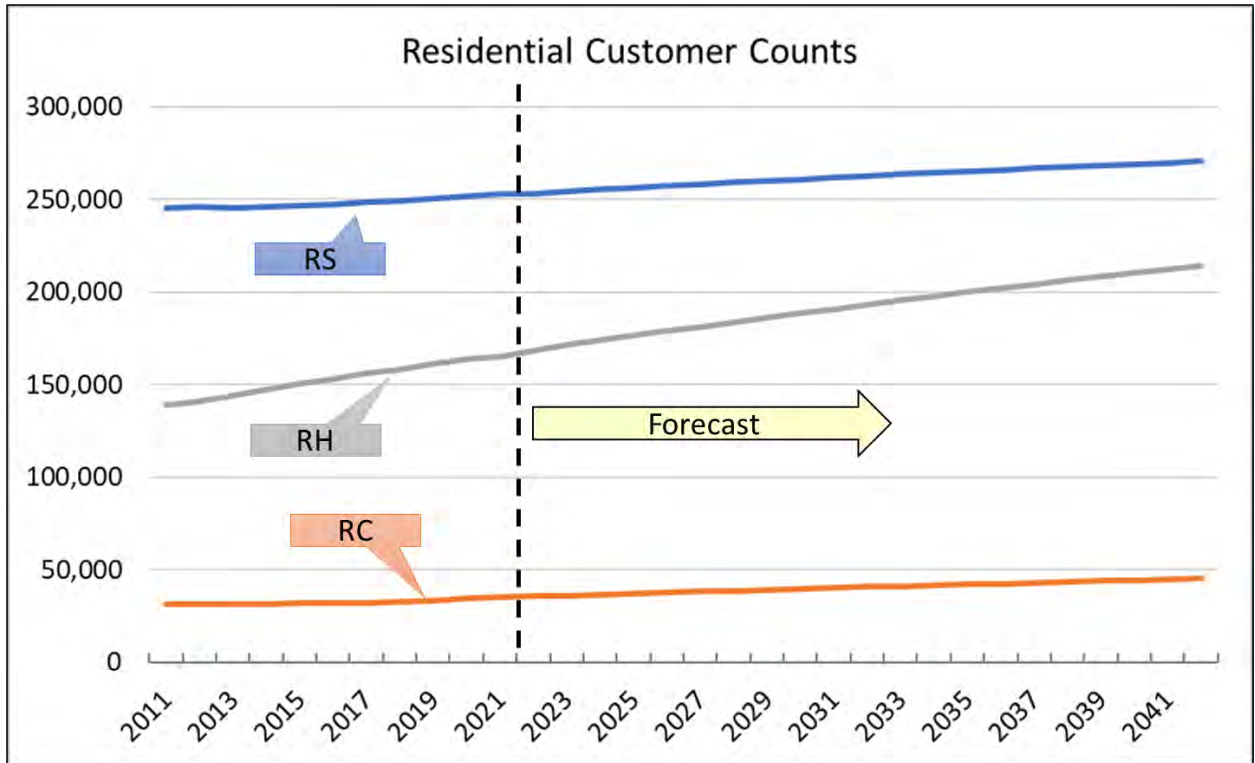
Figure 10: Residential Average Use



As depicted in Figure 10, average use has been declining since 2011. Average use flattens out, and even increases, over the forecast period as increases in economic growth counters improving end-use efficiency and future EE program saving are not included in the forecast. Total rate class average use increases partly due to the increasing share of customers with electric heat.

Customer Forecast. The customer forecast is based on the population forecast for Marion County. The correlation between Marion County population and number of AES Indiana residential customers is over ninety percent. While all residential customer classes are forecasted to increase, the RH and RC classes are increasing at a significantly faster rate than the RS class. RH and RC customers are forecasted to increase 1.2% annually over the forecast period, RS customers are forecasted to increase 0.3% annually. Figure 11 shows the residential customer forecast.

Figure 11: Residential Customers



The residential sales forecast is generated as the product of the average use and customer forecasts. Total residential sales are calculated by adding across the rate schedule forecasts. Table 2-2 shows the forecasted residential customer, sales, and average use before future EE, photovoltaic and electric vehicle adjustments.

Table 2-2: Residential Forecast

Year	Sales		Customers		Average Use	
	(MWh)	Change		Change	(kWh)	Change
2022	5,120,205		415,728		12,316	
2023	5,148,145	0.5%	418,276	0.6%	12,308	-0.1%
2024	5,183,132	0.7%	421,275	0.7%	12,303	0.0%
2025	5,208,018	0.5%	425,237	0.9%	12,247	-0.5%
2026	5,246,104	0.7%	429,000	0.9%	12,229	-0.2%
2027	5,299,299	1.0%	432,885	0.9%	12,242	0.1%
2028	5,360,175	1.1%	437,014	1.0%	12,265	0.2%
2029	5,416,700	1.1%	440,588	0.8%	12,294	0.2%
2030	5,472,660	1.0%	445,760	1.2%	12,277	-0.1%
2031	5,532,095	1.1%	450,367	1.0%	12,284	0.1%
2032	5,592,595	1.1%	453,800	0.8%	12,324	0.3%
2033	5,654,854	1.1%	457,267	0.8%	12,367	0.3%
2034	5,723,758	1.2%	462,142	1.1%	12,385	0.2%
2035	5,792,730	1.2%	466,305	0.9%	12,423	0.3%
2036	5,862,577	1.2%	470,260	0.8%	12,467	0.4%
2037	5,934,492	1.2%	474,157	0.8%	12,516	0.4%
2038	6,006,119	1.2%	478,188	0.9%	12,560	0.4%
2039	6,076,064	1.2%	481,976	0.8%	12,607	0.4%
2040	6,142,240	1.1%	485,759	0.8%	12,645	0.3%
2041	6,210,088	1.1%	489,543	0.8%	12,685	0.3%
2042	6,279,732	1.1%	493,330	0.8%	12,729	0.3%
2022-42		1.0%		0.9%		0.2%

2.2 Nonresidential Models

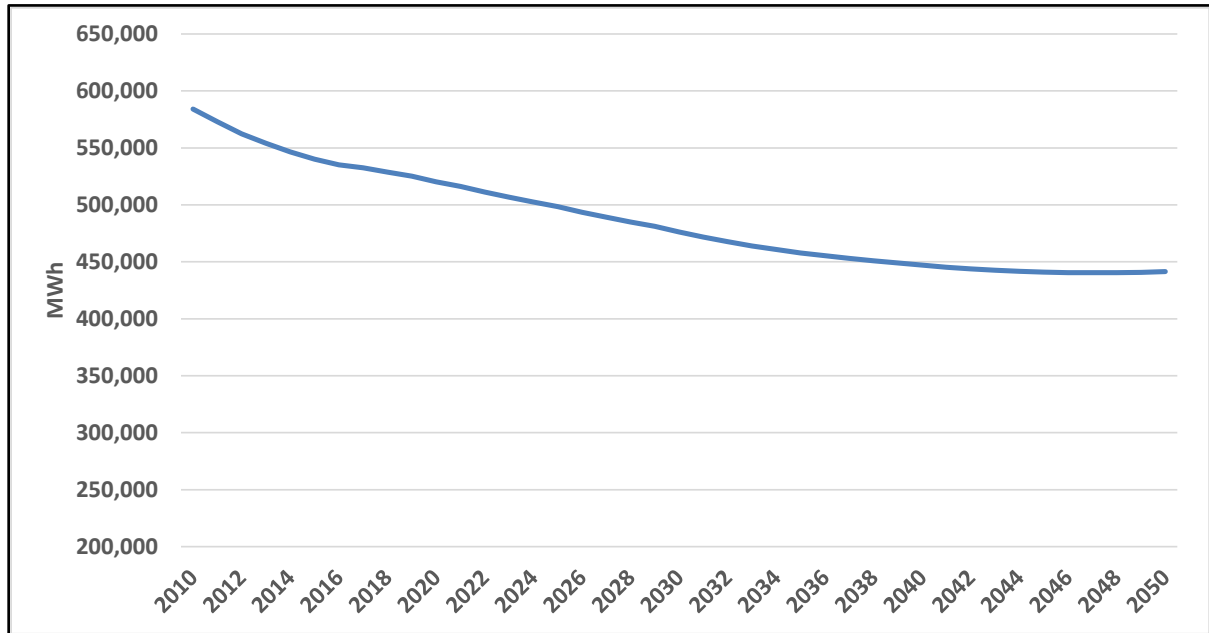
Commercial sales are also estimated using an SAE model structure. The difference is that in the commercial sector the sales forecast is based on a total sales model rather than an average use and customer model. Commercial sales are expressed as a function of heating requirements, cooling requirements, and other commercial use:

- $$ComSales_m = B_0 + (B_1 \times XHeat_m) + (B_2 \times XCool_m) + (B_3 \times XOther_m) + (B_4 \times EE_m) + e_m$$

The constructed model variables include HDD, CDD, billing days, commercial economic activity variable, price, end-use intensity trends (measured on a kWh per sqft basis), and historical EE savings. To be consistent with rate class sales that are in MWh, the intensity estimates are also scaled to MWh. All but miscellaneous end-use intensities are trending

down as end-use efficiency continues to improve. Total intensity is declining through the forecast period as depicted in Figure 12.

Figure 12: SS Rate Class Total Energy Intensity Trend



A detailed description of the Commercial SAE model is included in Appendix B.

Separate monthly regression models are estimated for each non-residential rate schedule, all but the high load factor rate schedules (H2 and H3) are modeled using the SAE model specification; the commercial model specification explains sales variation well based on model fit statistics. The high load factor rates are primarily industrial loads and include some of AES Indiana’s largest customers.

Commercial sales like residential have been trending down. Since 2011 annual commercial sales have declined on average 0.9%. The COVID-19 pandemic had a significant impact on commercial electric sales, with sales declining by over 7% in 2020. Sales continue to recover in 2021 but have not fully returned to pre-COVID levels. Excluding 2020 and 2021, commercial sales have declined on average 0.4% annually from 2011-2019. Aside from the negative shock from COVID, the primary factors driving commercial sales are expected economic activity, declining end-use intensities, electric prices, and historical EE program savings. Over the next twenty years, employment and output averages 0.6% and 2.1% annual growth, and total end-use intensity declines 0.7% per year. The combination of these

factors results in 0.4% annual commercial sales growth through 2042 before EE savings adjustments.

Economic Driver. The economic variable is weighted between non-manufacturing employment and non-manufacturing output for the Indianapolis MSA. The variable is more heavily weighted on employment than output as the stronger weighting on employment yields better in-sample and out-of-sample model fit statistics. The two concepts account for different but overlapping aspects of business activity; employment growth captures commercial customer growth and expansion at existing customers’ sites and output growth reflects productivity growth and increase in product and service demand. The constructed economic variable for the general service (SS) rate schedule is defined as:

- $SLEconVar_m = (NonManOutput_m^{0.35}) \times (NonManEmployment_m^{0.65})$

The weighting varies for the commercial rate schedules – secondary service (SL), general service electric heat (SH), and general service all electric (SE).

Overall, the constructed model variables explain historical variation well as measured by model Adjusted R-Squared and MAPE. Adjusted R-Squared varies from 0.87 to 0.98 with MAPEs that vary from 5.77% to 1.00%. Model statistics and forecast plots are included in Appendix A.

Industrial Models. The high load factor rates (H1, H2, and H3) are primarily industrial customers. The H1 billed sales is based on manufacturing employment, and industrial output. The industrial economic variable is weighted between manufacturing employment and manufacturing output with a stronger weight on output:

- $H1EconVar_m = (ManOutput_m^{0.6}) \times (ManEmployment_m^{0.4})$

The economic weighting is derived by evaluating the model in-sample and out-sample statistics.

The H2 and H3 rate schedules have relatively few customers. H2 currently has 5 customers and H3 has 3 customers. Other than seasonal cooling load variation, H2 and H3 sales have been flat. H2 did see a significant drop in sales with the onset of COVID19 but much of that had recovered by end of 2021. H2 and H3 sales are held constant through the forecast period. Model statistics and forecast plots are included in Appendix A.

Table 2-3 shows the commercial and industrial sales forecast; sales forecast excludes the impact of future EE program activity.

Table 2-3: Non-Residential Sales Forecast

Year	Commercial		Industrial	
	(MWh)	Change	(MWh)	Change
2022	5,099,965		2,933,049	
2023	5,175,810	1.5%	2,940,658	0.3%
2024	5,242,675	1.3%	2,942,141	0.1%
2025	5,256,152	0.3%	2,931,960	-0.3%
2026	5,263,430	0.1%	2,905,114	-0.9%
2027	5,283,036	0.4%	2,907,949	0.1%
2028	5,313,462	0.6%	2,921,722	0.5%
2029	5,327,254	0.3%	2,920,310	0.0%
2030	5,326,090	0.0%	2,912,630	-0.3%
2031	5,327,322	0.0%	2,908,714	-0.1%
2032	5,334,535	0.1%	2,901,176	-0.3%
2033	5,344,582	0.2%	2,896,113	-0.2%
2034	5,358,687	0.3%	2,893,268	-0.1%
2035	5,374,903	0.3%	2,891,749	-0.1%
2036	5,393,600	0.3%	2,891,692	0.0%
2037	5,413,422	0.4%	2,891,729	0.0%
2038	5,434,746	0.4%	2,892,841	0.0%
2039	5,459,080	0.4%	2,895,513	0.1%
2040	5,481,652	0.4%	2,897,307	0.1%
2041	5,509,752	0.5%	2,901,085	0.1%
2042	5,539,743	0.5%	2,905,324	0.1%
2022-42		0.4%		0.0%

2.3 Street and Security Lighting Models

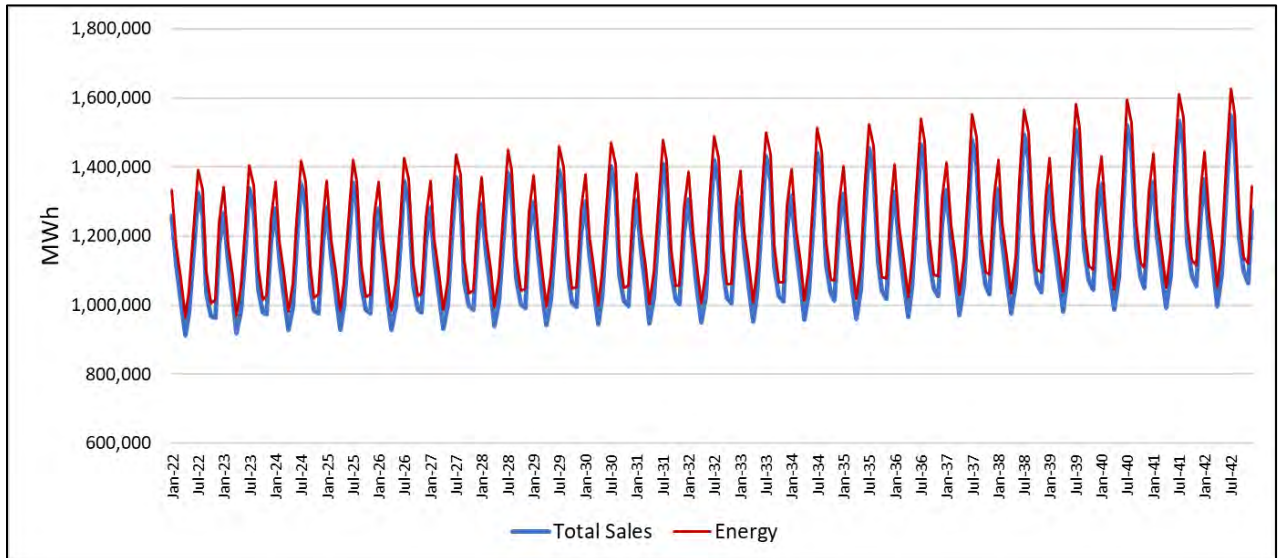
Street lighting sales declined rapidly beginning in 2018, coinciding with the start of a LED conversion program. The program has converted 26,000 lights, or approximately 60% of all fixtures. With the program near completion, street lighting sales should remain flat. Street lighting sales are modeled using a seasonal exponential smoothing model. Security lighting sales are estimated using a trend and monthly binaries model. The monthly binary variables capture the variation in monthly sales across the year with the highest level of lighting in January and lowest level of lighting in July. Lighting models are included in Appendix A.

2.4 Energy and Peak Forecast Models

Energy Forecast. System energy forecast is derived by summing monthly rate schedule sales forecast and adjusting sales upwards for line losses. The adjustment factor is based on the historical ratio of monthly energy to sales for the last four years. The adjustment factors

are calculated for each month. The annual forecast adjustment factor is 1.056. Total baseline sales and energy increase 0.6% annually through the forecast period. Again, the baseline forecast does not include the impact of future EE savings, solar load growth, or electric vehicles. Figure 13 compares monthly energy and sales forecast, excluding future EE program savings.

Figure 13: Energy and Sales Forecast)



Peak Forecast. The peak model relates monthly system peak demand to peak-day temperatures, heating and cooling load requirements, and base loads at time of peak. Heating, cooling, and base-use energy requirements are derived from the sales forecast models. Cooling (*CoolLoad*) and heating (*HeatLoad*) are interacted with peak-day CDD (*PkCDD*) and HDD (*PkHDD*):

- $PkCool_m = CoolLoad_m \times PkCDD_m$
- $PkHeat_m = HeatLoad_m \times PkHDD_m$

The logic of the interaction is that the impact of peak-producing weather conditions depends on system cooling and heating requirements.

The base-load variable (*PkBase_m*) captures non-weather sensitive loads at the time of the monthly peak. *PkBase* is calculated by multiplying end-use load estimates with end-use coincident peak factors and then aggregating across end-uses and customer classes. Figure 14 to Figure 16 show the calculated peak model variables.

Figure 14: Peak Heating Variable

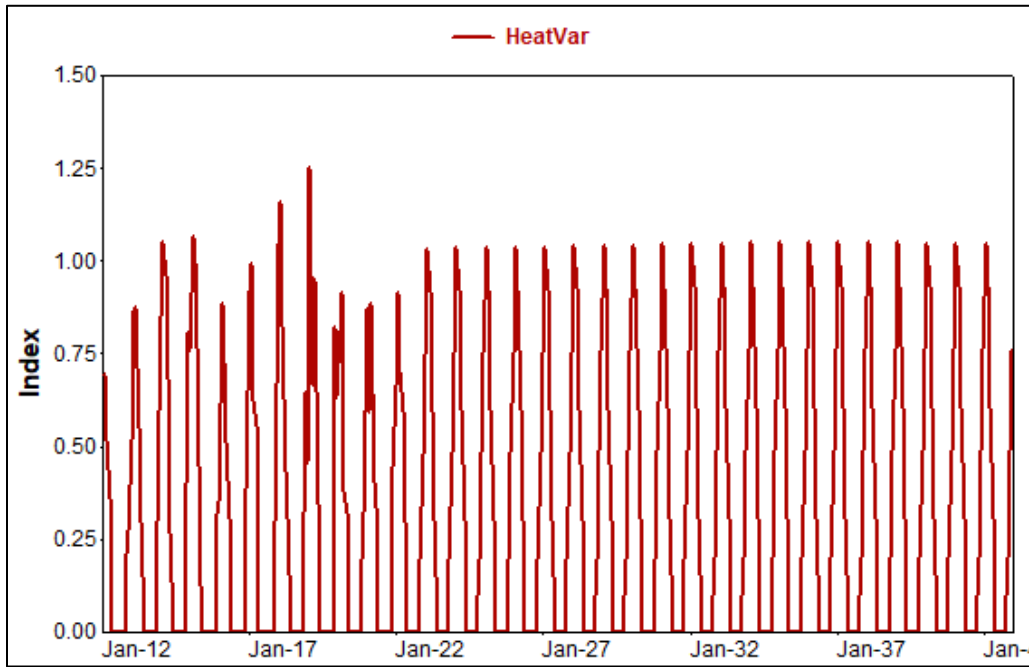


Figure 15: Peak Cooling Variable

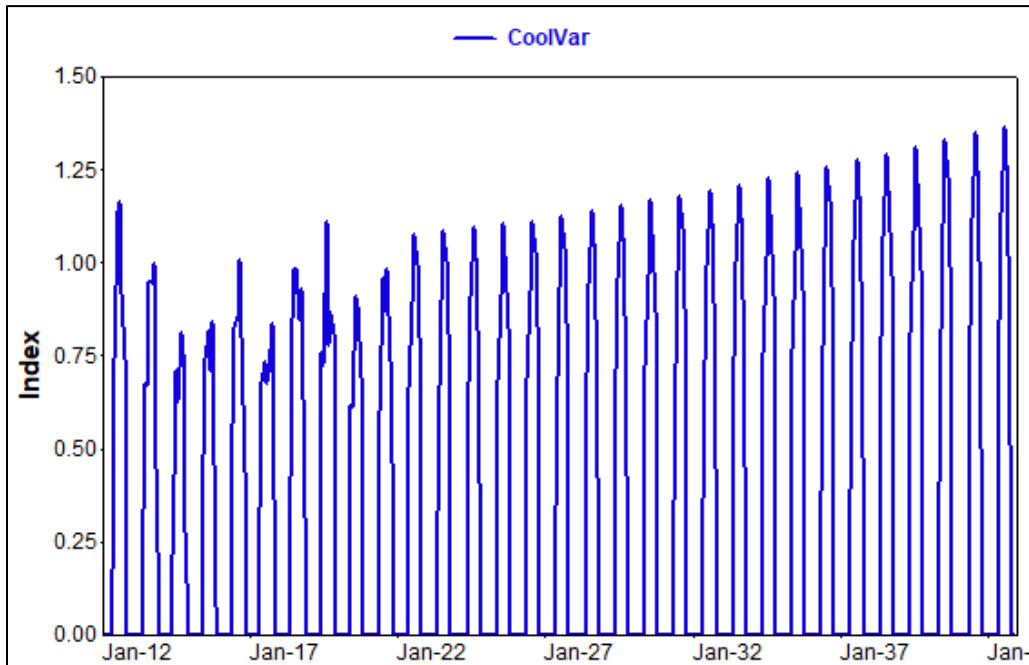
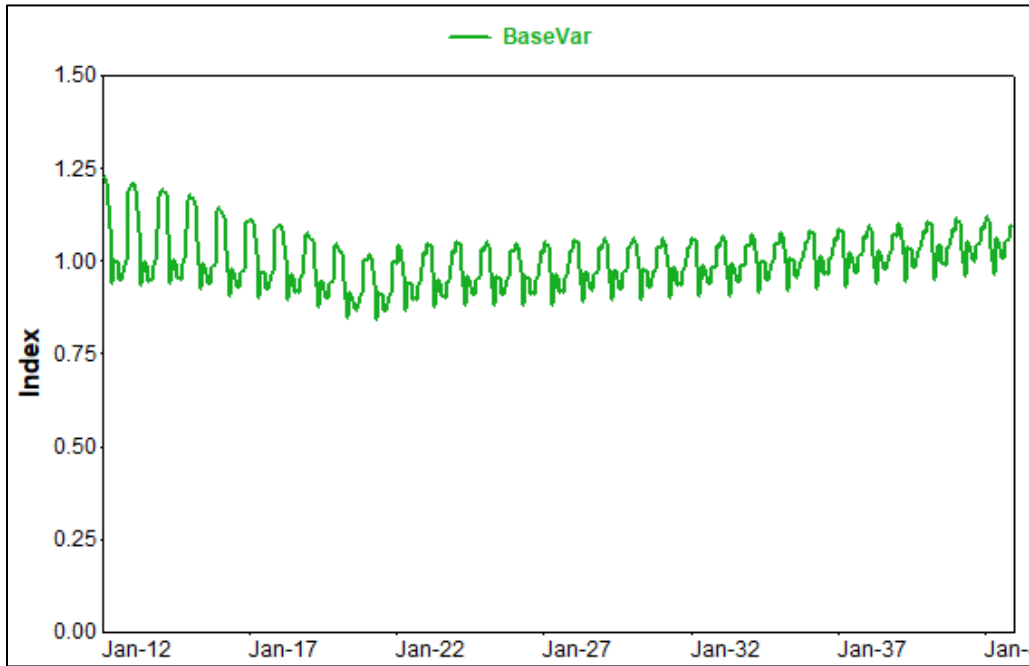


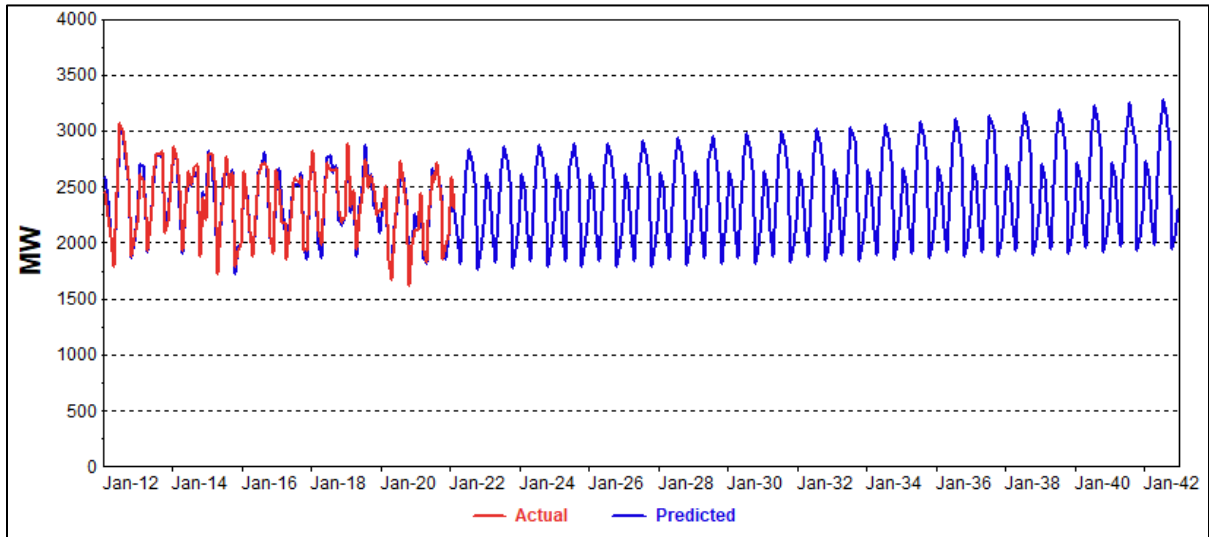
Figure 16: Peak Base Variable



The peak model is estimated over the period January 2012 to December 2021. The model explains monthly peak variation well with an adjusted R^2 of 0.94 and an in-sample MAPE of 2.45%. The model variables – *PkHeat*, *PKCool*, and *PkBase* are highly statistically significant.

Figure 17 shows actual and predicted model results.

Figure 17: System Peak Model



Excluding future EE, solar, and EVs, the baseline peak occurs in the summer and averages 0.7% annual growth; this compares with 0.5% annual energy growth. Model statistics and parameters are included in Appendix A.

3 Forecast Assumptions

3.1 Weather Data

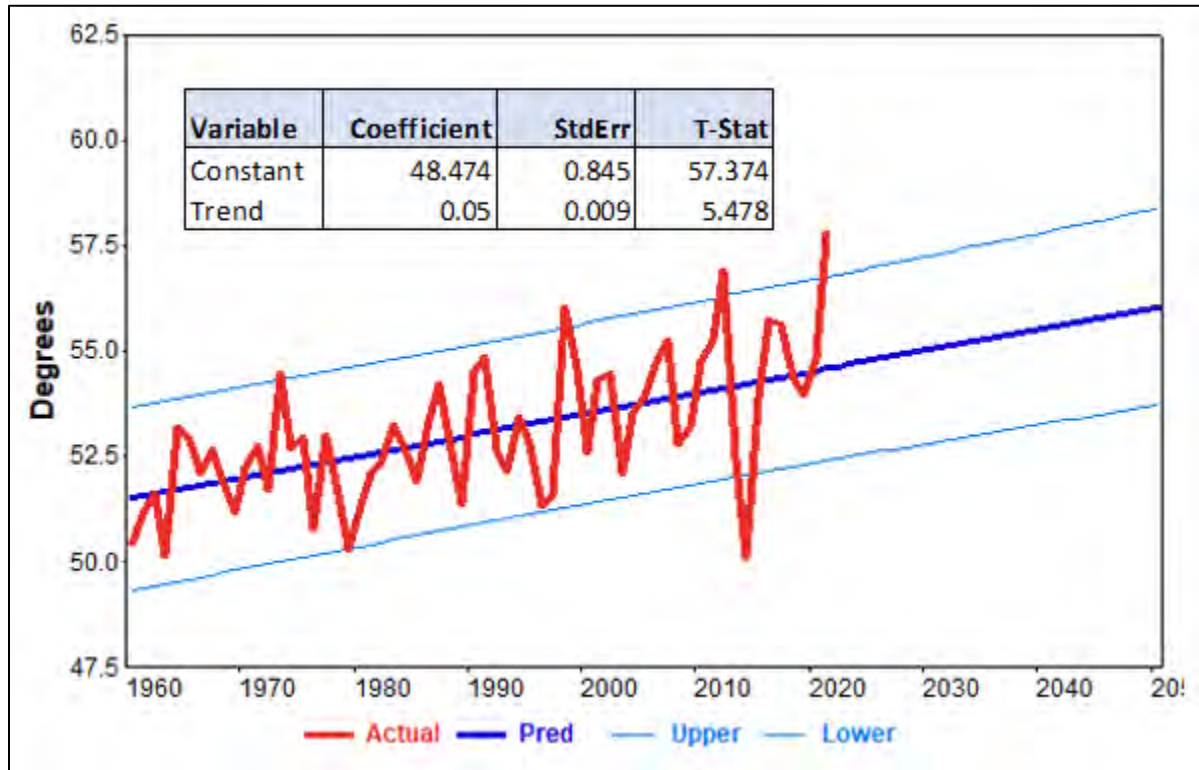
Monthly variation in winter usage is captured with heating-degree days (HDD) while variance in summer usage is modeled using monthly cooling degree days (CDD). HDD and CDD are often referred to as spline variables as they either take on a positive value or are 0. HDD are positive when temperatures are below a specified temperature reference point and are 0 when temperatures are at or above the temperature reference point. CDD are positive when temperatures are above a temperature reference point and are 0 when temperatures are at or below the temperature reference point. The best temperature breakpoints in terms of statistical model fit varies by customer class. Commercial heating and cooling generally start at lower temperature points than residential. Temperature breakpoints are evaluated as part of the model estimation process. For the residential rate classes, the best temperature breakpoints are 60 degrees for HDD and 65 degrees for CDD. In the non-residential classes, HDD with a 55 degree reference point and CDD with a 60 degree reference point improve the overall model fit. Both historical and forecasted monthly degree-days are calculated from Indianapolis International Airport daily temperature data.

Capturing Increasing Temperatures. Traditionally, utilities base their long-term forecast on what the industry calls *normal* weather. Normal weather is calculated by averaging historical weather usually over a 20-year or 30-year period. Given the large variation in month-to-month and year over year weather conditions, it seemed reasonable to assume that the best representation of current and forecast weather is an average of the past.

Recent studies that Itron and others have conducted have shown that this is probably not the best assumption; over the last fifty years, average temperatures have been increasing. We have estimated temperature increases of 0.4 degrees (Puget Sound) to 1.5 degrees (Reno) per decade. Given increasing temperatures, normal CDD will underestimate cooling requirements and normal HDD will overestimate heating requirements.

Not surprisingly, average temperatures have also been increasing in Indianapolis at constant rate. Figure 18 shows the long-term Indianapolis temperature trend, and 90% confidence interval.

Figure 18: Indianapolis Temperature Trend



Since 1960, average annual temperatures have been increasing 0.05 degrees per year, or 0.5 degrees per decade. The trend coefficient is highly statistically significant indicating a high probability of increasing temperatures. In 1960, the expected temperature was 51.5 degrees and in 2021 the expected annual temperature was 54.6 degrees. The average annual temperature in 2021 is 6 percent higher than 1960. Temperatures on the coldest days are increasing at an even faster rate of 1.1 degrees per decade.

For the baseline forecast, we assume that temperatures will continue to increase at the historical trend rate. Some of the climate models indicate temperatures may increase at even faster rates. Increase in temperature at 0.5 degrees per decade translates into a 0.3% annual increase in the number of CDD and a 0.4% annual decline in the number of HDD.

Figure 19 and Figure 20 show historical and forecasted monthly HDD with a base of 60 degrees and CDD with a base of 65 degrees. Decline in HDD lower long-term heating requirements with increasing CDD result in higher cooling requirements.

Figure 19: Heating Degree Days (Base 60)

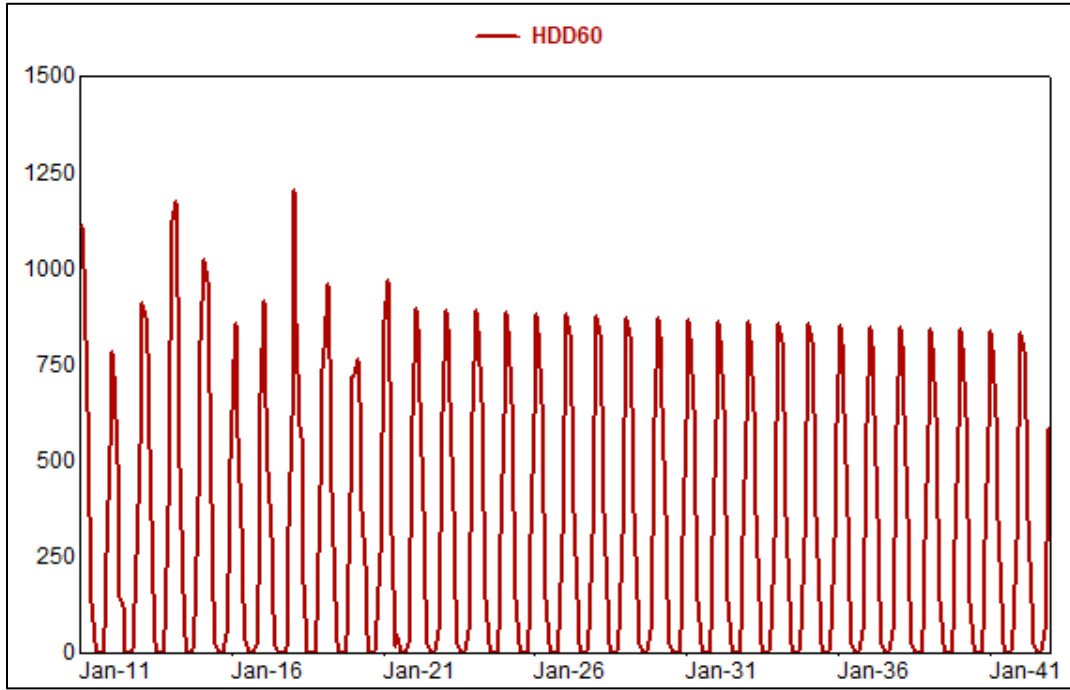
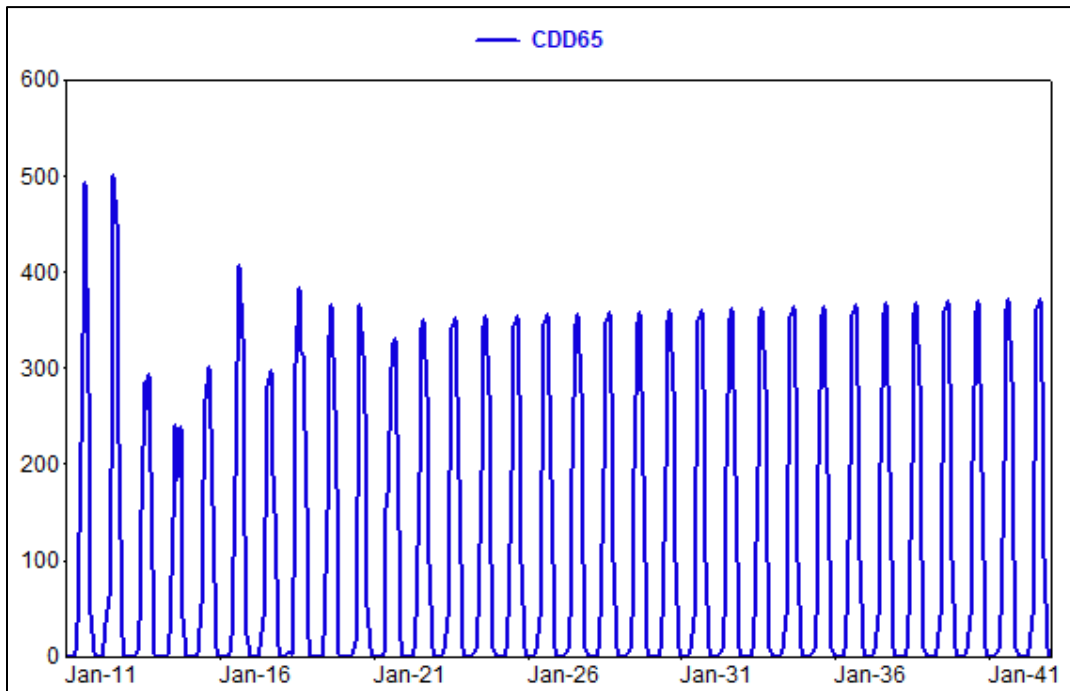


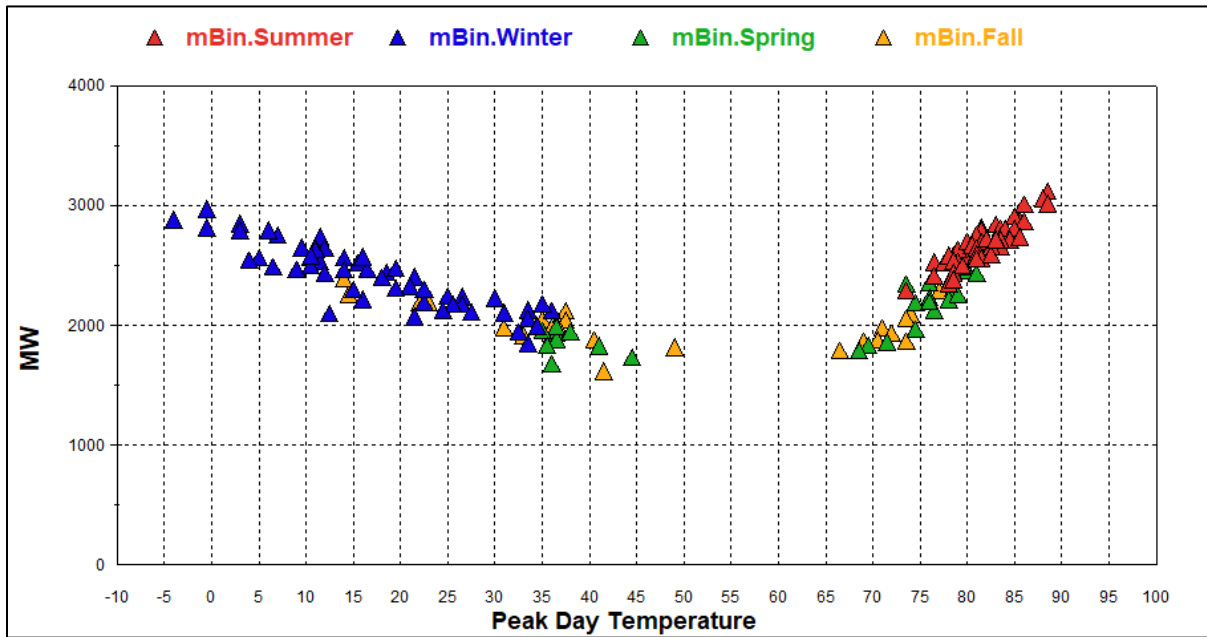
Figure 20: Cooling Degree Days (Base 65)



Peak-Day Weather Variables

Peak-day CDD and HDD are used in forecasting system peak demand. Peak-day HDD and CDD are derived by finding the HDD and CDD that occurred on the day of the peak. The appropriate breakpoints for defining peak-day HDD and CDD are determined by evaluating the relationship between monthly peak and the peak-day average temperature as shown in Figure 21.

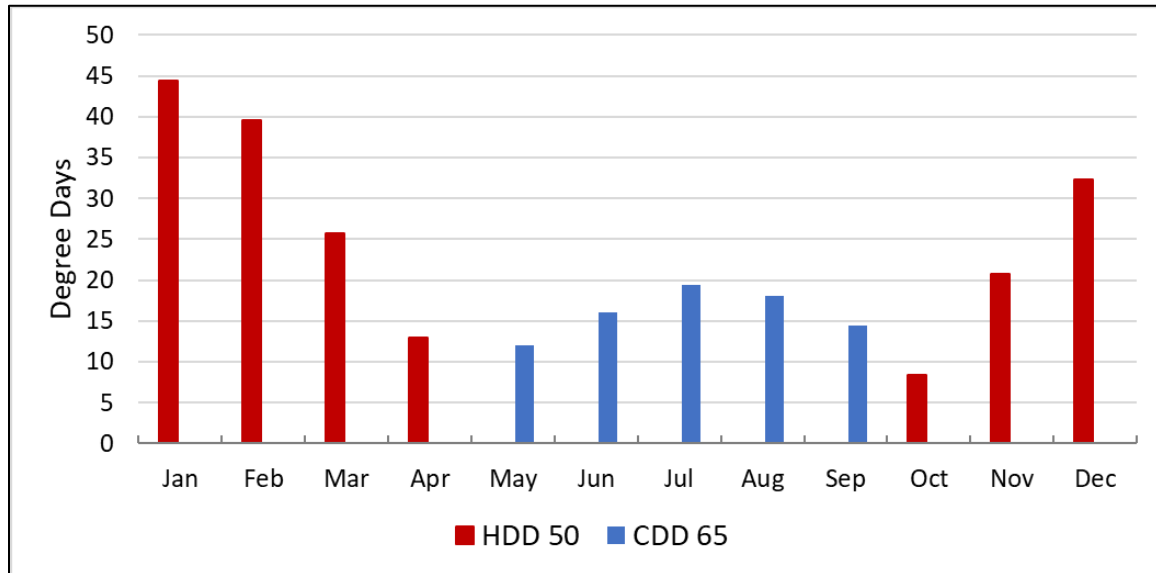
Figure 21: Monthly Peak Demand /Temperature Relationship



Peak-day cooling occurs when temperatures are above 65 degrees, and peak-day heating occurs when temperatures are below 50 degrees.

Normal peak-day HDD and CDD are calculated using 20 years of historical weather data (2001 to 2020). Normal peak-day HDD and CDD are based on the hottest and coldest days that occurred in each month over the historical time period. Peak-day weather is not adjusted for increasing average temperature as temperature trend impact is captured in the heating and cooling requirements; trending both peak-day and monthly degree-days would result in “double-counting” the impact of increasing temperatures. Figure 22 shows normal peak-day HDD (base 50 degrees) and peak-day CDD (base 65 degrees).

Figure 22: Normal Peak-Day HDD & CDD



3.2 Economic Data

Economic projections are key forecast drivers. The rate class sales forecasts are based on Moody Analytics historical and projected economic data (September 2021 forecast) for Marion County and the greater Indianapolis Metropolitan Statistical Area (MSA). The primary economic drivers in the residential model are Marion County population projections, real income projections and household size. Commercial sales are driven by Indianapolis MSA non-manufacturing employment and non-manufacturing output. The primary industrial sales model variables are manufacturing employment and manufacturing output. Table 3-1 through Table 3-3 shows the economic forecasts applicable to each customer class.

Table 3-1: Residential Economic Drivers

Year	Population		Household		Household Income	
	(000's)	Change	Size	Change	(Real \$)	Change
2022	985		2.4		48,223	
2023	992	0.7%	2.4	-0.6%	48,757	1.1%
2024	998	0.6%	2.4	-0.6%	49,664	1.9%
2025	1,004	0.6%	2.4	-0.6%	50,222	1.1%
2026	1,010	0.6%	2.4	-0.6%	50,776	1.1%
2027	1,017	0.6%	2.3	-0.5%	51,500	1.4%
2028	1,022	0.6%	2.3	-0.5%	52,477	1.9%
2029	1,028	0.6%	2.3	-0.4%	53,487	1.9%
2030	1,034	0.6%	2.3	-0.4%	54,448	1.8%
2031	1,040	0.6%	2.3	-0.4%	55,338	1.6%
2032	1,046	0.6%	2.3	-0.4%	56,192	1.5%
2033	1,052	0.5%	2.3	-0.4%	57,033	1.5%
2034	1,057	0.5%	2.3	-0.3%	57,881	1.5%
2035	1,063	0.5%	2.3	-0.3%	58,723	1.5%
2036	1,068	0.5%	2.3	-0.4%	59,552	1.4%
2037	1,073	0.5%	2.3	-0.3%	60,371	1.4%
2038	1,078	0.5%	2.2	-0.3%	61,155	1.3%
2039	1,083	0.5%	2.2	-0.3%	61,901	1.2%
2040	1,088	0.5%	2.2	-0.3%	62,662	1.2%
2041	1,093	0.4%	2.2	-0.3%	63,472	1.3%
2042	1,098	0.4%	2.2	-0.3%	64,304	1.3%
2022-42		0.5%		-0.4%		1.4%

Table 3-2: Commercial Economic Drivers

Year	Non-Manufacturing		Non-Manufacturing	
	Employment (thou's)	Change	Output (mil Real \$)	Change
2022	1,009		260,623	
2023	1,028	1.9%	267,147	2.5%
2024	1,040	1.2%	276,295	3.4%
2025	1,047	0.6%	284,085	2.8%
2026	1,052	0.5%	291,076	2.5%
2027	1,058	0.6%	297,045	2.1%
2028	1,065	0.6%	303,805	2.3%
2029	1,072	0.6%	310,421	2.2%
2030	1,078	0.6%	316,803	2.1%
2031	1,084	0.5%	323,088	2.0%
2032	1,089	0.5%	329,700	2.0%
2033	1,095	0.5%	336,311	2.0%
2034	1,100	0.5%	343,007	2.0%
2035	1,106	0.5%	349,661	1.9%
2036	1,111	0.4%	356,390	1.9%
2037	1,115	0.4%	363,025	1.9%
2038	1,120	0.4%	369,601	1.8%
2039	1,125	0.4%	376,226	1.8%
2040	1,130	0.5%	382,974	1.8%
2041	1,135	0.5%	389,820	1.8%
2042	1,141	0.5%	396,646	1.8%
2022-42		0.6%		2.1%

Table 3-3: Industrial Economic Drivers

Year	Manufacturing		Manufacturing	
	Employment (thou's)	Change	Output (mil Real \$)	Change
2022	95.5		100,900	
2023	95.5	0.0%	102,595	1.7%
2024	94.9	-0.6%	105,818	3.1%
2025	93.9	-1.0%	107,392	1.5%
2026	93.0	-1.0%	108,241	0.8%
2027	92.3	-0.8%	109,461	1.1%
2028	91.7	-0.7%	111,492	1.9%
2029	91.1	-0.7%	113,524	1.8%
2030	90.5	-0.7%	115,574	1.8%
2031	89.9	-0.6%	117,832	2.0%
2032	89.3	-0.7%	120,224	2.0%
2033	88.7	-0.6%	122,663	2.0%
2034	88.2	-0.6%	125,154	2.0%
2035	87.6	-0.7%	127,639	2.0%
2036	87.1	-0.6%	130,097	1.9%
2037	86.5	-0.7%	132,410	1.8%
2038	86.0	-0.6%	134,691	1.7%
2039	85.4	-0.6%	137,019	1.7%
2040	84.9	-0.6%	139,411	1.7%
2041	84.5	-0.6%	141,728	1.7%
2042	84.0	-0.6%	143,990	1.6%
2022-42		-0.6%		1.8%

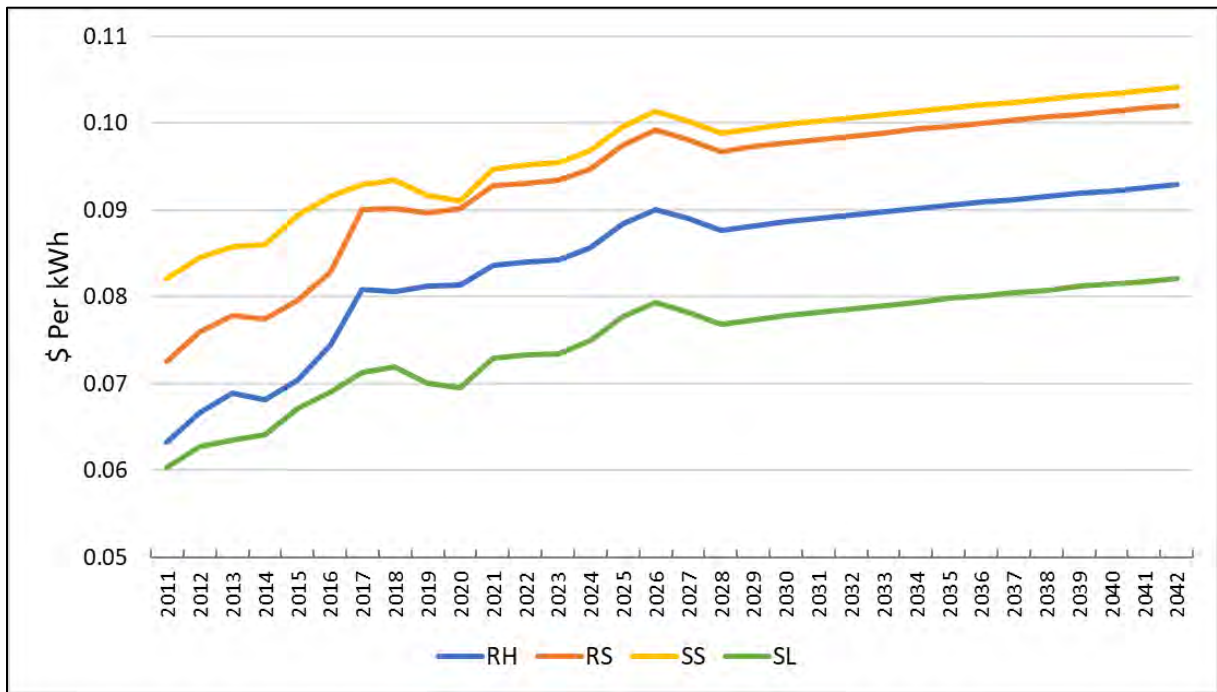
3.3 COVID-19 Impact

By the spring of 2020, Indiana, like many others states across the country, issued a “Stay at Home” order in response to the COVID-19 virus. This had the impact of significantly reducing commercial and industrial usage as businesses shutdown and significantly increasing residential usage as work activity shifted from the office to the home. As these restrictions were lifted most businesses re-opened, although even today some portion of the workforce remains working from home. To capture the impact, the residential average use and non-residential rate class models include a COVID impact variable. This variable is constructed using Google Mobility Report data for the residential, workplace and retail place types for Marion County. Google Mobility Report data tracks daily cell phone locations by place type compared to a pre-COVID baseline. The residential place type active increased while the workplace and retail decreased, this data correlates well to the actual changes in electric sales.

3.4 Prices

Historical prices (in real dollars) are derived from billed sales and revenue data. Historical prices are calculated as a 12-month moving average of the average rate (revenues divided by sales); prices are expressed in real dollars. Prices impact residential and commercial sales through imposed short-term price elasticities. Short-term price elasticities are small; residential elasticities are set at -0.05 and commercial and industrial price elasticities are set at -0.15. Figure 23 shows price forecasts for the residential RH and RS schedules, the commercial SS and SL schedules. Electric prices are expected to average 0.5% growth over the forecast period.

Figure 23: Historical and projected real electricity prices (cents per kWh)



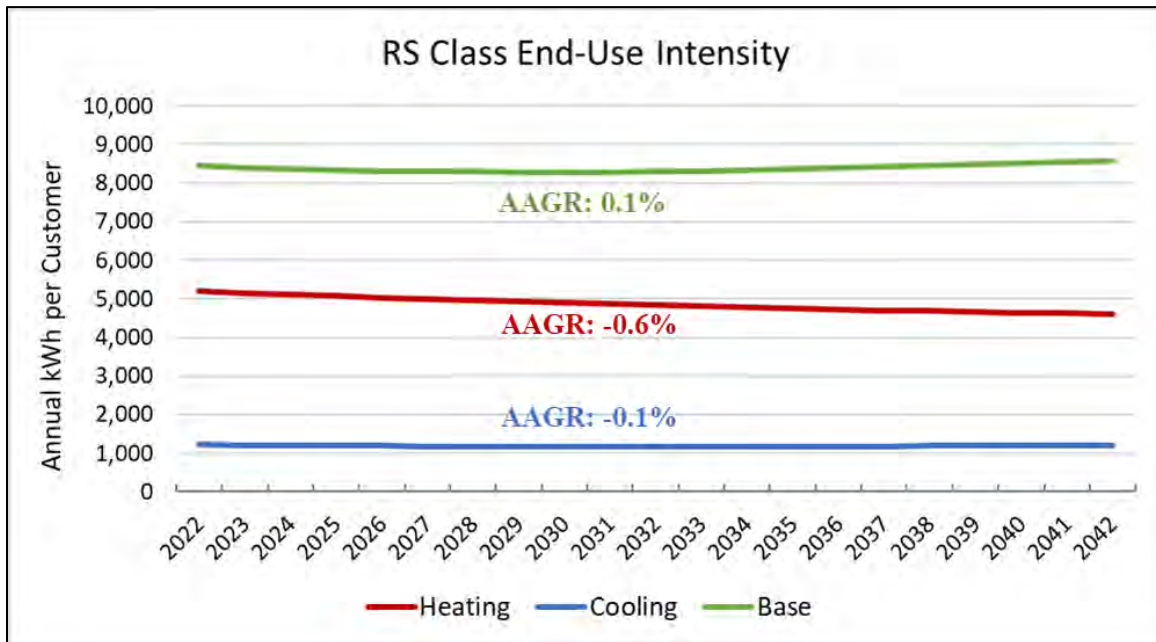
3.5 Appliance Saturation and Efficiency Trends

Over the long-term, changes in end-use saturation and stock efficiency impact class sales, system energy, and peak demand. End-use energy intensities, expressed in kWh per household for the residential sector and kWh per square foot for the commercial sectors, are incorporated into the constructed forecast model variables. Energy intensities reflect both change in ownership (saturation) and average stock efficiency. Energy intensities are derived from Energy Information Administration’s (EIA) 2021 Annual Energy Outlook for the East

North Central Census Division. The residential sector is further calibrated to AES Indiana’s service territory based on information from DSM potential studies. The residential sector incorporates saturation and efficiency trends for twenty end-uses. The commercial sector captures end-use intensity projections for ten end-use classifications across ten building types.

Residential end-use intensities are used in constructing residential XHeat, XCool, and XOther in the residential average use model. Figure 24 shows the resulting aggregated end-use intensity projections.

Figure 24: Residential End-Use Energy Intensities



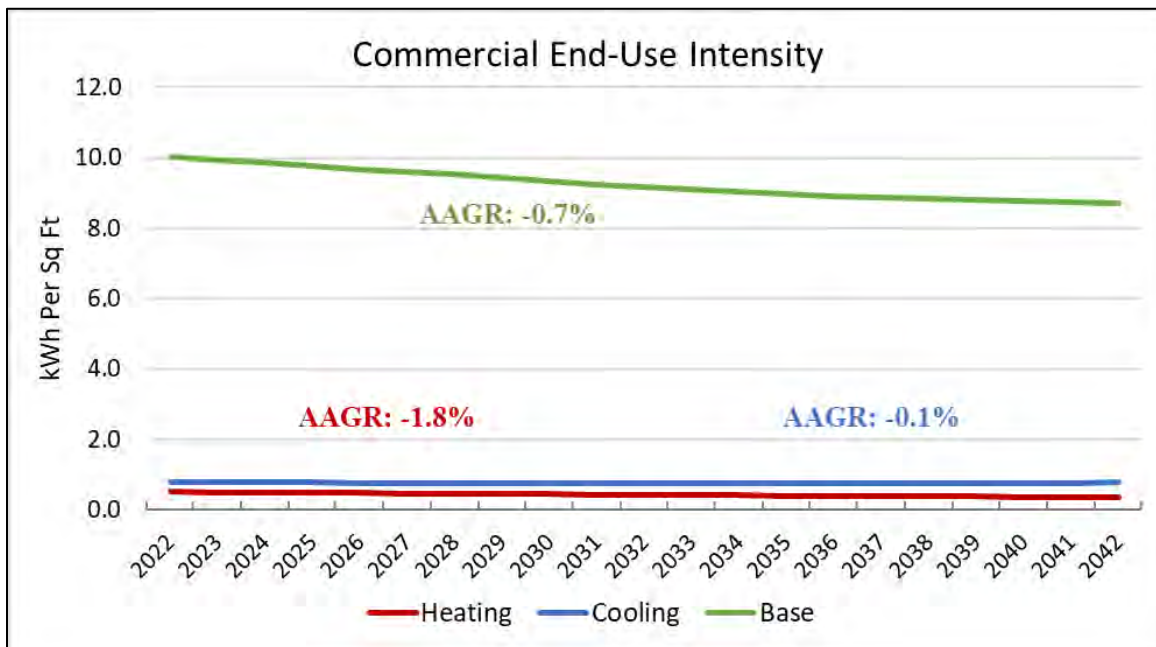
*AAGR=Average Annual Growth Rate

While overall, heating use per household is declining, total AES Indiana heating load is increasing as a result of strong growth in electric heat customers. Cooling intensity declines 0.1% annually through the forecast period as overall air conditioning efficiency improvements and change from less efficient room air conditioning to central air conditioning slightly outweighs overall increase in air conditioning saturation. Again, while cooling intensity is declining overall cooling load is increasing as the number of new customers is increasing faster than cooling use per customer is declining. Total non-weather sensitive end-use intensity (Base) declines in the first 10 years of the forecast before increasing over the last 10 years. Most non-weather sensitive end-uses are declining driven

by end-use efficiency improvements. Declines in intensities across most of the end-use categories are partially offset by miscellaneous end-use sales growth.

Commercial end-use intensities are expressed in kWh per sqft. As in the residential sector, there have been significant improvements in end-use efficiency as a result of new codes and standards. Figure 25 shows commercial end-use energy intensity forecasts for the aggregated end-use categories.

Figure 25: Commercial End-Use Energy Intensity



Commercial usage is dominated by non-weather sensitive end-uses, which over the forecast period are projected to decline 0.7% annually, driven by improvements in lighting and ventilation efficiency. Cooling intensity declines 0.1% annually through the forecast period, with efficiency improvement only slightly stronger than saturation increases. Heating intensity declines an even stronger 1.8% annual rate though commercial electric heating is relatively small.

3.6 Historical EE Program Savings

Over the past ten years AES Indiana has promoted energy efficiency (EE) savings through utility sponsored programs. These programs have had a significant impact on electricity usage across nearly all customer classes. The EE program savings are above and beyond naturally occurring savings, and impact of federal codes and standards.

The residential and commercial models incorporate EE to account for historical program savings. The EE variables help explain historical usage trends. In the forecast period EE is held constant, as incremental EE program savings are treated as a supply-side resource in the IRP modeling framework. The EE variables are based on annual verified EE savings that are converted to a monthly series. In the residential average use models, EE is expressed as savings per customer. Figure 26 and Figure 27 shows the cumulative MWh savings and savings as a percentage of class sales for the residential, commercial, and industrial classes.

Figure 26: Residential EE Savings

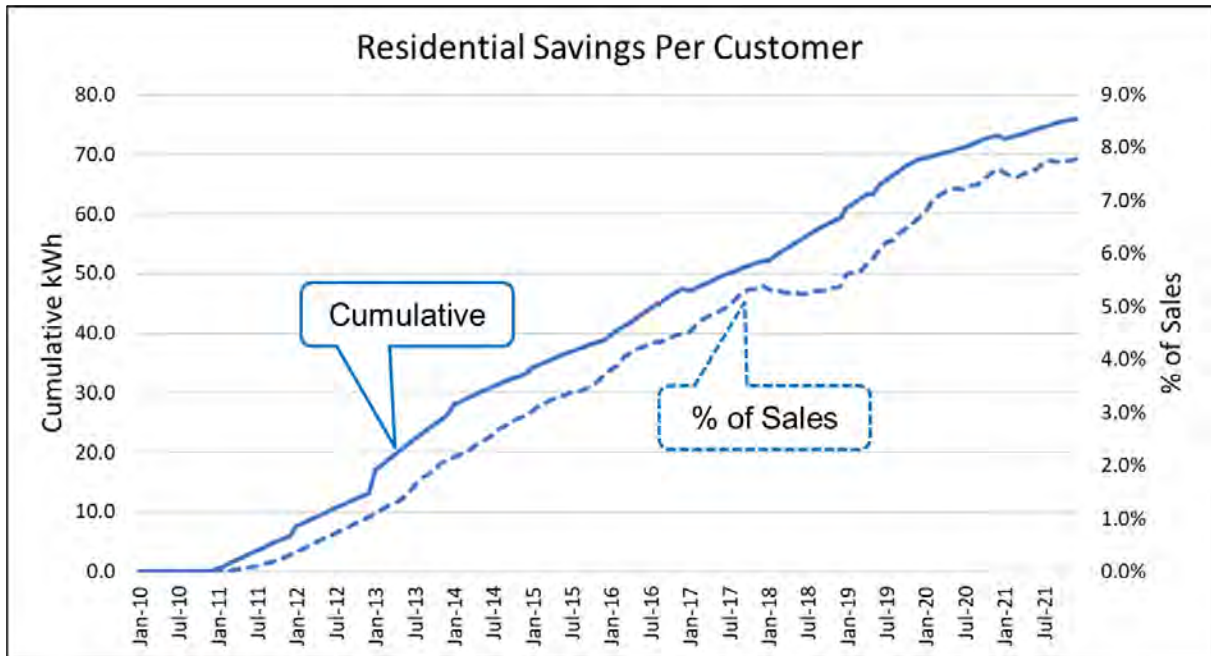
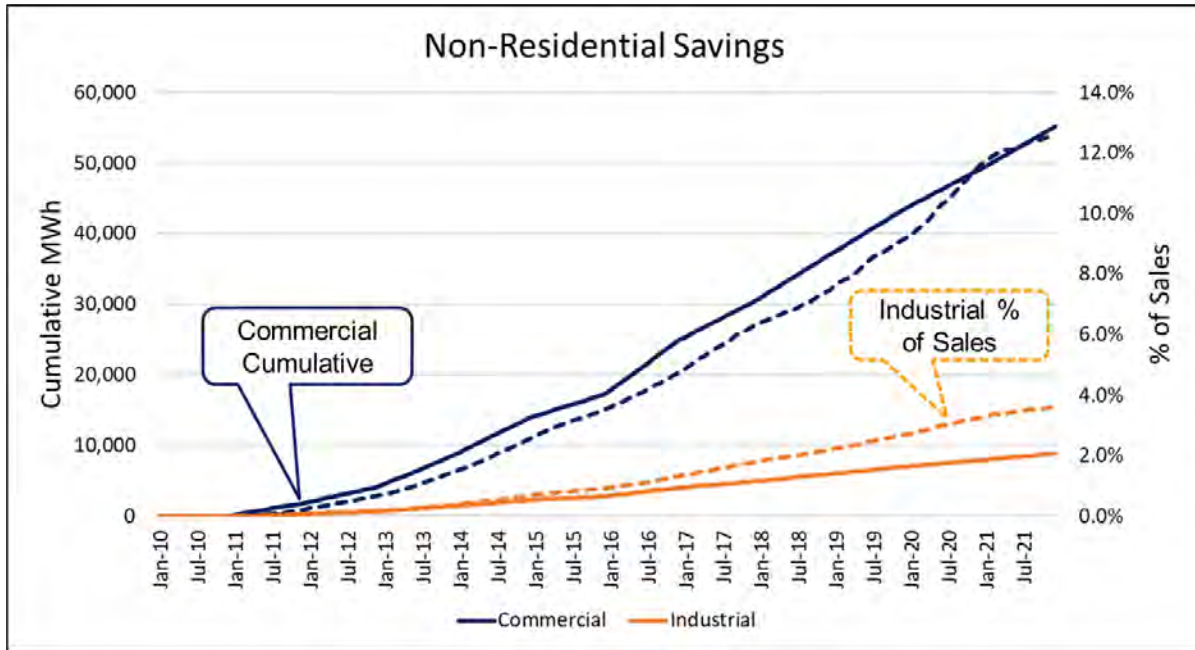


Figure 27: Non-Residential EE Savings



4 Forecast Sensitivities

High and low forecast scenarios are based on alternative economic scenarios provided by Moody Analytics.

The high case is Moody Analytics Alternative Scenario 1 – Upside – 10th Percentile. In this scenario, there is just a 10% probability that the economy for the Indianapolis MSA could potentially perform better.

The low case is based on Moody Analytics Alternative Scenario 3 – Downside – 90th Percentile scenario. This is the opposite boundary where there is a 10% or less probability that economy will perform worse.

The economic scenarios are constructed by applying the scenario economic growth rates to the baseline economic variables starting in the first month of the forecast period (2022). Scenarios are further adjusted to ensure the growth rates are less than or equal to the baseline growth rates in the low case and greater than or equal to the baseline growth rates in the high case.

The estimated rate class models are used to generate the high and low sales forecasts. Heating, cooling, and base-load energy requirements derived from the scenarios drive the high and low system peak forecast. Table 4-1 and Table 4-2 summarize base, high, and low case energy, and peak forecasts.

Table 4-1: Scenario Forecasts: Energy

Year	Baseline		Low Scenario		High Scenario	
	(MWh)	change	(MWh)	change	(MWh)	change
2022	13,986,185		13,730,461		14,040,156	
2023	14,024,823	0.3%	13,647,974	-0.6%	14,105,462	0.5%
2024	14,133,336	0.8%	13,751,860	0.8%	14,217,033	0.8%
2025	14,162,987	0.2%	13,779,967	0.2%	14,259,179	0.3%
2026	14,182,532	0.1%	13,797,417	0.1%	14,289,229	0.2%
2027	14,262,645	0.6%	13,874,989	0.6%	14,371,347	0.6%
2028	14,373,450	0.8%	13,982,390	0.8%	14,483,077	0.8%
2029	14,446,266	0.5%	14,052,471	0.5%	14,557,288	0.5%
2030	14,496,004	0.3%	14,098,157	0.3%	14,608,424	0.4%
2031	14,555,951	0.4%	14,154,709	0.4%	14,669,504	0.4%
2032	14,619,528	0.4%	14,215,016	0.4%	14,733,988	0.4%
2033	14,690,601	0.5%	14,281,061	0.5%	14,806,326	0.5%
2034	14,775,368	0.6%	14,362,804	0.6%	14,892,551	0.6%
2035	14,863,828	0.6%	14,446,481	0.6%	14,984,181	0.6%
2036	14,957,410	0.6%	14,536,042	0.6%	15,081,119	0.6%
2037	15,054,463	0.6%	14,628,845	0.6%	15,180,645	0.7%
2038	15,153,931	0.7%	14,723,851	0.6%	15,283,189	0.7%
2039	15,256,457	0.7%	14,820,646	0.7%	15,387,479	0.7%
2040	15,352,201	0.6%	14,909,653	0.6%	15,484,756	0.6%
2041	15,457,655	0.7%	15,005,944	0.6%	15,592,886	0.7%
2042	15,567,503	0.7%	15,105,575	0.7%	15,706,773	0.7%
2022-42		0.54%		0.48%		0.56%

Table 4-2: Scenario Forecasts: Demand

Year	Baseline		Low Scenario		High Scenario	
	(MW)	change	(MW)	change	(MW)	change
2022	2,829		2,781		2,840	
2023	2,852	0.8%	2,787	0.2%	2,865	0.9%
2024	2,873	0.7%	2,807	0.7%	2,887	0.8%
2025	2,878	0.2%	2,812	0.2%	2,895	0.3%
2026	2,885	0.3%	2,819	0.2%	2,904	0.3%
2027	2,905	0.7%	2,838	0.7%	2,924	0.7%
2028	2,930	0.9%	2,862	0.9%	2,949	0.9%
2029	2,950	0.7%	2,881	0.7%	2,969	0.7%
2030	2,969	0.6%	2,899	0.6%	2,989	0.7%
2031	2,988	0.6%	2,918	0.6%	3,008	0.7%
2032	3,009	0.7%	2,938	0.7%	3,029	0.7%
2033	3,031	0.7%	2,958	0.7%	3,052	0.7%
2034	3,055	0.8%	2,982	0.8%	3,076	0.8%
2035	3,080	0.8%	3,005	0.8%	3,101	0.8%
2036	3,105	0.8%	3,030	0.8%	3,127	0.8%
2037	3,132	0.9%	3,056	0.8%	3,155	0.9%
2038	3,158	0.8%	3,081	0.8%	3,182	0.9%
2039	3,186	0.9%	3,107	0.8%	3,210	0.9%
2040	3,214	0.9%	3,134	0.9%	3,238	0.9%
2041	3,244	0.9%	3,162	0.9%	3,269	1.0%
2042	3,275	0.9%	3,191	0.9%	3,300	1.0%
2022-42		0.73%		0.69%		0.76%

5 Appendix A: Model Statistics

RS Average Use Model

Variable	Coefficient	StdErr	T-Stat	P-Value
RS_Vars.XOther	1.02	0.013	68.975	0.00%
RS_Vars.XCool	1.67	0.021	61.152	0.00%
RS_Vars.XHeat	0.82	0.029	71.416	0.00%
mBin.Jan	23.51	4.854	3.936	0.00%
mBin.Mar	-18.49	5.547	-2.39	0.11%
mBin.Apr	-38.12	6.815	-4.167	0.00%
mBin.May	-29.29	5.906	-2.919	0.00%
mBin.Nov	-22.47	4.549	-5.458	0.00%
mBin.Oct17	-48.13	14.215	-2.922	0.10%
mBin.May21	-210.40	14.839	-6.963	0.00%
COVID_Shift.Res	47.44	15.004	2.145	0.20%
DSM_10YrML.RS_Constant	-1.39	0.145	-8.788	0.00%
MA(1)	0.56	0.077	6.688	0.00%

Model Statistics	
Iterations	18
Adjusted Observations	132
Deg. of Freedom for Error	119
R-Squared	0.993
Adjusted R-Squared	0.992
AIC	5.725
BIC	6.009
Model Sum of Squares	4,824,488
Sum of Squared Errors	33,230
Mean Squared Error	279.24
Std. Error of Regression	16.71
Mean Abs. Dev. (MAD)	11.88
Mean Abs. % Err. (MAPE)	1.43%
Durbin-Watson Statistic	2.11

RS Customer Model

Variable	Coefficient	StdErr	T-Stat	P-Value
CONST	-216268.204	5835.68	-37.06	0.00%
Econ.MarionPop	390.175	6.318	61.755	0.00%
mBin.May19	2270.705	100.483	22.598	0.00%
mBin.Yr16Plus	628.115	193.735	3.242	0.15%
MA(1)	1.638	0.08	20.418	0.00%
MA(2)	1.713	0.136	12.569	0.00%
MA(3)	1.642	0.145	11.356	0.00%
MA(4)	1.14	0.136	8.391	0.00%
MA(5)	0.5	0.08	6.276	0.00%
Model Statistics				
Iterations	52			
Adjusted Observations	132			
Deg. of Freedom for Error	123			
R-Squared	0.999			
Adjusted R-Squared	0.999			
AIC	11.32			
BIC	11.51			
Model Sum of Squares	10,101,483,592			
Sum of Squared Errors	9,469,010			
Mean Squared Error	76983.82			
Std. Error of Regression	277.46			
Mean Abs. Dev. (MAD)	219.45			
Mean Abs. % Err. (MAPE)	0.15%			
Durbin-Watson Statistic	1.50			

RC Average Use Model

Variable	Coefficient	StdErr	T-Stat	P-Value
RC_Vars.XHeat	1.481	0.027	54.544	0.00%
RC_Vars.XCool	1.53	0.026	59.588	0.00%
RC_Vars.XOther	1.378	0.013	106.876	0.00%
mBin.Jan	25.494	5.385	4.735	0.00%
mBin.Apr	-17.013	5.987	-2.841	0.53%
mBin.May	-26.127	6.397	-4.084	0.01%
mBin.Jul	35.548	6.547	5.43	0.00%
mBin.Aug	45.023	6.538	6.886	0.00%
mBin.Oct	-18.78	6.055	-3.102	0.24%
mBin.Nov	-32.466	5.831	-5.568	0.00%
mBin.Apr12	-53.372	16.497	-3.235	0.16%
mBin.Sep20	68.584	16.068	4.268	0.00%
mBin.May21	-183.565	16.495	-11.129	0.00%
COVID_Shift.Res	33.74	11.242	3.001	0.33%
DSM_10YrML.RC_Constant	-1.851	0.089	-20.809	0.00%
MA(1)	0.198	0.094	2.097	3.81%
Model Statistics				
Iterations	17			
Adjusted Observations	132			
Deg. of Freedom for Error	116			
R-Squared	0.994			
Adjusted R-Squared	0.993			
AIC	5.629			
BIC	5.979			
Model Sum of Squares	4,887,472			
Sum of Squared Errors	28,841			
Mean Squared Error	248.63			
Std. Error of Regression	15.77			
Mean Abs. Dev. (MAD)	11.61			
Mean Abs. % Err. (MAPE)	1.08%			
Durbin-Watson Statistic	1.97			

RC Customer Model

Variable	Coefficient	StdErr	T-Stat	P-Value
CONST	-46381.575	7145.536	-6.491	0.00%
Econ.MarionPop	83.166	7.397	11.244	0.00%
mBin.Jan	38.48	16.626	2.314	2.24%
mBin.Feb	43.031	18.714	2.299	2.32%
mBin.Mar	20.133	16.077	1.252	21.29%
mBin.Jun	-58.156	17.116	-3.398	0.09%
mBin.Jul	-62.97	22.085	-2.851	0.51%
mBin.Aug	-73.076	24.185	-3.022	0.31%
mBin.Sep	-91.574	24.185	-3.786	0.02%
mBin.Oct	-93.905	22.084	-4.252	0.00%
mBin.Nov	-51.28	17.115	-2.996	0.33%
AR(1)	0.958	0.01	98.018	0.00%
Model Statistics				
Iterations	30			
Adjusted Observations	131			
Deg. of Freedom for Error	119			
R-Squared	0.998			
Adjusted R-Squared	0.998			
AIC	8.29			
BIC	8.55			
Model Sum of Squares	221,965,102			
Sum of Squared Errors	433,041			
Mean Squared Error	3639			
Std. Error of Regression	60.32			
Mean Abs. Dev. (MAD)	41			
Mean Abs. % Err. (MAPE)	0.12%			
Durbin-Watson Statistic	1.62			

RH Average Use Model

Variable	Coefficient	StdErr	T-Stat	P-Value
RH_Vars.XOther	0.913	0.016	55.629	0.00%
RH_Vars.XHeat	1.692	0.015	113.607	0.00%
RH_Vars.XCool	1.179	0.029	40.424	0.00%
mBin.Mar	-27.937	11.153	-2.505	1.36%
mBin.Apr	-43.095	10.638	-4.051	0.01%
mBin.Nov	-82.197	10.612	-7.745	0.00%
mBin.Dec	-87.72	10.803	-8.12	0.00%
COVID_Shift.Res	35.116	25.184	1.394	16.58%
DSM_10YrML.RH_Constant	-1.514	0.134	-11.261	0.00%
MA(1)	0.348	0.09	3.852	0.02%

Model Statistics	
Iterations	18
Adjusted Observations	132
Deg. of Freedom for Error	122
R-Squared	0.996
Adjusted R-Squared	0.996
AIC	6.998
BIC	7.217
Model Sum of Squares	32,912,744
Sum of Squared Errors	124,203
Mean Squared Error	1018.05
Std. Error of Regression	31.91
Mean Abs. Dev. (MAD)	24.68
Mean Abs. % Err. (MAPE)	2.06%
Durbin-Watson Statistic	1.91

RH Customer Model

Variable	Coefficient	StdErr	T-Stat	P-Value
CONST	-216268.204	5835.68	-37.06	0.00%
Econ.MarionPop	390.175	6.318	61.755	0.00%
mBin.May19	2270.705	100.483	22.598	0.00%
mBin.Yr16Plus	628.115	193.735	3.242	0.15%
MA(1)	1.638	0.08	20.418	0.00%
MA(2)	1.713	0.136	12.569	0.00%
MA(3)	1.642	0.145	11.356	0.00%
MA(4)	1.14	0.136	8.391	0.00%
MA(5)	0.5	0.08	6.276	0.00%
Model Statistics				
Iterations	52			
Adjusted Observations	132			
Deg. of Freedom for Error	123			
R-Squared	0.999			
Adjusted R-Squared	0.999			
AIC	11.32			
BIC	11.51			
Model Sum of Squares	10,101,483,592			
Sum of Squared Errors	9,469,010			
Mean Squared Error	76983.82			
Std. Error of Regression	277.46			
Mean Abs. Dev. (MAD)	219.45			
Mean Abs. % Err. (MAPE)	0.15%			
Durbin-Watson Statistic	1.50			

CR Sales

Variable	Coefficient	StdErr	T-Stat	P-Value
CR_Custs.Filled	229.809	6.683	34.387	0.00%
mBin.Jan	832.885	178.274	4.672	0.00%
mBin.Jun	551.794	154.127	3.58	0.06%
mBin.Jul	718.884	174.773	4.113	0.01%
mBin.Aug	534.18	153.779	3.474	0.09%
mBin.Dec	164.899	152.833	1.079	28.42%
mBin.Oct	-341.78	134.706	-2.537	1.33%
mBin.Nov16	-1316.122	357.222	-3.684	0.04%
mBin.Jan19	1913.357	382.736	4.999	0.00%
mBin.Jan21	943.731	380.847	2.478	1.56%
AR(1)	0.657	0.092	7.146	0.00%

Model Statistics	
Iterations	12
Adjusted Observations	83
Deg. of Freedom for Error	72
R-Squared	0.868
Adjusted R-Squared	0.85
AIC	12.17
BIC	12.49
Model Sum of Squares	80,711,429
Sum of Squared Errors	12,286,038
Mean Squared Error	170639.42
Std. Error of Regression	413.09
Mean Abs. Dev. (MAD)	304.73
Mean Abs. % Err. (MAPE)	6.24%
Durbin-Watson Statistic	1.94

Residential APL Sales

Variable	Coefficient	StdErr	T-Stat	P-Value
mBin.TrendVar2	-54772290.45	1932932.1	-28.336	0.00%
mBin.Jan	57604372.73	1996880.1	28.847	0.00%
mBin.Feb	57456320.73	1996944.7	28.772	0.00%
mBin.Mar	57432871.43	1997009.1	28.759	0.00%
mBin.Apr	57287154.77	1997073.4	28.686	0.00%
mBin.May	57241319.34	1997137.4	28.662	0.00%
mBin.Jun	57173947.46	1997201.2	28.627	0.00%
mBin.Jul	57213505.6	1997264.8	28.646	0.00%
mBin.Aug	57278052.36	1997328.2	28.677	0.00%
mBin.Sep	57328959.59	1997391.4	28.702	0.00%
mBin.Oct	57489580.6	1997454.4	28.781	0.00%
mBin.Nov	57535134.6	1997517.2	28.803	0.00%
mBin.Dec	57609263.83	1997579.9	28.84	0.00%
Model Statistics				
Iterations	1			
Adjusted Observations	132			
Deg. of Freedom for Error	119			
R-Squared	0.974			
Adjusted R-Squared	0.972			
AIC	20.55			
BIC	20.83			
Model Sum of Squares	3,425,868,194,980			
Sum of Squared Errors	90,749,636,712			
Mean Squared Error	762601989.2			
Std. Error of Regression	27615.25			
Mean Abs. Dev. (MAD)	18480			
Mean Abs. % Err. (MAPE)	2.36%			
Durbin-Watson Statistic	1.25			

SS Sales

Variable	Coefficient	StdErr	T-Stat	P-Value
SS_Vars.XOther	0.901	0.007	134.584	0.00%
SS_Vars.XHeat	29.844	1.054	28.315	0.00%
SS_Vars.XCool	9.875	0.186	53.193	0.00%
mBin.Jan	-3897.755	592.217	-6.582	0.00%
mBin.Mar	1284.559	478.516	2.684	0.83%
mBin.Nov	-2427.39	560.344	-4.332	0.00%
mBin.Dec	-4381.034	617.595	-7.094	0.00%
mBin.Jun19	-4576.186	1536.143	-2.979	0.35%
mBin.May20	-2441.017	1546.083	-1.579	11.71%
mBin.May21	-19491.102	1546.904	-12.6	0.00%
mBin.Yr2020Plus	2451.768	895.417	2.738	0.71%
DSM_10YrML.SS_Constant	-0.476	0.065	-7.328	0.00%
AR(1)	0.432	0.084	5.116	0.00%
Model Statistics				
Iterations	12			
Adjusted Observations	131			
Deg. of Freedom for Error	118			
R-Squared	0.979			
Adjusted R-Squared	0.977			
AIC	14.9366			
BIC	15.2219			
Model Sum of Squares	15,184,927,145			
Sum of Squared Errors	329,583,200			
Mean Squared Error	2793077.97			
Std. Error of Regression	1671.25			
Mean Abs. Dev. (MAD)	1252.479			
Mean Abs. % Err. (MAPE)	1.21%			
Durbin-Watson Statistic	1.99			

SH Sales

Variable	Coefficient	StdErr	T-Stat	P-Value
SH_Vars.XOther	0.628	0.021	30.213	0.00%
SH_Vars.XHeat	108.07	3.812	28.351	0.00%
SH_Vars.XCool	8.587	1.162	7.393	0.00%
mBin.Jan	3799.822	771.219	4.927	0.00%
mBin.Feb	8475.99	891.778	9.505	0.00%
mBin.Mar	8184.564	798.052	10.256	0.00%
mBin.Apr	5424.527	792.726	6.843	0.00%
mBin.May	4119.754	925.856	4.45	0.00%
mBin.Jun	3454.764	1395.043	2.476	1.47%
mBin.Jul	4520.725	1930.928	2.341	2.10%
mBin.Aug	6695.713	1946.089	3.441	0.08%
mBin.Sep	4611.447	1667.249	2.766	0.66%
mBin.Oct	3597.529	905.269	3.974	0.01%
mBin.Jul19	-2496.355	1662.148	-1.502	13.59%
mBin.May21	-4541.675	1855.725	-2.447	1.59%
DSM_10YrML.SH_Constant	-2.019	0.278	-7.26	0.00%
AR(1)	0.495	0.085	5.83	0.00%

Model Statistics	
Iterations	11
Adjusted Observations	131
Deg. of Freedom for Error	114
R-Squared	0.981
Adjusted R-Squared	0.978
AIC	15.0812
BIC	15.4543
Model Sum of Squares	18,511,880,839
Sum of Squared Errors	358,273,571
Mean Squared Error	3142750.624
Std. Error of Regression	1772.78
Mean Abs. Dev. (MAD)	1327.376
Mean Abs. % Err. (MAPE)	2.98%
Durbin-Watson Statistic	1.98

SE Sales

Variable	Coefficient	StdErr	T-Stat	P-Value
CONST	1478.821	36.286	40.754	0.00%
mRevWthr.CDD65	0.777	0.136	5.719	0.00%
mRevWthr.HDD55	0.682	0.06	11.306	0.00%
mBin.Apr	-73.639	28.895	-2.548	1.21%
mBin.Jul	-100.524	30.81	-3.263	0.15%
mBin.Nov	-75.548	29.728	-2.541	1.23%
mBin.Jun17	-404.383	91.998	-4.396	0.00%
mBin.Nov18	-459.595	119.273	-3.853	0.02%
mBin.Dec18	-477.781	114.591	-4.169	0.01%
mBin.May20	-286.513	116.996	-2.449	1.58%
mBin.Jun20	-300.213	116.556	-2.576	1.12%
mBin.Yr16Plus	-250.256	42.715	-5.859	0.00%
mBin.Yr18Plus	-173.577	44.645	-3.888	0.02%
MA(1)	0.618	0.079	7.851	0.00%
Model Statistics				
Iterations	13			
Adjusted Observations	132			
Deg. of Freedom for Error	118			
R-Squared	0.881			
Adjusted R-Squared	0.867			
AIC	9.5516			
BIC	9.8574			
Model Sum of Squares	11,082,513			
Sum of Squared Errors	1,501,981			
Mean Squared Error	12728.656			
Std. Error of Regression	112.821			
Mean Abs. Dev. (MAD)	85.702			
Mean Abs. % Err. (MAPE)	5.77%			
Durbin-Watson Statistic	1.80			

CB Sales

Variable	Coefficient	StdErr	T-Stat	P-Value
CONST	29.409	1.843	15.96	0.00%
mRevWthr.HDD60	0.014	0.001	10.646	0.00%
mBin.Mar	2.305	0.816	2.823	0.56%
mBin.Apr	5.437	1.056	5.148	0.00%
mBin.May	5.897	1.152	5.12	0.00%
mBin.Jun	6.585	1.081	6.094	0.00%
mBin.Jul	3.06	0.837	3.655	0.04%
mBin.Nov17	-7.083	2.11	-3.357	0.11%
AR(1)	0.86	0.046	18.887	0.00%

Model Statistics	
Iterations	7
Adjusted Observations	131
Deg. of Freedom for Error	122
R-Squared	0.87
Adjusted R-Squared	0.862
AIC	2.12
BIC	2.32
Model Sum of Squares	6,374
Sum of Squared Errors	950
Mean Squared Error	7.79
Std. Error of Regression	2.79
Mean Abs. Dev. (MAD)	2
Mean Abs. % Err. (MAPE)	5.44%
Durbin-Watson Statistic	2.12

Small C&I APL Sales

Variable	Coefficient	StdErr	T-Stat	P-Value
mBin.Jan	3263.97	30.728	106.222	0.00%
mBin.Feb	2797.399	31.228	89.579	0.00%
mBin.Mar	2722.817	31.228	87.19	0.00%
mBin.Apr	2248.109	31.228	71.989	0.00%
mBin.May	2093.381	31.228	67.034	0.00%
mBin.Jun	1883.179	31.228	60.303	0.00%
mBin.Jul	2005.841	31.228	64.231	0.00%
mBin.Aug	2201.231	31.228	70.488	0.00%
mBin.Sep	2373.894	31.228	76.017	0.00%
mBin.Oct	2911.022	31.228	93.217	0.00%
mBin.Nov	3045.707	31.228	97.53	0.00%
mBin.Dec	3265.756	30.956	105.496	0.00%
MA(1)	0.453	0.082	5.509	0.00%
Model Statistics				
Iterations	8			
Adjusted Observations	132			
Deg. of Freedom for Error	119			
R-Squared	0.966			
Adjusted R-Squared	0.962			
AIC	9.19			
BIC	9.47			
Model Sum of Squares	29,895,366			
Sum of Squared Errors	1,058,878			
Mean Squared Error	8898.14			
Std. Error of Regression	94.33			
Mean Abs. Dev. (MAD)	65.87			
Mean Abs. % Err. (MAPE)	2.56%			
Durbin-Watson Statistic	1.71			

SL Sales

Variable	Coefficient	StdErr	T-Stat	P-Value
SLVars.XOther	261187.918	17576.84	14.86	0.00%
SLVars.XHeat	87097.753	20977.9	4.152	0.01%
SLVars.XCool	116056.093	3777.983	30.719	0.00%
mBin.Yr10Plus	30327.284	15687.18	1.933	5.57%
mBin.Feb	8166.226	2017.792	4.047	0.01%
mBin.Mar	7507.893	1656.084	4.534	0.00%
mBin.May	1879.011	1285.914	1.461	14.67%
mBin.Aug	9484.18	1455.048	6.518	0.00%
mBin.Sep	7778.766	1555.212	5.002	0.00%
mBin.Oct	6391.572	1338.604	4.775	0.00%
mBin.Feb19	13847.104	4297.967	3.222	0.17%
mBin.Mar19	19203.746	4269.218	4.498	0.00%
mBin.May21	-40819.119	3991.488	-10.227	0.00%
mBin.Yr19Plus	-13248.09	2318.856	-5.713	0.00%
COVID_Shift.SCI	-14786.925	4126.713	-3.583	0.05%
DSM_10YrML.SL_Constant	-0.538	0.101	-5.334	0.00%
AR(1)	0.411	0.088	4.672	0.00%

Model Statistics	
Iterations	15
Adjusted Observations	131
Deg. of Freedom for Error	114
R-Squared	0.983
Adjusted R-Squared	0.98
AIC	16.7324
BIC	17.1055
Model Sum of Squares	105,205,103,172
Sum of Squared Errors	1,867,876,125
Mean Squared Error	16384878.29
Std. Error of Regression	4047.824
Mean Abs. Dev. (MAD)	2848.891
Mean Abs. % Err. (MAPE)	1.00%
Durbin-Watson Statistic	2.02

PL Sales

Variable	Coefficient	StdErr	T-Stat	P-Value
PLVars.XOther	1.03	0.006	185.439	0.00%
PLVars.XCool	0.788	0.023	33.751	0.00%
mBin.Aug12	-7254.925	3164.635	-2.292	2.36%
mBin.Jul14	-9048.608	3103.511	-2.916	0.42%
mBin.Jun16	-8107.395	3128.272	-2.592	1.07%
mBin.Jun18	-8992.955	3133.821	-2.87	0.49%
mBin.Feb20	-12461.053	3274.704	-3.805	0.02%
mBin.Mar21	11702.828	3154.345	3.71	0.03%
mBin.Yr17Plus	-4464.835	1246.668	-3.581	0.05%
mBin.Yr2020Plus	16670.702	1419.94	11.74	0.00%
COVID_Shift.LCI	336.822	3012.566	0.112	91.12%
DSM_10YrML.PL_Constant	-5.128	0.276	-18.599	0.00%
Model Statistics				
Iterations	1			
Adjusted Observations	132			
Deg. of Freedom for Error	120			
R-Squared	0.965			
Adjusted R-Squared	0.962			
AIC	16.14			
BIC	16.4021			
Model Sum of Squares	31,293,838,874			
Sum of Squared Errors	1,124,920,762			
Mean Squared Error	9374339.683			
Std. Error of Regression	3061.754			
Mean Abs. Dev. (MAD)	2213.306			
Mean Abs. % Err. (MAPE)	2.28%			
Durbin-Watson Statistic	1.62			

H1 Sales

Variable	Coefficient	StdErr	T-Stat	P-Value
HLVars.XOther	0.903	0.008	117.146	0.00%
HLVars.XCool	0.561	0.042	13.318	0.00%
mBin.Dec12	-21173.023	5223.151	-4.054	0.01%
mBin.Jan15	25636.931	5231.401	4.901	0.00%
mBin.Feb	5020.474	1828	2.746	0.70%
mBin.Mar	6982.98	1823.167	3.83	0.02%
mBin.Apr	3107.894	1749.677	1.776	7.83%
mBin.May	8048.586	1771.006	4.545	0.00%
mBin.Jun	2064.69	1746.669	1.182	23.96%
mBin.Mar19	-19712.162	5403.769	-3.648	0.04%
mBin.Jun19	-25557.508	5404.166	-4.729	0.00%
mBin.Feb21	-15943.406	5507.807	-2.895	0.45%
mBin.May21	-19731.765	5529.753	-3.568	0.05%
mBin.Yr2020Plus	-9346.419	1209.903	-7.725	0.00%
Model Statistics				
Iterations	1			
Adjusted Observations	132			
Deg. of Freedom for Error	118			
R-Squared	0.791			
Adjusted R-Squared	0.768			
AIC	17.1923			
BIC	17.4981			
Model Sum of Squares	11,824,220,039			
Sum of Squared Errors	3,126,011,107			
Mean Squared Error	26491619.55			
Std. Error of Regression	5147.001			
Mean Abs. Dev. (MAD)	3765.673			
Mean Abs. % Err. (MAPE)	3.39%			
Durbin-Watson Statistic	1.44			

H2 Sales

Variable	Coefficient	StdErr	T-Stat	P-Value
CONST	17378.085	204.522	84.969	0.00%
mCalWthr.CDD60	7.968	0.685	11.639	0.00%
mBin.Feb11	-10760.636	1362.307	-7.899	0.00%
mBin.Mar11	10006.314	1352.501	7.398	0.00%
mBin.Aug15	-12923.661	1354.648	-9.54	0.00%
mBin.Sep15	15932.889	1352.535	11.78	0.00%
mBin.Feb21	-2088.038	1362.677	-1.532	12.81%
mBin.Jan21	-2121.336	1365.355	-1.554	12.29%
COVID_Shift.LCI	-3723.244	1159.241	-3.212	0.17%
mBin.Yr19Plus	-1527.146	381.061	-4.008	0.01%
AR(1)	0.167	0.091	1.829	6.99%

Model Statistics	
Iterations	8
Adjusted Observations	131
Deg. of Freedom for Error	120
R-Squared	0.843
Adjusted R-Squared	0.83
AIC	14.4919
BIC	14.7334
Model Sum of Squares	1,169,089,007
Sum of Squared Errors	217,824,029
Mean Squared Error	1815200.241
Std. Error of Regression	1347.294
Mean Abs. Dev. (MAD)	1029.447
Mean Abs. % Err. (MAPE)	5.79%
Durbin-Watson Statistic	2.08

H3 Sales

Variable	Coefficient	StdErr	T-Stat	P-Value
CONST	21534.047	2263.945	9.512	0.00%
mCalWthr.CDD60	6.362	1.998	3.185	0.18%
mBin.May11Plus	6633.034	2365.576	2.804	0.58%
mBin.YrPlus16	-7524.763	806.722	-9.328	0.00%

Model Statistics	
Iterations	1
Adjusted Observations	132
Deg. of Freedom for Error	128
R-Squared	0.437
Adjusted R-Squared	0.423
AIC	16.8658
BIC	16.9531
Model Sum of Squares	2,033,887,909
Sum of Squared Errors	2,624,009,711
Mean Squared Error	20500075.87
Std. Error of Regression	4527.701
Mean Abs. Dev. (MAD)	2278.675
Mean Abs. % Err. (MAPE)	258.51%
Durbin-Watson Statistic	2.90

Large C&I APL Sales

Variable	Coefficient	StdErr	T-Stat	P-Value
mBin.Jan	568.461	12.278	46.297	0.00%
mBin.Feb	506.174	11.727	43.165	0.00%
mBin.Mar	490.251	11.496	42.645	0.00%
mBin.Apr	402.978	11.39	35.381	0.00%
mBin.May	374.361	11.336	33.023	0.00%
mBin.Jun	339.089	11.308	29.987	0.00%
mBin.Jul	358.641	11.293	31.759	0.00%
mBin.Aug	389.039	11.284	34.476	0.00%
mBin.Sep	420.839	11.28	37.31	0.00%
mBin.Oct	494.343	11.277	43.837	0.00%
mBin.Nov	532.841	11.275	47.257	0.00%
mBin.Dec	570.654	11.275	50.614	0.00%
mBin.Yr19Plus	-62.301	11.463	-5.435	0.00%
AR(1)	0.592	0.089	6.642	0.00%

Model Statistics	
Iterations	9
Adjusted Observations	95
Deg. of Freedom for Error	81
R-Squared	0.939
Adjusted R-Squared	0.93
AIC	6.48
BIC	6.86
Model Sum of Squares	714,142
Sum of Squared Errors	46,068
Mean Squared Error	568.74
Std. Error of Regression	23.85
Mean Abs. Dev. (MAD)	14.91
Mean Abs. % Err. (MAPE)	3.46%
Durbin-Watson Statistic	1.91

Street Lighting Sales

Variable	Coefficient	StdErr	T-Stat	P-Value
Simple	1.339	0.139	9.621	0
Seasonal	0.436	0.298	1.462	0.151
Model Statistics				
Iterations	29			
Adjusted Observations	47			
Deg. of Freedom for Error	45			
R-Squared	0.964			
Adjusted R-Squared	0.964			
AIC	10.8			
BIC	10.9			
Model Sum of Squares	58,077,824			
Sum of Squared Errors	2,139,302			
Mean Squared Error	47540			
Std. Error of Regression	218			
Mean Abs. Dev. (MAD)	129			
Mean Abs. % Err. (MAPE)	3.90%			
Durbin-Watson Statistic	2.21			

Peaks

Variable	Coefficient	StdErr	T-Stat	P-Value
mCPkEndUses.BaseVar	1575.965	37.257	42.3	0.00%
mPkWthr.HeatVar	921.328	49.627	18.565	0.00%
mPkWthr.CoolVar	915.469	64.371	14.222	0.00%
mBin.Apr	177.019	34.135	5.186	0.00%
mBin.May	146.482	58.616	2.499	1.40%
mBin.Jun	350.015	64.651	5.414	0.00%
mBin.Jul	430.246	68.253	6.304	0.00%
mBin.Aug	407.103	66.412	6.13	0.00%
mBin.Sep	332.662	65.071	5.112	0.00%
mBin.Oct	102.327	46.113	2.219	2.86%
mBin.Nov	-117.118	32.97	-3.552	0.06%
mBin.Dec	-133.296	30.31	-4.398	0.00%
mBin.May14	227.742	84.962	2.681	0.85%
mBin.Dec18	247.578	84.504	2.93	0.42%
mBin.Nov20	213.69	83.779	2.551	1.22%

Model Statistics	
Iterations	1
Adjusted Observations	120
Deg. of Freedom for Error	105
R-Squared	0.947
Adjusted R-Squared	0.94
AIC	8.863
BIC	9.211
Model Sum of Squares	11,860,358
Sum of Squared Errors	660,103
Mean Squared Error	6286.7
Std. Error of Regression	79.29
Mean Abs. Dev. (MAD)	56.64
Mean Abs. % Err. (MAPE)	2.45%
Durbin-Watson Statistic	1.89

6 Appendix B: Residential SAE Modeling Framework

The traditional approach to forecasting monthly sales for a customer class is to develop an econometric model that relates monthly sales to weather, seasonal variables, and economic conditions. From a forecasting perspective, econometric models are well suited to identify historical trends and to project these trends into the future. In contrast, the strength of the end-use modeling approach is the ability to identify the end-use factors that drive energy use. By incorporating end-use structure into an econometric model, the statistically adjusted end-use (SAE) modeling framework exploits the strengths of both approaches.

There are several advantages to this approach.

- The equipment efficiency and saturation trends, dwelling square footage, and thermal shell integrity changes embodied in the long-run end-use forecasts are introduced explicitly into the short-term monthly sales forecast. This provides a strong bridge between the two forecasts.
- By explicitly introducing trends in equipment saturations, equipment efficiency, dwelling square footage, and thermal integrity levels, it is easier to explain changes in usage levels and changes in weather-sensitivity over time.
- Data for short-term models are often not sufficiently robust to support estimation of a full set of price, economic, and demographic effects. By bundling these factors with equipment-oriented drivers, a rich set of elasticities can be incorporated into the final model.

This section describes the SAE approach, the associated supporting SAE spreadsheets, and the *MetrixND* project files that are used in the implementation. The source for the SAE spreadsheets is the 2021 Annual Energy Outlook (AEO) database provided by the Energy Information Administration (EIA).

6.2 Residential Statistically Adjusted End-Use Modeling Framework

The statistically adjusted end-use modeling framework begins by defining energy use ($USE_{y,m}$) in year (y) and month (m) as the sum of energy used by heating equipment ($Heat_{y,m}$), cooling equipment ($Cool_{y,m}$), and other equipment ($Other_{y,m}$). Formally,

$$USE_{y,m} = Heat_{y,m} + Cool_{y,m} + Other_{y,m} \quad (1)$$

Although monthly sales are measured for individual customers, the end-use components are not. Substituting estimates for the end-use elements gives the following econometric equation.

$$USE_m = a + b_1 \times XHeat_m + b_2 \times XCool_m + b_3 \times XOther_m + \varepsilon_m \quad (2)$$

$XHeat_m$, $XCool_m$, and $XOther_m$ are explanatory variables constructed from end-use information, dwelling data, weather data, and market data. As will be shown below, the equations used to construct these X-variables are simplified end-use models, and the X-variables are the estimated usage levels for each of the major end uses based on these models. The estimated model can then be thought of as a statistically adjusted end-use model, where the estimated slopes are the adjustment factors.

6.2.1 Constructing $XHeat$

As represented in the SAE spreadsheets, energy use by space heating systems depends on the following types of variables.

- Heating degree days
- Heating equipment saturation levels
- Heating equipment operating efficiencies
- Thermal integrity and footage of homes
- Average household size, household income, and energy prices

The heating variable is represented as the product of an annual equipment index and a monthly usage multiplier. That is,

$$XHeat_{y,m} = HeatIndex_{y,m} \times HeatUse_{y,m} \quad (3)$$

Where:

- $XHeat_{y,m}$ is estimated heating energy use in year (y) and month (m)
- $HeatIndex_{y,m}$ is the monthly index of heating equipment
- $HeatUse_{y,m}$ is the monthly usage multiplier

The heating equipment index is defined as a weighted average across equipment types of equipment saturation levels normalized by operating efficiency levels. Given a set of fixed weights, the index will change over time with changes in equipment saturations (*Sat*), operating efficiencies (*Eff*), building structural index (*StructuralIndex*), and energy prices. Formally, the equipment index is defined as:

$$HeatIndex_y = StructuralIndex_y \times \sum_{Type} Weight^{Type} \times \frac{\left(\frac{Sat_y^{Type}}{Eff_y^{Type}} \right)}{\left(\frac{Sat_{base\ yr}^{Type}}{Eff_{base\ yr}^{Type}} \right)} \quad (4)$$

The *StructuralIndex* is constructed by combining the EIA’s building shell efficiency index trends with surface area estimates:

$$StructuralIndex_y = \frac{BuildingShellEfficiencyIndex_y \times SurfaceArea_y}{BuildingShellEfficiencyIndex_{base\ yr} \times SurfaceArea_{base\ yr}} \quad (5)$$

The *StructuralIndex* is defined on the *StructuralVars* tab of the SAE spreadsheets. Surface area is derived to account for roof and wall area of a standard dwelling based on the regional average square footage data obtained from EIA. The relationship between the square footage and surface area is constructed assuming an aspect ratio of 0.75 and an average of 25% two-story and 75% single-story. Given these assumptions, the approximate linear relationship for surface area is:

$$SurfaceArea_y = 892 + 1.44 \times Footage_y \quad (6)$$

For electric heating equipment, the SAE spreadsheets contain two equipment types: electric resistance furnaces/room units and electric space heating heat pumps. Examples of weights for these two equipment types for the U.S. are given in Table 6-1.

Table 6-1: Electric Space Heating Equipment Weights

Equipment Type	Weight (kWh)
Electric Resistance Furnace/Room units	767
Electric Space Heating Heat Pump	127

Data for the equipment saturation and efficiency trends are presented on the *Shares* and *Efficiencies* tabs of the SAE spreadsheets. The efficiency for electric space heating heat pumps is given in terms of Heating Seasonal Performance Factor [BTU/Wh], and the efficiencies for electric furnaces and room units are estimated as 100%, which is equivalent to 3.41 BTU/Wh.

Heating system usage levels are impacted on a monthly basis by several factors, including weather, household size, income levels, prices, and billing days. The estimates for space heating equipment usage levels are computed as follows:

$$HeatUse_{y,m} = \left(\frac{HDD_{y,m}}{HDD_{base\ yr}} \right) \times \left(\frac{HHSize_y}{HHSize_{base\ yr,m}} \right)^{0.25} \times \left(\frac{Income_y}{Income_{base\ yr,m}} \right)^{0.15} \times \left(\frac{Elec\ Price_{y,m}}{Elec\ Price_{base\ yr,m}} \right)^{-0.1} \quad (7)$$

Where:

- *HDD* is the number of heating degree days in year (*y*) and month (*m*).
- *HHSize* is average household size in a year (*y*)
- *Income* is average real income per household in year (*y*)
- *ElecPrice* is the average real price of electricity in month (*m*) and year (*y*)

By construction, the *HeatUse_{y,m}* variable has an annual sum that is close to 1.0 in the base year. The first term, which involves heating degree days, serve to allocate annual values to months of the year. The remaining terms average to 1.0 in the base year. In other years, the values will reflect changes in the economic drivers, as transformed through the end-use elasticity parameters. The price impacts captured by the Usage equation represent short-term price response.

6.2.2 Constructing XCool

The explanatory variable for cooling loads is constructed in a similar manner. The amount of energy used by cooling systems depends on the following types of variables.

- Cooling degree days
- Cooling equipment saturation levels
- Cooling equipment operating efficiencies
- Thermal integrity and footage of homes
- Average household size, household income, and energy prices

The cooling variable is represented as the product of an equipment-based index and monthly usage multiplier. That is,

$$XCool_{y,m} = CoolIndex_y \times CoolUse_{y,m} \quad (8)$$

Where

- $XCool_{y,m}$ is estimated cooling energy use in year (y) and month (m)
- $CoolIndex_y$ is an index of cooling equipment
- $CoolUse_{y,m}$ is the monthly usage multiplier

As with heating, the cooling equipment index is defined as a weighted average across equipment types of equipment saturation levels normalized by operating efficiency levels. Formally, the cooling equipment index is defined as:

$$CoolIndex_y = StructuralIndex_y \times \sum_{Type} Weight^{Type} \times \frac{\left(\frac{Sat_y^{Type}}{Eff_y^{Type}} \right)}{\left(\frac{Sat_{base\ yr}^{Type}}{Eff_{base\ yr}^{Type}} \right)} \quad (9)$$

For cooling equipment, the SAE spreadsheets contain three equipment types: central air conditioning, space cooling heat pump, and room air conditioning. Examples of weights for these three equipment types for the U.S. are given in Table 6-2.

Table 6-2: Space Cooling Equipment Weights

Equipment Type	Weight (kWh)
Central Air Conditioning	1,219
Space Cooling Heat Pump	240
Room Air Conditioning	177

The equipment saturation and efficiency trends data are presented on the *Shares* and *Efficiencies* tabs of the SAE spreadsheets. The efficiency for space cooling heat pumps and central air conditioning (A/C) units are given in terms of Seasonal Energy Efficiency Ratio [BTU/Wh], and room A/C units efficiencies are given in terms of Energy Efficiency Ratio [BTU/Wh].

Cooling system usage levels are impacted on a monthly basis by several factors, including weather, household size, income levels, and prices. The estimates of cooling equipment usage levels are computed as follows:

$$CoolUse_{y,m} = \left(\frac{CDD_{y,m}}{CDD_{base\ yr}} \right) \times \left(\frac{HHSize_y}{HHSize_{base\ yr,m}} \right)^{0.25} \times \left(\frac{Income_y}{Income_{base\ yr,m}} \right)^{0.15} \times \left(\frac{Elec\ Price_{y,m}}{Elec\ Price_{base\ yr,m}} \right)^{-0.1} \quad (10)$$

Where:

- *CDD* is the number of cooling degree days in year (*y*) and month (*m*).
- *HHSize* is average household size in a year (*y*)
- *Income* is average real income per household in year (*y*)
- *ElecPrice* is the average real price of electricity in month (*m*) and year (*y*)

By construction, the *CoolUse* variable has an annual sum that is close to 1.0 in the base year. The first term, which involves cooling degree days, serves to allocate annual values to months of the year. The remaining terms average to 1.0 in the base year. In other years, the values will change to reflect changes in the economic driver changes.

6.2.3 Constructing *XOther*

Monthly estimates of non-weather sensitive sales can be derived in a similar fashion to space heating and cooling. Based on end-use concepts, other sales are driven by:

- Appliance and equipment saturation levels
- Appliance efficiency levels
- Average number of days in the billing cycle for each month
- Average household size, real income, and real prices

The explanatory variable for other uses is defined as follows:

$$XOther_{y,m} = OtherEqIndex_{y,m} \times OtherUse_{y,m} \tag{11}$$

The first term on the right-hand side of this expression (*OtherEqIndex_y*) embodies information about appliance saturation and efficiency levels and monthly usage multipliers. The second term (*OtherUse*) captures the impact of changes in prices, income, household size, and number of billing-days on appliance utilization.

End-use indices are constructed in the SAE models. A separate end-use index is constructed for each end-use equipment type using the following function form.

$$ApplianceIndex_{y,m} = Weight^{Type} \times \frac{\left(\frac{Sat_y^{Type}}{UEC_y^{Type}} \right)}{\left(\frac{Sat_{base\ yr}^{Type}}{UEC_{base\ yr}^{Type}} \right)} \times MoMult_m^{Type} \times \quad (12)$$

Where:

- *Weight* is the weight for each appliance type
- *Sat* represents the fraction of households, who own an appliance type
- *MoMult_m* is a monthly multiplier for the appliance type in month (*m*)
- *Eff* is the average operating efficiency the appliance
- *UEC* is the unit energy consumption for appliances

This index combines information about trends in saturation levels and efficiency levels for the main appliance categories with monthly multipliers for lighting, water heating, and refrigeration.

The appliance saturation and efficiency trends data are presented on the *Shares* and *Efficiencies* tabs of the SAE spreadsheets.

Further monthly variation is introduced by multiplying by usage factors that cut across all end uses, constructed as follows:

$$ApplianceUse_{y,m} = \left(\frac{BDays_{y,m}}{30.5} \right) \times \left(\frac{HHSize_y}{HHSize_{base\ yr,m}} \right)^{0.26} \times \left(\frac{Income_y}{Income_{base\ yr,m}} \right)^{0.15} \times \left(\frac{Elec\ Price_{y,m}}{Elec\ Price_{base\ yr,m}} \right)^{-0.1} \quad (13)$$

The index for other uses is derived then by summing across the appliances:

$$OtherEqIndex_{y,m} = \sum_k ApplianceIndex_{y,m} \times ApplianceUse_{y,m} \quad (14)$$

7 Appendix C: Commercial SAE Modeling Framework

The traditional approach to forecasting monthly sales for a customer class is to develop an econometric model that relates monthly sales to weather, seasonal variables, and economic conditions. From a forecasting perspective, the strength of econometric models is that they are well suited to identifying historical trends and to projecting these trends into the future. In contrast, the strength of the end-use modeling approach is the ability to identify the end-use factors that are driving energy use. By incorporating end-use structure into an econometric model, the statistically adjusted end-use (SAE) modeling framework exploits the strengths of both approaches.

There are several advantages to this approach.

- The equipment efficiency trends and saturation changes embodied in the long-run end-use forecasts are introduced explicitly into the short-term monthly sales forecast. This provides a strong bridge between the two forecasts.
- By explicitly introducing trends in equipment saturations and equipment efficiency levels, it is easier to explain changes in usage levels and changes in weather-sensitivity over time.
- Data for short-term models are often not sufficiently robust to support estimation of a full set of price, economic, and demographic effects. By bundling these factors with equipment-oriented drivers, a rich set of elasticities can be built into the final model.

This document describes this approach, the associated supporting Commercial SAE spreadsheets, and *MetrixND* project files that are used in the implementation. The source for the commercial SAE spreadsheets is the 2021 Annual Energy Outlook (AEO) database provided by the Energy Information Administration (EIA).

7.2 Commercial Statistically Adjusted End-Use Model Framework

The commercial statistically adjusted end-use model framework begins by defining energy use ($USE_{y,m}$) in year (y) and month (m) as the sum of energy used by heating equipment ($Heat_{y,m}$), cooling equipment ($Cool_{y,m}$) and other equipment ($Other_{y,m}$). Formally,

$$USE_{y,m} = Heat_{y,m} + Cool_{y,m} + Other_{y,m} \quad (1)$$

Although monthly sales are measured for individual customers, the end-use components are not. Substituting estimates for the end-use elements gives the following econometric equation.

$$USE_m = a + b_1 \times XHeat_m + b_2 \times XCool_m + b_3 \times XOther_m + \varepsilon_m \quad (2)$$

Here, $XHeat_m$, $XCool_m$, and $XOther_m$ are explanatory variables constructed from end-use information, weather data, and market data. As will be shown below, the equations used to construct these X-variables are simplified end-use models, and the X-variables are the estimated usage levels for each of the major end uses based on these models. The estimated model can then be thought of as a statistically adjusted end-use model, where the estimated slopes are the adjustment factors.

7.2.1 Constructing XHeat

As represented in the Commercial SAE spreadsheets, energy use by space heating systems depends on the following types of variables.

- Heating degree days,
- Heating equipment saturation levels,
- Heating equipment operating efficiencies,
- Commercial output, employment, population, and energy price.

The heating variable is represented as the product of an annual equipment index and a monthly usage multiplier. That is,

$$XHeat_{y,m} = HeatIndex_y \times HeatUse_{y,m} \quad (3)$$

Where:

- $XHeat_{y,m}$ is estimated heating energy use in year (y) and month (m),
- $HeatIndex_y$ is the annual index of heating equipment, and
- $HeatUse_{y,m}$ is the monthly usage multiplier.

The heating equipment index is composed of electric space heating equipment saturation levels normalized by operating efficiency levels. The index will change over time with changes in heating equipment saturations (*HeatShare*) and operating efficiencies (*Eff*). Formally, the equipment index is defined as:

$$HeatIndex_y = HeatSales_{base\ yr} \times \frac{\left(\frac{HeatShare_y}{Eff_y}\right)}{\left(\frac{HeatShare_{base\ yr}}{Eff_{base\ yr}}\right)} \quad (4)$$

The ratio on the right is equal to 1.0 in the base year. In other years, it will be greater than one if equipment saturation levels are above their base year level. This will be counteracted by higher efficiency levels, which will drive the index downward. Base year space heating sales are defined as follows.

$$HeatSales_{base\ yr} = \left(\frac{kWh}{Sqft}\right)_{Heating} \times \left(\frac{CommercialSales_{base\ yr}}{\sum_e kWh/Sqft_e}\right) \quad (5)$$

Here, base-year sales for space heating is the product of the average space heating intensity value and the ratio of total commercial sales in the base year over the sum of the end-use intensity values. In the Commercial SAE Spreadsheets, the space heating sales value is defined on the *BaseYrInput* tab. The resulting *HeatIndex_y* value in the base year will be equal to the estimated annual heating sales in that year. Variations from this value in other years will be proportional to saturation and efficiency variations around their base values.

Heating system usage levels are impacted on a monthly basis by several factors, including weather, commercial level economic activity, prices and billing days. Using the COMMEND default elasticity parameters, the estimates for space heating equipment usage levels are computed as follows:

$$HeatUse_{y,m} = \left(\frac{HDD_{y,m}}{HDD_{base\ yr}}\right) \times \left(\frac{EconVar_{y,m}}{EconVar_{base\ yr,m}}\right) \times \left(\frac{Price_{y,m}}{Price_{base\ yr,m}}\right)^{-0.10} \quad (6)$$

Where:

- *HDD* is the number of heating degree days in month (m) and year (y).
- *EconVar* is the weighted commercial economic variable that blends Output, Employment, and Population in month (m), and year (y).
- *Price* is the average real price of electricity in month (m) and year (y).

By construction, the *HeatUse_{y,m}* variable has an annual sum that is close to one in the base year. The first term, which involves heating degree days, serves to allocate annual values to months of the year. The remaining terms average to one in the base year. In other years, the values will reflect changes in commercial output and prices, as transformed through the end-use elasticity parameters. For example, if the real price of electricity goes up 10% relative to the base year value, the price term will contribute a multiplier of about .98 (computed as 1.10 to the -0.18 power).

7.2.2 Constructing XCool

The explanatory variable for cooling loads is constructed in a similar manner. The amount of energy used by cooling systems depends on the following types of variables.

- Cooling degree days,
- Cooling equipment saturation levels,
- Cooling equipment operating efficiencies,
- Commercial output, employment, population, and energy price.

The cooling variable is represented as the product of an equipment-based index and monthly usage multiplier. That is,

$$XCool_{y,m} = CoolIndex_y \times CoolUse_{y,m} \quad (7)$$

Where:

- $XCool_{y,m}$ is estimated cooling energy use in year (y) and month (m),
- $CoolIndex_y$ is an index of cooling equipment, and
- $CoolUse_{y,m}$ is the monthly usage multiplier.

As with heating, the cooling equipment index depends on equipment saturation levels ($CoolShare$) normalized by operating efficiency levels (Eff). Formally, the cooling equipment index is defined as:

$$CoolIndex_y = CoolSales_{base\ yr} \times \frac{\left(\frac{CoolShare_y}{Eff_y}\right)}{\left(\frac{CoolShare_{base\ yr}}{Eff_{base\ yr}}\right)} \quad (8)$$

Data values in 2004 are used as a base year for normalizing the index, and the ratio on the right is equal to 1.0 in the base year. In other years, it will be greater than one if equipment saturation levels are above their base year level. This will be counteracted by higher efficiency levels, which will drive the index downward. Estimates of base year cooling sales are defined as follows.

$$CoolSales_{base\ yr} = \left(\frac{kWh}{Sqft}\right)_{Cooling} \times \left(\frac{CommercialSales_{base\ yr}}{\sum_e kWh/Sqft_e}\right) \quad (9)$$

Here, base-year sales for space cooling is the product of the average space cooling intensity value and the ratio of total commercial sales in the base year over the sum of the end-use

intensity values. In the Commercial SAE Spreadsheets, the space cooling sales value is defined on the *BaseYrInput* tab. The resulting *CoolIndex* value in the base year will be equal to the estimated annual cooling sales in that year. Variations from this value in other years will be proportional to saturation and efficiency variations around their base values.

Cooling system usage levels are impacted on a monthly basis by several factors, including weather, economic activity levels and prices. Using the COMMEND default parameters, the estimates of cooling equipment usage levels are computed as follows:

$$CoolUse_{y,m} = \left(\frac{CDD_{y,m}}{CDD_{base\ yr}} \right) \times \left(\frac{EconVar_{y,m}}{EconVar_{base\ yr,m}} \right) \times \left(\frac{Price_{y,m}}{Price_{base\ yr,m}} \right)^{-0.15} \quad (10)$$

Where:

- *HDD* is the number of heating degree days in month (m) and year (y).
- *EconVar* is the weighted commercial economic variable that blends Output, Employment, and Population in month (m), and year (y).
- *Price* is the average real price of electricity in month (m) and year (y).

By construction, the *CoolUse* variable has an annual sum that is close to one in the base year. The first term, which involves cooling degree days, serves to allocate annual values to months of the year. The remaining terms average to one in the base year. In other years, the values will change to reflect changes in commercial output and prices.

7.2.3 Constructing XOther

Monthly estimates of non-weather sensitive sales can be derived in a similar fashion to space heating and cooling. Based on end-use concepts, other sales are driven by:

- Equipment saturation levels,
- Equipment efficiency levels,
- Average number of days in the billing cycle for each month, and
- Real commercial output and real prices.

The explanatory variable for other uses is defined as follows:

$$XOther_{y,m} = OtherIndex_{y,m} \times OtherUse_{y,m} \quad (11)$$

The second term on the right-hand side of this expression embodies information about equipment saturation levels and efficiency levels. The equipment index for other uses is defined as follows:

$$OtherIndex_{y,m} = \sum_{Type} Weight_{base\ yr}^{Type} \times \left(\frac{Share_y^{Type} / Eff_y^{Type}}{Share_{base\ yr}^{Type} / Eff_{base\ yr}^{Type}} \right) \quad (12)$$

Where:

- *Weight* is the weight for each equipment type,
- *Share* represents the fraction of floor stock with an equipment type, and
- *Eff* is the average operating efficiency.

This index combines information about trends in saturation levels and efficiency levels for the main equipment categories. The weights are defined as follows.

$$Weight_{base\ yr}^{Type} = \left(\frac{kWh}{Sqft} \right)_{Type} \times \left(\frac{CommercialSales_{04}}{\sum_e kWh/Sqft_e} \right) \quad (13)$$

Further monthly variation is introduced by multiplying by usage factors that cut across all end-uses, constructed as follows:

$$OtherUse_{y,m} = \left(\frac{BDays_{y,m}}{30.5} \right) \times \left(\frac{EconVar_{y,m}}{EconVar_{base\ yr,m}} \right) \times \left(\frac{Price_{y,m}}{Price_{base\ yr,m}} \right)^{-0.15} \quad (14)$$

The logo for AES Indiana features the lowercase letters 'aes' in a stylized, rounded font. The 'a' is blue, the 'e' is purple, and the 's' is green. To the right of 'aes' is the word 'Indiana' in a black, sans-serif font. Below 'Indiana' is the text '2022 IRP' in a bold, black, sans-serif font.

aes Indiana
2022 IRP

Attachment 5-4

(AES Indiana's 2022 DER and Other Electrification MPS)

AES INDIANA



2022 Demand Side Management Market Potential Study

November 18,
2022

FINAL REPORT

AES INDIANA



2022
Market Potential Study
Distributed Energy
Resources and
Electrification

September 2,
2022

FINAL REPORT

VOLUME I 2022 MPS – DER and Electrification Report

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Chapter 1 Introduction

1 Introduction

1.1 BACKGROUND & STUDY SCOPE

This distributed energy resource (“DER”) and electrification Market Potential Study was conducted to as part of a broader effort that included an energy efficiency and demand response potential study in support of Integrated Resource Plan (IRP) and DSM planning for AES Indiana. The study included an analysis of various DER options including solar photovoltaics and combined heat and power, a study of transportation electrification, including both commercial sector and residential sector vehicles, and a building electrification analysis of the residential, commercial, and industrial sectors.

1.2 STUDY LIMITATIONS

This DER and Electrification Market Potential Study was developed using the best currently available data to inform the estimates of future potential. The long-term projections of these technologies remain highly uncertain as the cost-effectiveness of DER could change in future years and become a more attractive option, while electrification projections continue to evolve based on various factors such as policy decisions, manufacturer goals and consumer preferences.

1.3 ORGANIZATION OF REPORT

The remainder of this report is organized in seven sections as follows:

Section 2 Distributed Energy Resources provides the approach to analyzing DER potential and the technical, economic and market potential for solar photovoltaics and combined heat and power.

Section 3 Transportation Electrification provides the results of the analysis for commercial and residential transportation electrification.

Section 4 Building Electrification provides approach and results of the building electrification analysis for the residential, commercial, and industrial sectors.

Chapter 2 Distributed Energy Resource

2 Distributed Energy Resources

The GDS Team considered distributed energy resources (DER) as sources of behind-the-meter customer-sited generation. The DER potential study followed the same method as the energy efficiency potential study in that the DER analysis reviewed the opportunity for technical, economic, and achievable potential. We used the same forecast data as used in the energy efficiency study to assess DER potential. The analysis limited resources for this potential study to technologies that are behind-the-meter and owned by the customer and did not consider market potential for supply-side resources. Specifically, this market potential assessment for DER focused on solar photovoltaic (PV) and combined heat and power (CHP) systems for the period 2023 to 2042.

2.1 APPROACH

The following section discusses the methods used to conduct the DER potential analysis. We detail approaches used to assess technical, economic, and achievable potential for solar PV and CHP.

2.1.1 Distributed Energy Resources Potential

2.1.1.1 Solar Photovoltaic Systems

Photovoltaic systems utilize solar panels, a packaged collection of photovoltaic cells, to convert sunlight into electricity. A system is constructed with multiple solar panels, a DC/AC inverter(s), a racking system to hold the panels, and electrical system interconnections. These systems are often roof-mounted and face south-west, south, and/or, south-east.

The study analyzed the potential associated with roof-mounted systems installed on residential and non-residential sector buildings. For the non-residential sector, the analysis also estimated potential for ground mounted (or covered parking) systems for a few specific business types. The analysis included battery storage as an additional configuration with each solar PV system type; however, due to the uncertainty associated with battery dispatch schedules, potential battery generation is excluded from this analysis. As noted above, this study did not explore the market potential associated utility-scale solar PV installations.

The approach to estimating technical potential required calculating the total square footage of suitable rooftop area within the AES-IN's territory and calculating solar PV system generation based on building and regional characteristics. Technical potential is computed using the following equation.

$$PV \text{ Technical Potential} = \Sigma(\text{Suitable Rooftop Square Footage} \times PV \text{ System Generation per Sq. Ft.})$$

The two key parameters in prior equation were estimated based on multiple data sources relevant to the AES-IN territory. Methods for defining these parameters are discussed below.

The GDS Team estimated total rooftop square footage using the forecast disaggregation analysis to characterize the residential and non-residential building stocks. The building stocks were characterized based on relevant parameters such as number of facilities, average number of floors, average premise consumption, and premise EUI. The GDS Team used these parameters to estimate the total rooftop square footage.

To estimate the fraction of the total roof area that is suitable for rooftop solar PV, the GDS Team relied on research completed by the National Renewable Energy Laboratory (NREL). NREL has developed estimates of the portion of total rooftops across the country that are suitable for solar PV based on analysis of LIDAR data. NREL criteria for suitable roof area include:

- **Contiguous rooftop area size:** Rooftops with fewer than 10 square meters of contiguous roof area excluded.

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- **Rooftop orientation (tilt and azimuth):** Northeast through northwest orientation and roof pitches greater than 60 degrees excluded.
- **Shading:** Roof areas that had a minimum solar exposure of less than 80% relative to an unshaded roof were excluded.

Based on NREL’s data, the GDS Team was able to apply unique suitability factors to estimate the total square footage of suitable rooftop for residential and non-residential buildings across AES-IN’s territory.

The second key parameter – PV system generation – was estimated by developing standardized solar PV system configurations. These included system sizes for residential premises ranging from 3 to 20 kW (DC) and 10 to 2,000 kW (DC) for non-residential premises. Additionally, the GDS Team selected battery system sizes for each solar PV system size to dispatch energy for 2-4 hours.

The Team relied on NREL’s PVWatts¹ (Version 6.1.4) and System Advisor Model (SAM)² tools to estimate system generation for both residential and non-residential sited systems. These tools model PV power density based on site specific data from NREL’s LIDAR-based NSRDB to estimate total solar irradiance in conjunction with PV system specifications. The PV system simulations were generated based on Indianapolis, IN characteristics. The GDS Team based assumptions for PV system azimuth on rooftop orientation data sourced from Google’s Project Sunroof, also based on Indianapolis, IN. The analysis assumptions are summarized in Table 2-1.

TABLE 2-1: KEY ASSUMPTIONS IN SOLAR PV ANALYSIS

Parameter	Assumptions
Residential System Sizes (Nominal DC Capacity)	3 kW, 5 kW, 7.5 kW, 10 kW, 15 kW, 20 kW
Non-Residential System Sizes (Nominal DC Capacity)	10 kW, 15 kW, 20 kW, 25 kW, 50 kW, 100 kW, 250 kW, 500 kW, 1,000 kW, 2,000 kW
System losses	14.1%
Tilt	By region
Azimuth:	By region
DC to AC size ratio	1.2
Inverter efficiency	96% (micro-inverter)
Battery Round-Trip Efficiency	85%

Based on the simulations and resulting capacity factors for residential and non-residential buildings for the Indianapolis, we applied the state-specific capacity factor to the system size to estimate annual electricity generation. These system generation values were used to calculate total energy generation per square foot of rooftop and extrapolated based on the total suitable rooftop square footage to estimate overall all technical potential. As a final step, the GDS Team removed from the technical potential for any generation occurring from existing systems. Data on existing systems was provided directly by AES-IN.

2.1.1.2 Combined Heat and Power

CHP systems generate electric power and useful thermal energy in a single integrated system. Heat that is normally wasted in conventional power generation is recovered as useful thermal energy. Due to the

1 PVWatts estimates solar PV energy production and costs. Developed by the National Renewable Energy Laboratory. (NREL) <http://pvwatts.nrel.gov/>

2 SAM estimates hourly solar PV energy production and costs with more detailed inputs and outputs than PVwatts. Developed by the National Renewable Energy Laboratory. (NREL) [http:// https://sam.nrel.gov/](http://https://sam.nrel.gov/)

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integration of both power and thermal generation, CHP systems are more efficient than separate sources for electric power generation and thermal energy production.

In most CHP applications, a heat engine creates shaft power that drives an electrical generator (fuel cells can produce electrical power directly from electrochemical reactions). The waste heat from the engine is then recovered to provide steam or hot water to meet on-site needs. By combining the thermal and electrical energy generation in one process, the total efficiency of a CHP application far exceeds that of a separate plant and boiler system. Overall, the efficiency of CHP technologies can reach 80% or more, while simple-cycle electricity generation reaches only 30% and combined cycle generation typically achieves 50%. When considering both thermal and electric energy generation, CHP requires 40% less energy input to achieve the same energy output as a separate plant and boiler system. Figure 2-1 illustrates this point.

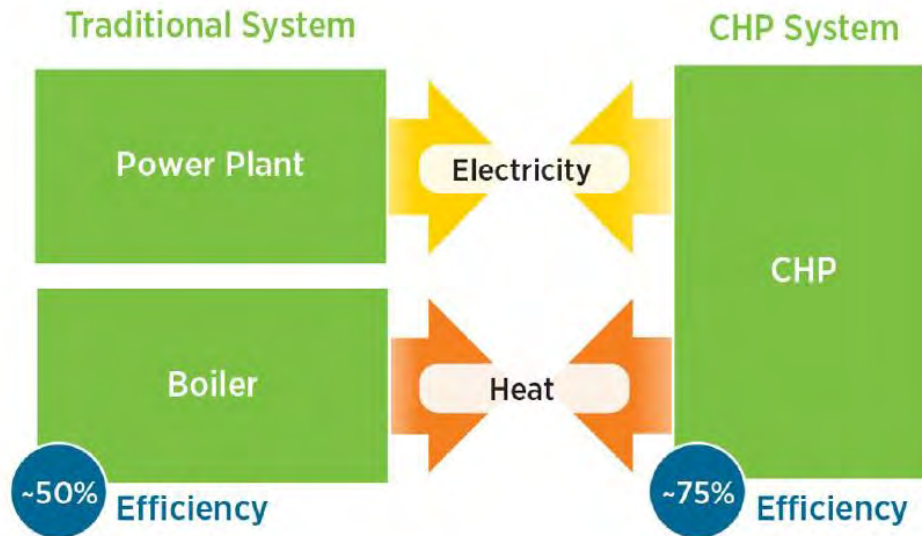


Figure courtesy of US DOE Energy Efficiency & Renewable Energy

FIGURE 2-1: CHP ENERGY FLOW DIAGRAM

Common technologies used in CHP applications and explored in this study include:

- Steam turbines
- Gas turbines
- Micro turbines
- Fuel Cells
- Reciprocating engines

Applications with steady demand for electricity and thermal energy are potentially good economic targets for CHP deployment. Industrial applications, particularly in industries with continuous processing and high steam requirements, are very economic and represent a large share of existing CHP capacity today. Commercial applications such as hospitals, nursing homes, laundries, and hotels with large hot water needs are well suited for CHP. Institutional applications such as colleges and schools, prisons, and residential and recreational facilities are also excellent prospects for CHP.

Selecting a specific CHP technology depends on several factors, which include but are not limited to power requirements, the duty cycle, space constraints, thermal energy needs, emission regulations, fuel availability, utility prices, and interconnection issues. Table 2-2 summarizes the CHP technologies evaluated in this study and their assumed operating parameters.

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TABLE 2-2: CHP TECHNOLOGY COMPARISON³

Parameter	Reciprocating Engine	Gas Turbine	Steam Turbine	Micro-Turbine	Fuel Cell
Size (kW)	50-5,000	500-50,000	10-100,000	30-250	200-2,000
Electric Efficiency	28-39%	25-40% (simple) 40-60% (combined)	5-15%	25-28%	36-42%
Overall Efficiency	73-79%	64-72%	~80%	67-72%	62%-67%
Fuels	Natural gas, biogas, propane, liquid fuels	Natural gas, biogas, propane, distillate oil	All	Natural gas, biogas, propane, distillate oil	Hydrogen, natural gas, propane
NO _x Emissions (lb/MWh)	0.15-2.17	0.55-0.68	Function of boiler emissions	0.14-0.17	0.01-0.04
Uses for Heat Recovery	Hot water, low pressure steam, district heating	Direct heat, hot water-, low- or high-pressure steam, district heating	Low- or high-pressure steam, district heating	Direct heat, hot water, low pressure steam	Hot water-, low- or high-pressure steam
Thermal Output (Btu/kWh)	3,000-6,100	3,200-5,000	n/a	4,800-6,300	1,500-3,000
Useable Temp (°F)	200-500	500-1,100	n/a	400-650	140-700

To estimate technical potential for CHP, the GDS Team first developed a screening process based on the DOE’s national technical potential study of CHP resources⁴ to identify probable CHP candidate premises. First, customers with less than 50,000 kWh annual consumption were removed from eligibility as a CHP candidate. Second, we considered customer loads to assess if and what CHP system type and size may be a potential match to a customer. To effectively utilize CHP, a facility must have coincident electric and thermal energy requirements for a large load factor of the year. A continuous process industry with nearly constant steam or hot water demand electric load is an excellent target, such as a chemicals manufacturer or a hospital. Facilities with intermittent electric and thermal loads are progressively less attractive as the number of hours of coincident load diminishes. We therefore screened for eligible customers based on the customer’s annual kWh usage and an approximate sized CHP system based on a thermal factor.

The team calculated and applied a thermal factor to potential candidate customer loads to reflect thermal load considerations in CHP sizing. In most cases, on-site thermal energy demand is smaller than electrical demand. Thus, CHP size is usually dictated by the thermal load to achieve proper efficiencies and adequate returns on investment. The Team used power to heat ratios⁵ for both the CHP technology as well as different market segments to calculate the thermal factor as shown in following equation.

³ Combined Heat and Power Market Assessment. ICF International for the California Energy Commission, April 2010.

⁴ U.S. Department of Energy. Combined Heat and Power (CHP) Technical Potential in the United States, March 2016.

⁵ Power to heat ratios were sourced from a combination of the following sources:

- U.S. Environmental Protection Agency Combined Heat and Power Partnership. Catalog of CHP Technologies, September 2017.
- U.S. Environmental Protection Agency Combined Heat and Power Partnership. Spark Spread Estimator Version 1.2
- U.S. Department of Energy. Combined Heat and Power (CHP) Technical Potential in the United States, March 2016.

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$$Thermal\ Factor = \frac{P/H\ (CHP\ System)}{P/H\ (Customer\ Segment)}$$

A thermal factor of one (1.0) would result in the CHP system capacity being equal to the electric demand of the facility. A thermal factor of less than one would indicate that the application is thermally limited, and the resulting CHP system size would be below the electric demand of the facility. A thermal factor greater than one indicates that a CHP system sized to the thermal load would produce more electricity than can be used on-site, resulting in excess power that could be exported to the grid. Following the method applied in the DOE national technical potential study, the thermal factor was multiplied by each customer’s annual consumption to estimate the appropriate CHP system size. The GDS Team screened and removed any CHP technology that did not fall within +/- 15% generation of the customer’s annual kWh consumption. A summary of the power to heat ratios by segment is listed in Table 2-3, as sourced from the DOE EPA CHP potential study.

TABLE 2-3: POWER TO HEAT RATIO BY SEGMENT

Industrial Segment	Heat to Power Ratio	Commercial Segment	Heat to Power Ratio
Utilities	1.29	Education	0.50
Smelting	0.26	Healthcare	0.75
Food Manufacturing	1.10	Institutions	0.94
Transportation Manufacturing	0.33	Grocery	0.62
Paper Manufacturing	2.37	Lodging	0.62
Plastics Manufacturing	0.31	Office	0.20
Misc. Manufacturing	1.34	Retail	0.84
Agriculture	0.25	Warehouse	0.68
Construction	0.25	Misc.	0.68
Metal Manufacturing	3.83		

After applying the screening method, we reviewed which CHP systems were eligible matches for given customer sites. In cases where multiple CHP technologies were viable for a single customer site, an applicability factor was assigned for each eligible CHP technology. After assigning applicability factors, the GDS Team summed the total CHP generation across the population. The GDS Team removed from the technical potential any generation occurring from existing systems. Data on existing systems was provided directly by AES-IN.

2.1.2 Economic Potential

Economic potential represents the DER generation possible given full adoption of all cost-effective DER measures. For the cost effectiveness analysis on solar PV and CHP, the GDS Team used a Total Resource Cost (TRC) hurdle of 1.0. To assess the TRC, the GDS Team relied on the same avoided energy and capacity costs used in the energy efficiency analysis. These avoided costs serve as the benefits while the costs are represented as the installation and O&M costs of the modeled solar PV and CHP measures.

2.1.2.1 Solar Photovoltaic

To estimate economic potential for solar PV, we gathered pertinent data on system costs along with calculated generation benefits to use in the benefit-cost analysis, which we conducted at the system measure

Chapter 2 Distributed Energy Resource

level. The GDS Team assessed system component costs based on data included in the National Renewable Energy Laboratory’s (NREL) Q1 2020 Benchmarking report as well as public data files from Tracking the Sun⁶ and compared these national cost parameters to AES-IN-specific values by using various market data provided by Energy Sage.⁷ This analysis produced an estimated installation cost per watt installed, which we applied to each system size to estimate total installed cost. Additionally, the GDS Team included O&M costs that scale with system size.⁸ Finally, we assumed the impact of the federal investment tax credit (ITC) to follow the existing schedule at the time of this report which equates to a 10% tax credit for commercial systems by 2024 and a 0% tax credit for residential systems by 2024.

In addition to modeling solar PV system costs, the GDS Team estimated cost impacts for solar PV systems coupled with battery storage based on analysis from NREL’s Q1 2020 Benchmarking report and Lazard’s Levelized Cost of Storage Analysis.⁹ The GDS Team estimated an average lithium-ion battery installation cost of \$1,093/kWh and \$721/kWh for the residential and non-residential sectors, respectively, inclusive of the ITC. Table 2-4 provides the average solar PV installation cost by sector.

TABLE 2-4: AVERAGE SOLAR PV INSTALLATION COST

Sector	System Cost (\$/ DC W) ¹
Residential	\$3.05
Non-Residential (<100 kW)	\$2.56
Non-Residential (>100 kW)	\$2.20
Non-Residential - Tracking (<100 kW)	\$3.95
Non-Residential - Tracking (>100 kW)	\$3.39

¹Costs reflect impact of federal investment tax credit; battery systems not reflected in cost.

2.1.2.2 Combined Heat and Power

To assess costs for the various CHP technologies analyzed in the potential study, the GDS Team relied on data sourced from the EPA Catalog of CHP Technologies.¹⁰ Costs were calculated for fuel cell, gas turbine, micro turbine, reciprocating engine, and steam turbine CHP configurations at various capacity sizes. These costs reflect the inclusion of the ITC based on the existing schedule at the time of this report which equates to a 10% tax credit for CHP through 2023.

Table 2-5 summarizes detailed CHP cost considerations and assumptions utilized in the cost-effectiveness screening. These costs reflect the inclusion of the ITC based on the existing schedule at the time of this report which equates to a 10% tax credit for CHP through 2023.

⁶ Feldman, D, et. al., U.S. Solar Photovoltaic System and Energy Storage Cost Benchmark: Q1 2020. NREL, January 2021.

⁷ <https://www.energysage.com/solar-panels/in/>; <https://www.energysage.com/solar-panels/mi/> (accessed March 2021).

⁸ Feldman, D, et. al., U.S. Solar Photovoltaic System and Energy Storage Cost Benchmark: Q1 2020. NREL, January 2021.

⁹ Ibid.

¹⁰ U.S. Environmental Protection Agency Combined Heat and Power Partnership. Catalog of CHP Technologies, September 2017.

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TABLE 2-5: DETAILED CHP COST CONSIDERATION SUMMARY

Technology Type	Size (kW)	Installed System Cost (\$/W)	O&M Costs (\$/kWh)	Technology Type	Size (kW)	Installed System Cost (\$/W)	O&M Costs (\$/kWh)
Fuel Cell	125	\$17.33	\$0.35	Reciprocating Engine	125	\$2.85	\$0.07
	250	\$12.42	\$0.31		250	\$2.81	\$0.07
	500	\$6.69	\$0.27		500	\$2.73	\$0.07
	750	\$6.10	\$0.27		750	\$2.64	\$0.07
	1000	\$5.50	\$0.26		1000	\$2.55	\$0.06
	1250	\$4.91	\$0.26		1250	\$2.47	\$0.06
	1500	\$4.32	\$0.26		1500	\$2.38	\$0.06
	2000	\$3.13	\$0.26		2000	\$2.21	\$0.06
Gas Turbine	750	\$3.84	\$0.09		2500	\$2.04	\$0.05
	1000	\$3.77	\$0.09		3000	\$1.86	\$0.05
	1250	\$3.69	\$0.09		3000	\$1.86	\$0.05
	1500	\$3.62	\$0.09		4000	\$1.74	\$0.05
	2000	\$3.48	\$0.09		4500	\$1.71	\$0.05
	2500	\$3.34	\$0.09		5000	\$1.68	\$0.04
	3000	\$3.20	\$0.09		Steam Turbine	500	\$4.95
	3500	\$3.06	\$0.09	750		\$4.95	\$0.18
	4000	\$2.92	\$0.09	1000		\$4.95	\$0.18
	4500	\$2.78	\$0.09	1250		\$4.95	\$0.18
5000	\$2.64	\$0.09	1500	\$4.95		\$0.18	
5500	\$2.50	\$0.09	2000	\$4.95		\$0.18	
6000	\$2.36	\$0.08	2500	\$4.95		\$0.18	
Micro Turbine	50	\$3.50	\$0.05	3000		\$4.95	\$0.18
	100	\$3.30	\$0.05	3500		\$4.95	\$0.18
	150	\$3.10	\$0.05	4000		\$4.95	\$0.18
	200	\$2.90	\$0.05	4500		\$4.95	\$0.18
				5000		\$4.95	\$0.18
				5500	\$4.95	\$0.18	
				6000	\$4.95	\$0.18	

2.1.3 Market Potential

Market potential is the amount of energy that can realistically be saved given likely future utility program intervention and various market barriers. The anticipated approach to assess achievable potential for the DER potential analysis was to follow the same logic and methods as used in the energy efficiency achievable potential analysis. However, as discussed in Section 2.2 below, market potential was not assessed as neither the solar PV nor CHP technologies passed a TRC screen of 1.0.

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2.2 DER POTENTIAL FINDINGS

This section of the report presents the Technical, Economic, Achievable (MAP and RAP) for CHP and solar PV.

2.2.1 Solar Photovoltaics

Table 2-6 summarizes the solar PV cumulative annual potential estimates for electric demand and Table 2-7 for electric energy within AES-IN’s territory. The residential 2042 technical market potential for solar PV represents 46.6% of the 2042 residential sector sales forecast. Additionally, the non-residential 2042 technical market potential represents 60.7% of the 2042 non-residential sector sales forecast.

TABLE 2-6: SUMMART OF SOLAR PV ELECTRIC DEMAND MARKET POTENTIAL

Year	Technical DC Capacity (MW)	Technical Peak Capacity (MW)	Economic (MW)	MAP (MW)	RAP (MW)
2023	319	104	0	0	0
2027	1,836	575	0	0	0
2032	5,416	1,695	0	0	0
2042	6,344	1,985	0	0	0

TABLE 2-7: SUMMARY OF SOLAR PV ELECTRIC ENERGY MARKET POTENTIAL

Year	Technical (MWh)	Economic (MWh)	MAP (MWh)	RAP (MWh)
2023	415,268	0	0	0
2027	2,297,314	0	0	0
2032	6,767,212	0	0	0
2042	7,926,314	0	0	0

Table 2-8 summarizes the cost effectiveness results for each technology and for the TRC cost-effectiveness perspective.

TABLE 2-8: SUMMARY OF SOLAR PV COST-EFFECTIVENESS

Solar PV Technologies	TRC Test Range
Residential Roof-mounted (3 – 20 kW)	0.40
Residential Roof-mounted with Batteries (3 – 20 kW)	0.19 – 0.35
Non-residential Roof mounted (10 – 50 kW)	0.42
Non-residential Roof mounted with Batteries (10 – 50 kW)	0.31 – 0.35
Non-residential Ground mounted (100 kW – 2MW)	0.48
Non-residential Ground mounted with Batteries (100 kW – 2MW)	0.41 – 0.42
Non-residential Ground mounted Tracking (100 kW – 2MW)	0.44
Non-residential Ground mounted Tracking with Batteries (10 – 50 kW)	0.39 – 0.40

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It is notable that no solar PV technologies pass cost-effectiveness screening under the TRC. This test is the primary cost-effectiveness criteria used to determine whether a utility sponsored program intervention is prudent. Low avoided costs serve as the primary driver behind the cost effectiveness results. At a technology level, the introduction of battery storage reduces cost effectiveness despite potential capacity benefit gains. Similarly, benefits achieved through additional generation using tracking-enabled systems are ultimately outweighed by the higher installation cost associated with the tracking technology.

It is notable while the TRC test for solar PV systems doesn't meet a 1.0 cost-effectiveness threshold, AES-IN customers install solar PV systems at their homes and businesses. Consequently, a baseline, business-as-usual (BAU) forecast was developed for integration into the IRP modeling. The BAU forecasts are based upon the:

- AES-IN customer and rooftop characterization described earlier
- Number of existing systems
- Trend of existing system installation from 2015-2020
- Willingness to participate and market adoption data collected from AES-IN customers
- Bass-diffusion curve and coefficients based upon the NREL dGen model¹¹ and EIA DGPV interconnection and Census data

Three adoption scenarios for BAU solar PV installations are described below for the Residential sector:

- Low; up to 6% market adoption
- Medium; up to 15% market adoption
- High; up to 29% market adoption

The BAU forecasts for system and energy (MWh-DC) are shown in Figure 2-2 and Figure 2-3, respectively.

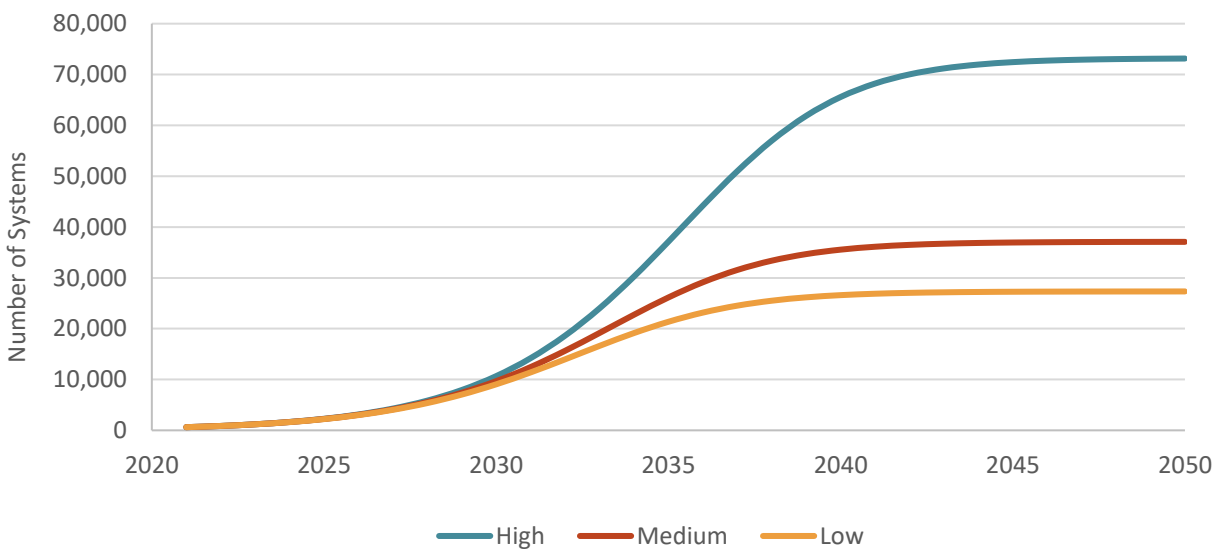


FIGURE 2-2: RESIDENTIAL SOLAR PV SYSTEM FORECAST (BUSINESS-AS-USUAL)

¹¹ <https://www.nrel.gov/analysis/dgen/>

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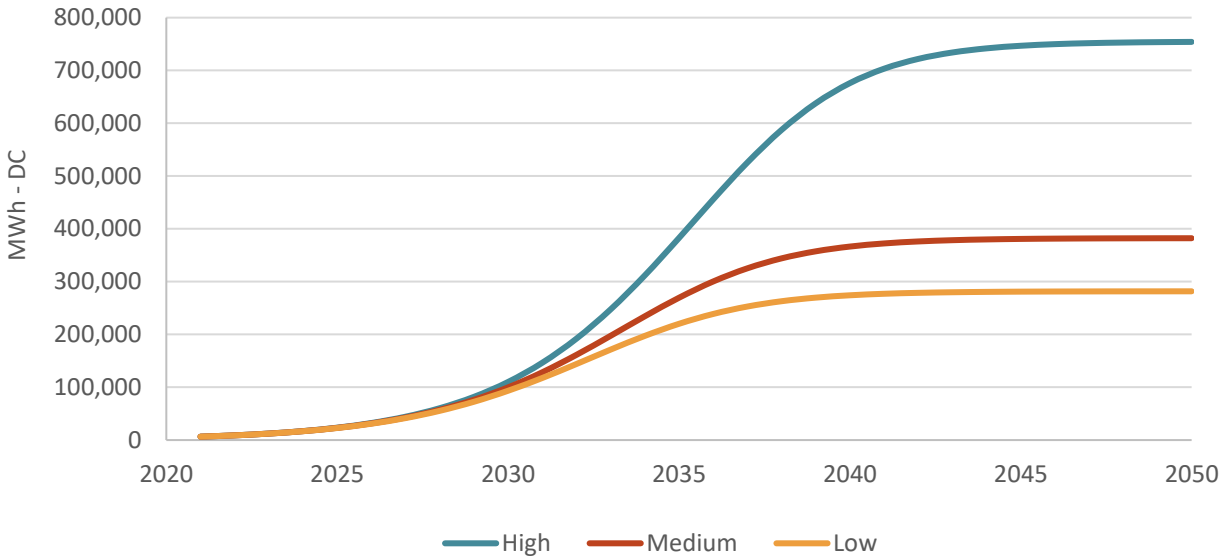


FIGURE 2-3: RESIDENTIAL SOLAR PV SYSTEM ENERGY CONSUMPTION (MWH-DC) (BUSINESS-AS-USUAL)

Three adoption scenarios for BAU solar PV installations are described below for the Non-residential sector:

- Low; up to 7% market adoption
- Medium; up to 19% market adoption
- High; up to 35% market adoption

The BAU forecasts for system and energy (MWh-DC) are shown in Figure 2-4 and Figure 2-5, respectively.

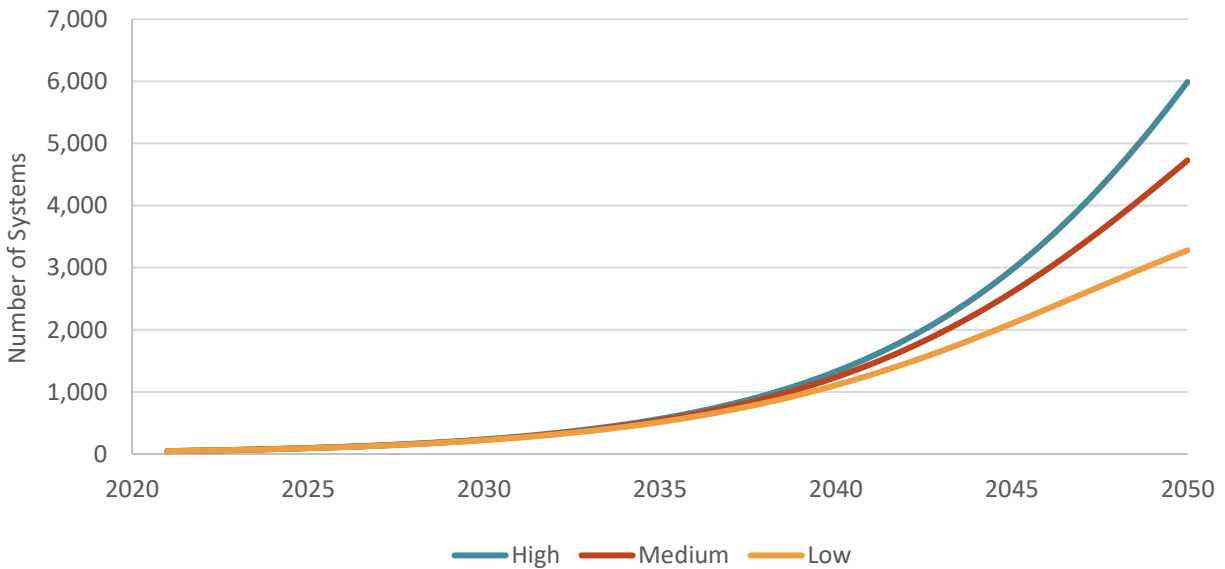


FIGURE 2-4: NON-RESIDENTIAL SOLAR PV SYSTEM FORECAST (BUSINESS-AS-USUAL)

Chapter 2 Distributed Energy Resource

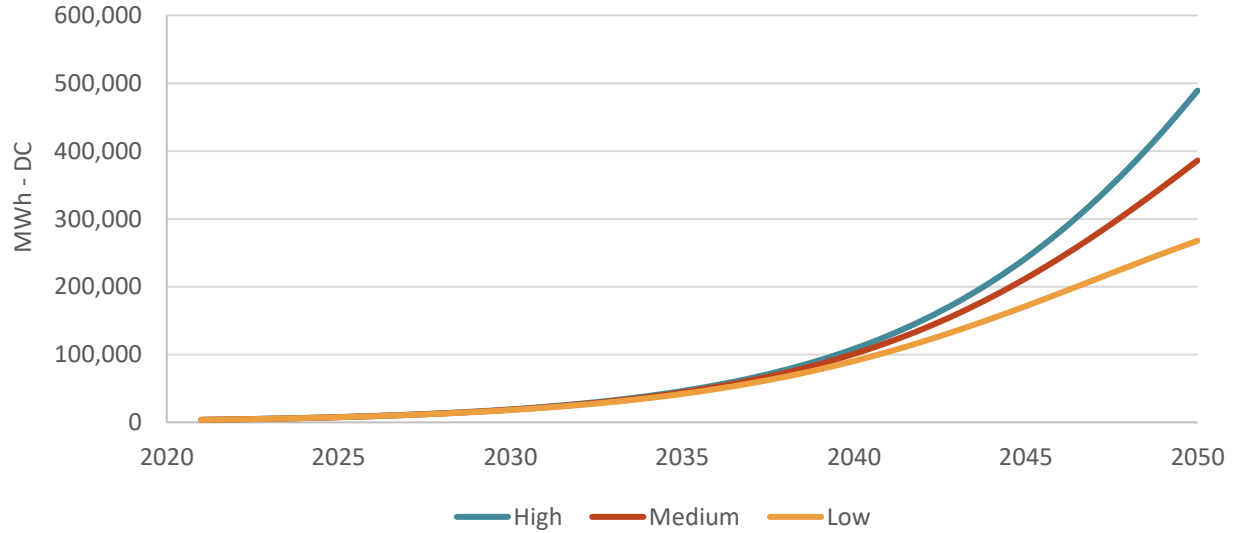


FIGURE 2-5: NON-RESIDENTIAL SOLAR PV SYSTEM ENERGY CONSUMPTION (MWH-DC) (BUSINESS-AS-USUAL)

2.2.2 Combined Heat & Power

Table 2-9 summarizes the CHP cumulative annual potential estimates for electric demand and Table 2-10 for electric energy within AES-IN territory. 2042 technical market potential for CHP represents of the 2042 non-residential sector sales forecast.

TABLE 2-9: SUMMARY OF CHP ELECTRIC DEMAND MARKET POTENTIAL

Year	Technical Peak Capacity (MW)	Economic (MW)	MAP (MW)	RAP (MW)
2023	7	0	0	0
2027	40	0	0	0
2032	125	0	0	0
2042	150	0	0	0

TABLE 2-10: SUMMARY OF CHP ELECTRIC MARKET POTENTIAL

Year	Technical (MWh)	Economic (MWh)	MAP (MWh)	RAP (MWh)
2023	59,521	0	0	0
2027	346,669	0	0	0
2032	1,089,496	0	0	0
2042	1,308,179	0	0	0

Table 2-11 summarizes the cost effectiveness results for each technology and for the TRC cost-effectiveness perspective.

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TABLE 2-11: SUMMARY OF CHP COST-EFFECTIVENESS

CHP Technologies	TRC Test Range
Fuel Cell (125 – 2,000 kW)	0.14 – 0.32
Gas Turbine (750 – 6,000 kW)	0.46 – 0.77
Micro-Turbine (50 – 200 kW)	0.26 – 0.30
Reciprocating Engine (125 – 5,000 kW)	0.32 – 0.54
Steam Turbine (500 – 6,000KW)	Less than 0.1

It is notable that no CHP technologies pass cost-effectiveness screening under the TRC. This test is the primary cost-effectiveness criteria used to determine whether a utility sponsored program intervention is prudent. Low avoided costs serve as the primary driver behind the cost effectiveness results. However, it may be the case that certain site location conditions have important performance parameters that allow for a favorable cost-effectiveness assessment for that specific site, even if the average system and facility is not cost-effective as analyzed.

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Wide-scale adoption of EVs across the U.S. will necessitate a substantial amount of energy supply to meet the needs of consumers over time. As traditional internal combustion engine (ICE) vehicles are offset by both battery electric vehicles (BEVs) and plug-in hybrid electric vehicles (PHEVs), electric service providers will need to account for the expanding EV market in their resource planning efforts.¹² EVs increase the demand for electricity that regulated electric utilities like AES-IN are required to supply to customers in their service territory. The growing adoption of EVs amongst all customer classes (residential, commercial, and industrial) poses supply and demand challenges that may require increased focus towards the assessment of the transportation sector and how it effects retail electric rates.

As of December 2021, the Federal Highway Administration provides that there are over 275 million vehicles in the U.S., and roughly 6.1 million in Indiana.¹³ The Department of Energy (DOE), in accordance with the National Renewable Energy Laboratory (NREL) estimates that for 2021, just over 1 million electric vehicles were registered in the U.S.¹⁴ The annual number of EV sales has been steadily increasing over time as well. In 2010, there were just over 15,000 EVs sold in the U.S.; in 2015 that number grew to over 120,000; and in 2021, that number was up to over 600,000.¹⁵ As of the beginning of 2022, the Environmental Protection Agency's (EPA) fuel economy report notes over 65 different makes and models of EV passenger cars are available to consumers, with new makes and models reported to hit the market year after year.

Differentiating between residential and commercial vehicles is the first step to determining the impact of new EVs in AES-IN's service territory. Residential vehicles can be typically defined as light- or medium-duty passenger vehicles or trucks used for daily commutes or recreational purposes. Commercial vehicles can be any type of vehicle used for business purposes (e.g., used for the transportation of goods or people; owned by a company or the public sector). This range of potential commercial vehicles can include light-duty passenger cars such as taxis and cop cars, all the way to vans, large trucks, and transit/school buses. Determining the number of each vehicle type takes a bottom-up approach before the energy consumption values can be approximated for AES-IN's service territory.

While EV passenger cars have a wide variety of options, the market for small delivery trucks and vans, large heavy-duty trucks (e.g., semi and tractor trailer trucks), limos, transit buses, school buses, is currently limited to a small number of makes and models, as of 2022. The adoption of these vehicles is still in its infancy. For example, car manufacturers like Tesla, Volvo, Dailmer, and BYD are still in the process of developing an EV semi-truck, with production estimates as early as Q4, 2022.¹⁶ Additionally, regarding school buses, of the roughly 500,000 in the U.S. as of December 2021, less than 1% are electric.¹⁷ Getting initial vehicle counts of these vehicle types is useful but forecasting out the adoption of each, and its associated energy usage has its limitations.

3.1 COMMERCIAL TRANSPORTATION ELECTRIFICATION

Within the market potential study, The GDS Team developed a commercial Electric Vehicle (EV) forecast for the AES-IN service territory over the 20-year resource planning period (2021-2041), to assess the potential energy and demand consumption attributed to increasing EV adoption by the commercial sector. This

¹² For purposes of this report, "EV" will refer to both battery electric vehicles and plug-in hybrid vehicles.

¹³ Federal Highway Administration, Highway Statistics Series "Highway Statistics 2020" (December 2021)

¹⁴ U.S. Dept. of Energy, Alternative Fuels Data Center "10962-Electric Vehicle Registrations by State, 2021"

¹⁵ U.S. Dept. of Energy, "New Plug-in Electric Vehicle Sales in the United States Nearly Doubled from 2020 to 2021"

¹⁶ See U.S. News "Future Electric Semi Trucks" 02/18/22.

¹⁷ See SchoolBusFleet "School Bus Statistics" Dec. 2021

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analysis should be utilized as a supplement to support AES-IN’s energy forecasting efforts. This analysis utilizes existing, publicly available, historical data and trends along with supplemental information supplied by AES-IN. The forecast in this report is solely a business-as-usual forecast; meaning there are no assumptions built in for utility intervention, or State or Federal policy implications throughout the planning period.

This section describes the overall methodology used to develop the commercial EV forecast. The structure of this report will be as follows:

- Characterizing the commercial EV market in AES-IN’s service territory as it relates to commercial vehicle registrations, sales, and historical trends;
- Developing EV measures, segmented by measure group to determine unique energy consumption values;
- Defining EV market penetration scenarios (low, medium, and high case);
- Approach used to forecast vehicle classes and energy consumption through the 20-year resource planning period; and
- Offering concluding findings and remarks surrounding the forecasted scenarios considered, and challenges posed by future adoption of heavy-duty EVs.

3.1.1 Commercial EV Market Characterization

First, to establish a forecasted value of commercial vehicles in AES-IN’s service territory, an AES-IN provided baseline year of 2021 is used. Commercial vehicle types are determined, and primary data is collected for historical U.S. vehicle registrations from sources such as the U.S. Dept. of Transportation’s Federal Highway Administration (FHA), and the DOE. Historical values are compared against national, state, and city population values year-over-year,¹⁸ and number of registered vehicles in a specific State and County can be extrapolated for a single historical year. Commercial vehicle types are then grouped in segments based on characteristics.

3.1.1.1 Vehicle Classification

The Federal government typically classifies vehicles based on the vehicle’s Gross Vehicle Weight Rating (GVWR). Eight cohorts of vehicles are categorized ranging from Class 1 (GVWR < 6,000 lbs) to Class 8 (GVWR > 33,000 lbs). This analysis utilizes these classifications and further categorizes each based on current EV models available in the market today. Table 3-1 provides a listing of the federal commercial vehicle cohorts by GVWR.

TABLE 3-1: FEDERAL COMMERCIAL VEHICLE COHORTS

Gross Vehicle Weight Rating (GVWR) (lbs)	Federal Highway Admin Vehicle Class	Federal Highway Admin GVWR Category
<6,000	Class 1: <6,000 lbs	Light Duty (< 10,000 lbs)
10,000	Class 2: 6,001 - 10,000 lbs	
14,000	Class 3: 10,001 - 14,000 lbs	Medium Duty (10,001-19,500 lbs)
16,000	Class 4: 14,001 - 16,000 lbs	
19,500	Class 5: 16,001 - 19,500 lbs	Light Heavy Duty (19,001 -26,000 lbs)
26,000	Class 6: 19,501 - 26,000 lbs	
33,000	Class 7: 26,001 - 33,000 lbs	Heavy Duty (> 26,000 lbs)
>33,000	Class 8: >33,000 lbs	

¹⁸ U.S. Census Bureau, U.S. population data, 2021

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Classes 1 and 2 are typical passenger vehicle on the road today. Of the 275 million vehicles registered in the U.S. in 2020, 37% would be considered under this class. Semi and Tractor trailer trucks make up most of the Class 7 and 8 vehicles, with the FHA reporting that over 13 million registered in 2020. The amount of fuel needed to power these different Classes of vehicles varies greatly, and furthermore, the Miles Per Gallon (“MPG”) of a Class 1 vehicle could dramatically differ from a Class 8 vehicle.¹⁹ For an EV model of each class, the amount of electricity needed to supply one vehicle to travel equal distances will also greatly vary.

For purposes of this study, based on the data that was available to be collected, along with vehicle characteristics and EV models available, the federal classes discussed were further recategorized into unique segments for all commercial vehicle types. Table 3-2 shows each of the vehicle segments.

TABLE 3-2: COMMERCIAL EV SEGMENTS

Segment	Class/ Additional Description
Government Passenger Cars	Light & Medium Duty, SUVs
Government Trucks	Light, Medium and Heavy Duty
Police Cars	Light & Medium Duty, SUVs
Police Trucks	Light, Medium and Heavy Duty
Private Vehicle – Class 1	Excluding all other segments
Private Vehicle – Class 2	Excluding all other segments
Private Vehicle – Class 3 through 6	Excluding all other segments
Private Vehicle – Class 7 & 8	Excluding all other segments
School Buses	-
Transit Buses	-
Limos	All Types

Each segment was scaled to Marion County based on population changes year-over-year. A total count of vehicles was determined for 2021, to be used as the initial baseline for scenario development and forecasting efforts.

3.1.2 Technology Characterization

Data on current makes and models of commercial EVs available in the U.S. market as of 2021 were collected and analyzed. Unique model characteristics such as Gross Vehicle Weight Rating (GVWR),²⁰ range, Manufacturer Suggested Retail Price (MSRP), Miles Per Gallon Equivalent (MPGe),²¹ etc., were compared to models into unique commercial EV cohorts.

Based on the range and battery, miles per kWh was defined for each model, and then averaged within each vehicle cohort, if multiple products are available. The FHA publishes an annual Vehicle Miles Traveled (VMT) every year based on types of vehicles. Using the miles per kWh values, and VMT values regionalized to central States, annual kWh values are derived for each of the vehicle segments.

Along with the uniqueness of the vehicle segments, each has a useful life, which is the length of time that the individual vehicle will, on average, be replaced. The DOT, EPA and individual car manufacturers provide insight towards the useful life of different vehicle types. The values have been collected and averaged and are used in the forecast of commercial EVs. Table 3-3 provides a summary of the vehicle segments, useful life,

¹⁹ EPA ratings for Class 1 vehicles are on average 24.2 MPG, while Class 8 vehicles can range from 2.5 to 6.5 MPG.

²⁰ Values provided by the DOE, Office of Energy Efficiency & Renewable Energy.

²¹ EPA unit used for alternative fuel vehicles. 1 U.S. gallon of unleaded gasoline equals 33.7 kilowatt-hours of electricity based on an energy standard of 115,000 BTUs (British thermal units) per gallon of gasoline.

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and number of commercial vehicles within AES-IN’s service territory used in this study. The turnover and new purchase for each commercial vehicle provides the opportunity for vehicle to switch to electric from internal combustion.

TABLE 3-3: USEFUL LIFE AND BASELINE YEAR MARKET SIZE FOR EACH VEHICLE SEGMENT

Segment	Estimated Vehicles in 2021	Useful Life (years)
Government Passenger Cars	12	5,416
Government Trucks	8	2,267
Police Cars	5	1,326
Police Trucks	5	284
Private Vehicle – Class 1	12	100,524
Private Vehicle – Class 2	12	10,538
Private Vehicle – Class 3 through 6	15	32,405
Private Vehicle – Class 7 & 8	15	17,170
School Buses	14	288
Transit Buses	14	2,115
Limos	15	107

3.1.3 Forecasting Scenarios and Assumptions

Various industry sources have offered opinions and projections towards the future of the U.S. EV market. For example, the Energy Information Administration (EIA),²² the International Energy Agency (IEA),²³ and NREL²⁴ all publish annual studies on potential EV penetration and adoption, with unique sales forecasts for the U.S. The characterization of the current EV market and the best estimates of future trends are based on leveraging both national and local historical data to the extent possible. Local data was used when available, such as historical values of school and transit buses in Marion County, IN.

Due to the 20-yr length of the study timeframe, and the current state of the EV market, this study uses three linear-trend scenarios of EV shares of total vehicle sales as described below:

- Low – starting at 1.7% in 2020 rising to 9.1% in 2042
- Medium – starting at 1.7% in 2020 rising to 18.2% in 2042
- High – starting at 1.7% in 2020 rising to 36.0% in 2042

A linear regression analysis is utilized for each cohort to develop a projected of new commercial vehicle purchases and replacements for each cohort within the forecasted years in the planning period. The linear regression approach is used because of its simplicity and the uncertainty of the EV market. The forecast does not include any additional market interventions by AES-IN, such as customer incentives of exceptional energy rate structures.

3.1.4 Commercial Transportation Electrification Results

Figure 3-1 and Figure 3-2 show the forecasts for incremental new commercial electric vehicles and incremental energy usage for all three scenarios (low, medium, high).

²² U.S. Energy Information Administration, Annual Energy Outlook 2022 (AEO2022) “Light-duty vehicle sales by technology or fuel type”

²³ International Energy Agency: Global EV Outlook 2021

²⁴ NREL: Electrification Futures Study (“EFS”), May 2021

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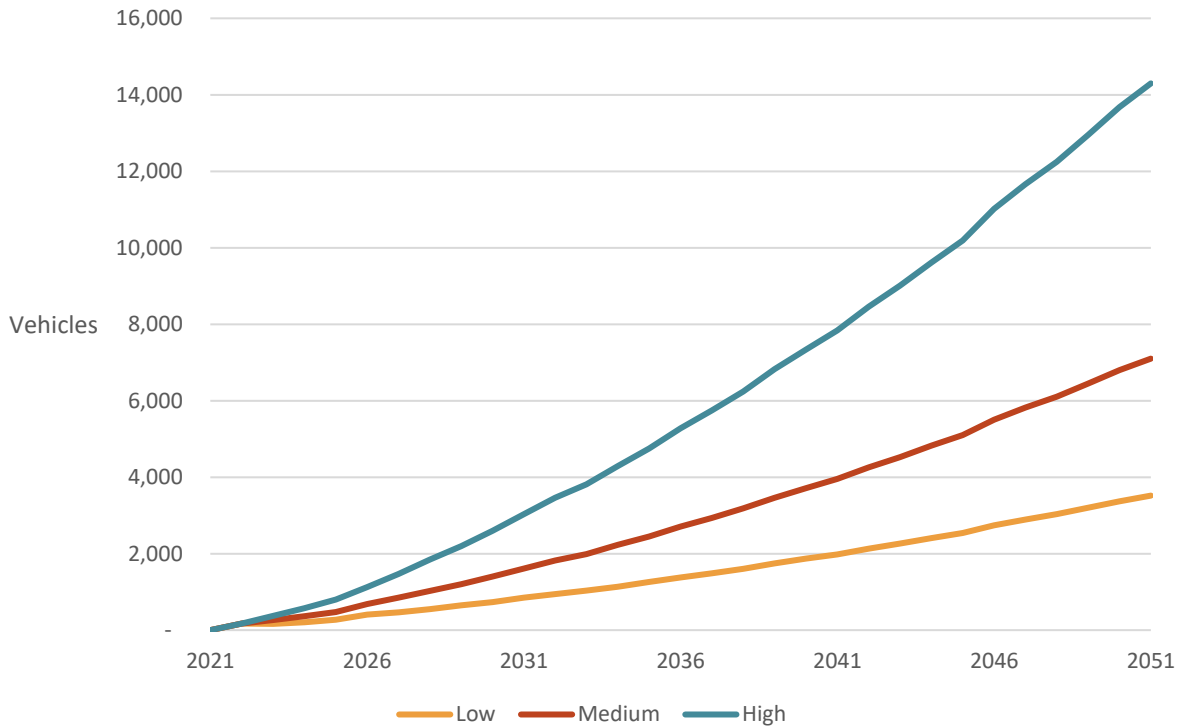


FIGURE 3-1: INCREMENTAL NEW COMMERCIAL ELECTRIC VEHICLES

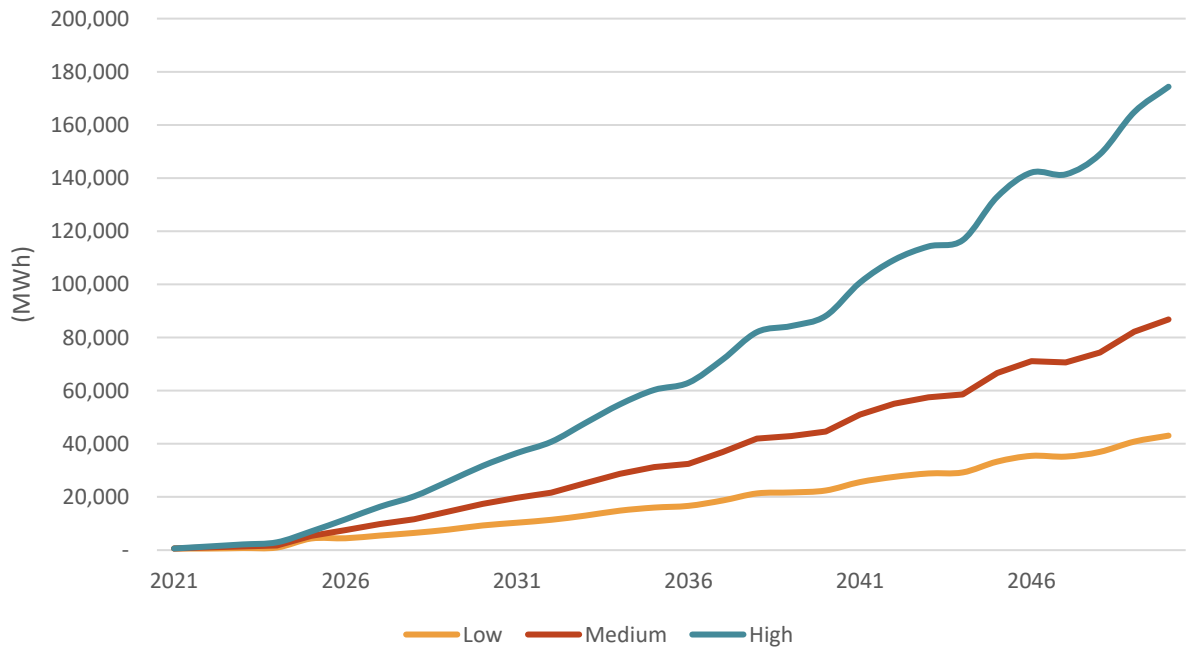


FIGURE 3-2: INCREMENTAL ENERGY USAGE FROM NEW COMMERCIAL ELECTRIFICATION VEHICLES

After the offset adoption of some of the larger vehicles is realized after 2024, the commercial EV’s incremental energy usage takes a significant jump under all three scenarios. By 2030, under the “low scenario” the commercial EV sector will consume 7,700 MWh of energy supply. Under the high scenario, that energy supply increases to over 25,800 MWh. By 2041, incremental energy usage ranges from roughly 22k

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MWh to 88k MWh between the low and high scenarios. Under all scenarios, Class 7 and 8 vehicles account for nearly 50% of all energy needs every year. The adoption of these vehicles has the most potential to influence the energy usage values of the commercial EV market. Table 3-4 shows the EV cumulative energy usage as percentage of total forecasted AES-IN non-residential energy sales through 2041 in the low and high scenarios.

TABLE 3-4: CUMULATIVE ENERGY USAGE – NON-RESIDENTIAL EV

Year	Non-Residential Sales Forecast (GWh)	EV % (Low)	EV % (High)
2022	8,025	0.01%	0.01%
2026	8,087	0.09%	0.18%
2031	8,080	0.51%	1.48%
2036	8,052	1.32%	4.47%
2041	8,080	2.57%	9.30%

It is notable that no commercial EV technologies pass cost-effectiveness screening under a TRC 1.0 threshold. This test is the primary cost-effectiveness criteria used to determine whether a utility sponsored program intervention is prudent. Consequently, no technical, economic, or achievable potential is estimated.

3.1.5 Conclusion

As the EV market continues to develop, new EV models, technology enhancements, and overall public opinion will begin to influence the rate of EV adoption. Studies like this are a challenging exercise because they lack the ability to accurately take these factors into account with such a new and uncertain market. Electric utilities like AES-IN may need to account for the potential load on their distribution lines associated with more of their customers choosing to purchase EVs over conventional ICE vehicles. Assessing potential supply and demand needs is common practice with electric utilities although greater assessment will need to be done towards EV usage year-after-year.

Heavy-duty vehicles like tractor trailer and semi-trucks account for only 10% of all commercial vehicles in AES-IN’s service territory but have the potential to account for roughly 50% of the commercial EV market’s energy needs. Analysis of the adoption of these vehicles will need to be closely monitored by AES-IN as they evaluate their generation supply. Indiana is home to the second largest FedEx hub in the world and is ranked first in the U.S. in pass-through highways, with access to five major interstates. The need to supply these vehicles as more EV models are made and adopted, may result in greater EV energy usage in AES-IN’s service territory relative to most other electric utilities.

Although this study utilizes forecast absent utility intervention, it is expected that federal and state policies can influence the adoption rate of EVs both on the residential and commercial level. AES-IN doesn’t currently have a mandated requirement for energy efficiency, beneficial electrification, or EV adoption, but many States around the country do have these policies. Greater incentives towards adoption in these States, along with the Federal level can influence the levels of EV adoption seen in AES-IN’s service territory. Thus, there remains a high level of uncertainty surrounding future deployment of commercial EVs in the AES-IN territory. This study is the result of publicly available data and trends available at the time of publication and should be used to aide AES-IN’s resource planning efforts today and as more information becomes available.

3.2 RESIDENTIAL TRANSPORTATION ELECTRIFICATION

GDS developed a residential electric vehicle (EV) forecast for AES-IN, which includes low, base, and high scenarios for the number of residential EV’s and the associated total energy consumption by the forecasted EV’s. The forecasting model is based on many inputs and assumptions. This section describes the methodology, data inputs, some of which will be detailed below.

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The first key input in the residential EV model is the number of AES-IN customers that make up potential EV owners. GDS utilized the most recently completed load forecast from AES-IN to input the number of residential customers on the system. The number of residential customers is essentially the number of households served by AES-IN, therefore the number of residential customers can be multiplied by the number of vehicles per household to estimate the total number of vehicles within the AES-IN service territory. The U.S. Census Bureau estimates there are 1.86 vehicles per household in the Indianapolis metropolitan area.

A second key assumption is the number of EV’s currently in the AES-IN service territory. GDS utilized Indiana Bureau of Motor Vehicles (BMV) registration data and the 2021 residential consumer survey conducted for the 2021 MPS to determine the number of residential EV’s served by AES-IN. Based on the data discussed above, GDS estimates that in 2021 3,575 EV’s were served by AES-IN.

The final key assumption used in the EV model is the percentage of EV’s that make up new vehicle sales. GDS started with publicly available data from the Energy Information Administration (EIA) and their published Annual Energy Outlook (AEO) for 2021.²⁵ The 2021 AEO projects that 11.7% of new vehicle sales will be EV’s in the year 2050. GDS conducted broad and thorough EV industry research to understand the AEO projections and form a basis for what new vehicle sales percentage should be in alternate scenarios. The AEO estimate of 11.7% is on the low end of the current industry projections based on GDS research, so the AEO trend was closely followed for the low scenario. GDS then developed a base case and high case scenario based on the industry research. As seen in Figure 3-3 below, the various scenarios all produce a linear growth trend for EV sales as a percentage of new vehicle sales, with the Low scenario closely following the AEO projections and the Base and High scenarios representing more optimistic projections. While the High scenario may appear overly optimistic compared to the Low and Base scenarios, many auto manufacturers have stated goals for EV sales that far outpace the percentages in the High scenario.

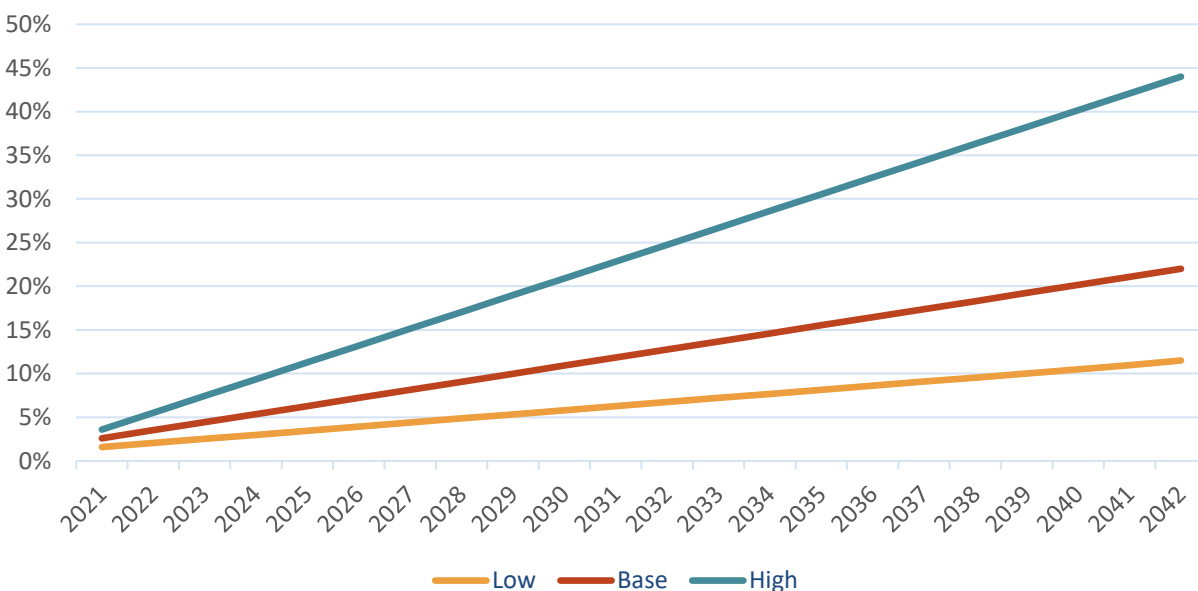


FIGURE 3-3: EV SALES AS A PERCENTAGE OF NEW VEHICLE SALES

Given the initial number of EV’s in Indianapolis and the projected percentage of new vehicle EV sales, the cumulative number of EV’s served by AES-IN can be projected annually. The projection for total number of EV’s accounts for the typical “lifespan” of a vehicle as well. Figure 3-4 below shows the projections for total number of electric vehicles.

²⁵ https://www.eia.gov/outlooks/aeo/tables_ref.php

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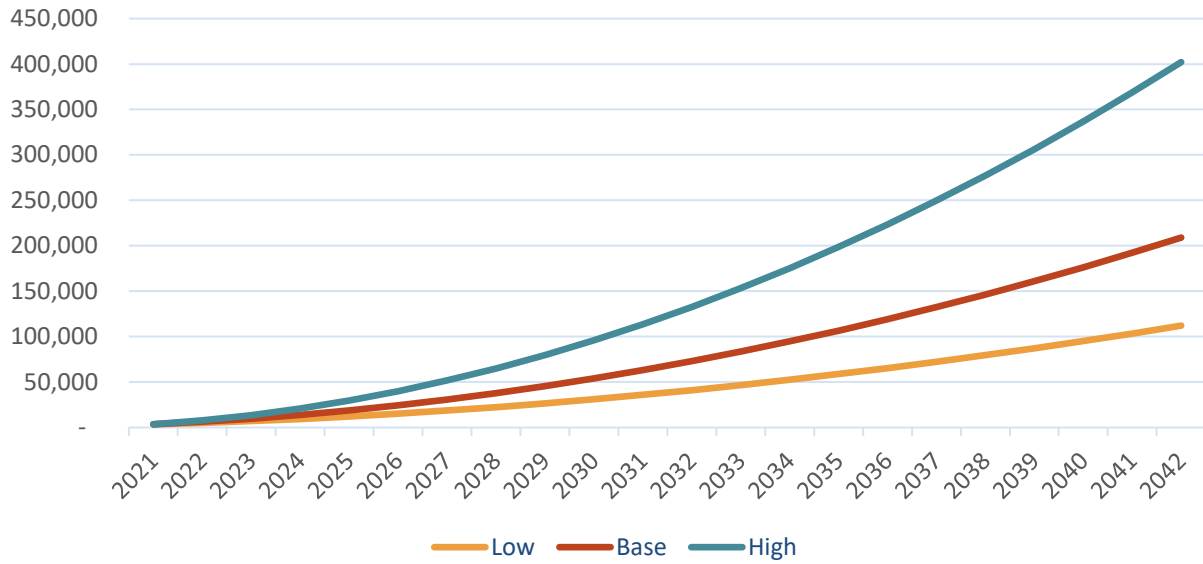


FIGURE 3-4: TOTAL EV'S

The total number of electric vehicles and several other inputs, including average miles driven per year and kWh per mile efficiency, are used to calculate the total energy sales attributable to the projected number of EV's on the AES-IN system. The expected average miles driven varies between scenarios, representing another layer of either optimistic or pessimistic assumptions regarding EV adoption and use. As seen below in Figure 3-5, the differences between the scenarios in expected MWh sales has increased due to the changing miles/year assumption.

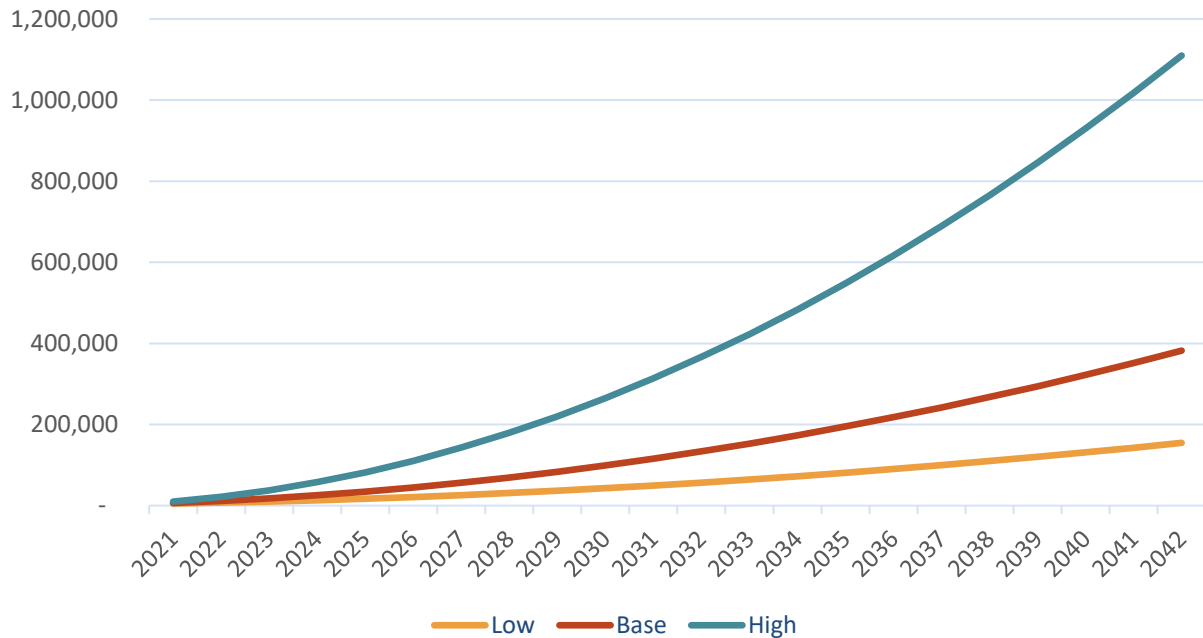


FIGURE 3-5: MWH SALES ATTRIBUTABLE TO EV'S

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4 Building Electrification

This chapter describes a building electrification forecast to understand the cost-effectiveness of building electrification measures and a range of possible electrification adoption impacts on AES’s base forecast of MWh sales. The forecast includes the residential, commercial, and industrial sectors.

4.1 OVERVIEW OF APPROACH

GDS approached the forecast of building electrification load impacts using three methods, varying by each sector. Each are summarized below. In all cases, GDS assumed that building electrification would offset natural gas consumption.

4.1.1 Residential Sector

The residential building electrification forecast was developed using a bottom-up approach. In this approach, the count of single family and multifamily buildings using natural gas for space heating, water heating, cooking, and laundry had electrification measures applied to the natural gas loads. GDS first utilized AES customer data to understand the share of end-uses that utilize natural gas. Table 4-1 summarizes the share of homes currently using natural gas.

TABLE 4-1: RESIDENTIAL USE OF NATURAL GAS BY END USE

Housing Type / End Use	Single Family	Multifamily	Total
Existing Customer Count	341,467	121,225	462,692
Space Heating Share	55.25%	22.89%	46.8%
Water Heating	49.71%	20.97%	42.2%
Gas range or stovetop	29.48%	14.32%	25.5%
Gas oven	24.75%	16.41%	22.6%
Gas clothes dryer	8.31%	5.34%	7.5%

GDS developed baseline technology models using assumptions from the Illinois TRM V10 for space heating and water heating natural gas consumption. GDS developed estimates of cooking equipment performance for gas ranges/stovetops and gas ovens. Gas clothes dryers were dropped from the model due to the limited share currently using natural gas. The resulting natural gas consumption was compared to reported natural gas sales by Citizens Energy Group in American Gas Association 2019 sales data. The bottom-up measure modeling estimated a total of 20,001,293 annual MMBTU of natural gas consumption, 96 percent of the 2019 Citizens Energy Group sales.

GDS applied assumptions regarding possible electrification alternatives to each end-use. These included:

- Dual-fuel and 100 percent offset HVAC heat pumps operating at a range of efficiencies from 16 SEER/8.1 HSPF to 21 SEER/9.0 HSPF, and ground-source heat pumps
- Electric resistance water heaters and heat pump water heaters
- Induction and electric resistance stovetops
- Electric resistance ovens

The technical performance of these measures developed electricity consumption estimates for each technology. GDS also applied assumptions regarding the technical feasibility for AES customers to incorporate a technology in their home.

GDS analyzed the economics of the natural gas and electrification technologies. As a starting point, customer perspectives based on equipment costs and retail rates for electricity and natural gas drove a life-cycle cost

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analysis and simple payback metric in which the cost of equipment, available AES incentives, and operational costs created a customer-based benefit-cost ratio. The metrics provide insight into the lifecycle cost of purchasing and operating equipment, as well as whether operational energy costs were more or less for the electrification technologies than their natural gas counterparts. Additionally, GDS developed an analysis of utility economics in which the additional revenue from electrification electricity sales was offset by wholesale energy costs and program incentives. While not used directly, this second economic analysis provides insight into utility economic thresholds for program costs or incentives. Under the Utility Cost Test (UCT) used in Indiana to gauge energy efficiency cost-effectiveness, electrification would not pass the test due to increasing energy sales. The UCT was not used in economic modeling.

The general outcome of the economic modeling found that:

- Air-source heat pumps were cost-effective for customers. Ground-source heat pumps were not due to equipment costs.
- Electric water heating was cost-effective for customers (electric resistance or heat pump).
- Electric resistance stovetops were cost-effective for customers, though induction stovetops and electric resistance ovens were not.
- For residential new construction, all end-uses could be cost-effectively electrified for customers, other than electric resistance ovens.

With the resulting cost-effectiveness results for customers, GDS then utilized a Bass diffusion curve to develop estimates of low, medium, and high scenarios for future market adoptions. For existing residential buildings, the adoption curves assumed that half of customers would adopt electrification over time. The medium adoption scenario assumed 25 percent would adopt electrification, and the low adoption scenario assumed 12.5 percent would adopt electrification. For the high scenario, the available annual equipment sales were confirmed to approach 100 percent of sales across HVAC and water heating annual unit sales but did not exceed that amount.

Finally, GDS compared the forecasted electrification electricity sales increase to NREL's 2018 Electrification Futures study reference case. The NREL study analyzed, nationally, residential electrification electricity sales. The NREL study's reference case was used as a "Business As Usual" (BAU) case from which the low, medium, and high adoption scenarios could reflect varying levels of possible program interventions.

4.1.2 Commercial Sector

For the commercial building sector, GDS employed a top-down analysis. In this case, GDS began with the Citizens Energy Group 2019 commercial sector natural sales, as reported to the American Gas Association. GDS then disaggregated those sales into end-use consumption using a variety of data sources, including EIA's CBECs data for the Midwest region, USDOE's Energy Scout data, ACEEE reports, and other existing industry literature that presented estimates of commercial building natural gas consumption end-use shares. Of the possible commercial end-uses, only space heating, water heating, and cooking had data. As such, the analysis focuses on possible electrification from only those end uses. GDS acknowledges that other end uses of commercial natural gas exist, such as commercial laundry drying, gas-based cooling, or combined heat and power equipment. The electrification of those end-uses, due to the apparently low-share of commercial sector natural gas consumption, is expected to have minor impacts on overall electricity consumption. The general impact of electrifying space heating, water heating, and cooking end uses may also be representative of the impacts of electrifying the unaccounted-for end-uses and may be implicitly assumed in the forecast.

Table 4-2 describes the end-use share assumptions for each of the end-uses modeled for electrification.

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TABLE 4-2: COMMERCIAL SECTOR END-USE NATURAL GAS CONSUMPTION

End Use	Share
Space Heating	60 percent
Water Heating	30 percent
Cooking	10 percent

Within each end-use GDS developed a variety of technology models that captured a range of possible baseline and electrified equipment configurations. For all technologies, GDS developed the technology performance assumptions utilizing the Illinois TRM V10 for space heating and water heating. Parameters for high, low, and average use were developed to capture diversity within the commercial sector, though the sector was modeled as a whole and did not include measure permutations for different building types. For commercial cooking, GDS developed estimates of energy and cost impacts from its own research, focusing on commercial-scale professional cooking equipment.

For new construction, GDS utilized the AES commercial forecast to identify how new construction electricity load was expected to grow absent DSM programs. The aggregate growth of load absent DSM program was approximately 5.2 percent across the forecast period. GDS assumed that same growth rate for natural gas consumption, allowing that growth to occur at an equal level year-to-year to inform possible new natural gas consumption that could be electrified. New construction electrification potential was only applied to space heating and hot water loads due to the small share and high uncertainty regarding the presence of new gas cooking. Averages of the existing commercial sector measure performances were applied to these new construction loads.

GDS applied assumptions regarding possible electrification alternatives to each end-use. These included:

- Electric resistance and heat pump water heaters in distributed and central water heating configurations with higher and lower hot water consumption assumptions.
- Replacing residential-size furnaces and boilers with central or ductless heat pumps
- Replacing a boiler or furnace with rooftop or window air conditioning with ductless heat pumps
- Replacing a boiler or furnace with chillers with large VRF heat pumps and ground source heat pumps
- For HVAC systems, heating loads used configurations of average (IL TRM) loads, and then higher and lower HVAC loads to reflect more or less efficient commercial buildings

The purpose of the mix of technologies and consumption level assumptions was to understand the mix of possible energy loads and equipment configurations. GDS developed assumptions on the share of furnaces and boilers and cooling equipment using DOE’s Energy Scout Data for the Indianapolis climate region. This mix provides a range of possible equipment costs and energy impacts to support the economic analysis and thermodynamic relationship of equipment type electrification impacts on utility electricity sales.

GDS analyzed the economics of the natural gas and electrification technologies. As a starting point, customer perspectives based on equipment costs and retail rates for electricity and natural gas drove a life-cycle cost analysis and simple payback metric in which the cost of equipment, available AES incentives, and operational costs created a customer-based benefit-cost ratio. The metrics provide insight into the lifecycle cost of purchasing and operating equipment, as well as whether operational energy costs were more or less for the electrification technologies than their natural gas counterparts. Additionally, GDS developed an analysis of utility economics in which the additional revenue from electrification electricity sales was offset by wholesale energy costs and program incentives. While not used directly, this second economic analysis provides insight into utility economic thresholds for program costs or incentives. Under the Utility Cost Test (UCT) used in Indiana to gauge energy efficiency cost-effectiveness, electrification would not pass the test due to increasing energy sales. The UCT was not used in economic modeling.

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The general outcome of the economic modeling found that:

- Under current and forecasted retail rates, HVAC heat pumps and water heaters were not cost effective to electrify.
- Of cooking equipment, only combination ovens and steam cookers were shown to be cost effective to electrify

As a result of the economic analysis, GDS elected to provide flexibility in the potential adoption of electrification measures for the commercial sector. GDS reduced the threshold of cost-effectiveness to 0.70 and elected to assume that new construction HVAC and water heating electrification would be cost effective. This approach provides several benefits to the forecast:

- Allows for the diversity of the commercial sector to allow that cost-effective conditions may exist that could not be directly modeled with the available data.
- Accounts for commercial sector customers to that may choose to make sub-economic decisions.
- Acknowledges that some commercial sector customers in the economy are choosing to electrify despite sub-economic outcomes or that non-energy impacts may overcome energy economics.
- Allows that economic conditions, including equipment costs and relative costs of energy, may shift to favor electrification over the forecast period.

Nevertheless, GDS still found that electrification measures did not pass cost-effectiveness criteria. For HVAC, ground source heat pumps and larger commercial VRF systems remained non-cost effective when compared to natural gas options. For water heating, electric resistance water heating remained non-cost effective. For cooking, electric griddles and fryers remained not cost-effective. The outcome points to the importance of possible program interventions to encourage electrification.

To model the possible adoption of commercial sector electrification and its impact on AES electricity sales, GDS applied Bass diffusion curves based on NREL research. The scenarios all assumed that 50 percent of the commercial sector could ultimately adopt electrification. Three Bass diffusion curves were selected to model the adoption of electrification to reflect high/medium/low adoptions.

- High adoption utilized the residential sector Bass parameters, reflecting rapid adoption over time.
- Medium adoption utilized NREL's national estimate for commercial sector curves, reflecting a pace of adoption based on a national average, which may be more reflective of AES' service territory than the State as a whole.
- Low adoption utilized NREL's Indiana-specific commercial sector parameters, reflecting a slower pace to durable goods adoption.

The selection of these curves are compared to NREL's Electrification Futures Study reference case, which was used to estimate a "Business As Usual" (BAU) scenario. The High/Medium/Low adoptions envision program support and market acceptance above that of the BAU case.

4.1.3 Industrial Sector

Despite challenging energy economics, the industrial sector, nationally, has exhibited some adoptions of electrification. The industrial sector differs from the residential and commercial sectors due to specialized process equipment that may consume considerable amounts of natural gas, though varies by industrial type. For example, using industrial heat pumps to provide low-grade process heat will have substantially different outcomes than replacing a gas steam boiler with an arc boiler using electricity. The specific timing and type of technology that may be adopted is highly uncertain, particularly for a specific utility service territory. Corporate decisions will be based on energy economics, possible decarbonization goals, and the timing for aging process equipment to be replaced.

Chapter 4 Building Electrification

GDS utilized data from NREL’s Electrification Futures Study to estimate the possible impact of electrification growth in AES’ industrial sector. The NREL study provides national-level estimates of industrial electrification, with NREL’s reference case indicating zero industrial electrification. NREL’s low and medium case envision nearly zero industrial adoptions of electrification. Only in NREL’s high case does industrial electrification exhibit meaningful growth.

GDS began with AES’ forecast of industrial sales across the forecast period. GDS notes that industrial electricity sales are approximately 15 percent of AES’ total electricity sales, indicating that the industrial sector makes up a relatively small portion of AES’ customer base, further suggesting caution at making assumptions for electrification for a specific service territory. To estimate the impact of NREL’s high case for industrial electrification, GDS analyzed the NREL assumption regarding overall industrial load growth and removed the share of load growth already accounted for in AES’ forecast. The remaining share was assumed to be driven by electrification. The growth occurs in the last decade of the forecast.

To model adoptions of industrial electrification and the resulting increase in electricity sales above the current forecast, GDS applied a compound annual growth rate that models the entire period’s growth in industrial electrification. Three scenarios were developed to estimate the load impacts:

- A high scenario that utilizes NREL’s high case
- A medium scenario that assumes two-thirds the growth of the high case occurs
- A low scenario that assumes one-third the growth of the high case occurs

These three scenarios can be compared to NREL’s reference case, which serves as a “Business As Usual” (BAU) scenario. With NREL’s reference case indicating that no industrial electrification would occur, the BAU case is inherently reflecting that AES’ industrial sector would not adopt electrification technologies.

4.2 RESULTS

Below we present the results of the building electrification modeling in aggregate, by sector, and for each of the adoption scenarios. For the total across all sectors and for each sector, the results show the estimated impact of electrification and 2042 results compared to the base forecast for 2042.

4.2.1 All Sectors

Table 4-3 shows the impact of additional electrification load compared to the AES base electricity sales forecast for the combined residential, commercial, and industrial sectors for selected forecast years. The 2042 electricity sales under the three electrification scenarios are compared to the base electrification forecast, which does not include any assumed electrification growth.

TABLE 4-3: CUMULATIVE ELECTRIFICATION SALES ABOVE BASE FORECAST, MWH

Scenario	2023	2025	2030	2035	2040	2042	Percent Above Base Forecast
Low	8,910	16,954	52,983	109,200	163,058	187,904	1.3%
Medium	10,709	22,653	74,905	181,388	301,705	347,890	2.4%
High	12,727	29,661	111,370	329,653	598,830	654,627	4.4%

The above results for additional load due to electrification show a range of 1.3 percent to 4.4 percent above the AES base forecast, which does not include electrification. As a comparison, the business-usual-case (BAU) based on NREL’s Electrification Futures study Reference Case, was modeled as showing 0.9 percent growth above the base forecast by 2042. As a national model, the growth in total electric consumption does not necessarily mirror AES’s forecast are not illustrative of year-on-year differences between scenarios that are

Chapter 4 Building Electrification

specific to AES. In the BAU forecast, NREL’s modeling assumes no incremental load growth due to electrification occurring for the industrial sector.

4.2.2 Residential Sector

Table 4-4 presents the impact of additional electrification load compared to the AES base electricity sales forecast for the residential sector.

TABLE 4-4: CUMULATIVE RESIDENTIAL BUILDING ELECTRIFICATION SALES ABOVE BASE FORECAST, MWH

Scenario	2023	2025	2030	2035	2040	2042	Percent Above Base Forecast
Low	3,786	7,150	28,233	60,645	73,712	75,624	1.2%
Medium	3,807	7,322	32,907	95,698	140,253	146,732	2.3%
High	3,818	7,410	35,760	131,534	254,286	278,720	4.4%

The above results for additional load due to residential building electrification show a range of 1.2 percent to 4.4 percent above the AES base forecast, which does not include electrification. As a comparison, the business-usual-case (BAU) based on NREL’s Electrification Futures study Reference Case, was modeled as showing 0.85 percent growth above the base forecast by 2042. A contributor to the residential sector results is that both single-family and multifamily buildings already exhibit relatively high shares of electric market penetration for end uses.

4.2.3 Commercial Sector

Table 4-5 presents the impact of additional commercial building electrification load compared to the AES base electricity sales forecast for the commercial sector.

TABLE 4-5: CUMULATIVE COMMERCIAL BUILDING ELECTRIFICATION SALES ABOVE BASE FORECAST, MWH

Scenario	2023	2025	2030	2035	2040	2042	Percent Above Base Forecast
Low	3,535	5,036	12,034	27,890	60,734	80,488	1.3%
Medium	3,674	5,649	16,179	43,735	103,360	136,611	2.1%
High	4,092	7,800	37,075	135,499	257,840	279,569	4.3%

The above results for additional load due to commercial building electrification show a range of 1.25 percent to 4.3 percent above the AES base forecast, which does not include electrification. As a comparison, the business-usual-case (BAU) based on NREL’s Electrification Futures study Reference Case, was modeled as showing 1.2 percent growth above the base forecast by 2042. That both the BAU case (derived from NREL) and the Low scenario result in similar load growth assumptions suggest that commercial sector electrification decision making regarding may be similar between national perspectives and AES’s commercial sector.

4.2.4 Industrial Sector

Table 4-6 presents the impact of additional electrification load compared to the AES base electricity sales forecast for the industrial sector.

Chapter 4 Building Electrification

TABLE 4-6: CUMULATIVE INDUSTRIAL BUILDING ELECTRIFICATION SALES ABOVE BASE FORECAST, MWH

Scenario	2023	2025	2030	2035	2040	2042	Percent Above Base Forecast
Low	1,590	4,769	12,717	20,664	28,612	31,791	1.6%
Medium	3,227	9,682	25,819	41,955	58,092	64,546	3.3%
High	4,817	14,451	38,535	62,620	86,704	96,338	4.9%

The above results for additional load due to industrial sector building electrification (including processes) show a range of 1.5% to 4.4% above the AES base forecast, which does not include electrification. NREL’s Reference Case informs a BAU case, which indicates no industrial electrification load growth. Note that the High scenario directly utilizes NREL’s High Case to inform the AES low growth assumption. As such, the High Scenario assumes the same general mix of industry types, processes, and other drivers of NREL’s High Case. The Low and Medium Scenarios are assumed as multiples of the High Case to provide a range of possible impacts, though without reflection on the decision making, thermodynamics, and technologies that may drive electrification decisions by AES’s industrial customers over the next two decades.

AES INDIANA



2022
Market Potential Study
Distributed Energy
Resources and
Electrification

FINAL REPORT

September 2,
2022

The logo for AES Indiana features the lowercase letters 'aes' in a stylized, rounded font. The 'a' is blue, the 'e' is purple, and the 's' is green. To the right of 'aes' is the word 'Indiana' in a black, sans-serif font. Below 'Indiana' is the text '2022 IRP' in a bold, black, sans-serif font.

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Attachment 5-6

(AES Indiana's 10-Year Energy and Peak Forecast)

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Attachment 5-7a-b

(AES Indiana's 20-Year Base, High, and Low Load Forecasts)

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Attachment 5-8

(Energy Forecast Drivers)

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Attachment 5-9

(Peak Forecast Drivers and Input Data)

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Attachment 6-2

(Decrement Load Shapes Summary)

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Attachment 6-3

(AES Indiana's 2022 Market Potential Study)

AES INDIANA



2022 Demand Side Management Market Potential Study

November 18,
2022

FINAL REPORT

prepared by
GDS ASSOCIATES INC

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VOLUME I

2022 AES INDIANA Demand Side Management Market Potential Study

prepared for



NOVEMBER 2022

Chapter 1 Introduction

1 Introduction

1.1 BACKGROUND & STUDY SCOPE

This Market Potential Study was conducted to support the Integrated Resource Plan (IRP) and DSM planning for AES Indiana. The study included primary market research and a comprehensive review of current programs, historical savings, and projected energy savings opportunities to develop estimates of technical, economic, and achievable potential. Separate estimates of electric energy efficiency and demand response potential were developed. The GDS Team worked collaboratively alongside AES Indiana and the AES Indiana Oversight Board to produce estimates of future saving potential, using the best available information and best practices for developing market potential saving estimates.

The Market Potential Study included primary market research at residential dwellings, as well as commercial and industrial facilities, to better understand the mix of customers, building characteristics, and efficiency trends for each customer segment. This research effort served to create more AES Indiana-specific saturation and efficiency profiles for both the Market Potential Study, but for future load forecasting efforts as well.

1.2 TYPES OF POTENTIAL ESTIMATED

The scope of this study distinguishes three types of energy efficiency potential: (1) technical, (2) economic, and (3) achievable.

- **Technical Potential** is the theoretical maximum amount of energy use that could be displaced by efficiency, disregarding all non-engineering constraints such as cost-effectiveness and the willingness of end users to adopt the efficiency measures. Technical potential is constrained only by factors such as technical feasibility and applicability of measures.
- **Economic Potential** refers to the subset of the technical potential that is economically cost-effective as compared to conventional supply-side energy resources. Economic potential follows the same adoption rates as technical potential. Like technical potential, the economic scenario ignores market barriers to ensuring actual implementation of efficiency. Finally, economic potential only considers the costs of efficiency measures themselves, ignoring any programmatic costs (e.g., marketing, analysis, administration) that would be necessary to capture them. This study uses the Utility Cost Test (UCT) to assess cost-effectiveness.
- **Achievable Potential** is the amount of energy that can realistically be saved given various market barriers. Achievable potential considers real-world barriers to encouraging end users to adopt efficiency measures; the non-measure costs of delivering programs (for administration, marketing, analysis, and EM&V); and the capability of programs and administrators to boost program activity over time. Barriers include financial, customer awareness and WTP in programs, technical constraints, and other barriers the “program intervention” is modeled to overcome. Additional considerations include political and/or regulatory constraints. The potential study evaluated two achievable potential scenarios:
 - **MAP** estimates achievable potential on paying incentives equal to 100% of measure incremental costs and aggressive adoption rates.
 - **RAP** estimates achievable potential with AES Indiana paying incentive levels (as a percent of incremental measure costs) closely calibrated to historical levels but is not constrained by any previously determined spending levels.

1.3 STUDY LIMITATIONS

As with any assessment of energy efficiency potential, this study necessarily builds on various assumptions and data sources, including the following:

- Energy efficiency measure lives, savings, and costs
- Projected penetration rates for energy efficiency measures
- Projections of electric avoided costs
- Future known changes to codes and standards

Chapter 1 Introduction

- AES Indiana load forecasts and assumptions on their disaggregation by sector, segment, and end use
- End-use saturations and fuel shares

While the GDS team has sought to use the best and most current available data, there are often reasonable alternative assumptions which would yield slightly different results.

1.4 ORGANIZATION OF REPORT

The remainder of this report is organized in seven sections as follows:

Section 2 Market Research details the primary market research completed in conjunction with the market potential analysis.

Section 3 Baseline Forecast provides an overview of the of the forecasted energy sales by sector.

Section 4 Energy Efficiency Potential Analysis details the methodology used to develop the estimates of technical, economic, and achievable energy efficiency and demand response potential savings and provides sector-level results.

Section 5 Demand Response Potential provides a breakdown of the technical, economic, and achievable potential demand response by program type.

Appendices for the DSM Market Potential are included in Volume II of this report. MPS appendices include detailed measure level assumptions by customer segment, and C&I potential including opt-out customers.

Chapter 2 Market Research

2 Market Research

The initial step in the assessment of future potential is to develop a clear understanding of the current market segments, as well as a clear understanding of the market research data available in the AES Indiana service area. In late 2021 AES Indiana requested the GDS team to conduct market research that would inform critical elements of the market potential study. The research objectives were developed in coordination with AES Indiana and the potential study team. Primary market research activities were focused on collecting updated equipment penetration, saturation, and efficiency characteristics; as well as customer willingness to participate (WTP) in program offerings across select end-uses and measures.

The resulting data was used to develop updated estimates of baseline and efficient equipment saturation estimates in the market potential study and develop expected long-term adoption rates for energy efficiency, demand response, and DERs over the study horizon. The GDS team conducted surveys of business and residential customers during January and February of 2022 with the objectives of gathering primary data on the following topics:

- Willingness to participate in a variety of energy efficiency and demand response program scenarios.
- Baseline / Saturation of energy-using equipment
- Program awareness
- Barriers

Survey results served as inputs for the market potential model, enabling the market potential analysis to take into consideration the specific market conditions that exist in AES Indiana’s service territory. Figure 2-1 presents a summary of the specific technologies and Demand Side Management (DSM) topic areas addressed within the business and residential surveys.

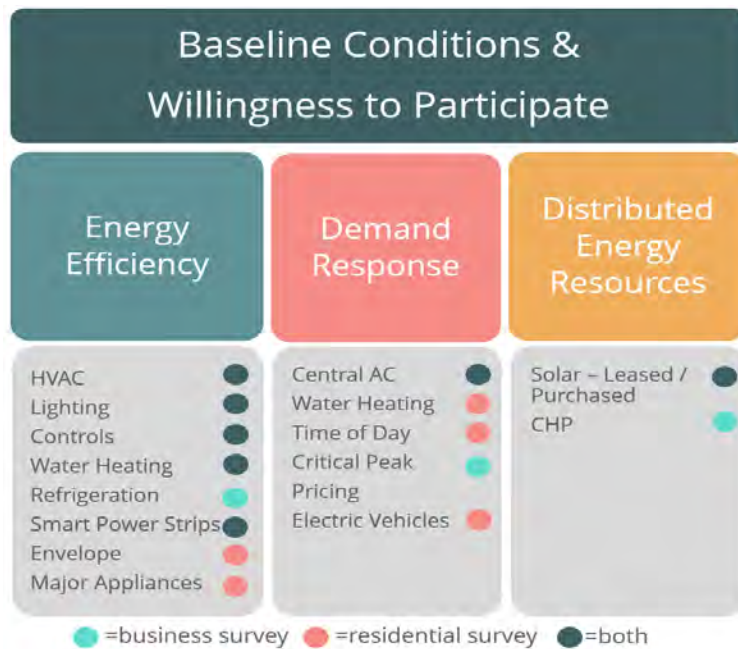


FIGURE 2-1: SURVEY SCOPE

Data collection results specific to the AES Indiana service area are provided below.

Chapter 2 Market Research

2.1 PRIMARY DATA COLLECTION

The following subsections provide an overview of the primary data collection activities conducted by the GDS team to support the market potential analysis of energy efficiency, demand response, and DER potential. The GDS team conducted survey research in the residential and non-residential sectors.

2.1.1 Survey Administration

GDS administered an online baseline end-use survey and willingness to participate survey to both the business and residential groups. Surveys were administered in an online format, with email recruitment followed by reminder emails when necessary. The residential response rate was higher than expected, while the business response rate was about as expected.

2.1.2 Sampling Approach

GDS administered an online baseline end-use survey and willingness to participate survey to both the business and residential groups. Surveys were administered in an online format, with email recruitment followed by reminder emails when necessary. The residential response rate was higher than expected, while the business response rate was about as expected.

The team developed a sampling approach with an objective of achieving industry-standard statistical significance (90% confidence, 10% relative precision, or 90/10) at the strata level for all questions, taking into consideration there would be variation in the different willingness to participate (WTP) modules included in each survey. Different WTP modules were included in the surveys to keep survey length manageable for respondents. The sample design assumed a coefficient of variation (CV) of 0.5 for the residential sample, and 0.7 for the business sample, assuming there would be greater variation among business responses.

Overall, the response outcomes were positive, and the survey effort produced a robust set of primary data. The team set aggressive sampling targets, with a goal of having high levels of statistical significance for sub-groups within the population. The response fell short on some of those targets, but the team gathered a strong data set that meets the needs of the analysis. Table 2-1 provides the sampling targets and response outcomes.

The business survey did not achieve 90/10 but did meet 85/15 statistical significance level. Even after splitting the baseline and WTP surveys, the length of the business survey could have been a factor in the low completion rate. The residential survey achieved 90/10 for all strata, and 95/5 for the non-multifamily strata and the combined non-residential customer group.

TABLE 2-1: SURVEY SAMPLING TARGETS AND RESPONSE SUMMARY

Group	Emailed	Target Completes	Completed (Partial Survey)	Completed (Entire Survey)
C&I Baseline Survey				
Commercial	2,975	65	48	36
Industrial	249	3	3	2
Total	3,224	68	51	38
C&I Willingness to Participate Survey				
Commercial	5,880	62	144	92
Industrial	545	6	9	5
Total	6,425	68	153	97
Residential Baseline Survey				
Multifamily	2,720	68	44	135

Chapter 2 Market Research

Group	Emailed	Target Completes	Completed (Partial Survey)	Completed (Entire Survey)
Non-Multifamily	12,280	316	137	652
Total	15,000	384	181	787
Residential Willingness to Participate Survey				
Multifamily	2,720	68	57	74
Non-Multifamily	12,280	316	186	388
Total	15,000	384	243	462

2.1.3 Residential Online Survey

The residential customer research targeted homeowners and tenants in the following key segments: customers occupying multifamily homes and non-multifamily homes. Multifamily homes were those customers living in an apartment, condominium, duplex, triplex, or quadraplex.

A baseline end-use residential online customer survey collected home characteristics, equipment penetration for key end-uses – such as heating, cooling, water heating, insulation, major appliances, energy conservation, and electric vehicles – and a separate survey collected information on barriers and willingness to adopt a range of energy efficient measures at varying incentive levels. Table 2-2 provides the targeted and completed baseline and willingness to participate residential online surveys.

TABLE 2-2: TARGETED AND COMPLETED RESIDENTIAL SECTOR ONLINE SERVICES

Strata	Target Completes	Total Completed
Baseline End-Use Survey		
Multifamily	68	135
Non-Multifamily	316	652
Willingness to Participate Survey		
Multifamily	68	74
Non-Multifamily	316	388

2.1.4 Business Sector Online Survey

Primary data collection was also conducted in the non-residential sector via a baseline end-use and a willingness to participate online survey with business customers. The baseline end-use survey collected business and facility characteristics, as well as equipment penetrations for key end-uses, such as lighting, heating, cooling, water heating, refrigeration, thermostats, and on-site generation (including solar PV systems). A separate non-residential online survey also collected information on barriers to energy efficiency and willingness-to-adopt energy efficient measures under various incentive offerings. In total, GDS collected complete survey data from 135 commercial and industrial customers, with 38 fully completing the baseline survey and 97 fully completing the willingness to participate survey.

2.2 RESIDENTIAL MARKET DATA

The tables below provide some key home and equipment characteristics by residential market segment. The results have been weighted to align the sample distribution with that of the overall residential populations in the AES Indiana service territory.

Chapter 2 Market Research

Table 2-3 provides current information on home type and some general house characteristics for residential customers. Some key characteristics for the market potential study are home type, multi-level or not, and home size.

TABLE 2-3: RESIDENTIAL HOME INFORMATION

	Total	Single Family	Mobile Home	Duplex/Triplex/Condo	Apartment
Home Type – Survey Responses	N/A	70%	3%	5%	6%
Home Type – AES Customer Data	N/A	82%	3%	2%	13%
Own Home	68%	78%	85%	72%	8%
Multi-level Home	44%	46%	15%	56%	36%
Have Basement	35%	41%	0%	16%	12%
Over Four Occupants	9%	10%	31%	4%	6%
1,800 sq ft Home or Larger	40%	43%	31%	48%	21%
Have Crawlspace	33%	37%	46%	16%	12%

Table 2-4 presents some key household and equipment characteristics for the residential sector by AES Indiana housing type. The data presented below includes the average number of occupants per household, and the average number of certain appliances within the various home types.

TABLE 2-4: KEY HOUSEHOLD AND EQUIPMENT CHARACTERISTICS (AVG # PER HH)

Household Characteristics	Total	Single Family	Mobile Home	Duplex/Triplex/Condo	Apartment
Average Number					
Occupants	2.5	2.5	3.3	2.4	2.2
Electric Oven	0.7	0.7	0.7	0.9	0.8
Microwave Oven	1.0	1.0	0.9	1.1	0.9
Dishwasher	0.8	0.7	0.5	1.0	0.9
Sump Pump	0.3	0.4	0.0	0.3	0.1
Attic Fan	0.1	0.1	0.0	0.1	0.1
Refrigerators	1.1	1.2	1.1	1.1	1.0
Stand-Alone Freezers	0.4	0.5	0.4	0.3	0.2
Smart Plugs/Outlets	0.3	0.3	0.3	0.2	0.2

Table 2-5 provides example summary data by market segment for major residential end-uses. These data points of electric appliances and water heating equipment penetrations help quantify the eligible population of equipment by market segment. In addition, the research also provided recent market conditions for remaining efficiency opportunities. For example, the research determined the percent of households that have emerging technologies such as heat pump water heaters, as well as the percent of homes with insulation and air sealing needs.

Chapter 2 Market Research

TABLE 2-5: SELECT RESIDENTIAL MARKET RESEARCH RESULTS FOR KEY END-USES

End-Use	Equipment	Total	Single Family	Mobile Home	Duplex/Triplex/Condo	Apartment
WH	Electric WH	52%	47%	93%	67%	72%
	Heat Pump WH <i>(as a % of electric WH)</i>	5%	3%	0%	4%	13%
Shell	Uninsulated Attic	6%	4%	23%	8%	16%
	Uninsulated Walls	42%	38%	38%	48%	69%
	Uninsulated Window Shutters	84%	82%	85%	84%	94%
	Uninsulated Bottom Floor	90%	89%	62%	96%	94%
	Single Pane Windows	62%	57%	77%	72%	90%
	No heating system pipe or duct insulation	80%	78%	54%	100%	88%
	Windows that are not caulked or weather stripped	52%	46%	62%	56%	83%
Appliance	In Unit Electric Clothes Washer	88%	93%	100%	89%	62%
	In Unit Electric Clothes Dryer	82%	86%	100%	81%	59%
	In Unit Gas Clothes Dryer	8%	9%	0%	15%	4%
	Electric Vehicle	2%	2%	0%	4%	1%
	PEV/EV Charger at Home	2%	2%	0%	0%	0%

2.3 BUSINESS MARKET DATA

Table 2-6 provides select demographic information in the business sector. Over half of AES Indiana businesses own their own building, indicating the authority to make decisions on building appliances and other energy efficiency matters. Additionally, 70% of AES Indiana business buildings are more than 20 years old.

TABLE 2-6: COMMERCIAL BUILDING CHARACTERISTICS

Own	56%
Lease	40%
Manage Building	61%
Do not Manage Building	36%
% of Facilities Built Before 2001	70%
Average Size of Facility (Sq. Ft)	27,546
Average Weekday Hours of Operation	12.9
Average Weekend Hours of Operation	9.3

Chapter 2 Market Research

The penetration of different lighting fixtures in AES Indiana businesses is shown in Table 2-7. Linear LED fixtures are estimated to be in nearly 50% of all facilities. The table also includes the percent of facilities with different lighting control types as well as the percent of lighting that is controlled. Table 2-8 provides example end-use penetration levels for various major end-uses.

TABLE 2-7: COMMERCIAL SECTOR LIGHTING END-USE CHARACTERISTICS

End Use	Equipment	Total
Lighting (% with Type)	Linear Fluorescent	53%
	Linear LED	49%
	Nonlinear LED	33%
	Incandescent	31%
	Compact Fluorescent	7%
	High Intensity Discharge	42%
Lighting (% of all Lighting)	Linear Fluorescent	41%
	Linear LED	25%
	Nonlinear LED	5%
	Incandescent	9%
	Compact Fluorescent	3%
	High Intensity Discharge	18%
Lighting Controls	Occupancy Sensors	24%
	<i>% of Lighting Controlled</i>	7%
	Daylight Dimming	8%
	<i>% of Lighting Controlled</i>	1%
	Time Controls	8%
	<i>% of Lighting Controlled</i>	0%
	Advanced Lighting Controls	0%
	<i>% of Lighting Controlled</i>	0%

TABLE 2-8: COMMERCIAL SECTOR EQUIPMENT PENETRATION ACROSS KEY END-USES

End Use	Equipment	Penetration
Heating	Boiler	5%
	Furnace	54%
	Heat Pump	9%
	Electric Resistance	4%
	Unit Heater	11%
	Infrared	0%
Cooling	Packaged System AC	51%
	Split System AC	29%
	Heat Pump (Ducted)	7%
	Heat Pump (Ductless)	2%
	Chiller	2%
	Window AC	9%
Thermostats	Smart Thermostats	11%
	% of Space Controlled by Smart Thermostat	12%

Chapter 2 Market Research

End Use	Equipment	Penetration
Ventilation	Demand Controlled Ventilation	11%
	Vent Hoods	20%
	Vent Hoods with Demand Controlled Vent.	55%
Refrigeration	Has Commercial Refrigeration?	8%
	Ice Machines	5%
Smart Strips	Smart Strips (% of All Strips)	12%
Water Heating	Electric WH	58%
On-Site Generation	Renewable Energy Generation	5%
	Emergency/Backup Generation	5%
	Cogeneration/CHP	0%

2.4 ADOPTION CURVE MARKET DATA

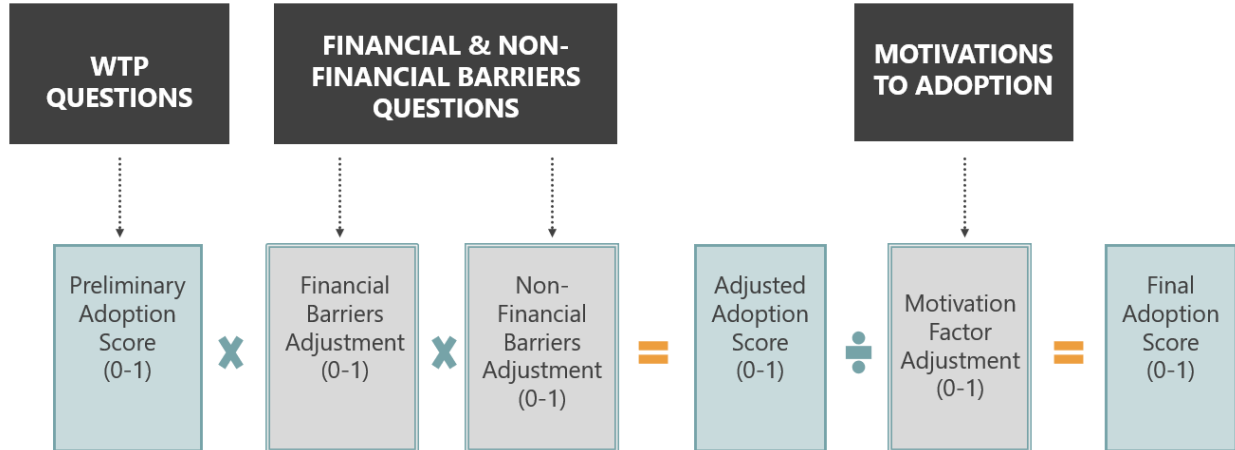
In addition to new primary research on building and end-use equipment characteristics, one of the major objectives of the primary research was to gather survey data that could be utilized to develop measure/program adoption curves to calculate estimates of achievable potential. Table 2-9 describes the end-uses or categories in which adoption rate estimates were developed for energy efficiency and demand response programs the GDS team.

TABLE 2-9: ADOPTION RATE CATEGORIES ANALYZED

Willingness to Participate	EE End Uses	DR Programs
Residential Customers	Heating/Cooling Systems Water Heating Major Appliances Insulation/Air Sealing	Thermostat Control Water Heater Control Time of Day Rate
Business Customers	Heating/Cooling Systems Water Heating Equip. Refrigeration Lighting Equipment	Central AC Control Customized DR (Critical Peak Pricing)

Adoption rate calculations were based on a battery of questions which assessed (1) the respondent’s willingness to adopt energy efficiency technologies or participate in demand response programs in scenarios with varying levels of program support, (2) the magnitude of the respondent’s financial and non-financial barriers as well as potential motivational factors to adoption/participation. Adoption rates were calculated based on the equation shown below.

EQUATION 2-1 ADOPTION RATE FORMULA FOR FINAL ADOPTION SCORE



Direct willingness-to-participate questions are the starting point of measure/program-specific adoption curve calculations. For each item, respondents were asked to rate the likelihood that they would purchase the energy efficient version of the equipment, or participate in the DR program, at various incentive levels, including no incentive and an incentive that covers the full incremental (or total) cost.

Responses to financial and non-financial barrier questions were then used to adjust the preliminary adoption score. If “cost” was a consideration to prevent customers from purchasing energy efficient equipment, GDS assumed a financial barrier adjustment. The 0% incentive level was reduced by 100%, the 25% incentive level was reduced by 80%, the 50% incentive level was reduced by 60%, the 75% incentive level was reduced by 40%, and the 100% incentive level was reduced by 20%.

If another reason (i.e., lack of knowledge, uncertainty about bill savings, etc.) was a consideration to prevent customers from purchasing energy efficient equipment, GDS assumed a non-financial barrier adjustment. The 0% incentive level was reduced by 50%, the 25% incentive level was reduced by 40%, the 50% incentive level was reduced by 30%, the 75% incentive level was reduced by 20%, and the 100% incentive level was reduced by 10%.

Last, if the respondent indicated a strong motivation for purchasing an efficient technology or participating in a demand response program (i.e. bill savings, progress towards sustainability goals, etc.) then the adjusted adoption score was increased. The 0% incentive was increased by 25%, the adjusted adoption rate at the 25% incentive level was increased by 66%, the 50% incentive level by 150%. Respondents who indicated a strong motivation factor were typically assigned a 100% adoption score at the 75% and 100% incentive levels.

2.4.1 Residential Sector Final Adoption Scores

Table 2-10 presents the adjusted adoption scores (after financial and non-financial adjustments) for AES Indiana residential customers.

TABLE 2-10: RESIDENTIAL FINAL ADOPTION SCORES BY INCENTIVE LEVEL

All Homeowners	Annual Incentive (% of incremental measure cost)				
	0%	25%	50%	75%	100%
Heating/Cooling	28%	52%	67%	80%	89%
Water Heating	22%	36%	49%	61%	72%
Insulation/Air Sealing	16%	31%	47%	63%	80%
Appliances	22%	38%	55%	68%	79%

Chapter 2 Market Research

Final adoption scores for residential direct load control (DLC) of central AC and water heating systems are shown in Table 2-11, depending on varying annual incentive levels. Current annual incentive offerings are \$20 for direct load control of central air conditioning systems for residential customers and \$30 for C/I customers. Table 2-12 provides the final adoption score for a Time of Use (TOU) rate option based on a prescribed difference between peak and off-peak rates.

TABLE 2-11: DLC DEMAND RESPONSE FINAL ADOPTION SCORES BY INCENTIVE LEVEL

DR – DLC	Annual Incentive (% of incremental measure cost)				
Market Rate	\$0	\$15	\$25	\$35	\$50
Central AC – SF	23%	41%	58%	67%	73%
Central AC – MF	27%	40%	50%	63%	83%
Water Heat – SF	21%	35%	46%	57%	63%
Water Heat – MF	28%	37%	56%	68%	76%
Income-Eligible	\$0	\$15	\$25	\$35	\$50
Central AC – SF	14%	24%	55%	63%	82%
Central AC – MF	N/A	N/A	N/A	N/A	N/A
Water Heat – SF	13%	16%	22%	23%	24%
Water Heat – MF	36%	44%	62%	68%	74%

TABLE 2-12: TOU DEMAND RESPONSE FINAL ADOPTION SCORES BY INCENTIVE LEVEL

DR – Rate	Lower off-peak rate			
Market Rate	\$0.08	\$0.06	\$0.04	\$0.03
DR-TOU – SF	36%	44%	56%	64%
DR TOU – MF	37%	48%	58%	65%
Income-Eligible	\$0.08	\$0.06	\$0.04	\$0.03
DR-TOU – SF	37%	40%	43%	47%
DR TOU – MF	38%	52%	63%	69%

2.4.2 Business Sector Final Adoption Scores

Table 2-13 presents the adjusted adoption scores (after financial and non-financial barrier and motivation factor adjustments) for AES Indiana non-residential customers across several end-uses, depending on whether the investment is a minor or major investment. Small businesses indicated a major investment to be on average approximately \$7,500. Final adoption scores were similar regardless of the initial investment amount.

In contrast to the residential sector energy efficiency WTP research, the nonresidential WTP survey questions incentives were described in the form of payback periods to better align with how purchasing decisions are likely to be considered.

TABLE 2-13: NONRESIDENTIAL FINAL ADOPTION SCORES BY INCENTIVE LEVEL AND INVESTMENT TYPE

Minor Inv.	Payback Performance (after incentive)				
	10 Years	5 Years	3 Years	1 Year	0 Years
HVAC	29%	46%	65%	73%	81%
Lighting	24%	38%	61%	76%	83%
Refrigeration	30%	51%	66%	74%	79%

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Water Heating	27%	43%	61%	72%	74%
Major Inv.	Payback Performance (after incentive)				
	10 Years	5 Years	3 Years	1 Years	0 Years
HVAC	34%	48%	62%	73%	83%
Lighting	23%	41%	63%	78%	85%
Refrigeration	30%	51%	68%	74%	79%
Water Heating	25%	44%	60%	71%	76%

Final adoption scores for business sector demand response options are shown in Table 2-14, depending on varying annual incentive levels for direct load control as well as volunteer load reduction. The table also provides business sector responses for participation likelihood in a Critical Peak Pricing (CPP) DR rate program on a prescribed difference between peak and off-peak rates designs.

TABLE 2-14: NONRESIDENTIAL DEMAND RESPONSE FINAL ADOPTION SCORES

DR – DLC	Annual Incentive				
	\$0	\$15	\$25	\$35	\$50
Central AC	28%	42%	61%	71%	77%
DR – Rates	Lower than current rate				
	5%	10%	20%	40%	
Critical Peak Pricing	23%	29%	39%	49%	

Chapter 3 Baseline Forecast

3 Baseline Forecast

The load forecast is a critical input into AES-Indiana's 2022 DSM Market Potential Study, having various uses in estimation of residential and business sector potential. Therefore, the GDS Team took considerable time and effort to review AES Indiana's most recently completed load forecast models and documentation to produce the various forecast components necessary as inputs into this analysis. The chapter describes the several ways in which the forecast is used for this study, presents the baseline and disaggregated forecasts, and describes the methodology and data sources used by GDS for the purposes of generating the load forecasts that were used in the potential analysis.

3.1 AES INDIANA LOAD FORECASTING SYSTEM

AES Indiana employs a sophisticated load forecasting system that uses econometric and Statistically Adjusted End-Use ("SAE") models to project number of consumers, average consumption per consumer, and total energy sales by class. Residential, Commercial, and Industrial consumers are projected using traditional econometric techniques. Residential average usage and commercial energy sales are projected using SAE model specifications. Industrial energy sales are projected using econometric techniques.

A residential SAE model specification takes end-use data drawn from utility, regional, and even national sources and develops monthly end-use indices designed to predict average household consumption. The end-use data includes market shares of key electric consuming appliances, average device efficiency trends, average building shell efficiency trends, price elasticity of demand, income elasticity of demand, and elasticity associated with the average number of people per household. A cooling index is developed to represent space cooling load and is further modified by Cooling Degree Days to incorporate summer weather into the model. Likewise, a heating index representing space heating is modified by Heating Degree Days. Finally, a base index is developed to represent consumption of all other end-uses in the home.

A commercial SAE model specification is like a residential specification, except end-use energy intensity indices are developed for each commercial building type based on area employment in various industry codes. National and regional commercial data is used to estimate end-use consumption for various industries (for example, restaurants will have higher cooking usage shares than offices).

AES Indiana also projects the impacts of DSM programs it has run in the past. The DSM impacts included in the load forecast based on the evaluated results of AES Indiana DSM programs.

3.2 ADJUSTMENTS TO THE AES-INDIANA LOAD FORECAST

Before assessing the future potential for energy efficiency and demand response in the AES Indiana service area, a few modifications to AES Indiana's 2021-vintage forecast were necessary to create an adjusted baseline forecast. These modifications are addressed in more detail below.

3.2.1 Appliance Market Share Adjustments

The base case forecast AES Indiana developed uses the Energy Information Administration's (EIA) Residential Energy Consumption Survey (RECS) as inputs for residential appliance market share data. The RECS market share data can be summarized by U.S. Census Region, however that is the most detailed level of data published. GDS utilized the residential baseline end-use survey (Chapter 2) to update the market share inputs with data specific to AES Indiana residential customers. AES Indiana utilized the updated market share data to produce an adjusted baseline forecast for the residential class customers. Using such detailed market share data provides more confidence in the accuracy of the forecast and allows GDS to understand which appliance end-uses may be most useful for targeting with EE or DSM programs.

Chapter 3 Baseline Forecast

3.2.2 Adjustment for Large C&I Opt-Out Customers

The 2021 AES Indiana business sector customer database containing usage and demographic data for all C&I customers, with indication for large customer opt-out of DSM/EE programs status was utilized to determine how to adjust for opt-out customers. The number of customers and total energy use was calculated both including and excluding opt-out customers. The load forecast for the C&I sectors was adjusted down by the percent of load attributed to opt-out customers from the customer database, in effect excluding from the potential analysis any load of opt-out customers. The opt-out adjustment was held constant for all years of the load forecast. In total, GDS removed approximately 28% of commercial energy sales and 76% of industrial energy sales due to large customer opt-out.

3.2.3 Reclassification of Load

The 2021 AES Indiana C&I sector customer database designated commercial and industrial rate code based on current tariff definition. When only using the account type/tariff definition to classify customers as either commercial or industrial, there were several manufacturing type premises classified as commercial, as well as several customers that GDS typically classifies as commercial classified as industrial, (i.e. a retail service building coded as an industrial account).

Additionally, the dataset also identified each business by Standard Industry Code (SIC). To reclassify AES Indiana C&I sector data, GDS mapped industry codes to a specified building type and classified the building type as either commercial or industrial. Customers with a building type classified as “Industrial Manufacturing” were coded as Industrial customers, while all other building types were coded as Commercial. While the goal for this analysis is to determine the actual amount of energy sales attributable to the commercial and industrial customer classes, it is only achievable by analyzing individual customer data. The result of this reclassification was a shift of approximately 36% of industrial sector sales, or 1,049,746 MWh, to the commercial sector. This 36% shift was then applied to the AES Indiana base case forecasted sales for the commercial and industrial classes. It is important to have accurate energy sales by customer class so that specific DSM/EE programs have the correct amount of energy sales eligible for savings.

3.3 LOAD FORECAST DISAGGREGATION

The baseline forecasts represent projected total energy sales by class. For the potential studies, it is useful to have the class forecasts disaggregated in several different ways. This section presents the forecast disaggregation scenarios used by GDS to determine intensity by end-use.

3.3.1 Residential Sector

The residential electric calibration effort led to an end-use intensity breakdown as shown below in Figure 3-1. Overall, we estimated per home consumption to be 11,133 kWh per year for 2021. The “Heating” end use is the leading end-use, confirming the heavy presence of electric heat sources within the AES Indiana service territory. The “Other” end use is the second leading end-use which includes plug loads such as electronics and miscellaneous small appliances. This reflects the increasing prominence of electronics and other plug-in load devices within the typical residential home.

Chapter 3 Baseline Forecast

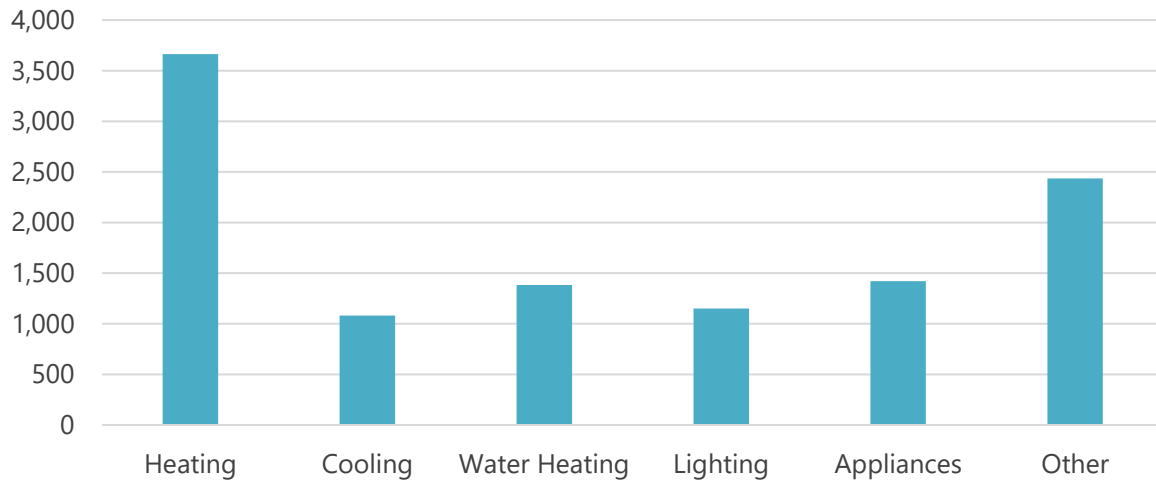


FIGURE 3-1 RESIDENTIAL ELECTRIC END-USE BREAKDOWN

3.3.2 C&I Sector

In the C&I sector, disaggregated forecast data provides the foundation for the development of energy efficiency potential estimates. GDS received a base case sales forecast from AES Indiana for the residential, commercial, and industrial sectors. As noted above, the C&I forecast was adjusted from the base case by using SIC information from AES Indiana to reclassify usage as commercial or industrial. SIC information from AES Indiana, along with CBECS building type consumption tables, was then used to segment the forecast into building types. The forecast was further segmented into end-uses by building type using regional specific projections of end-use consumption contained within EIA’s Annual Energy Outlook supporting workpapers. Figure 3-2 provides a breakdown of commercial electric sales by building type.¹

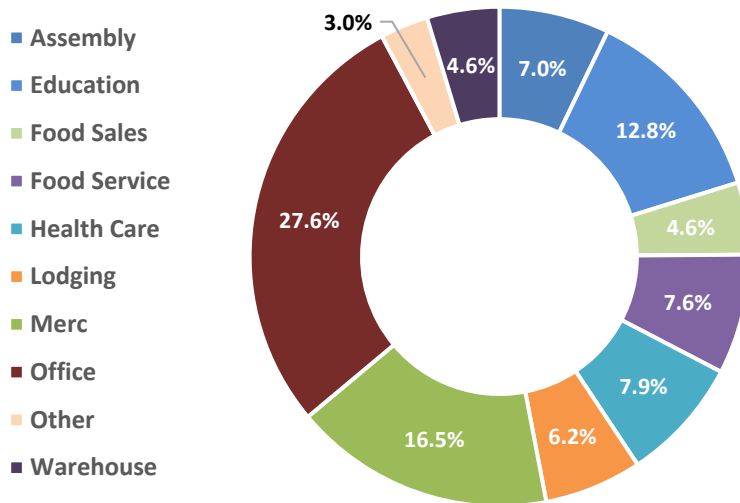


FIGURE 3-2: COMMERCIAL ELECTRIC SALES BREAKDOWN BY BUILDING TYPE

Figure 3-3 provides an illustration of the leading end-uses across all building types in the commercial sector. Lighting, space cooling, and ventilation are the primary end-uses with a significant share of load across most building types. Shares of refrigeration and office/computing are often dependent on the type of building, with

¹ “Other” commercial building types include buildings that engage in several different activities, a majority of which are commercial (e.g. retail space), though the single largest activity may be industrial or agricultural; “other” also includes miscellaneous buildings that do not fit into any other category.

Chapter 3 Baseline Forecast

refrigeration loads greatest in food sales and food service while office/computing loads are greatest in offices and education. Miscellaneous plug load is also a significant share of load in some building types, indicating that various small electric devices are becoming more common in commercial buildings.

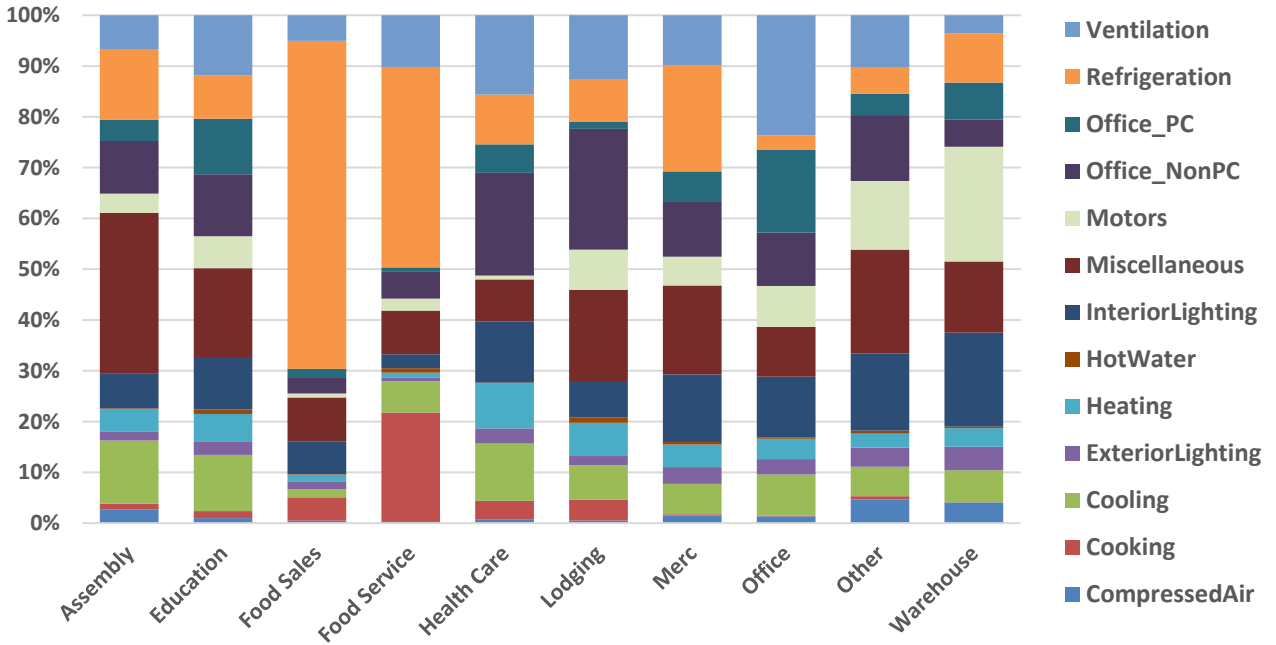


FIGURE 3-3: COMMERCIAL ELECTRIC END-USE BREAKDOWN BY BUILDING TYPE

Industrial sales were also segmented by end-use based on the overall distribution of sales by industry type and EIA MECS data on end-use consumption by industrial segment. Figure 3-4 provides a breakdown of the sales by end-use. Overall, the weighted average industrial sales by end-use in the AES Indiana service area was 42% Machine Drive, 14% Process Heat, 8% HVAC, 8% Compressed Air, 7% Lighting, and 7% Process Refrigeration. The remaining 12% was split between other process and other facility loads.

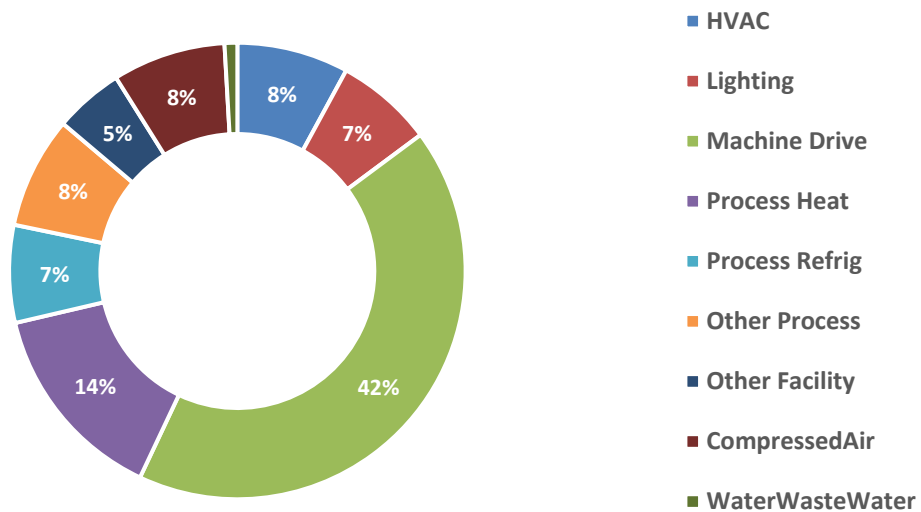


FIGURE 3-4: INDUSTRIAL ELECTRIC END-USE BREAKDOWN BY BUILDING TYPE

Chapter 4 Energy Efficiency Potential Analysis

4 Energy Efficiency Potential Analysis

This section describes the overall methodology utilized to assess the electric energy efficiency potential in the AES Indiana service area. The main objectives of this Market Potential Study were to estimate the technical, economic, maximum, and realistic potential savings from energy efficiency in the AES Indiana service territory; and to quantify these estimates of potential in terms of MWh and MW savings, for each level of energy efficiency and demand response potential.

4.1 OVERVIEW OF APPROACH

For the residential sector, GDS utilized a bottom-up approach to the modeling of energy efficiency potential, whereby measure-level estimates of costs, savings, and useful lives were used as the basis for developing the technical, economic, and achievable potential estimates. The measure data was used to build-up the technical potential, by applying the data to each relevant market segment. The measure data allowed for benefit-cost screening to assess economic potential, which was in turn used as the basis for achievable potential, taking into consideration incentives and estimates of annual adoption rates. For the C&I sector, GDS employed a bottom-up modeling approach to first estimate measure-level savings, costs, and cost-effectiveness, and then applied measure savings to all applicable shares of energy load.

4.2 MARKET CHARACTERIZATION

The initial step in the analysis was to gather a clear understanding of the current market segments in the AES Indiana service area. The GDS team coordinated with AES Indiana to gather utility sales and customer data and existing market research to define appropriate market sectors, market segments, vintages, saturation data and end uses. This information served as the basis for completing a forecast disaggregation and market characterization of both the residential and nonresidential sectors.

4.2.1 Forecast Disaggregation

As noted in Chapter **Error! Reference source not found.**, through the development of the baseline forecasts, the GDS Team produced disaggregated forecasts by sector and end-use. The resulting aggregate baseline forecasts were disaggregated by sector and then further segmented as follows:

- **Residential.** The residential forecast was broken out by housing type between existing income qualified and market-rate customers as well as new construction.
- **Commercial.** Typically based on major EIA CBECS business types: retail, warehouse, food sales, office, lodging, health, food service, education, and miscellaneous.
- **Industrial.** As determined by actual load consumption shares and major industry types as defined by EIA’s Manufacturing Energy Consumption Survey (MECS) data.

The segmentation analysis was performed by applying AES Indiana -specific segment and end-use consumption shares, derived from AES Indiana’s customer database and SIC code analysis (building segmentation), and by EIA CBECS and MECS data (end-use segmentation) to forecast year sales. Within the residential, commercial, and industrial market segments, the sector level disaggregated forecasts were further segmented by the major end uses shown in Table 4-1.

TABLE 4-1: ELECTRIC END-USE LOADS

Residential	C&I	
	Commercial	Industrial
Heating	Interior Lighting	Lighting
Cooling	Exterior Lighting	HVAC
Water Heating	Refrigeration	Machine Drive
Cooking	Space Cooling	Process Heat
Refrigerator	Space Heating	Process Cool / Refrigeration

Chapter 4 Energy Efficiency Potential Analysis

Freezer	Ventilation	Other Process
Dishwasher	Water Heating	Process – Machine Drive
Clothes Washer	Plug Loads / Office Equipment	Other Facility
Dryer	Cooking	Compressed Air
TV	Other	Water / Wastewater
Light	Whole Building / Behavioral	Process – Agriculture
Miscellaneous		Whole Building / Behavior

4.2.2 Eligible Opt-Out Customers

In Indiana, individual commercial or industrial customer sites with a peak load greater than 1MW are eligible to opt out of utility-funded electric energy efficiency programs. In the AES Indiana service area, approximately 28% of total reclassified retail commercial sales have opted out of utility-funded electric energy efficiency programs, while 76% of total reclassified retail industrial sales have opted out.

Figure 4-1 shows the total sales for the C&I sectors, as well as the sales, by sector, which have currently opted out of paying the charge levied to support utility-administered energy efficiency programs. The portion of sales that have not opted out include both ineligible load (i.e., does not meet the 1 MW peak demand requirement) as well as eligible load that has not yet opted out.

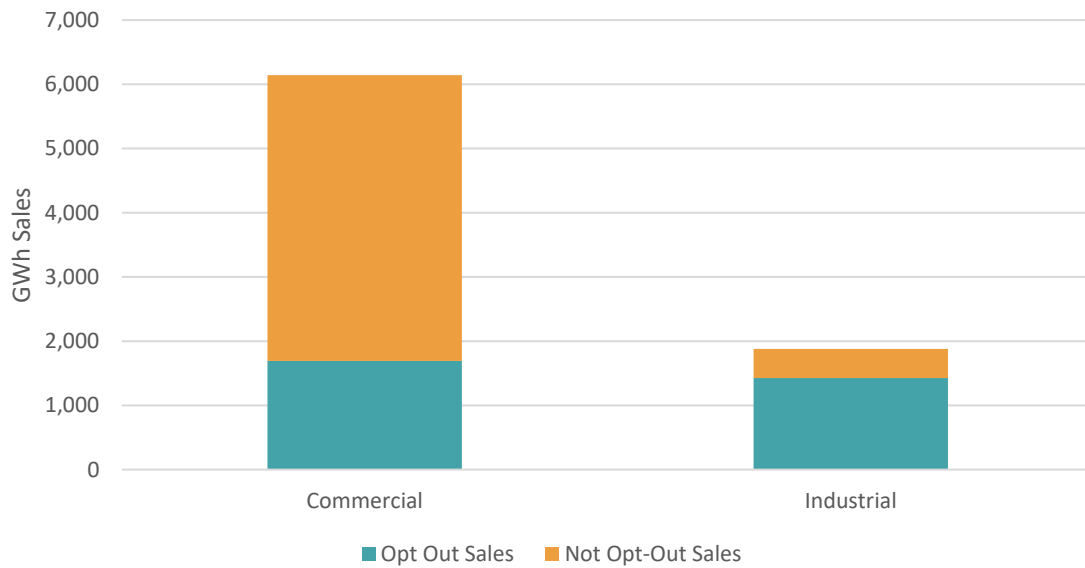


FIGURE 4-1 OPT-OUT SALES BY C&I SECTOR

GDS removed the sales from opt-out customers in the assessment of technical, economic, and achievable potential reflected in this report. As a sensitivity (included in Appendix A), GDS also examined the full potential in the C&I sector if these customers were no longer able to opt-out of utility-funded electric energy efficiency programs.

4.2.3 Building Stock/Equipment Saturation

To assess the potential electric energy efficiency savings available, estimates of the current saturation of baseline equipment and energy efficiency measures are necessary.

Chapter 4 Energy Efficiency Potential Analysis

4.2.3.1 Residential Sector

For the residential sector, GDS relied on the research efforts described in Chapter 2. GDS also relied on online and onsite surveys of AES Indiana customers conducted by the GDS Team in 2018 for the previous potential study. Other data sources included ENERGY STAR unit shipment data, AES Indiana evaluation reports, and EIA Residential Energy Consumption Survey data. The ENERGY STAR unit shipment data filled data gaps related to the increased saturation of energy efficient equipment across the U.S. in the last decade.

4.2.3.2 Business Sector

For the commercial sector, building stock and equipment saturation data was informed from a combination of primary market research (online surveys noted in Chapter **Error! Reference source not found.**), as well as other available regional or national data. The survey data helped inform the disaggregation of the end-use sales forecast further into measure groups consistent with the measures included in the potential analysis as well as saturation of energy efficient equipment.

Beyond the primary data collection, EIA regional data, as well as national studies on commercial energy consumption were used to inform consumption in the remaining end-uses where data from the primary market research was even more limited.² These sources typically informed estimates of base equipment saturation for cooking, refrigeration, water heating, plug loads, and other miscellaneous end-uses.

For the industrial sector, the analysis employed a top-down analysis at the end-use level. Accordingly, it was not critical to disaggregate the industrial sales at a measure-level. Instead, measures were developed to estimate savings at a total end-use level.

4.2.4 Remaining Factor

The remaining factor is the proportion of a given market segment that is not yet efficient and can still be converted to an efficient alternative. It is the inverse of the saturation of an energy efficient measure, prior to any adjustments. In this study, two key adjustments were made to recognize that the energy efficient saturation does not necessarily always fully represent the state of market transformation. First, while a percentage of installed measures may already be efficient, some customers may backslide (i.e. revert to standard technologies, or otherwise less efficient alternatives in the future, based on considerations like measure cost and availability and customer preferences). For example, historically, some customers have disliked CFL light quality, and have reverted to incandescent and halogen bulbs after the CFLs burn out.

Second, for measures categorized as market opportunity (i.e. replace-on-burnout), we assumed that 50% of the instances in which an efficient measure is already installed, the burnout or failure of those measures would be eligible for inclusion in the estimate of future savings potential. This adjustment assumes that 50% of the market is transformed, and no future savings potential exists, whereas the remaining 50% of the market is not transformed and could backslide without the intervention of an AES-Indiana program and an incentive. Similarly, for retrofit measures, we assumed that only 10% of the instances in which an efficient measure is already installed, the burnout or failure of those measures would be eligible for inclusion in the estimate of future savings potential. This recognizes the more proactive nature of retrofit measures, as the implementation of these measures are more likely to be elective in nature, compared to market opportunity measures, which are more likely to be needs-based. The uncertainty in these assumptions is appropriate, as they factor in a key component of natural customer decision making.

² Examples of secondary research include: Energy Savings Potential RD&D Opportunities for Commercial Building Appliances. 2016. DOE and Energy Star Shipment Data.

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4.3 MEASURE CHARACTERIZATION

4.3.1 Measure Lists

The study’s sector-level energy efficiency measure lists were informed by a range of sources including the Illinois TRM, current AES Indiana program offerings, measures included in other recent Indiana utility market potential studies, and commercially viable emerging technologies, among others. Measure list development was a collaborative effort in which GDS developed draft lists that were shared with AES Indiana and stakeholders. The final measure lists included in the study reflected the informed comments and considerations from the parties that participated in the measure list review process.

In total, GDS analyzed 353 measure types for this study. Several measures were included with multiple permutations to account for different specific market segments, such as different building types, efficiency levels, and replacement options. In total, GDS developed 2,106 measure permutations for this study. Each permutation was screened for cost-effectiveness under the UCT cost test. The parameters for cost-effectiveness under the UCT are discussed in detail later in Section 4.4.3.

TABLE 4-2: NUMBER OF MEASURES EVALUATED

	# of Measures	Total # of Measure Permutations
Residential	170	755
Commercial	184	1687
Total	354	2,442

4.3.2 Emerging Technologies

GDS considered several specific emerging technologies as part of analyzing future potential. In the residential sector, these technologies include several smart technologies, including smart appliances, smart water heater (WH) tank controls, smart window coverings, smart TVs, heat pump dryers and smart vents/sensors. In the non-residential sector, specific emerging technologies that were considered as part of the analysis include several commercial behavioral options, triple pane windows, energy recovery ventilators, variable refrigerant flow heat pumps, switch reluctance motors, Q-Sync Motors for Refrigeration, ozone commercial laundry, advanced lighting controls, power distribution equipment upgrades, and server virtualization. While this is not an exhaustive list of possible emerging technologies over the next twenty years it does consider many of the known technologies that are available today but may not yet have widespread market acceptance and/or product availability.

In addition to these specific technologies, GDS acknowledges that there could be future opportunities for innovative technologies as equipment standards improve and market trends occur. While this analysis does not make any explicit assumption about unknown future technologies, the methodology assumes that subsequent equipment replacement that occurs over the course of the study timeframe, and at the end of the initial equipment’s useful life, will continue to achieve similar levels of energy savings, relative to improved baselines, at similar incremental costs.

4.3.3 Assumptions & Sources

A significant amount of data is needed to estimate the electric savings potential for individual energy efficiency measures or programs across the residential and nonresidential customer sectors. GDS utilized data specific to AES Indiana when it was available and current. GDS used the most recent AES Indiana evaluation report findings (as well as AES Indiana program planning documents), the Illinois TRM, and the Michigan Energy Measures Database (MEMD), and EIA data for a large amount of the data requirements. Additional source documents included American Council for an Energy-Efficient Economy (ACEEE) research reports covering topics like emerging technologies.

Measure Savings: GDS relied on existing AES Indiana evaluation report findings and the Illinois TRM to inform calculations supporting estimates of annual measure savings as a percentage of base equipment usage. For

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custom measures and measures not included in the Illinois TRM, GDS estimated savings from a variety of sources, including:

- MEMD, IN TRM, and other regional/state TRMs
- Secondary sources such as the ACEEE, Department of Energy (DOE), EIA, ENERGY STAR®, and other technical potential studies

Measure Costs: Measure costs represent either incremental or full costs. These costs typically include the incremental cost of measure installation, when appropriate based on the measure definition. For purposes of this study, nominal measure costs held constant over time.

GDS obtained measure cost estimates primarily from AES Indiana evaluation report findings and the Illinois TRM. GDS also used the following supplementary data sources:

- MEMD, IN, and other regional/state TRMs
- Secondary sources such as the ACEEE, ENERGY STAR, and NREL

Costs and savings for new construction and replace on burnout measures were calculated as the incremental difference between the code minimum equipment and the energy efficiency measure. This approach was utilized because the consumer must select an efficiency level that is at least the code minimum equipment when purchasing new equipment. The incremental cost is calculated as the difference between the cost of high efficiency and standard efficiency (code compliant) equipment. However, for retrofit or direct install measures, the measure cost was the “full” cost of the measure, as the baseline scenario assumes the consumer would not make energy efficiency improvements in the absence of a program. In general, the savings for retrofit measures are calculated as the difference between the energy use of the removed equipment and the energy use of the new high efficiency equipment (until the removed equipment would have reached the end of its useful life).

Measure Life: Measure life represents the number of years that energy using equipment is expected to operate. GDS obtained measure life estimates from the AES Indiana evaluation report findings and the Illinois TRM:

- MEMD, IN TRM, and other regional/state TRMs
- Manufacturer data
- Savings calculators and life-cycle cost analyses

All measure savings, costs, and useful life assumption sources are documented in the Appendices volume of this report.

4.3.4 Treatment of Codes & Standards

Although this analysis does not attempt to predict how energy codes and standards will change over time, the analysis does attempt to reflect the latest legislated improvements to federal codes and standards. Where possible, improvements to baseline equipment standards can typically be met with incremental improvements to efficient equipment standards. However, in select case, such as screw-in lighting improvements to the baseline standard effectively were expected to eliminate the efficient technology from future consideration.

4.3.5 Net to Gross (NTG)

All estimates of technical, economic, and achievable potential, as well as measure level cost-effectiveness screening were conducted in terms of gross savings to reflect the absence of program design considerations in these phases of the analysis. The impacts of free-riders (participants who would have installed the high efficiency option in the absence of the program) and spillover customers (participants who install efficiency measures due to program activities, but never receive a program incentive) were considered in the development of DSM Inputs into AES Indiana’s upcoming IRP.

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4.4 ENERGY EFFICIENCY POTENTIAL

4.4.1 Types of Potential

This section reviews the types of potential analyzed in this report, as well as some key methodological considerations in the development of technical, economic, and achievable potential.

The first two types of potential, technical and economic, provide a theoretical upper bound for energy savings from energy efficiency measures. Still, even the best-designed portfolio of programs is unlikely to capture 100% of the technical or economic potential. Therefore, achievable potential attempts to estimate what savings may realistically be achieved through market interventions, when it can be captured, and how much it would cost to do so. Figure 4-2 illustrates the types of energy efficiency potential considered in this analysis.

FIGURE 4-2: TYPES OF ENERGY EFFICIENCY POTENTIAL

Not Technically Feasible	TECHNICAL POTENTIAL			
Not Technically Feasible	Not Cost Effective	ECONOMIC POTENTIAL		
Not Technically Feasible	Not Cost Effective	Market Barriers	MAXIMUM ACHIEVABLE POTENTIAL	
Not Technically Feasible	Not Cost Effective	Market Barriers	Partial Incentives	REALISTIC ACHIEVABLE POTENTIAL

4.4.2 Technical Potential

Technical potential is the theoretical maximum amount of energy use that could be displaced by efficiency, disregarding all non-engineering constraints such as cost-effectiveness and the willingness of end users to adopt the efficiency measures. Technical potential is only constrained by factors such as technical feasibility and applicability of measures. Under technical potential, GDS assumed that 100% of new construction and market opportunity measures are adopted as those opportunities become available (e.g., as new buildings are constructed, they immediately adopt efficiency measures, or as existing measures reach the end of their useful life). For retrofit measures, implementation was assumed to be resource constrained and that it was not possible to install all retrofit measures all at once. Rather, retrofit opportunities were assumed to be replaced incrementally until 100% of stock was converted to the efficient measure over a period of no more than 15 years.

The core equation used in the residential sector energy efficiency technical potential analysis for each individual efficiency measure is shown in Equation 4-1 below. The C&I sector employs a similar analytical approach.

EQUATION 4-1 CORE EQUATION FOR RESIDENTIAL SECTOR TECHNICAL POTENTIAL



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Where...

Base Case Equipment End-Use Intensity = the electricity used per customer per year by each base-case technology in each market segment. In other words, the base case equipment end-use intensity is the consumption of the electrical energy using equipment that the efficient technology replaces or affects.

Saturation Share = the fraction of the end-use electrical energy that is applicable for the efficient technology in each market segment. For example, for residential water heating, the saturation share would be the fraction of all residential electric customers that have electric water heating in their household.

Remaining Factor = the fraction of equipment that is not considered to already be energy efficient. To extend the example above, the fraction of electric water heaters that is not already energy efficient.

Feasibility Factor = (also functions as the applicability factor) the fraction of the applicable units that is technically feasible for conversion to the most efficient available technology from an engineering perspective (e.g., it may not be possible to install heat pump water heaters in all homes because of space limitations).

Savings Factor = the percentage reduction in electricity consumption resulting from the application of the efficient technology.

4.4.2.1 Competing Measures & Interactive Effects Adjustments

GDS prevents double-counting of savings, and accounts for competing measures and interactive savings effects, through three primary adjustment factors:

Baseline Saturation Adjustment. Competing measure shares are factored into the baseline saturation estimates. For example, nearly all homes can receive insulation. To account for this, GDS' analysis used multiple measure permutations that account for varying impacts of different heating/cooling combinations and baseline saturations were applied to reflect the proportions of households with each heating/cooling combination.

Applicability Factor Adjustment. Combined measures into measure groups, where total applicability factor across measures is set to 100%. For example, homes cannot receive a programmable thermostat, connected thermostat, and smart thermostat. In general, the models assign the measure with the most savings the greatest applicability factor in the measure group, with competing measures picking up any remaining share.

Interactive Savings Adjustment. As savings are introduced from select measures, the per-unit savings from other measures need to be adjusted (downward) to avoid over-counting. The analysis typically prioritizes market opportunity equipment measures (versus retrofit measures that can be installed at any time). For example, the savings from a smart thermostat are adjusted down to reflect the efficiency gains of installing an efficient air source heat pump.

4.4.3 Economic Potential

Economic potential refers to the subset of the technical potential that is economically cost-effective (based on screening with the UCT) as compared to conventional supply-side energy resources.

4.4.3.1 Utility Cost Test & Incentive Levels

The economic potential assessment included a screen for cost-effectiveness using the UCT at the measure level. In the AES-Indiana territory, the UCT considers electric energy, capacity, and transmission & distribution (T&D) savings as benefits, and utility incentives and direct install equipment expenses as the cost. Consistent with application of economic potential according to the National Action Plan for Energy Efficiency, the measure level economic screening does not consider non-incentive/measure delivery costs (e.g. admin, marketing, evaluation etc.) in determining cost-effectiveness.³

³ National Action Plan for Energy Efficiency: Understanding Cost-Effectiveness of Energy Efficiency Programs. *Note: Non-incentive delivery costs are included in the assessment of achievable potential.*

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Apart from the low-income segment of the residential sector, all measures were required to have a UCT benefit-cost ratio greater than 1.0 to be included in economic potential and all subsequent estimates of energy efficiency potential. Low-income measures were not required to be cost-effective.

For both the calculation of the measure-level UCT, as well as the determination of RAP, historical incentive levels (as a % of incremental measure cost) were calculated for current measure offerings. GDS relied on the prior AES-Indiana DSM plan estimates and historical AES Indiana evaluation reports files to map current measure offerings to their historical incentive levels.

- In the residential sector, incentives by program ranged from 20% to 100% and averaged 80%.
- In the non-residential sector, prescriptive incentives averaged 60% of the measure cost for interior lighting, 27% for exterior lighting and 37% for non-lighting measures.
- Custom measures received incentives equal to \$0.08 per first-year kWh saved (up to 50% of the measure cost) with Retro Commissioning incentives typically equal to \$17 per first-year kWh saved.
- In the MAP scenario, incentives were increased up to 100% of the incremental measure cost.⁴

4.4.3.2 Avoided Costs

Avoided energy supply costs are used to assess the value of energy savings. Avoided cost values for electric energy, electric capacity, and avoided T&D were provided by AES Indiana as part of an initial data request. Electric energy is based on an annual system marginal cost. For years outside of the avoided cost forecast timeframe, future year avoided costs are escalated by the rate of inflation.

AES Indiana provided the GDS team with annual on and off-peak avoided energy costs. GDS used this data to create 8,760 avoided cost values for each forecast year. GDS then applied these avoided costs to the 8,760 savings from each measure based on assigned end-use load shapes⁵ to determine the value of measures that save more energy during peak periods than those that might saving during off-peak periods. In addition, the avoided capacity and T&D avoided costs were applied to the estimated coincident peak demand savings for each measure.

4.4.4 Achievable Potential

Achievable potential is the amount of energy that can realistically be saved given various market barriers. Achievable potential considers real-world barriers to encouraging end users to adopt efficiency measures; the non-measure costs of delivering programs (for administration, marketing, analysis, and EM&V); and the capability of programs and administrators to boost program activity over time. Barriers include financial, customer awareness and WTP in programs, technical constraints, and other barriers the “program intervention” is modeled to overcome. Additional considerations include political and/or regulatory constraints. The potential study evaluated two achievable potential scenarios:

- **MAP** estimates achievable potential on paying incentives equal to 100% of measure incremental costs and aggressive adoption rates.
- **RAP** estimates achievable potential with AES Indiana paying incentive levels (as a percent of incremental measure costs) closely calibrated to historical levels but is not constrained by any previously determined spending levels.

⁴ The GDS team lowered MAP incentives to less than 100% of measure incremental cost in some cases if 100% incentives would preclude the measure from being cost-effective. MAP incentives were lowered to either 75% or 50% of the incremental measure cost if either of those incentive levels would allow for a measure to remain cost-effective.

⁵ End-use load shapes were derived from building energy simulation models created by housing type and building type, specific to the AES-Indiana service area.

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4.4.4.1 Market Adoption Rates

GDS assessed achievable potential on a measure-by-measure basis. In addition to accounting for the natural replacement cycle of equipment in the achievable potential scenario, GDS estimated measure specific maximum adoption rates that reflect the presence of market barriers and associated difficulties in achieving the 100% market adoption assumed in the technical and economic scenarios.

The initial step was to assess the long-term market adoption potential for energy efficiency technologies. Due to the wide variety of measures across multiple end-uses, GDS employed varied measure and end-use-specific ultimate adoption rates versus a singular universal market adoption curve. These long-term market adoption estimates were based on AES-Indiana-specific WTP market research. The AES-Indiana-specific research included questions to residential homeowners and nonresidential facility managers regarding their perceived willingness to purchase and install energy efficient technologies across various end uses and incentive/payback performance levels. This research is discussed in additional detail in Section 2.4.

One caveat to this approach is that the WTP adoption score is a simple function of incentive levels and/or payback performance. There are other factors that may influence a customer’s willingness to purchase an energy efficiency measure. For example, increased marketing and education programs can have a critical impact on the success of energy efficiency programs.

GDS utilized likelihood and willingness-to-participate data to estimate the long-term market adoption potential for both the maximum and realistic achievable scenarios. Table 4-3 presents the long-term market adoption rates at varied incentive levels used for the residential sector. Most end-uses are based on the WTP primary market research. Behavior was set to 100% to reflect that the program design is typically opt-out and participation levels are dictated by the utility. Last, GDS adjusted the AES-Indiana-specific adoption curves to reflect observed differences in WTP between the income-qualified and market-rate customers.

TABLE 4-3 RESIDENTIAL LONG-TERM MARKET ADOPTION RATES AT DISCRETE INCENTIVE LEVELS

End Use/Housing Type/Income	0% Incentive	25% Incentive	50% Incentive	75% Incentive	100% Incentive
Water Heat – SF/NLI	21%	39%	54%	69%	79%
Water Heat – SF/LI	16%	36%	48%	61%	68%
Water Heat – MF/NLI	21%	35%	50%	60%	70%
Water Heat – MF/LI	20%	35%	51%	60%	70%
HVAC Equip – SF/NLI	29%	42%	56%	91%	93%
HVAC Equip – SF/LI	25%	45%	64%	76%	83%
HVAC Equip – MF/NLI	24%	33%	65%	77%	80%
HVAC Equip – MF/LI	25%	39%	59%	67%	78%
Appliances – SF/NLI	22%	39%	58%	71%	82%
Appliances – SF/LI	13%	40%	59%	72%	83%
Appliances – MF/NLI	23%	29%	48%	55%	71%
Appliances – MF/LI	23%	37%	48%	62%	71%
HVAC Shell – SF/NLI	17%	39%	61%	78%	89%
HVAC Shell – SF/LI	10%	23%	42%	53%	69%
HVAC Shell – MF/NLI	19%	33%	47%	59%	70%
HVAC Shell – MF/LI	19%	33%	49%	60%	71%
Behavior	100%	100%	100%	100%	100%

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Table 4-4 presents the long-term market adoption rates used in the nonresidential sector. Again, the adoption scores were primarily informed by the AES-Indiana-specific WTP research. GDS included a 20-year payback performance level to reflect reduced adoption rates for measures with extremely long payback performance levels. The 20-year payback performance was set to 2/3rd of the 10-year level. The behavior adoption rate was limited to 90% to allow for control groups required in EM&V analyses.

TABLE 4-4 NONRESIDENTIAL LONG-TERM MARKET ADOPTION RATES AT DISCRETE PAYBACK INTERVALS

End-Use	20 Year Payback Period	10 Year Payback Period	5 Year Payback Period	3 Year Payback Period	1 Year Payback Period	0 Year Payback Period
Lighting/Office	15%	23%	41%	63%	78%	85%
HVAC	23%	34%	48%	62%	73%	83%
Refrigeration	20%	30%	51%	68%	74%	79%
Water Heat	17%	25%	44%	60%	71%	76%
Other	23%	34%	48%	62%	73%	83%

GDS then estimated initial year adoption rates by reviewing the current saturation levels of efficient technologies and (if necessary) calibrating the estimates of 2023 annual potential to recent historical levels achieved by AES-Indiana’s current DSM portfolio. One of the most impactful examples of this calibration was to front-load commercial lighting savings to achieve with AES-Indiana’s recent program achievements related to LED lighting. To align with these efforts, it was necessary to move forward in time the estimated lighting potential savings. For other end-uses or programs, GDS had to slow down the initial pace of adoption in the near term, though this had minor impact on the long-term potential. GDS then assumed a non-linear ramp rate from the initial year market adoption rate to the various long-term market adoption rates for each specific end-use.

4.4.4.2 Non-Incentive Costs

Consistent with National Action Plan for Energy Efficiency (NAPEE) guidelines⁶, utility non-incentive costs were included in the overall assessment of cost-effectiveness at the RAP scenario. Program non-incentive costs were calibrated to recent projected levels (using the 2021 portfolio summary) and set at:

- \$0.031 per PEER participant
- \$0.216 per first year kWh saved for residential Appliance Recycling program measures
- \$0.369 per first year kWh saved for Income-Qualified program measures
- \$0.132-\$0.265 per first year kWh saved for measures in the School Education, Efficient Products and Multifamily programs
- \$0.21 per first year kWh saved for the remaining residential measures
- \$0.040 per first year kWh saved for prescriptive C&I measures
- \$0.083 per first year kWh saved for custom C&I measures.

Non-incentive costs were then escalated annually at the rate of inflation.⁷

⁶ National Action Plan for Energy Efficiency (2007). Guide for Conducting Energy Efficiency Potential Studies. Prepared by Optimal Energy. This study notes that economic potential only considers the cost of efficiency measures themselves, ignoring programmatic costs. Conversely, achievable potential should consider the non-measures costs of delivering programs. Pg. 2-4.

⁷ As noted earlier in the report, measure costs and utility incentives were not escalated over the 20-year analysis timeframe to keep those costs constant in nominal dollars.

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4.5 RESIDENTIAL ENERGY EFFICIENCY POTENTIAL

This section provides the potential results for technical, economic, MAP and RAP for the residential sector. The cost-effectiveness results and budgets for the RAP scenario are also provided.

4.5.1 Scope of Measures & End Uses Analyzed

There were 170 total unique residential electric measures included in the analysis. Table 4-5 provides the number of unique measures by end-use. The measure list was developed based on a review of current AES Indiana programs, the Indiana TRM, other regional TRMs, and industry documents related to emerging technologies. Data collection activities to characterize measures formed the basis of the assessment of incremental costs, electric energy and demand savings, and measure life.

TABLE 4-5: RESIDENTIAL ENERGY EFFICIENCY MEASURES – BY END USE

End-Use	Number of Unique Measures
Appliances	23
Behavior	4
HVAC	49
Lighting	14
New Construction	4
Plug Loads	4
Pool/Pump	4
Shell	53
Water Heating	15
Total	170

4.5.2 Summary of Residential Electric Potential

Figure 4-3 provides the technical, economic, MAP and RAP results for the 3-year, 10-year, and 19-year timeframes. The 3-year technical potential is 16% of forecasted sales, and the economic potential is 11% of forecasted sales. The 3-year MAP is 4.1% and the RAP is 3.3%.

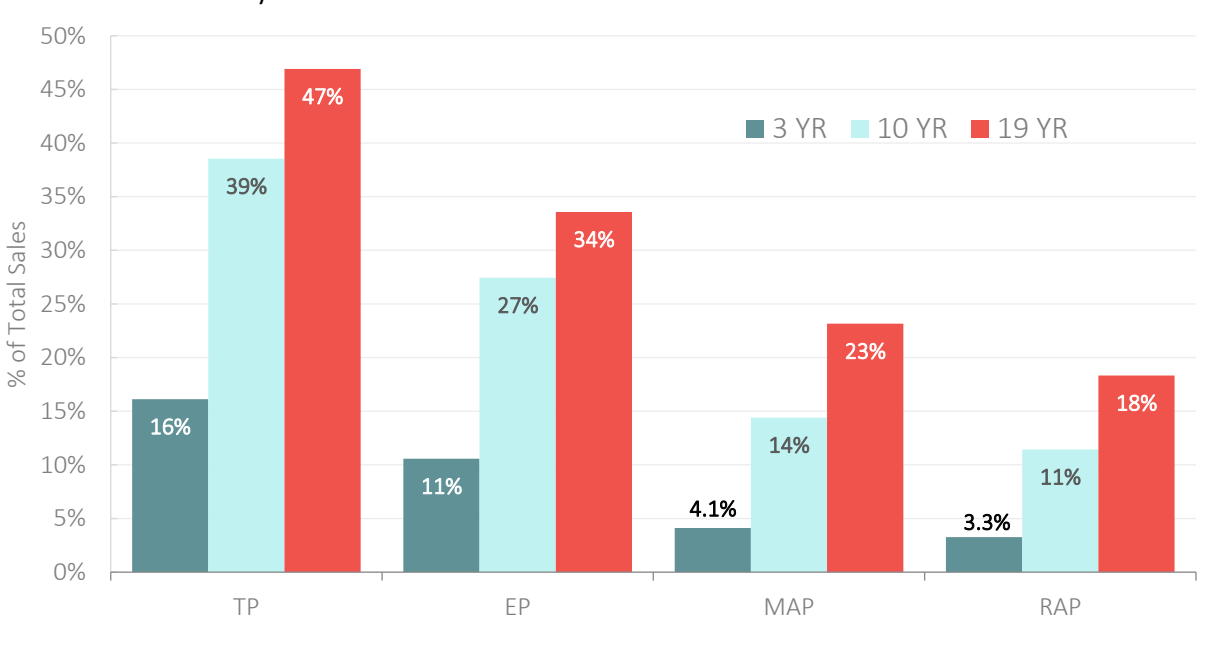


FIGURE 4-3: RESIDENTIAL ELECTRIC ENERGY CUMULATIVE ANNUAL POTENTIAL (AS A % OF RESIDENTIAL SALES)

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Table 4-6 provides cumulative annual technical, economic, MAP and RAP energy savings, in total MWh and as a percentage of the sector-level sales forecast. The RAP increases to 3.3% cumulative annual savings over the next three years.

TABLE 4-6: RESIDENTIAL CUMULATIVE ANNUAL ENERGY EFFICIENCY POTENTIAL SUMMARY

	2024	2025	2026	2033	2042
MWh					
Technical	331,822	611,621	848,287	2,183,950	2,951,972
Economic	214,886	391,081	556,041	1,554,873	2,113,142
MAP	83,453	147,566	216,208	816,496	1,457,663
RAP	68,585	118,341	171,696	648,357	1,153,791
Forecasted Sales	5,197,247	5,221,823	5,259,705	5,666,996	6,292,981
Energy Savings (as % of Forecast)					
Technical	6.4%	11.7%	16.1%	38.5%	46.9%
Economic	4.1%	7.5%	10.6%	27.4%	33.6%
MAP	1.6%	2.8%	4.1%	14.4%	23.2%
RAP	1.3%	2.3%	3.3%	11.4%	18.3%

Table 4-7 provides the incremental annual technical, economic, MAP and RAP energy savings, in total MWh and as a percentage of the sector-level sales forecast. The incremental RAP ranges from 1.3% to 1.5% per year over the next three years.

TABLE 4-7: RESIDENTIAL INCREMENTAL ANNUAL ENERGY EFFICIENCY POTENTIAL SUMMARY

	2024	2025	2026	2033	2042
MWh					
Technical	331,822	324,480	319,559	294,148	292,261
Economic	214,886	211,401	208,809	197,030	200,159
MAP	83,453	86,756	92,822	133,956	148,545
RAP	68,585	72,355	77,385	114,551	125,716
Forecasted Sales	5,197,247	5,221,823	5,259,705	5,666,996	6,292,981
Energy Savings (as % of Forecast)					
Technical	6.4%	6.2%	6.1%	5.2%	4.6%
Economic	4.1%	4.0%	4.0%	3.5%	3.2%
MAP	1.6%	1.7%	1.8%	2.4%	2.4%
RAP	1.3%	1.4%	1.5%	2.0%	2.0%

4.5.3 Residential Technical & Economic Potential

Table 4-8 provides cumulative annual technical and economic potential results across the 19-yr study timeframe. The technical potential is 47% of forecasted sales in 2042, and the economic potential is 34% of forecasted sales in 2042. The HVAC end use has the most technical and economic potential, with Water Heating and Shell end uses also contributing a significant amount of technical and economic potential as well.

TABLE 4-8: TECHNICAL AND ECONOMIC RESIDENTIAL ELECTRIC POTENTIAL

End Use	Technical Potential		Economic Potential	
	Energy (MWh)	Peak Demand (MW)	Energy (MWh)	Peak Demand (MW)
Appliances	193,579	28.0	161,710	23.7
Behavior	25,936	3.0	27,249	3.1
HVAC	1,204,945	382.8	944,033	336.5
Lighting	152,241	187.8	152,241	187.8
New Construction	65,242	5.2	21,621	5.2

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End Use	Technical Potential		Economic Potential	
	Energy (MWh)	Peak Demand (MW)	Energy (MWh)	Peak Demand (MW)
Plug Loads	261,268	29.8	101,630	11.6
Pool/Pump	131,955	19.4	108,265	16.7
Shell	490,697	165.9	287,576	79.4
Water Heating	426,109	55.3	308,816	44.5
Total	2,951,972	877	2,113,142	708
Savings as % of Forecast	46.9%	-	33.6%	-

4.5.4 Residential Achievable Potential Savings

Figure 4-4 provides the MAP and RAP across the 19-yr timeframe of the study. The green and red bars provide the respective incremental annual MAP and RAP in MWh per year energy savings. The green and orange lines provide the corresponding cumulative annual MAP and RAP as a percent of forecasted annual sales. The MAP rises to 23% by 2042, and the RAP rises to 18%.

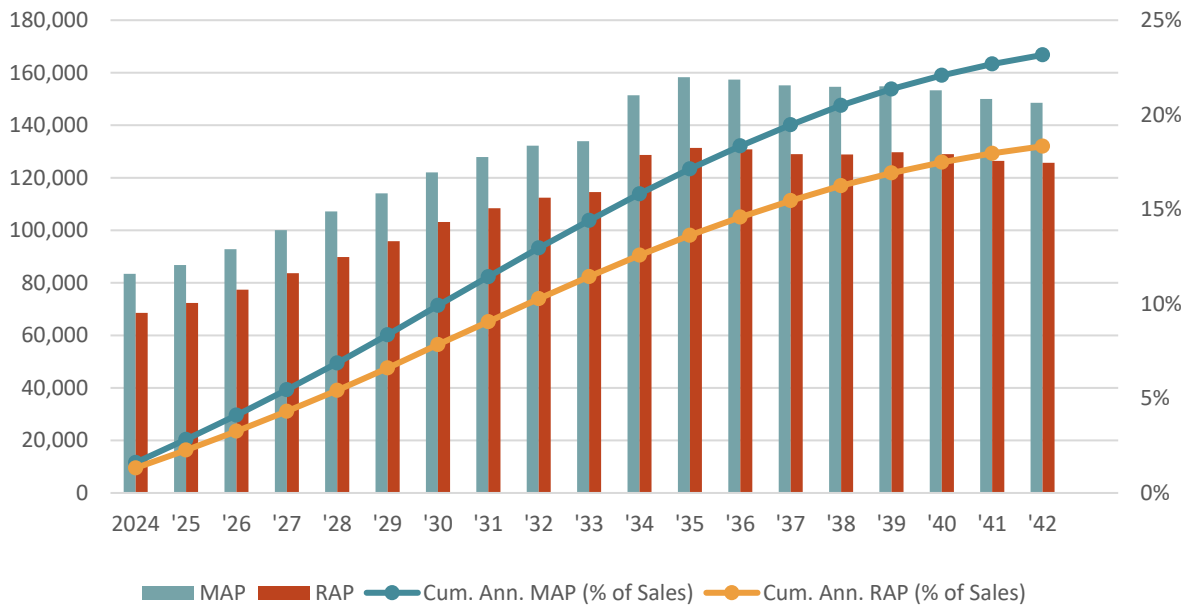


FIGURE 4-4: RESIDENTIAL ANNUAL MAP AND RAP

Figure 4-5 provides a breakdown of the RAP potential in 2042 across end-uses and building type market segments. As in technical and economic potential, HVAC is the leading end-use accounting for 37% of the total. The Shell and Water Heating end-uses combine to account for an additional 36% of the RAP. The single-family housing segment represents 59% of the potential and the multifamily segment represents 20% of the potential. The new construction segment accounts for 10% of potential, and measures dedicated to low-income customers account for 11% of potential.

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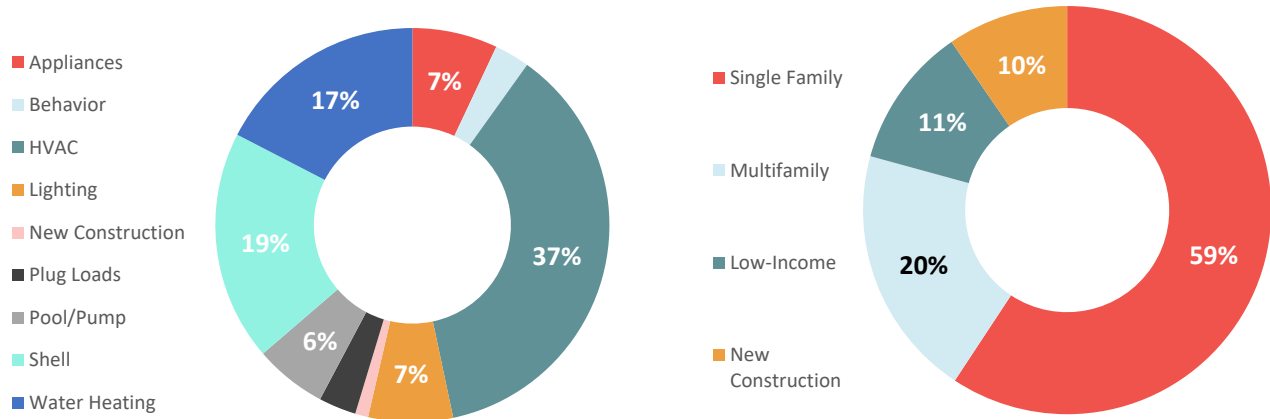


FIGURE 4-5: RESIDENTIAL POTENTIAL BY END-USE AND BUILDING TYPE – RAP 2042

Table 4-9 provides incremental and cumulative annual commercial sector energy and demand savings for MAP and RAP across the next three years as well as over the 10-yr and 19-yr time horizons. Incremental RAP energy savings begin at 68,600 MWh in 2024 followed by an increase over the next several years. Cumulative RAP energy savings rise to approximately 1.2 million MWh by 2042.

TABLE 4-9: RESIDENTIAL ANNUAL MAP AND RAP

	2024	2025	2026	2033	2042
Incremental Annual Energy (MWh)					
MAP	83,453	86,756	92,822	133,956	148,545
RAP	68,585	72,355	77,385	114,551	125,716
Incremental Annual Energy (MW)					
MAP	25.8	27.7	29.5	38.8	43.2
RAP	19.3	21.1	22.6	33.3	36.2
Cumulative Annual Energy (MWh)					
MAP	83,453	147,566	216,208	816,496	1,457,663
RAP	68,585	118,341	171,696	648,357	1,153,791
Cumulative Annual Energy (MW)					
MAP	25.8	50.9	77.5	293.0	486.5
RAP	19.3	37.9	57.7	229.1	394.2

Table 4-10 provides additional end-use level detail for the cumulative annual residential MAP and RAP. The HVAC, Shell and Water Heating end-uses provide more than 75% of the MAP and RAP over the study timeframe.

TABLE 4-10: RESIDENTIAL ANNUAL MAP AND RAP – END-USE DETAIL

	2024	2025	2026	2033	2042
MAP Cumulative Annual MWh					
Appliances	3,638	7,637	12,035	47,268	92,274
Behavior	22,409	22,817	23,020	27,234	31,375
HVAC	22,432	47,145	74,049	325,196	680,912
Lighting	4,786	10,143	16,270	72,967	107,032
New Construction	431	1,009	1,436	7,515	13,884

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	2024	2025	2026	2033	2042
Plug Loads	225	521	918	9,581	36,814
Pool/Pump	1,660	3,798	6,229	34,749	76,958
Shell	16,146	33,733	52,372	180,757	203,118
Water Heating	11,726	20,763	29,880	111,229	215,297
Total	83,453	147,566	216,208	816,496	1,457,663
% of Forecasted Sales	1.6%	2.8%	4.1%	14.4%	23.2%
RAP Cumulative Annual MWh					
Appliances	3,479	7,273	11,407	42,752	80,813
Behavior	22,475	22,948	23,223	28,178	33,347
HVAC	12,789	27,094	42,864	196,547	424,338
Lighting	3,272	6,938	11,178	52,961	80,075
New Construction	376	880	1,254	6,617	12,362
Plug Loads	217	502	885	9,233	35,477
Pool/Pump	1,177	2,755	4,577	28,772	68,480
Shell	14,867	31,206	48,711	178,376	217,948
Water Heating	9,934	18,746	27,596	104,920	200,951
Total	68,585	118,341	171,696	648,357	1,153,791
% of Forecasted Sales	1.3%	2.3%	3.3%	11.4%	18.3%

4.5.5 Residential Achievable Potential Benefits & Costs

Table 4-11 provides the net present value (NPV) benefits and cost, as calculated using the UCT, across the 2024-2042 timeframe for the MAP and RAP scenarios. The overall UCT ratio in the RAP scenario is 1.17. The overall UCT ratio in the MAP scenario is 0.95 due to higher assumed incentive costs.

TABLE 4-11: RESIDENTIAL MAP AND RAP NPV BENEFITS & COSTS

End Use	NPV Benefits	NPV Costs	UCT Ratio
MAP	\$798,562,463	\$842,902,070	0.95
RAP	\$637,960,175	\$546,541,247	1.17

Figure 4-6 provides the budget for the RAP scenario. The budget is broken into incentive and non-incentive budgets for each year of the study timeframe. The RAP budget in 2024 is almost \$28 million, which then rises to a peak of \$63 million in 2035 before decreasing back down to \$53 million in 2042.

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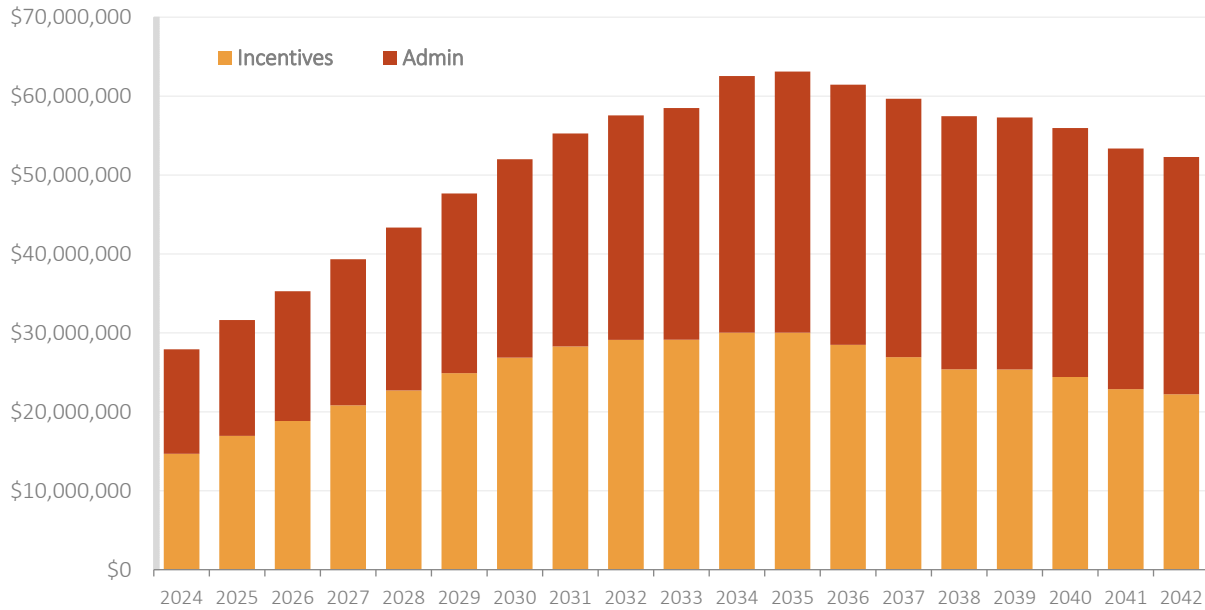


FIGURE 4-6: RESIDENTIAL ANNUAL BUDGETS – RAP

4.6 COMMERCIAL AND INDUSTRIAL ENERGY EFFICIENCY POTENTIAL

This section provides the potential results for technical, economic, MAP and RAP for the commercial and industrial sector. The cost-effectiveness results and budgets for the RAP scenario are also provided.

4.6.1 Scope of Measures & End Uses Analyzed

There were 170 total unique commercial and industrial (C&I) electric measures included in the analysis. Table 4-12 provides the number of unique measures by end-use. The measure list was developed based on a review of current AES Indiana programs, the Indiana TRM, other regional TRMs, and industry documents related to emerging technologies. Data collection activities to characterize measures formed the basis of the assessment of incremental costs, electric energy and demand savings, and measure life.

TABLE 4-12: COMMERCIAL AND INDUSTRIAL ENERGY EFFICIENCY MEASURES – BY END USE

End-Use	Number of Unique Measures
HVAC	57
Lighting	33
Refrigeration	27
Office Equipment	11
Whole Building	10
Cooking	9
Process	8
Compressed Air	7
Behavioral	6
Miscellaneous	6
Hot Water	5
Motors	5
Total	184

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4.6.2 Summary of Commercial and Industrial Electric Potential

Figure 4-7 provides the technical, economic, MAP and RAP results for the 3-year, 10-year, and 19-year timeframes. The 3-year technical potential is 9.5% of forecasted sales, and the economic potential is 9.1% of forecasted sales. The 3-year MAP is 6.8% and the RAP is 5.1%.

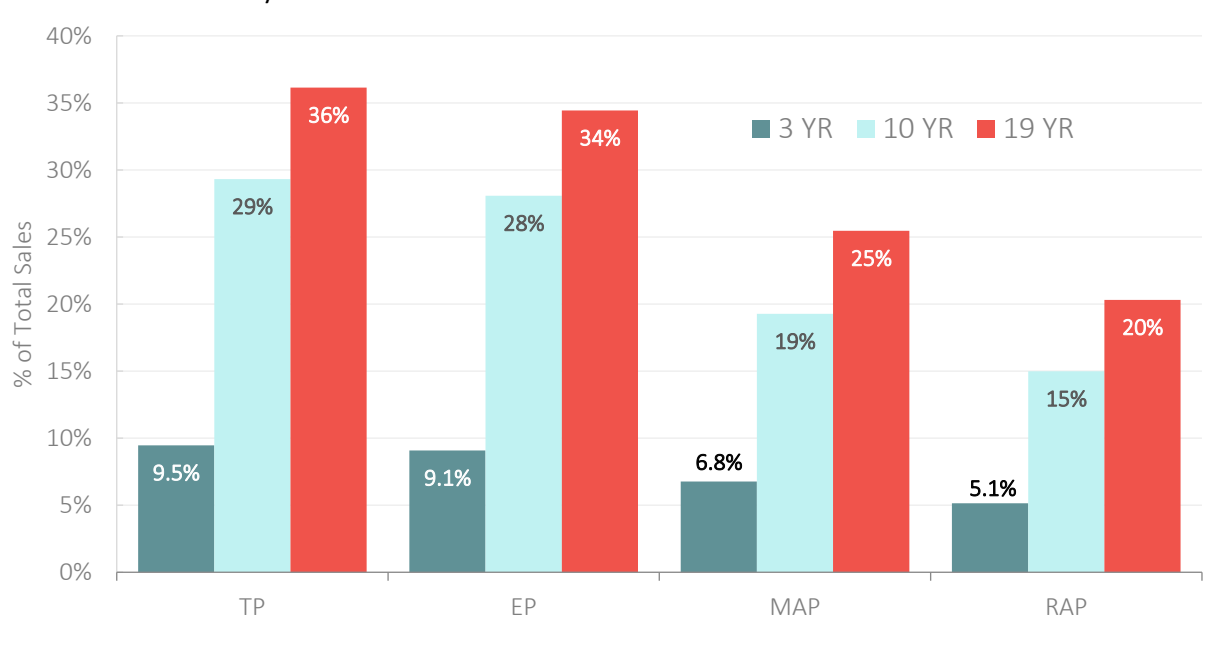


FIGURE 4-7: C&I ELECTRIC ENERGY CUMULATIVE ANNUAL POTENTIAL (AS A % OF COMMERCIAL AND INDUSTRIAL SALES)

Table 4-13 provides cumulative annual technical, economic, MAP and RAP energy savings, in total MWh and as a percentage of the sector-level sales forecast. The RAP increases to 5.1% cumulative annual savings over the next three years.

TABLE 4-13: C&I CUMULATIVE ANNUAL ENERGY EFFICIENCY POTENTIAL SUMMARY

	2024	2025	2026	2033	2042
MWh					
Technical	147,558	307,038	472,225	1,475,613	1,864,325
Economic	141,926	294,720	453,156	1,412,934	1,776,582
MAP	121,920	230,491	337,295	969,667	1,313,569
RAP	91,365	174,522	256,589	754,309	1,048,015
Forecasted Sales	4,998,239	5,000,270	4,988,297	5,032,809	5,158,648
Technical	3.0%	6.1%	9.5%	29.3%	36.1%
Economic	2.8%	5.9%	9.1%	28.1%	34.4%
MAP	2.4%	4.6%	6.8%	19.3%	25.5%
RAP	1.8%	3.5%	5.1%	15.0%	20.3%

Table 4-14 provides the incremental annual technical, economic, MAP and RAP energy savings, in total MWh and as a percentage of the sector-level sales forecast. The incremental RAP ranges from 1.6% to 1.8% per year over the next three years.

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TABLE 4-14: C&I INCREMENTAL ANNUAL ENERGY EFFICIENCY POTENTIAL SUMMARY

	2024	2025	2026	2033	2042
MWh					
Technical	147,558	159,480	166,589	168,954	204,800
Economic	141,926	152,794	158,491	149,080	173,394
MAP	121,920	108,570	106,840	92,060	77,940
RAP	91,365	83,157	82,103	76,579	63,010
Forecasted Sales	4,998,239	5,000,270	4,988,297	5,032,809	5,158,648
% of Forecasted Sales					
Technical	3.0%	3.2%	3.3%	3.4%	4.0%
Economic	2.8%	3.1%	3.2%	3.0%	3.4%
MAP	2.4%	2.2%	2.1%	1.8%	1.5%
RAP	1.8%	1.7%	1.6%	1.5%	1.2%

4.6.3 Commercial and Industrial Technical & Economic Potential

Table 4-15 provides cumulative annual technical and economic potential results across the 19-yr study timeframe. The technical potential is 36% of forecasted sales in 2042, and the economic potential is 34% of forecasted sales in 2042. The HVAC end use has the most technical and economic potential, with the Lighting, Refrigeration and Office Equipment end uses also contributing a significant amount of technical and economic potential as well.

TABLE 4-15: TECHNICAL AND ECONOMIC COMMERCIAL AND INDUSTRIAL ELECTRIC POTENTIAL

End Use	Technical Potential		Economic Potential	
	Energy (MWh)	Peak Demand (MW)	Energy (MWh)	Peak Demand (MW)
HVAC	441,141	197	440,736	197
Lighting	398,097	80	386,708	80
Refrigeration	221,392	35	219,827	35
Office Equipment	153,248	9	153,248	9
Whole Building	242,858	43	244,354	44
Cooking	28,725	3	28,725	3
Compressed Air	31,528	8	31,528	8
Behavioral	83,948	2	21,627	0
Process	56,085	10	56,085	10
Miscellaneous	108,104	21	94,545	21
Hot Water	12,050	2	12,050	2
Motors	87,150	14	87,150	14
Total	1,864,325	425	1,776,582	423
Savings as % of Forecast	36.1%	-	34.4%	-

4.6.4 Commercial and Industrial Achievable Potential

Figure 4-8 provides the MAP and RAP across the 19-yr timeframe of the study. The green and red bars provide the respective incremental annual MAP and RAP in MWh per year energy savings. The green and orange lines provide the corresponding cumulative annual MAP and RAP as a percent of forecasted annual sales. The MAP rises to 25% by 2042, and the RAP rises to 20%.

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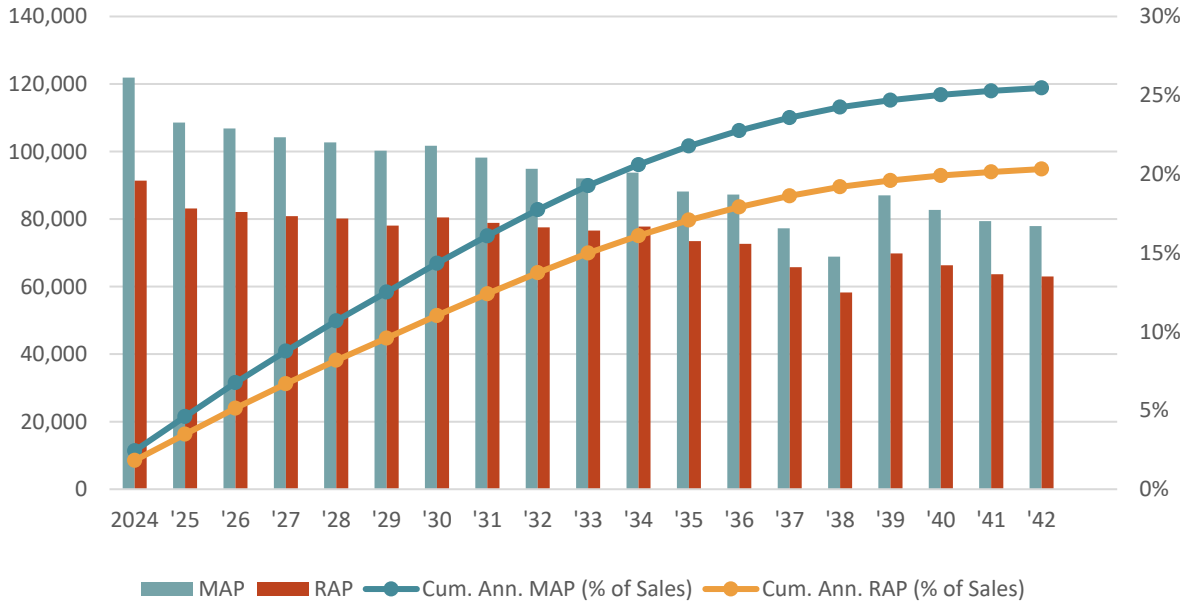


FIGURE 4-8: COMMERCIAL AND INDUSTRIAL ANNUAL MAP AND RAP

Figure 4-9 provides a breakdown of the RAP potential in 2042 across end-uses and building type market segments. As in technical and economic potential, HVAC and Lighting are the leading end-uses, accounting for 46% of the total. The Refrigeration, Office Equipment and Whole Building end-uses combine to account for an additional 36% of the RAP. The commercial sector represents 93% of the potential and the industrial sector represents 7% of the potential.

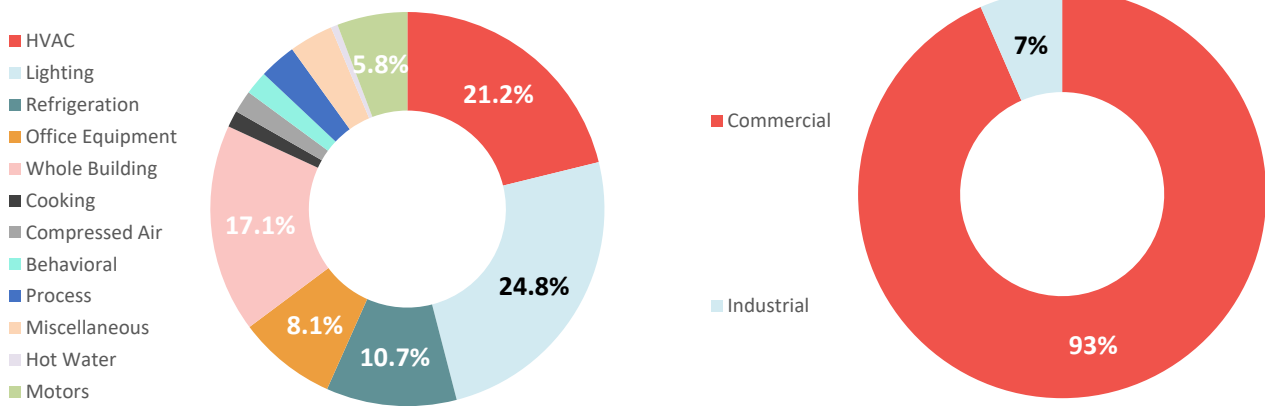


FIGURE 4-9: COMMERCIAL AND INDUSTRIAL POTENTIAL BY END-USE AND BUILDING TYPE – RAP 2042

Table 4-16 provides incremental and cumulative annual C&I sector energy and demand savings for MAP and RAP across the next three years as well as over the 10-yr and 19-yr time horizons. Incremental RAP energy savings begin at 91,400 MWh in 2024 followed by an increase over the next several years. Cumulative RAP energy savings rise to approximately 1 million MWh by 2042.

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TABLE 4-16: COMMERCIAL AND INDUSTRIAL ANNUAL MAP AND RAP

	2024	2025	2026	2033	2042
Incremental Annual Energy (MWh)					
MAP	121,920	108,570	106,840	92,060	77,940
RAP	91,365	83,157	82,103	76,579	63,010
Incremental Annual Energy (MW)					
MAP	21.8	22.5	22.4	19.6	15.5
RAP	16.3	16.6	16.5	14.4	11.8
Cumulative Annual Energy (MWh)					
MAP	121,920	230,491	337,295	969,667	1,313,569
RAP	91,365	174,522	256,589	754,309	1,048,015
Cumulative Annual Energy (MW)					
MAP	21.8	44.4	66.8	198.7	287.5
RAP	16.3	32.9	49.4	143.0	210.5

Table 4-17 provides additional end-use level detail for the cumulative annual commercial and industrial MAP and RAP. The HVAC, Lighting, and Refrigeration end-uses provide 60% of the MAP and RAP over the study timeframe.

TABLE 4-17: COMMERCIAL AND INDUSTRIAL ANNUAL MAP AND RAP – END-USE DETAIL

	2024	2025	2026	2033	2042
MAP Cumulative Annual MWh					
HVAC	18,514	39,584	62,075	225,703	326,144
Lighting	69,982	119,086	162,003	294,666	304,693
Refrigeration	11,897	24,348	36,883	106,473	128,095
Office Equipment	4,652	10,292	17,114	81,044	116,205
Whole Building	9,636	21,438	33,842	136,542	212,679
Cooking	497	1,099	1,808	9,474	17,434
Compressed Air	1,234	2,630	4,197	16,291	23,861
Behavioral	963	2,013	3,285	15,008	18,821
Process	1,311	2,841	4,568	20,156	39,043
Miscellaneous	910	2,024	3,324	20,136	48,650
Hot Water	322	671	1,049	3,597	7,174
Motors	2,003	4,466	7,148	40,577	70,770
Total	121,920	230,491	337,295	969,667	1,313,569
% of Forecasted Sales	2.4%	4.6%	6.8%	19.3%	25.5%
RAP Cumulative Annual MWh					
HVAC	9,771	21,523	34,453	141,372	221,845
Lighting	56,232	97,950	134,739	248,668	259,927
Refrigeration	8,798	18,338	28,211	89,110	112,227
Office Equipment	3,516	7,742	12,862	60,826	85,021
Whole Building	7,263	16,302	25,798	109,891	179,170
Cooking	349	782	1,301	7,303	14,343
Compressed Air	916	1,966	3,133	12,772	19,256
Behavioral	970	2,032	3,327	15,695	20,183
Process	964	2,128	3,485	16,424	31,862

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	2024	2025	2026	2033	2042
Miscellaneous	659	1,467	2,413	15,135	37,827
Hot Water	266	553	861	2,835	5,902
Motors	1,660	3,741	6,006	34,278	60,451
Total	91,365	174,522	256,589	754,309	1,048,015
% of Forecasted Sales	1.8%	3.5%	5.1%	15.0%	20.3%

4.6.5 Commercial and Industrial Achievable Potential Benefits & Costs

Table 4-18 provides the net present value (NPV) benefits and cost, as calculated using the UCT, across the 2024-2042 timeframe for the MAP and RAP scenarios. The overall UCT ratio in the RAP scenario is 3.61. The overall UCT ratio in the MAP scenario is 1.79 due to higher assumed incentive costs and greater participation.

TABLE 4-18: RESIDENTIAL MAP AND RAP NPV BENEFITS & COSTS

End Use	NPV Benefits	NPV Costs	UCT Ratio
MAP	\$677,847,333	\$377,801,254	1.79
RAP	\$499,594,928	\$138,545,911	3.61

Figure 4-10 provides the budget for the RAP scenario. The budget is broken into incentive and non-incentive budgets for each year of the study timeframe. The RAP budget in 2024 is almost \$13 million, which then rises to a peak of \$14.3 million in 2034 before decreasing back down to \$133 million in 2042.

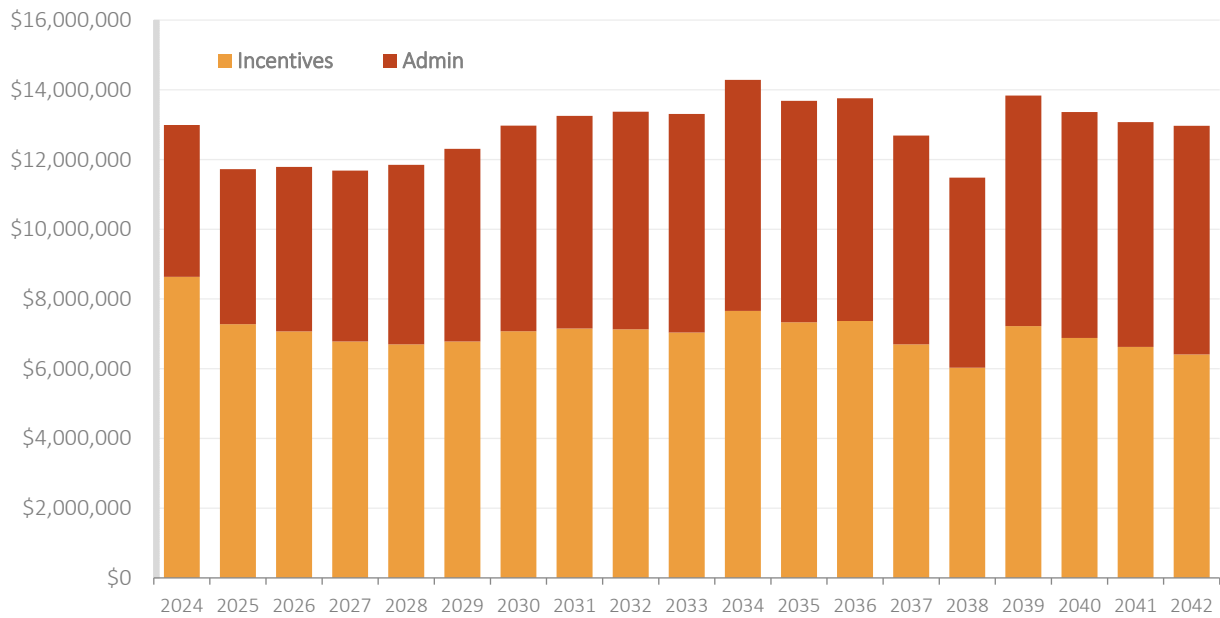


FIGURE 4-10: COMMERCIAL AND INDUSTRIAL ANNUAL BUDGETS – RAP

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5 Demand Response Potential

This section provides the results of the MAP and RAP potential for the demand response analysis. Results are broken down by sector and program. The cost-effectiveness results and budgets for the MAP and RAP scenarios are also provided. Section 5.1 provides a description of the demand response methodology.

5.1 DEMAND RESPONSE PROGRAM OPTIONS

Table 5-1 Demand Response Program Options and Eligible Markets Table 5-1 provides a brief description of the demand response program options considered and identifies the eligible customer segment for each demand response program that was considered in this study. This includes direct load control (DLC) and rate design options.

TABLE 5-1 DEMAND RESPONSE PROGRAM OPTIONS AND ELIGIBLE MARKETS

Demand Response Program Option	Program Description	Eligible Markets
DLC AC (Switch)	The compressor of the air conditioner is remotely shut off (cycled) by the system operator for periods that may range from 7 ½ to 15 minutes during every 30-minute period (i.e., 25%-50% duty cycle). GDS looked at both the one-way communicating Cannon switches and two-way communicating L+G switches. Both switch options were assumed to be phased out as customers switch to thermostats over time.	Residential and C&I Customers
DLC AC (Thermostat)	The system operator can remotely raise the AC’s thermostat set point during peak load conditions, lowering AC load. GDS looked at the three options AES Indiana currently has: a customer is given a free thermostat to participate along with an annual incentive, a customer is given a rebate through the marketplace or a storefront along with an annual incentive, or the customer brings an existing thermostat and is only given an annual incentive.	Residential and C&I Customers
DLC Space Heating	The system operator can remotely lower the HVAC’s thermostat set point during winter peak load conditions, lowering the heating load. This program is an add-on to the DLC AC Thermostat program. Only participants in the AC Thermostat program would be allowed to participate in the Space Heating program.	Residential and C&I Customers
DLC Water Heaters	The water heater is remotely shut off by the system operator for periods normally ranging from 2 to 8 hours.	Residential and C&I Customers
DLC Room AC	The compressor of the room air conditioner is remotely shut off (cycled) by the system operator for periods that may range from 7 ½ to 15 minutes during every 30-minute period (i.e., 25%-50% duty cycle). Controlled via load control switch. Participant cannot override control.	Residential Customers
DLC Lighting	Part of the lighting load is remotely shut off by the system operator for periods normally ranging from 2 to 4 hours.	C&I Customers

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Demand Response Program Option	Program Description	Eligible Markets
Battery Storage	Customer-sited stationary storage systems that are connected to the distribution system on the customer's side of the utility's service meter. The systems are installed on customer premises, provide savings or other benefits to the customers, and customers are typically the principal investors in the system. The primary drivers for customer adoption of BTM are opportunities for bill reductions, improving energy resilience, and mitigating power quality.	Residential Customers
Behavioral DR	Customers are given a rebate for less consumption during times selected as critical periods.	Residential Customers
Ice Storage Cooling Rate	The use of a cold storage medium such as ice, chilled water, or other liquids. Off-peak energy is used to produce chilled water or ice for use in cooling during peak hours. The cool storage process is limited to off-peak periods.	C&I Customers
Curtable Rate (Day Of)	A discounted rate is offered to the customer for agreeing to interrupt or curtail load during peak period.	C&I Customers
Curtable Rate (Day Ahead)	A discounted rate is offered to the customer for agreeing to interrupt or curtail load during peak period.	C&I Customers
Time of Use with Enabling Technology	A retail rate with different prices for usage during different blocks of time. Daily pricing blocks could include on-peak, mid-peak, and off-peak periods. Participants are required to have enabling technology (usually a smart thermostat) to help more consistently control the load during peak hours.	Residential and C&I Customers
Time of Use without Enabling Technology	A retail rate with different prices for usage during different blocks of time. Daily pricing blocks could include on-peak, mid-peak, and off-peak periods. Participants are not required to have enabling technology.	Residential and C&I Customers
Capacity Bidding	Flexible bidding program offering qualified businesses payments for agreeing to reduce load when an event is called. Participants make monthly nominations and receive capacity payments based on the amount of capacity reduction nominated each month, plus energy payments based on your actual kilowatt-hour (kWh) energy reduction when an event is called. The amount of capacity nomination can be adjusted on a monthly basis. The program can be Internet-based, providing ready access to program information and ease-of-use. Penalties occur if load nominations are not met.	C&I Customers
Demand Bidding	Year-round, flexible, Internet-based bidding program that offers business customers credits for voluntarily reducing power when a DBP event is called.	C&I Customers

Double-counting savings from demand response programs that affect the same end uses is a common issue that must be addressed when calculating the demand response savings potential. For example, a direct load control (DLC) program of air conditioning and a rate program both assume load reduction of the customers' air conditioners. For this reason, it is typically assumed that customers cannot participate in programs that affect the same end uses. One cannot save a kW of load in a specific hour more than once. In general, the hierarchy of demand response programs is accounted for by subtracting the number participants in a higher priority program from the eligible market for a lower priority program. Table 5-2 shows the hierarchy for each sector, with 1 being the top priority. Note that only cost-effective programs are included in the hierarchy.

TABLE 5-2 DR HIERARCHY FOR EACH SECTOR

Order	Residential Hierarchy	Small C&I Hierarchy	Large C&I Hierarchy
1	Direct Load Control	Direct Load Control	Interruptible Rate
2	Behavioral DR	Capacity Bidding	Capacity Bidding
3	Time of Use with Enabling Technology	Time of Use with Enabling Technology	Time of Use with Enabling Technology
4	Time of Use without Enabling Technology	Time of Use without Enabling Technology	Time of Use without Enabling Technology

5.1.1 Demand Response Potential Assessment Approach Overview

The analysis of demand response, where possible, closely followed the approach outlined for energy efficiency. The framework for assessing the cost-effectiveness of demand response programs is based on *A Framework for Evaluating the Cost-Effectiveness of Demand Response, prepared for the National Forum on the National Action Plan (NAPA) on Demand Response*.⁸ Additionally, GDS reviewed the May 2017 National Standard Practice Manual published by the National Efficiency Screening Project.⁹ GDS utilized this guide to define avoided ancillary services and energy and/or capacity price suppression benefits.

Direct load control and rate programs (excluding the interruptible rate program) demand response analysis was conducted using the GDS Demand Response Model. The interruptible rate program was analyzed using the Demand Side Analytics (DSA) program. GDS determined the estimated savings for each demand response program by performing a review of all benefits and cost associated with each program. A modeling approach that considers numerous required inputs for each program was used, including expected life, coincident peak (CP) kW load reductions, proposed incentive levels, program related expenses such as vendor service fees, marketing and evaluation cost and on-going O&M expenses.

The UCT was used to determine the cost-effectiveness of each demand response program. Benefits are based on avoided demand, energy (including load shifting), wholesale cost reductions and T&D costs. Costs include incremental program equipment costs (such as control switches or smart thermostats), fixed program capital costs (such as the cost of a central controller), program administrative, marketing, and evaluation costs. Incremental equipment program costs are included for both new and replacement units (such as control switches) to account for units that are replaced at the end of their useful life.

The demand response analysis includes estimates of technical, economic, and achievable potential. Achievable potential is broken into maximum achievable potential (MAP) and realistic achievable potential (RAP) in this study:

MAP represents an estimate of the maximum cost-effective demand response potential that can be achieved over the 19-year study period. For this study, this is defined as customer participation in demand response program options that reflect a “best practices” estimate of what could eventually be achieved. MAP assumes no barriers to effective delivery of programs.

RAP represents an estimate of the amount of demand response potential that can be realistically achieved over the 19-year study period. For this study, this is defined as achieving customer participation in demand response program options that reflect a realistic estimate of what could eventually be achieved assuming

⁸ Study was prepared by Synapse Energy Economics and the Regulatory Assistance Project, February 2013.

⁹[National Standard Practice Manual for Assessing Cost-Effectiveness of Energy Efficiency Resources](#), May 18, 2017, Prepared by The National Efficiency Screening Project

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typical or “average” industry experience. RAP is a discounted MAP, by considering program barriers that limit participation, therefore reducing savings that could be achieved.

5.1.2 Avoided Costs

Demand response avoided costs were consistent with those utilized in the energy efficiency potential analysis and were provided by AES Indiana. The primary benefit of demand response is avoided generation capacity, resulting from a reduction in the need for new peaking generation capacity. Demand response can also produce energy related benefits. If the demand response option is considered “load shifting,” such as direct load control of electric water heating, the consumption of energy is shifted from the control period to the period immediately following the period of control. For this study, GDS assumed that the energy is shifted with no loss of energy. If the program is not considered to be “load shifting” the measure is turned off during peak control hours, and the energy is saved altogether. Demand response programs can also potentially delay the construction of new transmission and distribution lines and facilities, which is reflected in avoided T&D costs.

5.1.3 Demand Response Program Assumptions

This section briefly discusses the general assumptions and sources used to complete the demand response potential analysis.

5.1.3.1 Direct Load Control Program Assumptions

Load Reduction: Demand reductions were based on load reductions found in AES Indiana’s existing demand response programs, and various secondary data sources including the FERC and other industry reports, including demand response potential studies that conducted primary research. DLC and thermostat-based demand response options were typically calculated based on a per-unit kW demand reduction.

Useful Life: The useful life of a smart thermostat is assumed to be 15 years . Load control switches have a useful life of 10 years. This life was used for all direct load control measures in this study.

Program Costs: One-time program development costs included in the first year of the analysis for new programs. No program development costs are assumed for programs that already exist. Each new program includes an evaluation cost, with evaluation cost for existing programs already being included in the administration costs. It was assumed that there would be a cost of \$50¹⁰ per new participant for marketing for the DLC programs. Marketing costs are assumed to be 33.3% higher for MAP. All program costs were escalated each year by the general rate of inflation assumed for this study.

Saturation: The number of control units per participant was assumed to be 1 for all direct load control programs using switches (such as water heaters and air conditioning switches), because load control switches can control up to two units. However, for controllable thermostats, some participants have more than one thermostat. The average number of residential thermostats per single family home was assumed to be 1.063 thermostats¹¹.

Program Adoption Levels: Long-term program adoption levels (or “steady state” participation) represent the enrollment rate once the fully achievable participation has been reached. GDS reviewed industry data and program adoption levels from several utility demand response programs. The main sources of participant rates are several studies completed by the Brattle Group. As noted earlier in this section, for direct load control programs, MAP participation rates rely on industry best adoption rates and RAP participation rates are based on industry average adoption levels. For the rate programs, the MAP steady-state participation rates assumed programs were opt-out based and RAP participation assumed opt-in status.

¹⁰ TVA Potential Study Volume III: Demand Response Potential, Global Energy Partners, December 2011

¹¹ IPL/GDS Residential Survey Questionnaire

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Customer participation in new demand response programs is assumed to reach the steady state take rate over a five-year period. The path to steady state customer participation follows an “S-shaped” curve, in which participation growth accelerates over the first half of the five-year period, and then slows over the second half of the period (see Figure 5-1). Existing programs have already gone through this ramp-up period, so they were escalated linearly to the final participation rate.

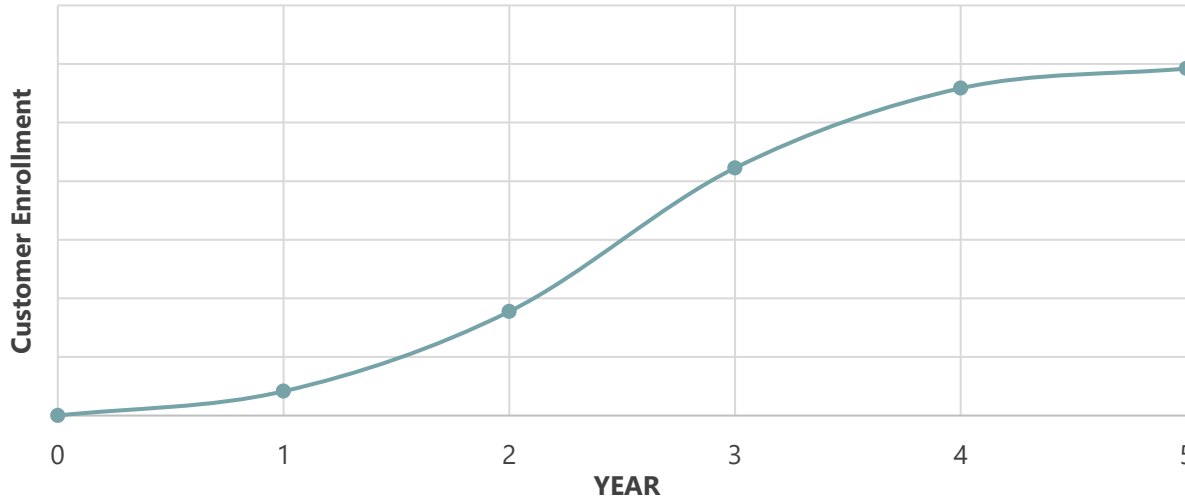


FIGURE 5-1: ILLUSTRATION OF S-SHAPED MARKET ADOPTION CURVE

5.1.3.2 Rate Program Assumptions

Load Reduction: Demand reductions were based on various secondary data sources including the FERC and other industry reports, including demand response potential studies that conducted primary research. Rate-based demand response options were typically assumed to reduce a percentage of the total facility coincident peak load.

Useful Life: The useful life of a smart thermostat is assumed to be 15 years. Smart thermostats were assumed to be the enabling technology required for the TOU with Enabling Technology program. For other rate programs that did not require any additional technology, the only equipment needed is a smart meter. The life of a smart meter was assumed to be 20 years.

Program Costs: One-time program development costs included in the first year of the analysis for new programs. No program development costs are assumed for programs that already exist. Each new program includes an evaluation cost, with evaluation cost for existing programs already being included in the administration costs. It was assumed that there would be a cost of \$50¹² per new participant for marketing for the DLC programs. Marketing costs are assumed to be 33.3% higher for MAP. All program costs were escalated each year by the general rate of inflation assumed for this study.

5.1.3.3 C&I Interruptible Rate Program Assumptions

One of the most prominent forms of demand response among non-residential customers is load curtailment agreements where the utility, or an aggregator on the utility’s behalf, enters financial agreements with businesses to reduce load when dispatched. Load curtailment potential is driven by a few key factors – incentive payments, the frequency of events, the duration of events, and the level of notification participants are given about pending events. The directional effect these factors have on demand response potential is shown in Figure 5-2.

¹² TVA Potential Study Volume III: Demand Response Potential, Global Energy Partners, December 2011

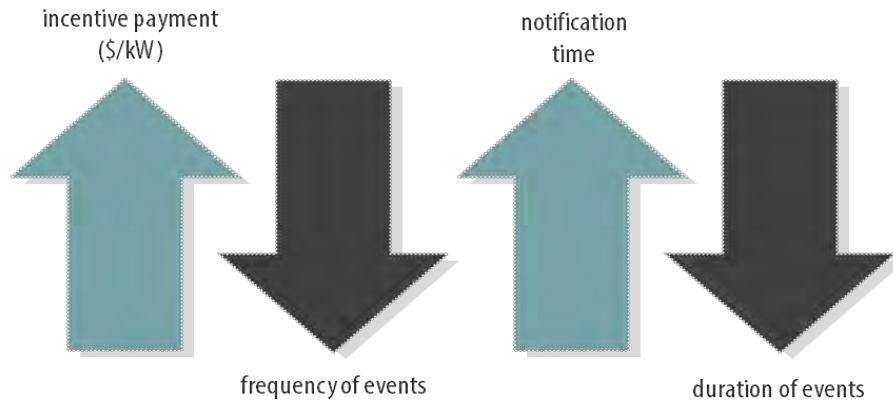


FIGURE 5-2: DRIVERS OF DR POTENTIAL

Several different estimates of Curtailment Load potential can be produced by turning levers related to these four inputs. Rather than producing several different scenario-based estimates, the research team made several simplifying assumptions regarding program design. Components of program design include how many demand response events will be called, how long the demand response events will last, how far in advance participants are notified of the upcoming demand response event, and the incentive payment participants receive (the amount and how it is distributed – annually, monthly, per event, etc.).

Program Design: Previous Indiana research suggests short demand response events would serve the region better than long events, as summer peaks are concentrated between 2:00 PM and 6:00 PM. Thus, our estimates of potential assume a four-hour event duration. We are also assuming that there will be an average of seven summer events will be called (28 total event hours for the summer).

Results were calculated for both a “day-ahead” notification design and a “day-of” notification design. “Day-ahead” notification assumes a 24-hour notice, and “day-of” notification assumes a 3-to-6-hour notice. Potential is higher under the “day-ahead” notification design, as this provides participants greater opportunities to shift energy-intensive tasks to off-peak periods.

Participant Incentive: For C&I Curtailable demand response, our team modeled the incentive as a reservation payment. This is an annual payment provided to the participant. In exchange, the participant agrees to curtail load when events are dispatched. For RAP, our approach to setting incentive levels involved optimizing net benefits. To determine the optimal incentive level, the research team performed a simulation where the critical input was the incentive level and the critical output was the net benefit of the demand response program. The simulation leveraged several of the inputs discussed herein. The results indicated that the optimal incentive level in 2020 is \$21/kW-year.

For MAP, the goal of the simulation was not to optimize net benefits. Instead, we used the simulation to determine the greatest possible incentive level that would produce a cost-effective program (e.g., largest incentive value such that the UCT ratio does not fall below 1). The results indicated an incentive level of \$39/kW-year should be used in estimating MAP for summer 2020.

In both cases, the incentive level is escalated annually at a rate that matches the growth rate of avoided costs. This growth rate is largely driven by the generation component (avoided cost of generation capacity was provided by AES Indiana).

Chapter 5 Demand Response Potential

Price Elasticity of Demand Coefficients: The price elasticity of demand coefficients used in this research were derived from two years of demand response performance data for C&I demand response participants in Pennsylvania. Information about sector (small/large), incentive levels, and the peak load share of each participant was used in the development of the elasticity coefficients. Traditional elasticity formulas were used.

Leveraging the inputs discussed above, C&I Curtailable load potential estimates were developed via a “top-down” approach. At a high level, the approach entails disaggregating the peak load forecast into peak load forecasts by sector, and then combining these forecasts with the price elasticity of demand coefficients to estimate potential. Price elasticity of demand can be thought of as the percentage change in the quantity of electricity demanded divided by the percentage change in the price (including an incentive) of demand response:

$$Elasticity = \frac{\% \text{ change in Quantity}}{\% \text{ change in Price}}$$

Rearranging the terms in the elasticity equation yields the following:

$$\% \text{ change in Quantity} = (Elasticity) \times (\% \text{ change in Price})$$

Note that “% change in Quantity” can also be expressed as:

$$\% \text{ change in Quantity} = \frac{(Summer \text{ peak} - DR \text{ potential}) - Summer \text{ Peak}}{Summer \text{ Peak}} * 100\%$$

Combining these two “% change in Quantity” equations yields:

$$(Elasticity) \times (\% \text{ change in Price}) = \frac{(Summer \text{ peak} - DR \text{ potential}) - Summer \text{ Peak}}{Summer \text{ Peak}} * 100\%$$

By making assumptions about price elasticity, the percentage change in price (related to electric retail rates and the incentive level), and the summer peak load, it is possible to estimate how much demand response potential exists in each market segment by solving for “demand response potential.” It is important to note that the estimates of C&I Curtailable Load demand response potential discussed in this section are not incremental to existing AES Indiana programs. That is, we are not estimating how much Curtailable Load demand response potential exists beyond the existing AES Indiana resources. It is also important to note that this top-down methodology produces estimates of Curtailable Load demand response potential at the system-level (inclusive of line losses).

5.2 TOTAL DEMAND RESPONSE POTENTIAL

Table 5-3 and Table 5-4 show the achievable cumulative annual potential savings for the Years 1-3, 10 and 19. Achievable potential includes a participation rate to estimate the realistic number of customers that are expected to participate in each cost-effective demand response program option. These values are at the customer meter. The MAP assumes the maximum participation that would happen in the real-world, while the RAP considers additional barriers to program implementation that could limit the amount of savings achieved. Programs marked with an asterisk were those that were found to not be cost-effective, and therefore do not provide any achievable potential. Two scenarios were looked at for the curtailable rate program: day of notifications and day ahead notifications. The non-residential sector sub-totals and residential and non-residential combined totals reflect these two scenarios.

TABLE 5-3: MAP SAVINGS BY PROGRAM

Sector	Program	2024	2025	2026	2033	2042
Residential	DLC AC - Switch	13	13	12	7	0
	DLC AC - Thermostat	22	29	36	89	163
	DLC Space Heating	0	0	5	50	53
	DLC Water Heating	2	5	8	65	147
	DLC Electric Vehicles*	0	0	0	0	0
	DLC Room AC*	0	0	0	0	0
	Battery Storage*	0	0	0	0	0
	Behavioral DR	0	0	2	14	9
	Time of Use with Enabling Technology	0	0	2	13	7
	Time of Use without Enabling Technology	0	0	1	8	5
	Sector Total		38	47	66	247
C&I	DLC AC - Switch*	0	0	0	0	0
	DLC AC - Thermostat	2	4	6	19	38
	DLC Space Heating	0	0	0	5	5
	DLC Water Heating	1	2	4	6	6
	Ice Storage Cooling Rate*	0	0	0	0	0
	DLC Lighting*	0	0	0	0	0
	Curtable (Day Of)	0	0	34	68	70
	Curtable (Day Ahead)	0	0	62	127	129
	Capacity Bidding	7	23	48	74	78
	Demand Bidding*	0	0	0	0	0
	Time of Use with Enabling Technology	0	0	1	7	3
	Time of Use without Enabling Technology	0	0	1	4	3
	Sector Total (Curtable Day Of)	9	29	94	184	203
	Sector Total (Curtable Day Ahead)	9	29	122	242	263
Residential & Non-Residential Total (Curtable Day Of)	48	76	160	430	588	
Residential & Non-Residential Total (Curtable Day Ahead)	48	76	188	489	648	

TABLE 5-4 RAP SAVINGS BY PROGRAM

Sector	Program	2024	2025	2026	2033	2042
Residential	DLC AC - Switch	13	13	12	7	0
	DLC AC - Thermostat	19	23	27	55	94
	DLC Space Heating	0	0	4	38	40
	DLC Water Heating	1	3	4	35	79
	DLC Electric Vehicles*	0	0	0	0	0
	DLC Room AC*	0	0	0	0	0

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Sector	Program	2024	2025	2026	2033	2042
	Battery Storage*	0	0	0	0	0
	Behavioral DR	0	0	1	9	8
	Time of Use with Enabling Technology	0	0	2	13	12
	Time of Use without Enabling Technology	0	0	1	8	7
	Sector Total	34	39	50	166	241
C&I	DLC AC - Switch*	0	0	0	0	0
	DLC AC - Thermostat	1	2	3	10	21
	DLC Space Heating	0	0	0	1	1
	DLC Water Heating	0	1	2	3	3
	Ice Storage Cooling Rate*	0	0	0	0	0
	DLC Lighting*	0	0	0	0	0
	Curtable (Day Of)	0	0	18	36	36
	Curtable (Day Ahead)	0	0	33	67	68
	Capacity Bidding	1	3	7	8	6
	Demand Bidding*	0	0	0	0	0
	Time of Use with Enabling Technology	0	0	1	7	5
	Time of Use without Enabling Technology	0	0	0	4	3
	Sector Total (Curtable Day Of)	2	6	30	69	76
	Sector Total (Curtable Day Ahead)	2	6	45	99	107
	Residential & Non-Residential Total (Curtable Day Of)		36	45	81	235
Residential & Non-Residential Total (Curtable Day Ahead)		36	45	96	265	348

5.3 BENEFITS & COSTS

Table 5-5 shows the MAP and RAP budget requirements (for only cost-effective programs) across the 2024-2042 timeframe that would be required to achieve the cumulative annual potential for each of the thermostat scenarios. The current and future hardware and software cost of a Demand Response Management System and the cost of non-equipment incentives are included in these budgets.

TABLE 5-5 SUMMARY OF MAP AND RAP BUDGET REQUIREMENTS

Year	MAP	RAP
2024	\$6,777,944	\$4,186,325
2025	\$9,137,878	\$4,853,491
2026	\$20,775,617	\$9,271,984
2033	\$28,921,182	\$14,312,257
2042	\$52,205,177	\$26,727,240

Figure 5-3 shows the cumulative annual RAP (MW) by sector. The residential sector RAP rises from 34 MW in 2024 to 241 MW in 2042. The commercial sector RAP starts at just 2 MW in the 2024 but rises to 76 MW by 2042.

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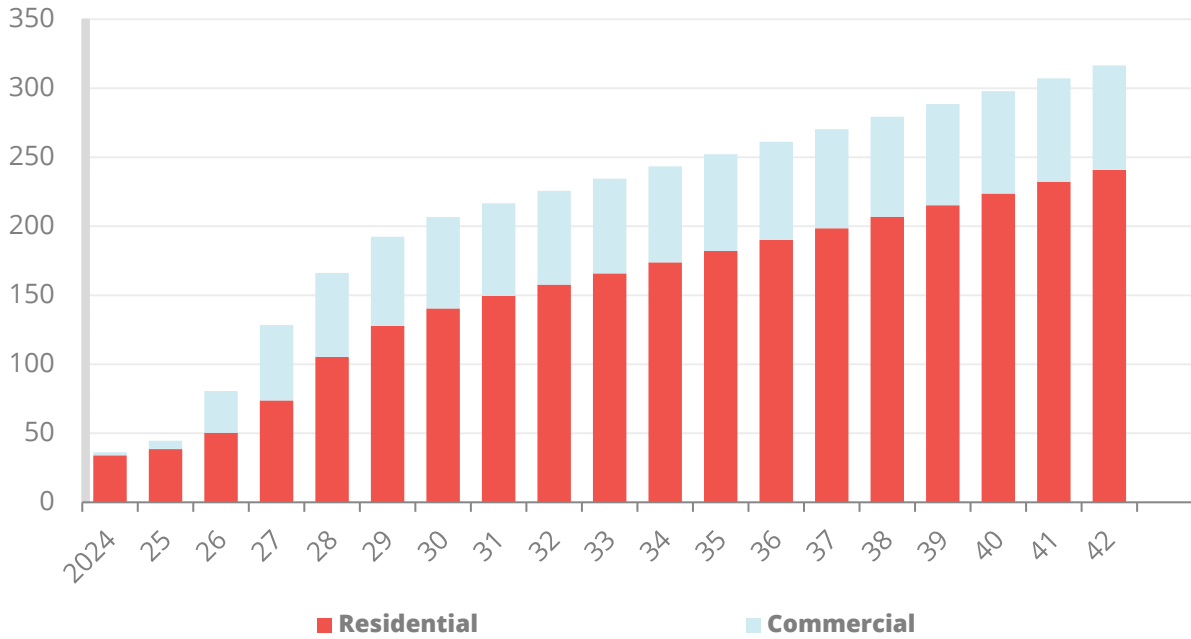


FIGURE 5-3 RESIDENTIAL AND COMMERCIAL DEMAND RESPONSE RAP

Figure 5-4 shows the cumulative annual RAP (MW) by program in the residential sector. The DLC AC – Switch program initially contributes 13 MW towards the RAP, but then fades out over the timeframe of the study. The DLC AC – Thermostat and DLC Space Heating and DLC Water Heating programs collectively account for about 90% of the residential RAP, with the total RAP exceeding 240 MW by 2042.

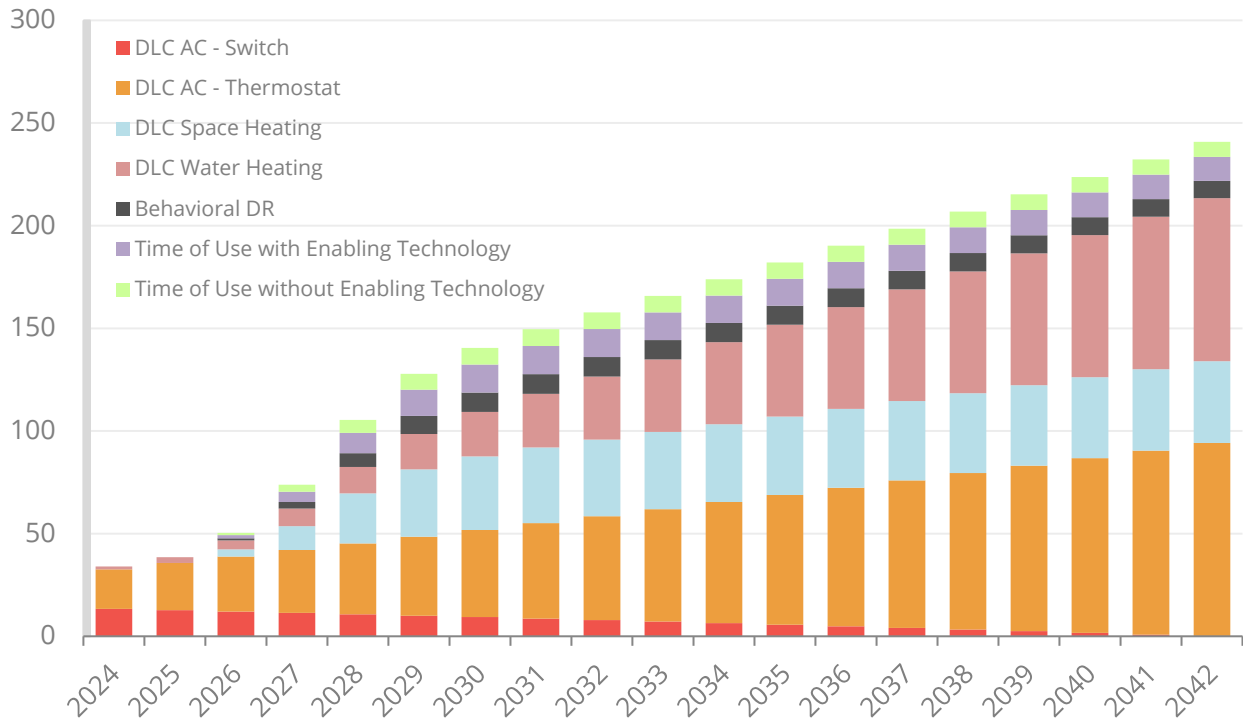


FIGURE 5-4 RESIDENTIAL SECTOR DEMAND RESPONSE RAP – BY PROGRAM

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Figure 5-5 shows the cumulative annual RAP (MW) by program in the non-residential sector. The DLC AC – Thermostat and Curtailable (Day of) programs account for about 80% of the non-residential RAP, with the total RAP exceeding 75 MW by 2042.

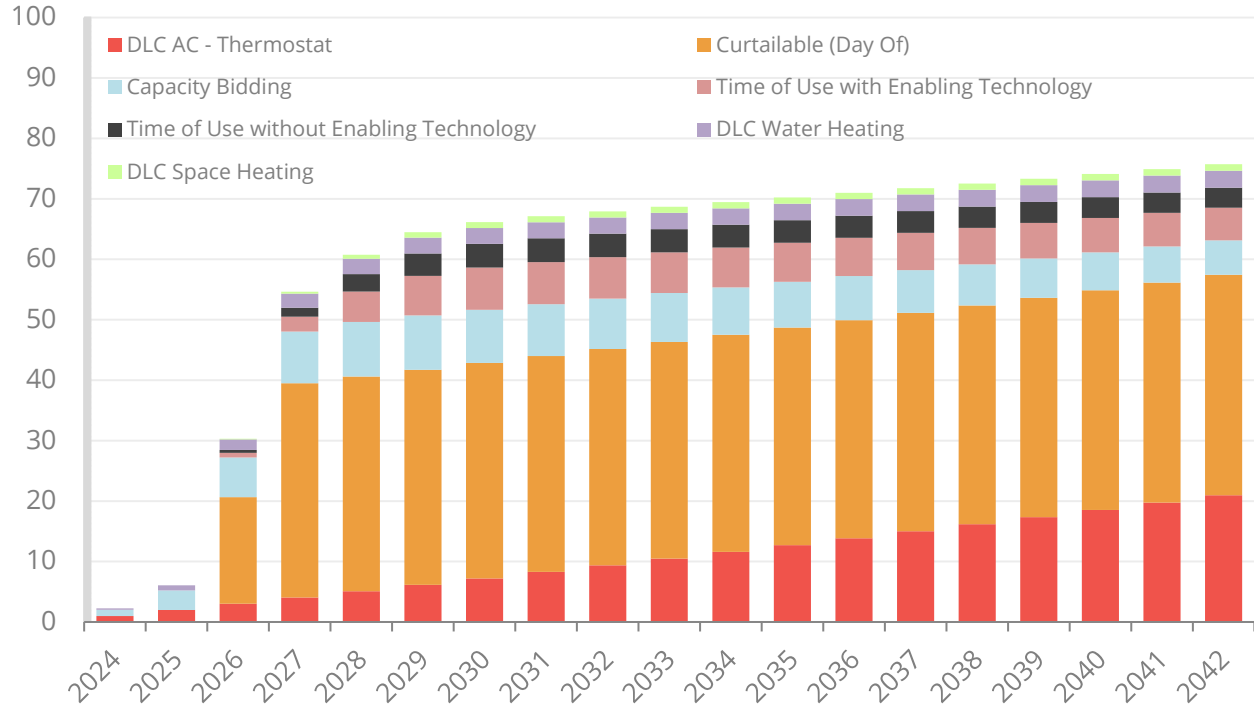


FIGURE 5-5 NON-RESIDENTIAL SECTOR DEMAND RESPONSE RAP – BY PROGRAM

Table 5-6 and Table 5-7 show the MAP and RAP residential NPVs of the total benefits, costs, and savings, along with the UCT ratio for each program for the length of the study. Programs marked with an asterisk were those that were found to not be cost-effective, and therefore do not provide any achievable potential.

TABLE 5-6 MAP NPV BENEFITS, COSTS, AND UCT RATIOS FOR EACH DEMAND RESPONSE PROGRAM

Sector	Program	NPV Benefits	NPV Costs	UCT Ratio
Residential	DLC AC - Switch	\$16,994,154	\$10,893,267	1.56
	DLC AC - Thermostat	\$144,949,535	\$70,067,246	2.07
	DLC Space Heating	\$65,203,724	\$13,415,022	4.86
	DLC Water Heating	\$155,288,336	\$89,578,503	1.73
	DLC Electric Vehicles*	\$6,887,478	\$6,918,672	1.00
	DLC Room AC*	\$1,411,659	\$25,040,656	0.06
	Battery Storage*	\$117,699,550	\$562,165,765	0.21
	Behavioral DR	\$16,588,369	\$5,447,273	3.05
	Time of Use with Enabling Technology	\$15,942,936	\$14,316,735	1.11
	Time of Use without Enabling Technology	\$9,755,166	\$5,892,742	1.66
	Sector Total		\$550,720,909	\$803,735,882
C&I	DLC AC - Switch*	\$68,515	\$417,639	0.16
	DLC AC - Thermostat	\$30,643,265	\$13,484,146	2.27

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Sector	Program	NPV Benefits	NPV Costs	UCT Ratio
	DLC Space Heating	\$6,151,103	\$1,749,239	3.52
	DLC Water Heating	\$14,061,705	\$6,631,955	2.12
	Ice Storage Cooling Rate*	\$3,201,634	\$20,436,899	0.16
	DLC Lighting*	\$1,192,459	\$5,089,217	0.23
	Curtable (Day Of)	\$104,708,768	\$105,539,639	0.99
	Curtable (Day Ahead)	\$104,708,768	\$105,539,639	0.99
	Capacity Bidding	\$107,306,214	\$15,380,782	6.98
	Demand Bidding*	\$3,501,063	\$3,966,402	0.88
	Time of Use with Enabling Technology	\$7,772,625	\$1,563,219	4.97
	Time of Use without Enabling Technology	\$4,966,307	\$903,961	5.49
	Sector Total (Curtable Day Of)	\$235,305,353	\$126,505,610	1.86
	Sector Total (Curtable Day Ahead)	\$283,573,659	\$175,163,099	1.62
Residential & Commercial Total (Curtable Day Of)		\$786,026,261	\$930,241,492	0.84
Residential & Commercial Total (Curtable Day Ahead)		\$834,294,568	\$978,898,982	0.85

TABLE 5-7 RAP NPV BENEFITS, COSTS, AND UCT RATIOS FOR EACH DEMAND RESPONSE PROGRAM

Sector	Program	NPV Benefits	NPV Costs	UCT Ratio
Residential	DLC AC - Switch	\$16,994,154	\$10,893,267	1.56
	DLC AC - Thermostat	\$90,315,885	\$46,492,661	1.94
	DLC Space Heating	\$48,902,793	\$8,421,482	5.81
	DLC Water Heating	\$84,022,859	\$45,329,467	1.85
	DLC Electric Vehicles*	\$2,702,531	\$4,146,957	0.65
	DLC Room AC*	\$910,748	\$16,143,042	0.06
	Battery Storage*	\$59,377,971	\$281,948,247	0.21
	Behavioral DR	\$11,321,347	\$2,675,998	4.23
	Time of Use with Enabling Technology	\$16,886,284	\$9,309,688	1.81
	Time of Use without Enabling Technology	\$10,346,266	\$2,162,256	4.78
	Sector Total	\$341,780,839	\$427,523,065	0.80
C&I	DLC AC - Switch*	\$68,515	\$417,641	0.16
	DLC AC - Thermostat	\$16,714,508	\$6,612,372	2.53
	DLC Space Heating	\$1,318,093	\$904,715	1.46
	DLC Water Heating	\$6,151,996	\$3,281,157	1.87
	Ice Storage Cooling Rate*	\$632,421	\$4,994,248	0.13
	DLC Lighting*	\$256,290	\$1,855,151	0.14
	Curtable (Day Of)	\$29,555,726	\$16,039,314	1.84
	Curtable (Day Ahead)	\$54,832,515	\$29,759,733	1.84
	Capacity Bidding	\$11,584,967	\$1,706,987	6.79
	Demand Bidding*	\$437,633	\$1,010,520	0.43

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Sector	Program	NPV Benefits	NPV Costs	UCT Ratio
	Time of Use with Enabling Technology	\$8,348,705	\$1,112,685	7.50
	Time of Use without Enabling Technology	\$4,838,368	\$482,537	10.03
	Sector Total (Curtailed Day Of)	\$79,907,223	\$38,417,327	2.08
	Sector Total (Curtailed Day Ahead)	\$105,184,012	\$52,137,745	2.02
Residential & Commercial Total (Curtailed Day Of)		\$421,688,062	\$465,940,392	0.91
Residential & Commercial Total (Curtailed Day Ahead)		\$446,964,851	\$479,660,810	0.93

VOLUME II

Appendices

prepared for



NOVEMBER 2022

Appendix A. Commercial Opt-Out Results

This section provides the potential results for technical, economic, MAP and RAP for the commercial sector, with opt-out customers included. A comparison of the RAP scenario (with without opt-out customers included) savings potential and RAP budgets is also provided.

Table A-1 provides cumulative annual technical, economic, MAP and RAP energy savings, in total MWh and as a percentage of the sector-level sales forecast. The RAP increases to 5.0% cumulative annual savings over the next three years.

TABLE A-1: C&I CUMULATIVE ANNUAL ENERGY EFFICIENCY POTENTIAL SUMMARY – INCLUDING OPT-OUT

	2024	2025	2026	2033	2042
MWh					
Technical	228,329	475,728	733,191	2,309,163	2,912,075
Economic	220,511	458,786	707,070	2,226,896	2,800,577
MAP	194,166	368,083	538,853	1,535,536	2,082,694
RAP	145,886	279,028	409,805	1,188,323	1,649,814
Forecasted Sales	8,175,708	8,179,029	8,159,445	8,232,254	8,438,092
% of Total Sales					
Technical	2.8%	5.8%	9.0%	28.1%	34.5%
Economic	2.7%	5.6%	8.7%	27.1%	33.2%
MAP	2.4%	4.5%	6.6%	18.7%	24.7%
RAP	1.8%	3.4%	5.0%	14.4%	19.6%

Figure A-1 provides the RAP results for the 3-year, 10-year, and 19-year timeframes for both the RAP scenario and the RAP scenario including opt-out customers. The savings as a percentage of forecasted sales is slightly higher in the RAP scenario, through total MWh savings are higher in the scenario in which opt-out customers are included in the analysis.

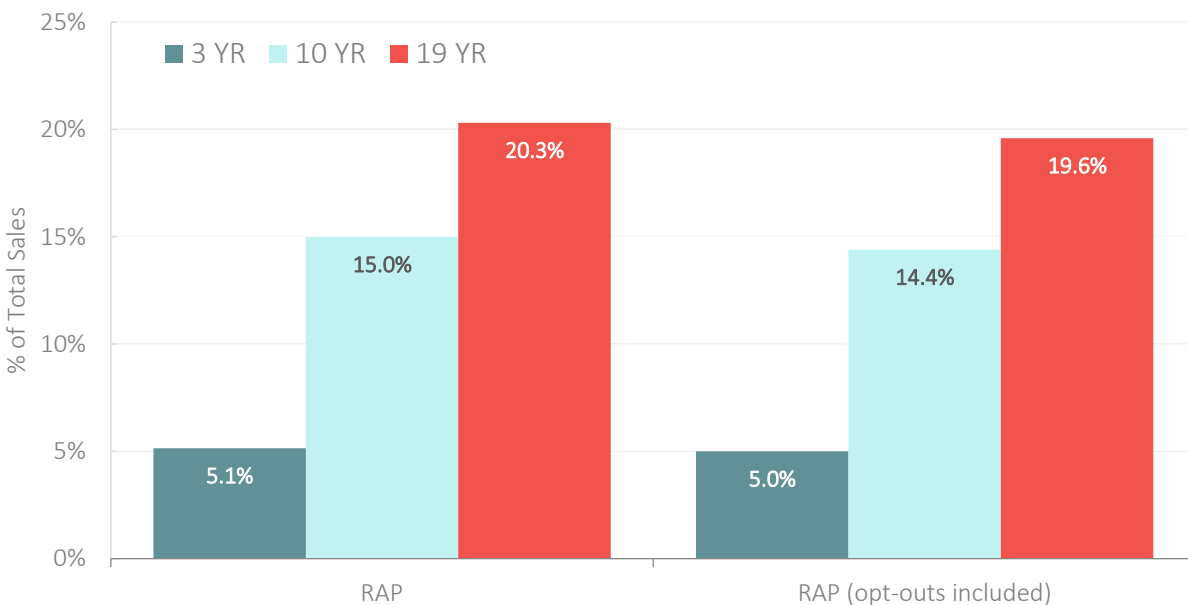


FIGURE A-1: C&I ELECTRIC ENERGY CUMULATIVE ANNUAL POTENTIAL (AS A % OF COMMERCIAL AND INDUSTRIAL SALES)

Figure A-2 provides the annual budgets for commercial RAP, with and without opt-out customers. The budgets in the RAP scenario range from \$12 million to \$14 million, while the budgets in the RAP scenario with opt-out customers included range from \$17 million to \$20 million.

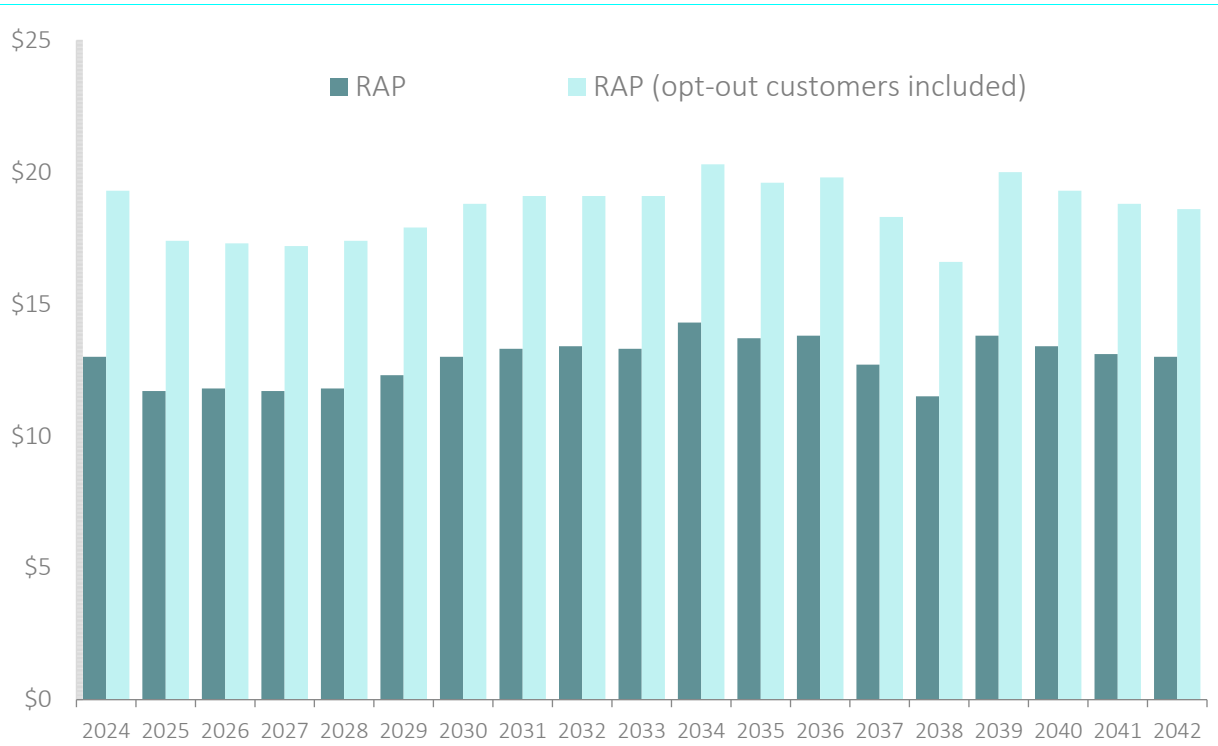


FIGURE A-2: C&I RAP BUDGETS – WITHOUT AND WITH OPT-OUT CUSTOMERS

Appendix B. Residential Sector Measure Detail

Appendix B: Residential Measure Assumptions

Measure #	End-Use	Measure Name	Program	Home Type	Replacement Type	Base Annual Electric	% Elec Savings	Per Unit Elec Savings	Per Unit Summer kW	EE EUL	Measure Cost	MAP Incentive (%)	RAP Incentive (%)	PP Incentive (%)	End Use Measure Group	Base Saturation	EE Saturation	MAP Adoption Rate	RAP Adoption Rate	PP Adoption Rate	UCT Score
1001	Appliances	ENERGY STAR Air Purifier	Efficient Products	SF	MO	533	57%	303	0.03	9	\$92	100%	54%	54%	PUR-1	12%	29%	78.6%	52.8%	52.8%	2.3
1002	Appliances	ENERGY STAR Air Purifier	Efficient Products	SF	NC	533	57%	303	0.03	9	\$92	100%	54%	54%	PUR-2	12%	0%	81.8%	59.8%	59.8%	2.3
1003	Appliances	ENERGY STAR Air Purifier	Efficient Products	MF	MO	533	57%	303	0.03	9	\$92	100%	54%	54%	PUR-3	12%	29%	66.3%	41.8%	41.8%	2.4
1004	Appliances	ENERGY STAR Air Purifier	Efficient Products	MF	NC	533	57%	303	0.03	9	\$92	100%	54%	54%	PUR-4	12%	0%	71.2%	50.4%	50.4%	2.4
1005	Appliances	ENERGY STAR Refrigerator - early replacement	IQW	SF	ER1	1,028	68%	696	0.10	6	\$580	130%	100%	100%	REF-2	99%	62%	39.7%	35.3%	35.3%	0.3
1006	Appliances	ENERGY STAR Refrigerator - early replacement	IQW	MF	ER1	1,028	68%	696	0.10	6	\$580	130%	100%	100%	REF-5	98%	55%	41.6%	41.6%	41.6%	0.3
1007	Appliances	ENERGY STAR Refrigerator - early replacement	Multifamily	MF	ER1	1,028	68%	696	0.10	6	\$755	100%	100%	100%	REF-4	98%	55%	43.3%	43.3%	43.3%	0.3
1008	Appliances	ENERGY STAR Refrigerator	Efficient Products	SF	MO	369	10%	37	0.01	17	\$40	80%	80%	80%	REF-1	99%	62%	62.0%	62.0%	62.0%	0.8
1009	Appliances	ENERGY STAR Refrigerator	Efficient Products	SF	NC	369	10%	37	0.01	17	\$40	80%	80%	80%	REF-3	99%	0%	72.7%	72.7%	72.7%	0.8
1010	Appliances	ENERGY STAR Refrigerator	Efficient Products	MF	MO	369	10%	37	0.01	17	\$40	80%	80%	80%	REF-4	98%	55%	56.4%	50.2%	50.2%	0.8
1011	Appliances	ENERGY STAR Refrigerator	Efficient Products	MF	NC	369	10%	37	0.01	17	\$40	80%	80%	80%	REF-6	98%	0%	63.7%	63.7%	63.7%	0.8
1012	Appliances	CEE Tier 2 Refrigerator	Efficient Products	SF	MO	369	15%	55	0.01	17	\$140	80%	80%	80%	REF-1	99%	62%	62.0%	62.0%	62.0%	0.3
1013	Appliances	CEE Tier 2 Refrigerator	Efficient Products	SF	NC	369	15%	55	0.01	17	\$140	80%	80%	80%	REF-3	99%	0%	72.7%	72.7%	72.7%	0.3
1014	Appliances	CEE Tier 2 Refrigerator	Efficient Products	MF	MO	369	15%	55	0.01	17	\$140	80%	80%	80%	REF-4	98%	55%	56.4%	50.2%	50.2%	0.3
1015	Appliances	CEE Tier 2 Refrigerator	Efficient Products	MF	NC	369	15%	55	0.01	17	\$140	80%	80%	80%	REF-6	98%	0%	63.7%	63.7%	63.7%	0.3
1016	Appliances	Smart Refrigerator	Efficient Products	SF	MO	369	20%	74	0.01	17	\$1,078	80%	80%	80%	REF-1	99%	62%	62.0%	62.0%	62.0%	0.1
1017	Appliances	Smart Refrigerator	Efficient Products	SF	NC	369	20%	74	0.01	17	\$1,078	80%	80%	80%	REF-3	99%	0%	72.7%	72.7%	72.7%	0.1
1018	Appliances	Smart Refrigerator	Efficient Products	MF	MO	369	20%	74	0.01	17	\$1,078	80%	80%	80%	REF-4	98%	55%	56.4%	50.2%	50.2%	0.1
1019	Appliances	Smart Refrigerator	Efficient Products	MF	NC	369	20%	74	0.01	17	\$1,078	80%	80%	80%	REF-6	98%	0%	63.7%	63.7%	63.7%	0.1
1020	Appliances	Refrigerator Recycling	Appliance Recycling	SF	Recycle	956	100%	956	0.12	7	\$50	100%	100%	100%	RR-1	17%	0%	81.8%	81.8%	81.8%	6.3
1021	Appliances	Refrigerator Recycling	Appliance Recycling	MF	Recycle	956	100%	956	0.12	7	\$50	100%	100%	100%	RR-2	4%	0%	71.2%	71.2%	71.2%	6.3
1022	Appliances	Freezer Recycling	Appliance Recycling	SF	Recycle	576	100%	576	0.07	7	\$50	100%	100%	100%	FR-1	3%	0%	81.8%	81.8%	81.8%	3.7
1023	Appliances	Freezer Recycling	Appliance Recycling	MF	Recycle	576	100%	576	0.07	7	\$50	100%	100%	100%	FR-2	0%	0%	71.2%	71.2%	71.2%	3.7
1024	Appliances	Dehumidifier Recycling	Appliance Recycling	SF	Recycle	1,000	100%	1,000	0.00	7	\$20	100%	100%	100%	DEH-1	24%	0%	81.8%	81.8%	81.8%	11.0
1025	Appliances	Dehumidifier Recycling	Appliance Recycling	MF	Recycle	1,000	100%	1,000	0.00	7	\$20	100%	100%	100%	DEH-2	13%	0%	71.2%	71.2%	71.2%	11.7
1026	Appliances	ENERGY STAR Freezer - Chest	Efficient Products	SF	MO	311	10%	31	0.01	22	\$35	71%	71%	71%	FRZ-1	43%	64%	63.3%	58.0%	58.0%	1.0
1027	Appliances	ENERGY STAR Freezer - Chest	Efficient Products	SF	NC	311	10%	31	0.01	22	\$35	71%	71%	71%	FRZ-2	43%	0%	68.6%	68.6%	68.6%	1.0
1028	Appliances	ENERGY STAR Freezer - Chest	Efficient Products	MF	MO	311	10%	31	0.01	22	\$35	71%	71%	71%	FRZ-3	19%	70%	67.9%	63.3%	63.3%	1.0
1029	Appliances	ENERGY STAR Freezer - Chest	Efficient Products	MF	NC	311	10%	31	0.01	22	\$35	71%	71%	71%	FRZ-4	19%	0%	59.7%	59.7%	59.7%	1.0
1030	Appliances	ENERGY STAR Freezer - Compact Upright	Efficient Products	SF	MO	467	10%	47	0.01	22	\$35	100%	71%	71%	FRZ-1	43%	64%	73.1%	58.0%	58.0%	1.5
1031	Appliances	ENERGY STAR Freezer - Compact Upright	Efficient Products	SF	NC	467	10%	47	0.01	22	\$35	100%	71%	71%	FRZ-2	43%	0%	81.8%	68.6%	68.6%	1.5
1032	Appliances	ENERGY STAR Freezer - Compact Upright	Efficient Products	MF	MO	467	10%	47	0.01	22	\$35	100%	71%	71%	FRZ-3	19%	70%	67.9%	63.3%	63.3%	1.5
1033	Appliances	ENERGY STAR Freezer - Compact Upright	Efficient Products	MF	NC	467	10%	47	0.01	22	\$35	100%	71%	71%	FRZ-4	19%	0%	71.2%	59.7%	59.7%	1.5
1034	Appliances	ENERGY STAR Dehumidifier	Efficient Products	SF	MO	1,095	12%	134	0.03	12	\$10	250%	100%	100%	DEH-1	24%	94%	92.5%	91.4%	91.4%	3.3
1035	Appliances	ENERGY STAR Dehumidifier	Efficient Products	SF	NC	1,095	12%	134	0.03	12	\$10	250%	100%	100%	DEH-2	24%	0%	81.8%	81.8%	81.8%	3.3
1036	Appliances	ENERGY STAR Dehumidifier	Efficient Products	MF	MO	1,095	12%	134	0.03	12	\$10	250%	100%	100%	DEH-3	13%	94%	92.5%	91.4%	91.4%	3.4
1037	Appliances	ENERGY STAR Dehumidifier	Efficient Products	MF	NC	1,095	12%	134	0.03	12	\$10	250%	100%	100%	DEH-4	13%	0%	71.2%	71.2%	71.2%	3.4
1038	Appliances	ENERGY STAR Most Efficient Dehumidifier	Efficient Products	SF	MO	1,095	17%	189	0.04	12	\$75	100%	35%	35%	DEH-1	24%	94%	92.5%	91.4%	91.4%	4.4
1039	Appliances	ENERGY STAR Most Efficient Dehumidifier	Efficient Products	SF	NC	1,095	17%	189	0.04	12	\$75	100%	35%	35%	DEH-2	24%	0%	81.8%	45.6%	45.6%	4.4
1040	Appliances	ENERGY STAR Most Efficient Dehumidifier	Efficient Products	MF	MO	1,095	17%	189	0.04	12	\$75	100%	35%	35%	DEH-3	13%	94%	92.5%	91.4%	91.4%	4.5
1041	Appliances	ENERGY STAR Most Efficient Dehumidifier	Efficient Products	MF	NC	1,095	17%	189	0.04	12	\$75	100%	35%	35%	DEH-4	13%	0%	71.2%	41.3%	41.3%	4.5
1042	Appliances	ENERGY STAR Dishwasher (E WH)	Efficient Products	SF	MO	307	12%	37	0.00	11	\$76	66%	66%	66%	DW-1	37%	83%	79.4%	76.4%	76.4%	0.3
1043	Appliances	ENERGY STAR Dishwasher (E WH)	Efficient Products	SF	NC	307	12%	37	0.00	11	\$76	66%	66%	66%	DW-2	37%	0%	65.7%	65.7%	65.7%	0.3
1044	Appliances	ENERGY STAR Dishwasher (E WH)	Efficient Products	MF	MO	307	12%	37	0.00	11	\$76	66%	66%	66%	DW-3	69%	83%	79.4%	76.4%	76.4%	0.3
1045	Appliances	ENERGY STAR Dishwasher (E WH)	Efficient Products	MF	NC	307	12%	37	0.00	11	\$76	66%	66%	66%	DW-4	69%	0%	56.7%	56.7%	56.7%	0.3
1046	Appliances	ENERGY STAR Dishwasher (NG WH)	Efficient Products	SF	MO	135	12%	16	0.00	11	\$76	66%	66%	66%	DW-5	36%	83%	79.4%	76.4%	76.4%	0.1
1047	Appliances	ENERGY STAR Dishwasher (NG WH)	Efficient Products	SF	NC	135	12%	16	0.00	11	\$76	66%	66%	66%	DW-6	36%	0%	65.7%	65.7%	65.7%	0.1
1048	Appliances	ENERGY STAR Dishwasher (NG WH)	Efficient Products	MF	MO	135	12%	16	0.00	11	\$76	66%	66%	66%	DW-7	18%	83%	79.4%	76.4%	76.4%	0.1
1049	Appliances	ENERGY STAR Dishwasher (NG WH)	Efficient Products	MF	NC	135	12%	16	0.00	11	\$76	66%	66%	66%	DW-8	18%	0%	56.7%	56.7%	56.7%	0.1
1050	Appliances	Smart Dishwasher (E WH)	Efficient Products	SF	MO	307	8%	24	0.00	11	\$76	66%	66%	66%	DW-1	37%	83%	79.4%	76.4%	76.4%	0.2
1051	Appliances	Smart Dishwasher (E WH)	Efficient Products	SF	NC	307	8%	24	0.00	11	\$76	66%	66%	66%	DW-2	37%	0%	65.7%	65.7%	65.7%	0.2
1052	Appliances	Smart Dishwasher (E WH)	Efficient Products	MF	MO	307	8%	24	0.00	11	\$76	66%	66%	66%	DW-3	69%	83%	79.4%	76.4%	76.4%	0.2
1053	Appliances	Smart Dishwasher (E WH)	Efficient Products	MF	NC	307	8%	24	0.00	11	\$76	66%	66%	66%	DW-4	69%	0%	56.7%	56.7%	56.7%	0.2
1054	Appliances	Smart Dishwasher (NG WH)	Efficient Products	SF	MO	135	8%	11	0.00	11	\$76	66%	66%	66%	DW-5	36%	83%	79.4%	76.4%	76.4%	0.1
1055	Appliances	Smart Dishwasher (NG WH)	Efficient Products	SF	NC	135	8%	11	0.00	11	\$76	66%	66%	66%	DW-6	36%	0%	65.7%	65.7%	65.7%	0.1
1056	Appliances	Smart Dishwasher (NG WH)	Efficient Products	MF	MO	135	8%	11	0.00	11	\$76	66%	66%	66%	DW-7	18%	83%	79.4%	76.4%	76.4%	0.1
1057	Appliances	Smart Dishwasher (NG WH)	Efficient Products	MF	NC	135	8%	11	0.00	11	\$76	66%	66%	66%	DW-8	18%	0%	56.7%	56.7%	56.7%	0.1
1058	Appliances	ENERGY STAR Clothes Washer (Electrc WH/Dryer)	Efficient Products	SF	MO	590	21%	126	0.02	14	\$84	75%	60%	60%	CW-1	47%	65%	63.7%	58.5%	58.5%	1.4
1059	Appliances	ENERGY STAR Clothes Washer (Electrc WH/Dryer)	Efficient Products	SF	NC	590	21%	126	0.02	14	\$84	75%	60%	60%	CW-2	47%	0%	70.5%	62.4%	62.4%	1.4
1060	Appliances	ENERGY STAR Clothes Washer (Electrc WH/Dryer)	Efficient Products	MF	MO	590	21%	126	0.02	14	\$84	75%	60%	60%	CW-3	47%	35%	53.9%	43.3%	43.3%	1.4

Appendix B: Residential Measure Assumptions

Measure #	End-Use	Measure Name	Program	Home Type	Replacement Type	Base Annual Electric	% Elec Savings	Per Unit Elec Savings	Per Unit Summer kW	EE EUL	Measure Cost	MAP Incentive (%)	RAP Incentive (%)	PP Incentive (%)	End Use Measure Group	Base Saturation	EE Saturation	MAP Adoption Rate	RAP Adoption Rate	PP Adoption Rate	UCT Score
1061	Appliances	ENERGY STAR Clothes Washer (Electrc WH/Dryer)	Efficient Products	MF	NC	590	21%	126	0.02	14	\$84	75%	60%	60%	CW-4	47%	0%	61.9%	53.1%	53.1%	1.4
1062	Appliances	ENERGY STAR Clothes Washer (NG WH/E Dryer)	Efficient Products	SF	MO	434	26%	115	0.01	14	\$84	75%	60%	60%	CW-5	52%	65%	63.7%	58.5%	58.5%	1.3
1063	Appliances	ENERGY STAR Clothes Washer (NG WH/E Dryer)	Efficient Products	SF	NC	434	26%	115	0.01	14	\$84	75%	60%	60%	CW-6	52%	0%	70.5%	62.4%	62.4%	1.3
1064	Appliances	ENERGY STAR Clothes Washer (NG WH/E Dryer)	Efficient Products	MF	MO	434	26%	115	0.01	14	\$84	75%	60%	60%	CW-7	14%	35%	53.9%	43.3%	43.3%	1.2
1065	Appliances	ENERGY STAR Clothes Washer (NG WH/E Dryer)	Efficient Products	MF	NC	434	26%	115	0.01	14	\$84	75%	60%	60%	CW-8	14%	0%	61.9%	53.1%	53.1%	1.2
1066	Appliances	Smart/CEE Tier 2 Clothes Washer (Electrc WH/Dryer)	Efficient Products	SF	MO	590	40%	236	0.03	14	\$141	75%	35%	35%	CW-1	47%	65%	63.7%	58.5%	58.5%	2.6
1067	Appliances	Smart/CEE Tier 2 Clothes Washer (Electrc WH/Dryer)	Efficient Products	SF	NC	590	40%	236	0.03	14	\$141	75%	35%	35%	CW-2	47%	0%	70.5%	45.9%	45.9%	2.6
1068	Appliances	Smart/CEE Tier 2 Clothes Washer (Electrc WH/Dryer)	Efficient Products	MF	MO	590	40%	236	0.03	14	\$141	75%	35%	35%	CW-3	47%	35%	53.9%	36.8%	36.8%	2.6
1069	Appliances	Smart/CEE Tier 2 Clothes Washer (Electrc WH/Dryer)	Efficient Products	MF	NC	590	40%	236	0.03	14	\$141	75%	35%	35%	CW-4	47%	0%	61.9%	41.5%	41.5%	2.6
1070	Appliances	Smart/CEE Tier 2 Clothes Washer (NG WH/E Dryer)	Efficient Products	SF	MO	434	26%	114	0.01	14	\$141	35%	35%	35%	CW-5	52%	65%	63.7%	58.5%	58.5%	1.3
1071	Appliances	Smart/CEE Tier 2 Clothes Washer (NG WH/E Dryer)	Efficient Products	SF	NC	434	26%	114	0.01	14	\$141	35%	35%	35%	CW-6	52%	0%	45.9%	45.9%	45.9%	1.3
1072	Appliances	Smart/CEE Tier 2 Clothes Washer (NG WH/E Dryer)	Efficient Products	MF	MO	434	26%	114	0.01	14	\$141	50%	35%	35%	CW-7	14%	35%	44.7%	36.8%	36.8%	1.2
1073	Appliances	Smart/CEE Tier 2 Clothes Washer (NG WH/E Dryer)	Efficient Products	MF	NC	434	26%	114	0.01	14	\$141	50%	35%	35%	CW-8	14%	0%	48.4%	41.5%	41.5%	1.2
1074	Appliances	ENERGY STAR Clothes Dryer (Electric)	Efficient Products	SF	MO	769	21%	160	0.02	16	\$152	50%	35%	35%	DRY-1	87%	60%	60.4%	54.7%	54.7%	1.9
1075	Appliances	ENERGY STAR Clothes Dryer (Electric)	Efficient Products	SF	NC	769	21%	160	0.02	16	\$152	50%	35%	35%	DRY-2	87%	0%	57.9%	45.6%	45.6%	1.9
1076	Appliances	ENERGY STAR Clothes Dryer (Electric)	Efficient Products	MF	MO	769	21%	160	0.02	16	\$152	50%	35%	35%	DRY-3	62%	35%	45.1%	37.2%	37.2%	1.8
1077	Appliances	ENERGY STAR Clothes Dryer (Electric)	Efficient Products	MF	NC	769	21%	160	0.02	16	\$152	50%	35%	35%	DRY-4	62%	0%	48.4%	41.3%	41.3%	1.8
1078	Appliances	Smart Clothes Dryer (Electric)	Efficient Products	SF	MO	769	7%	54	0.01	16	\$636	35%	35%	35%	DRY-1	87%	60%	60.4%	54.7%	54.7%	0.1
1079	Appliances	Smart Clothes Dryer (Electric)	Efficient Products	SF	NC	769	7%	54	0.01	16	\$636	35%	35%	35%	DRY-2	87%	0%	45.6%	45.6%	45.6%	0.1
1080	Appliances	Smart Clothes Dryer (Electric)	Efficient Products	MF	MO	769	7%	54	0.01	16	\$636	35%	35%	35%	DRY-3	62%	35%	45.1%	37.2%	37.2%	0.1
1081	Appliances	Smart Clothes Dryer (Electric)	Efficient Products	MF	NC	769	7%	54	0.01	16	\$636	35%	35%	35%	DRY-4	62%	0%	41.3%	41.3%	41.3%	0.1
1082	Appliances	Heat Pump Dryer	Efficient Products	SF	MO	769	49%	378	0.14	16	\$900	35%	35%	35%	DRY-1	87%	60%	60.4%	54.7%	54.7%	1.2
1083	Appliances	Heat Pump Dryer	Efficient Products	SF	NC	769	49%	378	0.14	16	\$900	35%	35%	35%	DRY-2	87%	0%	45.6%	45.6%	45.6%	1.2
1084	Appliances	Heat Pump Dryer	Efficient Products	MF	MO	769	49%	378	0.14	16	\$900	100%	35%	35%	DRY-3	62%	35%	65.0%	37.2%	37.2%	1.1
1085	Appliances	Heat Pump Dryer	Efficient Products	MF	NC	769	49%	378	0.14	16	\$900	100%	35%	35%	DRY-4	62%	0%	71.2%	41.3%	41.3%	1.1
2001	Behavior	Home Energy Reports	PEER	SF	MO	12,290	1%	96	0.01	1	\$0	100%	35%	35%	HER-1	100%	57%	100.0%	100.0%	100.0%	1.0
2002	Behavior	Home Energy Reports	PEER	SF	NC	12,290	1%	96	0.01	1	\$0	100%	35%	35%	HER-2	100%	0%	100.0%	100.0%	100.0%	1.0
2003	Behavior	Home Energy Reports	PEER	MF	MO	7,866	2%	96	0.01	1	\$0	100%	35%	35%	HER-3	100%	57%	100.0%	100.0%	100.0%	1.0
2004	Behavior	Home Energy Reports	PEER	MF	NC	7,866	2%	96	0.01	1	\$0	100%	35%	35%	HER-4	100%	0%	100.0%	100.0%	100.0%	1.0
2005	Behavior	Audit Recommendations	Efficient Products	SF	Retrofit	12,290	2%	188	0.02	1	\$100	100%	100%	100%	AUD-1	100%	0%	100.0%	100.0%	100.0%	0.1
2006	Behavior	Audit Recommendations	Efficient Products	MF	Retrofit	7,866	2%	188	0.02	1	\$100	100%	100%	100%	AUD-2	100%	0%	100.0%	100.0%	100.0%	0.1
2007	Behavior	Audit Recommendations	IQW	SF	Retrofit	12,290	2%	188	0.02	1	\$106	100%	100%	100%	AUD-3	100%	0%	100.0%	100.0%	100.0%	0.1
2008	Behavior	Audit Recommendations	IQW	MF	Retrofit	7,866	2%	188	0.02	1	\$106	100%	100%	100%	AUD-4	100%	0%	100.0%	100.0%	100.0%	0.1
2009	Behavior	Customer Education	Efficient Products	SF	MO	12,290	0%	27	0.00	1	\$0	100%	35%	35%	CUST-1	100%	0%	100.0%	100.0%	100.0%	1.0
2010	Behavior	Customer Education	Efficient Products	SF	NC	12,290	0%	27	0.00	1	\$0	100%	35%	35%	CUST-2	100%	0%	100.0%	100.0%	100.0%	1.0
2011	Behavior	Customer Education	Efficient Products	MF	MO	7,866	0%	27	0.00	1	\$0	100%	35%	35%	CUST-3	100%	0%	100.0%	100.0%	100.0%	1.0
2012	Behavior	Customer Education	Efficient Products	MF	NC	7,866	0%	27	0.00	1	\$0	100%	35%	35%	CUST-4	100%	0%	100.0%	100.0%	100.0%	1.0
2013	Behavior	AMI Data Portal	AMI	SF	MO	12,290	2%	246	0.03	1	\$0	100%	100%	100%	AMI-1	100%	0%	100.0%	100.0%	100.0%	43.1
2014	Behavior	AMI Data Portal	AMI	SF	NC	12,290	2%	246	0.03	1	\$0	100%	100%	100%	AMI-2	100%	0%	100.0%	100.0%	100.0%	43.1
2015	Behavior	AMI Data Portal	AMI	MF	MO	7,866	2%	157	0.02	1	\$0	100%	100%	100%	AMI-3	100%	0%	100.0%	100.0%	100.0%	27.6
2016	Behavior	AMI Data Portal	AMI	MF	NC	7,866	2%	157	0.02	1	\$0	100%	100%	100%	AMI-4	100%	0%	100.0%	100.0%	100.0%	27.6
3001	HVAC	ASHP Tune Up	Efficient Products	SF	Retrofit	6,061	5%	303	0.04	3	\$160	31%	31%	31%	TUNE-1	13%	54%	37.2%	28.3%	28.3%	1.0
3002	HVAC	ASHP Tune Up	Efficient Products	MF	Retrofit	2,573	5%	129	0.03	3	\$160	35%	35%	35%	TUNE-2	13%	54%	37.2%	28.3%	28.3%	0.4
3003	HVAC	Air Source Heat Pump 16 SEER - Heat pump baseline	Efficient Products	SF	MO	6,061	7%	435	0.13	16	\$1,233	20%	20%	20%	HP-1	13%	48%	52.2%	45.4%	45.4%	1.5
3004	HVAC	Air Source Heat Pump 16 SEER - Heat pump baseline	Efficient Products	SF	NC	6,061	7%	435	0.13	16	\$1,233	20%	20%	20%	HP-2	42%	0%	47.2%	47.2%	47.2%	1.5
3005	HVAC	Air Source Heat Pump 16 SEER - Heat pump baseline	Efficient Products	MF	MO	2,573	7%	184	0.09	16	\$1,233	20%	20%	20%	HP-3	13%	48%	52.2%	45.4%	45.4%	0.8
3006	HVAC	Air Source Heat Pump 16 SEER - Heat pump baseline	Efficient Products	MF	NC	2,573	7%	184	0.09	16	\$1,233	20%	20%	20%	HP-4	74%	0%	40.2%	40.2%	40.2%	0.8
3007	HVAC	Air Source Heat Pump 17 SEER - Heat pump baseline	Efficient Products	SF	MO	6,061	10%	612	0.25	16	\$1,644	35%	35%	35%	HP-1	13%	48%	52.2%	45.4%	45.4%	1.1
3008	HVAC	Air Source Heat Pump 17 SEER - Heat pump baseline	Efficient Products	SF	NC	6,061	10%	612	0.25	16	\$1,644	35%	35%	35%	HP-2	42%	0%	58.5%	58.5%	58.5%	1.1
3009	HVAC	Air Source Heat Pump 17 SEER - Heat pump baseline	Efficient Products	MF	MO	2,573	10%	261	0.17	16	\$1,644	21%	21%	21%	HP-3	13%	48%	52.2%	45.4%	45.4%	1.0
3010	HVAC	Air Source Heat Pump 17 SEER - Heat pump baseline	Efficient Products	MF	NC	2,573	10%	261	0.17	16	\$1,644	21%	21%	21%	HP-4	74%	0%	41.2%	41.2%	41.2%	1.0

Appendix B: Residential Measure Assumptions

Measure #	End-Use	Measure Name	Program	Home Type	Replacement Type	Base Annual Electric	% Elec Savings	Per Unit Elec Savings	Per Unit Summer kW	EE EUL	Measure Cost	MAP Incentive (%)	RAP Incentive (%)	PP Incentive (%)	End Use Measure Group	Base Saturation	EE Saturation	MAP Adoption Rate	RAP Adoption Rate	PP Adoption Rate	UCT Score
3011	HVAC	Air Source Heat Pump 18 SEER - Heat pump baseline	Efficient Products	SF	MO	6,061	16%	986	0.35	16	\$2,055	35%	35%	35%	HP-1	13%	48%	52.2%	45.4%	45.4%	1.3
3012	HVAC	Air Source Heat Pump 18 SEER - Heat pump baseline	Efficient Products	SF	NC	6,061	16%	986	0.35	16	\$2,055	35%	35%	35%	HP-2	42%	0%	58.5%	58.5%	58.5%	1.3
3013	HVAC	Air Source Heat Pump 18 SEER - Heat pump baseline	Efficient Products	MF	MO	2,573	16%	419	0.23	16	\$2,055	27%	27%	27%	HP-3	13%	48%	52.2%	45.4%	45.4%	1.0
3014	HVAC	Air Source Heat Pump 18 SEER - Heat pump baseline	Efficient Products	MF	NC	2,573	16%	419	0.23	16	\$2,055	27%	27%	27%	HP-4	74%	0%	46.4%	46.4%	46.4%	1.0
3015	HVAC	Air Source Heat Pump 21 SEER - Heat pump baseline	Efficient Products	SF	MO	6,061	21%	1,302	0.60	16	\$2,055	50%	35%	35%	HP-1	13%	48%	57.2%	45.4%	45.4%	2.0
3016	HVAC	Air Source Heat Pump 21 SEER - Heat pump baseline	Efficient Products	SF	NC	6,061	21%	1,302	0.60	16	\$2,055	50%	35%	35%	HP-2	42%	0%	67.5%	58.5%	58.5%	2.0
3017	HVAC	Air Source Heat Pump 21 SEER - Heat pump baseline	Efficient Products	MF	MO	2,573	22%	558	0.40	16	\$2,055	35%	35%	35%	HP-3	13%	48%	52.2%	45.4%	45.4%	1.2
3018	HVAC	Air Source Heat Pump 21 SEER - Heat pump baseline	Efficient Products	MF	NC	2,573	22%	558	0.40	16	\$2,055	35%	35%	35%	HP-4	74%	0%	52.1%	52.1%	52.1%	1.2
3019	HVAC	Ground Source Heat Pump 20 SEER - Heat pump baseline	Efficient Products	SF	MO	6,061	14%	864	0.53	25	\$11,871	80%	80%	80%	HP-1	13%	48%	76.8%	76.8%	76.8%	0.2
3020	HVAC	Ground Source Heat Pump 20 SEER - Heat pump baseline	Efficient Products	SF	NC	6,061	14%	864	0.53	25	\$11,871	80%	80%	80%	HP-2	42%	0%	82.4%	82.4%	82.4%	0.2
3021	HVAC	Ground Source Heat Pump 21.5 SEER - Heat pump baseline	Efficient Products	SF	MO	6,061	22%	1,320	0.64	25	\$11,871	80%	80%	80%	HP-1	13%	48%	76.8%	76.8%	76.8%	0.2
3022	HVAC	Ground Source Heat Pump 21.5 SEER - Heat pump baseline	Efficient Products	SF	NC	6,061	22%	1,320	0.64	25	\$11,871	80%	80%	80%	HP-2	42%	0%	82.4%	82.4%	82.4%	0.2
3023	HVAC	Ground Source Heat Pump 23.5 SEER - Heat pump baseline	Efficient Products	SF	MO	6,061	28%	1,716	0.76	25	\$11,871	80%	80%	80%	HP-1	13%	48%	76.8%	76.8%	76.8%	0.3
3024	HVAC	Ground Source Heat Pump 23.5 SEER - Heat pump baseline	Efficient Products	SF	NC	6,061	28%	1,716	0.76	25	\$11,871	80%	80%	80%	HP-2	42%	0%	82.4%	82.4%	82.4%	0.3
3025	HVAC	Ground Source Heat Pump 29 SEER - Heat pump baseline	Efficient Products	SF	MO	6,061	35%	2,126	1.02	25	\$11,871	80%	80%	80%	HP-1	13%	48%	76.8%	76.8%	76.8%	0.3
3026	HVAC	Ground Source Heat Pump 29 SEER - Heat pump baseline	Efficient Products	SF	NC	6,061	35%	2,126	1.02	25	\$11,871	80%	80%	80%	HP-2	42%	0%	82.4%	82.4%	82.4%	0.3
3027	HVAC	Ductless Heat Pump 17 SEER 9.5 HSPF - Heat pump baseline	Efficient Products	SF	MO	6,061	8%	493	0.25	15	\$267	112%	100%	100%	HP-1	13%	48%	86.8%	86.8%	86.8%	1.9
3028	HVAC	Ductless Heat Pump 17 SEER 9.5 HSPF - Heat pump baseline	Efficient Products	SF	NC	6,061	8%	493	0.25	15	\$267	112%	100%	100%	HP-2	42%	0%	90.0%	90.0%	90.0%	1.9
3029	HVAC	Ductless Heat Pump 17 SEER 9.5 HSPF - Heat pump baseline	Efficient Products	MF	MO	2,573	8%	212	0.17	15	\$267	112%	100%	100%	HP-3	13%	48%	77.9%	77.9%	77.9%	1.1
3030	HVAC	Ductless Heat Pump 17 SEER 9.5 HSPF - Heat pump baseline	Efficient Products	MF	NC	2,573	8%	212	0.17	15	\$267	112%	100%	100%	HP-4	74%	0%	83.3%	83.3%	83.3%	1.1
3031	HVAC	Ductless Heat Pump 19 SEER 9.5 HSPF - Heat pump baseline	Efficient Products	SF	MO	6,061	10%	590	0.44	15	\$267	112%	100%	100%	HP-1	13%	48%	86.8%	86.8%	86.8%	3.0
3032	HVAC	Ductless Heat Pump 19 SEER 9.5 HSPF - Heat pump baseline	Efficient Products	SF	NC	6,061	10%	590	0.44	15	\$267	112%	100%	100%	HP-2	42%	0%	90.0%	90.0%	90.0%	3.0
3033	HVAC	Ductless Heat Pump 19 SEER 9.5 HSPF - Heat pump baseline	Efficient Products	MF	MO	2,573	10%	258	0.30	15	\$267	112%	100%	100%	HP-3	13%	48%	77.9%	77.9%	77.9%	1.8
3034	HVAC	Ductless Heat Pump 19 SEER 9.5 HSPF - Heat pump baseline	Efficient Products	MF	NC	2,573	10%	258	0.30	15	\$267	112%	100%	100%	HP-4	74%	0%	83.3%	83.3%	83.3%	1.8
3035	HVAC	Ductless Heat Pump 21 SEER 10.0 HSPF - Heat pump baseline	Efficient Products	SF	MO	6,061	15%	901	0.60	15	\$533	100%	98%	98%	HP-1	13%	48%	86.8%	86.0%	86.0%	2.4
3036	HVAC	Ductless Heat Pump 21 SEER 10.0 HSPF - Heat pump baseline	Efficient Products	SF	NC	6,061	15%	901	0.60	15	\$533	100%	98%	98%	HP-2	42%	0%	90.0%	89.4%	89.4%	2.4
3037	HVAC	Ductless Heat Pump 21 SEER 10.0 HSPF - Heat pump baseline	Efficient Products	MF	MO	2,573	15%	392	0.40	15	\$533	100%	98%	98%	HP-3	13%	48%	77.9%	77.4%	77.4%	1.4
3038	HVAC	Ductless Heat Pump 21 SEER 10.0 HSPF - Heat pump baseline	Efficient Products	MF	NC	2,573	15%	392	0.40	15	\$533	100%	98%	98%	HP-4	74%	0%	83.3%	82.8%	82.8%	1.4
3039	HVAC	Ductless Heat Pump 23 SEER 10.0 HSPF - Heat pump baseline	Efficient Products	SF	MO	6,061	16%	966	0.73	15	\$820	100%	88%	88%	HP-1	13%	48%	86.8%	80.9%	80.9%	2.0
3040	HVAC	Ductless Heat Pump 23 SEER 10.0 HSPF - Heat pump baseline	Efficient Products	SF	NC	6,061	16%	966	0.73	15	\$820	100%	88%	88%	HP-2	42%	0%	90.0%	85.5%	85.5%	2.0
3041	HVAC	Ductless Heat Pump 23 SEER 10.0 HSPF - Heat pump baseline	Efficient Products	MF	MO	2,573	16%	423	0.49	15	\$820	100%	88%	88%	HP-3	13%	48%	77.9%	73.6%	73.6%	1.2
3042	HVAC	Ductless Heat Pump 23 SEER 10.0 HSPF - Heat pump baseline	Efficient Products	MF	NC	2,573	16%	423	0.49	15	\$820	100%	88%	88%	HP-4	74%	0%	83.3%	79.9%	79.9%	1.2
3043	HVAC	Air Source Heat Pump 16 SEER - Furnace baseline	Efficient Products	SF	MO	11,926	60%	7,110	0.28	16	\$1,233	100%	35%	35%	HP-5	26%	48%	86.8%	45.4%	45.4%	7.8
3044	HVAC	Air Source Heat Pump 16 SEER - Furnace baseline	Efficient Products	SF	NC	11,926	60%	7,110	0.28	16	\$1,233	100%	35%	35%	HP-6	0%	0%	0.0%	0.0%	0.0%	7.8
3045	HVAC	Air Source Heat Pump 16 SEER - Furnace baseline	Efficient Products	MF	MO	4,166	59%	2,462	0.19	16	\$1,233	100%	35%	35%	HP-7	50%	48%	77.9%	45.4%	45.4%	3.0
3046	HVAC	Air Source Heat Pump 16 SEER - Furnace baseline	Efficient Products	MF	NC	4,166	59%	2,462	0.19	16	\$1,233	100%	35%	35%	HP-8	0%	0%	0.0%	0.0%	0.0%	3.0
3047	HVAC	Air Source Heat Pump 17 SEER - Furnace baseline	Efficient Products	SF	MO	11,926	61%	7,264	0.40	16	\$1,644	100%	35%	35%	HP-5	26%	48%	86.8%	45.4%	45.4%	6.3
3048	HVAC	Air Source Heat Pump 17 SEER - Furnace baseline	Efficient Products	SF	NC	11,926	61%	7,264	0.40	16	\$1,644	100%	35%	35%	HP-6	0%	0%	0.0%	0.0%	0.0%	6.3

Appendix B: Residential Measure Assumptions

Measure #	End-Use	Measure Name	Program	Home Type	Replacement Type	Base Annual Electric	% Elec Savings	Per Unit Elec Savings	Per Unit Summer kW	EE EUL	Measure Cost	MAP Incentive (%)	RAP Incentive (%)	PP Incentive (%)	End Use Measure Group	Base Saturation	EE Saturation	MAP Adoption Rate	RAP Adoption Rate	PP Adoption Rate	UCT Score
3049	HVAC	Air Source Heat Pump 17 SEER - Furnace baseline	Efficient Products	MF	MO	4,166	60%	2,517	0.27	16	\$1,644	75%	35%	35%	HP-7	50%	48%	68.7%	45.4%	45.4%	2.5
3050	HVAC	Air Source Heat Pump 17 SEER - Furnace baseline	Efficient Products	MF	NC	4,166	60%	2,517	0.27	16	\$1,644	75%	35%	35%	HP-8	0%	0%	0.0%	0.0%	0.0%	2.5
3051	HVAC	Air Source Heat Pump 18 SEER - Furnace baseline	Efficient Products	SF	MO	11,926	64%	7,583	0.50	16	\$2,055	100%	35%	35%	HP-5	26%	48%	86.8%	45.4%	45.4%	5.4
3052	HVAC	Air Source Heat Pump 18 SEER - Furnace baseline	Efficient Products	SF	NC	11,926	64%	7,583	0.50	16	\$2,055	100%	35%	35%	HP-6	0%	0%	0.0%	0.0%	0.0%	5.4
3053	HVAC	Air Source Heat Pump 18 SEER - Furnace baseline	Efficient Products	MF	MO	4,166	63%	2,630	0.34	16	\$2,055	75%	35%	35%	HP-7	50%	48%	68.7%	45.4%	45.4%	2.2
3054	HVAC	Air Source Heat Pump 18 SEER - Furnace baseline	Efficient Products	MF	NC	4,166	63%	2,630	0.34	16	\$2,055	75%	35%	35%	HP-8	0%	0%	0.0%	0.0%	0.0%	2.2
3055	HVAC	Air Source Heat Pump 21 SEER - Furnace baseline	Efficient Products	SF	MO	11,926	66%	7,859	0.75	16	\$2,055	100%	35%	35%	HP-5	26%	48%	86.8%	45.4%	45.4%	6.1
3056	HVAC	Air Source Heat Pump 21 SEER - Furnace baseline	Efficient Products	SF	NC	11,926	66%	7,859	0.75	16	\$2,055	100%	35%	35%	HP-6	0%	0%	0.0%	0.0%	0.0%	6.1
3057	HVAC	Air Source Heat Pump 21 SEER - Furnace baseline	Efficient Products	MF	MO	4,166	66%	2,730	0.50	16	\$2,055	75%	35%	35%	HP-7	50%	48%	68.7%	45.4%	45.4%	2.6
3058	HVAC	Air Source Heat Pump 21 SEER - Furnace baseline	Efficient Products	MF	NC	4,166	66%	2,730	0.50	16	\$2,055	75%	35%	35%	HP-8	0%	0%	0.0%	0.0%	0.0%	2.6
3059	HVAC	Ductless Heat Pump 17 SEER 9.5 HSPF - Electric furnace baseline	Efficient Products	SF	MO	11,926	60%	7,163	0.40	15	\$1,004	100%	35%	35%	HP-5	26%	48%	86.8%	45.4%	45.4%	9.7
3060	HVAC	Ductless Heat Pump 17 SEER 9.5 HSPF - Electric furnace baseline	Efficient Products	SF	NC	11,926	60%	7,163	0.40	15	\$1,004	100%	35%	35%	HP-6	0%	0%	0.0%	0.0%	0.0%	9.7
3061	HVAC	Ductless Heat Pump 17 SEER 9.5 HSPF - Electric furnace baseline	Efficient Products	MF	MO	4,166	60%	2,482	0.27	15	\$1,004	100%	35%	35%	HP-7	50%	48%	77.9%	45.4%	45.4%	3.9
3062	HVAC	Ductless Heat Pump 17 SEER 9.5 HSPF - Electric furnace baseline	Efficient Products	MF	NC	4,166	60%	2,482	0.27	15	\$1,004	100%	35%	35%	HP-8	0%	0%	0.0%	0.0%	0.0%	3.9
3063	HVAC	Ductless Heat Pump 19 SEER 9.5 HSPF - Electric furnace baseline	Efficient Products	SF	MO	11,926	61%	7,253	0.60	15	\$1,004	100%	35%	35%	HP-5	26%	48%	86.8%	45.4%	45.4%	10.6
3064	HVAC	Ductless Heat Pump 19 SEER 9.5 HSPF - Electric furnace baseline	Efficient Products	SF	NC	11,926	61%	7,253	0.60	15	\$1,004	100%	35%	35%	HP-6	0%	0%	0.0%	0.0%	0.0%	10.6
3065	HVAC	Ductless Heat Pump 19 SEER 9.5 HSPF - Electric furnace baseline	Efficient Products	MF	MO	4,166	60%	2,517	0.40	15	\$1,004	100%	35%	35%	HP-7	50%	48%	77.9%	45.4%	45.4%	4.4
3066	HVAC	Ductless Heat Pump 19 SEER 9.5 HSPF - Electric furnace baseline	Efficient Products	MF	NC	4,166	60%	2,517	0.40	15	\$1,004	100%	35%	35%	HP-8	0%	0%	0.0%	0.0%	0.0%	4.4
3067	HVAC	Ductless Heat Pump 21 SEER 10.0 HSPF - Electric furnace baseline	Efficient Products	SF	MO	11,926	63%	7,521	0.75	15	\$1,070	100%	49%	49%	HP-5	26%	48%	86.8%	56.4%	56.4%	7.8
3068	HVAC	Ductless Heat Pump 21 SEER 10.0 HSPF - Electric furnace baseline	Efficient Products	SF	NC	11,926	63%	7,521	0.75	15	\$1,070	100%	49%	49%	HP-6	0%	0%	0.0%	0.0%	0.0%	7.8
3069	HVAC	Ductless Heat Pump 21 SEER 10.0 HSPF - Electric furnace baseline	Efficient Products	MF	MO	4,166	63%	2,613	0.50	15	\$1,070	100%	49%	49%	HP-7	50%	48%	77.9%	51.9%	51.9%	3.3
3070	HVAC	Ductless Heat Pump 21 SEER 10.0 HSPF - Electric furnace baseline	Efficient Products	MF	NC	4,166	63%	2,613	0.50	15	\$1,070	100%	49%	49%	HP-8	0%	0%	0.0%	0.0%	0.0%	3.3
3071	HVAC	Ductless Heat Pump 23 SEER 10.0 HSPF - Electric furnace baseline	Efficient Products	SF	MO	11,926	64%	7,581	0.89	15	\$1,557	100%	47%	47%	HP-5	26%	48%	86.8%	54.3%	54.3%	5.9
3072	HVAC	Ductless Heat Pump 23 SEER 10.0 HSPF - Electric furnace baseline	Efficient Products	SF	NC	11,926	64%	7,581	0.89	15	\$1,557	100%	47%	47%	HP-6	0%	0%	0.0%	0.0%	0.0%	5.9
3073	HVAC	Ductless Heat Pump 23 SEER 10.0 HSPF - Electric furnace baseline	Efficient Products	MF	MO	4,166	63%	2,637	0.59	15	\$1,557	100%	47%	47%	HP-7	50%	48%	77.9%	49.1%	49.1%	2.6
3074	HVAC	Ductless Heat Pump 23 SEER 10.0 HSPF - Electric furnace baseline	Efficient Products	MF	NC	4,166	63%	2,637	0.59	15	\$1,557	100%	47%	47%	HP-8	0%	0%	0.0%	0.0%	0.0%	2.6
3075	HVAC	AC Tune Up	Efficient Products	SF	Retrofit	1,081	5%	54	0.04	3	\$160	35%	35%	35%	TUNE-3	80%	54%	37.2%	28.3%	28.3%	0.4
3076	HVAC	AC Tune Up	Efficient Products	MF	Retrofit	422	5%	21	0.03	3	\$160	35%	35%	35%	TUNE-4	79%	54%	37.2%	28.3%	28.3%	0.2
3077	HVAC	Ductless Heat Pump 17 SEER 9.5 HSPF - Electric baseboard baseline	Efficient Products	SF	MO	11,565	66%	7,610	0.40	15	\$2,324	100%	35%	35%	HP-9	4%	48%	86.8%	45.4%	45.4%	4.4
3078	HVAC	Ductless Heat Pump 17 SEER 9.5 HSPF - Electric baseboard baseline	Efficient Products	SF	NC	11,565	66%	7,610	0.40	15	\$2,324	100%	35%	35%	HP-10	0%	0%	0.0%	0.0%	0.0%	4.4
3079	HVAC	Ductless Heat Pump 17 SEER 9.5 HSPF - Electric baseboard baseline	Efficient Products	MF	MO	3,935	66%	2,597	0.27	15	\$2,324	50%	35%	35%	HP-11	11%	48%	53.0%	45.4%	45.4%	1.7
3080	HVAC	Ductless Heat Pump 17 SEER 9.5 HSPF - Electric baseboard baseline	Efficient Products	MF	NC	3,935	66%	2,597	0.27	15	\$2,324	50%	35%	35%	HP-12	0%	0%	0.0%	0.0%	0.0%	1.7
3081	HVAC	Ductless Heat Pump 19 SEER 9.5 HSPF - Electric baseboard baseline	Efficient Products	SF	MO	11,565	67%	7,708	0.60	15	\$2,324	100%	35%	35%	HP-9	4%	48%	86.8%	45.4%	45.4%	4.8
3082	HVAC	Ductless Heat Pump 19 SEER 9.5 HSPF - Electric baseboard baseline	Efficient Products	SF	NC	11,565	67%	7,708	0.60	15	\$2,324	100%	35%	35%	HP-10	0%	0%	0.0%	0.0%	0.0%	4.8
3083	HVAC	Ductless Heat Pump 19 SEER 9.5 HSPF - Electric baseboard baseline	Efficient Products	MF	MO	3,935	67%	2,633	0.40	15	\$2,324	50%	35%	35%	HP-11	11%	48%	53.0%	45.4%	45.4%	2.0
3084	HVAC	Ductless Heat Pump 19 SEER 9.5 HSPF - Electric baseboard baseline	Efficient Products	MF	NC	3,935	67%	2,633	0.40	15	\$2,324	50%	35%	35%	HP-12	0%	0%	0.0%	0.0%	0.0%	2.0
3085	HVAC	Ductless Heat Pump 21 SEER 10.0 HSPF - Electric baseboard baseline	Efficient Products	SF	MO	11,565	69%	7,994	0.75	15	\$2,590	100%	35%	35%	HP-9	4%	48%	86.8%	45.4%	45.4%	4.7
3086	HVAC	Ductless Heat Pump 21 SEER 10.0 HSPF - Electric baseboard baseline	Efficient Products	SF	NC	11,565	69%	7,994	0.75	15	\$2,590	100%	35%	35%	HP-10	0%	0%	0.0%	0.0%	0.0%	4.7
3087	HVAC	Ductless Heat Pump 21 SEER 10.0 HSPF - Electric baseboard baseline	Efficient Products	MF	MO	3,935	69%	2,734	0.50	15	\$2,590	50%	35%	35%	HP-11	11%	48%	53.0%	45.4%	45.4%	2.0

Appendix B: Residential Measure Assumptions

Measure #	End-Use	Measure Name	Program	Home Type	Replacement Type	Base Annual Electric	% Elec Savings	Per Unit Elec Savings	Per Unit Summer kW	EE EUL	Measure Cost	MAP Incentive (%)	RAP Incentive (%)	PP Incentive (%)	End Use Measure Group	Base Saturation	EE Saturation	MAP Adoption Rate	RAP Adoption Rate	PP Adoption Rate	UCT Score
3088	HVAC	Ductless Heat Pump 21 SEER 10.0 HSPF - Electric baseboard baseline	Efficient Products	MF	NC	3,935	69%	2,734	0.50	15	\$2,590	50%	35%	35%	HP-12	0%	0%	0.0%	0.0%	0.0%	2.0
3089	HVAC	Ductless Heat Pump 23 SEER 10.0 HSPF - Electric baseboard baseline	Efficient Products	SF	MO	11,565	70%	8,059	0.89	15	\$2,877	100%	35%	35%	HP-9	4%	48%	86.8%	45.4%	45.4%	4.5
3090	HVAC	Ductless Heat Pump 23 SEER 10.0 HSPF - Electric baseboard baseline	Efficient Products	SF	NC	11,565	70%	8,059	0.89	15	\$2,877	100%	35%	35%	HP-10	0%	0%	0.0%	0.0%	0.0%	4.5
3091	HVAC	Ductless Heat Pump 23 SEER 10.0 HSPF - Electric baseboard baseline	Efficient Products	MF	MO	3,935	70%	2,758	0.59	15	\$2,877	50%	35%	35%	HP-11	11%	48%	53.0%	45.4%	45.4%	1.9
3092	HVAC	Ductless Heat Pump 23 SEER 10.0 HSPF - Electric baseboard baseline	Efficient Products	MF	NC	3,935	70%	2,758	0.59	15	\$2,877	50%	35%	35%	HP-12	0%	0%	0.0%	0.0%	0.0%	1.9
3093	HVAC	Central Air Conditioner 15 SEER	Efficient Products	SF	MO	1,081	7%	72	0.15	18	\$104	192%	100%	100%	CAC-1	54%	48%	86.8%	86.8%	86.8%	1.4
3094	HVAC	Central Air Conditioner 15 SEER	Efficient Products	SF	NC	1,081	7%	72	0.15	18	\$104	192%	100%	100%	CAC-2	80%	0%	90.0%	90.0%	90.0%	1.4
3095	HVAC	Central Air Conditioner 15 SEER	Efficient Products	MF	MO	422	7%	28	0.10	18	\$104	192%	100%	100%	CAC-3	29%	48%	77.9%	77.9%	77.9%	0.9
3096	HVAC	Central Air Conditioner 15 SEER	Efficient Products	MF	NC	422	7%	28	0.10	18	\$104	192%	100%	100%	CAC-4	79%	0%	83.3%	83.3%	83.3%	0.9
3097	HVAC	Central Air Conditioner 16 SEER	Efficient Products	SF	MO	1,081	13%	135	0.28	18	\$221	136%	100%	100%	CAC-1	54%	48%	86.8%	86.8%	86.8%	1.8
3098	HVAC	Central Air Conditioner 16 SEER	Efficient Products	SF	NC	1,081	13%	135	0.28	18	\$221	136%	100%	100%	CAC-2	80%	0%	90.0%	90.0%	90.0%	1.8
3099	HVAC	Central Air Conditioner 16 SEER	Efficient Products	MF	MO	422	13%	53	0.19	18	\$221	136%	100%	100%	CAC-3	29%	48%	77.9%	77.9%	77.9%	1.1
3100	HVAC	Central Air Conditioner 16 SEER	Efficient Products	MF	NC	422	13%	53	0.19	18	\$221	136%	100%	100%	CAC-4	79%	0%	83.3%	83.3%	83.3%	1.1
3101	HVAC	Central Air Conditioner 17 SEER	Efficient Products	SF	MO	1,081	18%	191	0.40	18	\$620	100%	56%	56%	CAC-1	54%	48%	86.8%	61.4%	61.4%	2.1
3102	HVAC	Central Air Conditioner 17 SEER	Efficient Products	SF	NC	1,081	18%	191	0.40	18	\$620	100%	56%	56%	CAC-2	80%	0%	90.0%	70.7%	70.7%	2.1
3103	HVAC	Central Air Conditioner 17 SEER	Efficient Products	MF	MO	422	18%	74	0.27	18	\$620	75%	56%	56%	CAC-3	29%	48%	68.7%	56.8%	56.8%	1.4
3104	HVAC	Central Air Conditioner 17 SEER	Efficient Products	MF	NC	422	18%	74	0.27	18	\$620	75%	56%	56%	CAC-4	79%	0%	76.3%	67.2%	67.2%	1.4
3105	HVAC	Central Air Conditioner 18 SEER	Efficient Products	SF	MO	1,081	22%	240	0.50	18	\$620	100%	65%	65%	CAC-1	54%	48%	86.8%	66.8%	66.8%	2.4
3106	HVAC	Central Air Conditioner 18 SEER	Efficient Products	SF	NC	1,081	22%	240	0.50	18	\$620	100%	65%	65%	CAC-2	80%	0%	90.0%	74.8%	74.8%	2.4
3107	HVAC	Central Air Conditioner 18 SEER	Efficient Products	MF	MO	422	22%	94	0.34	18	\$620	75%	65%	65%	CAC-3	29%	48%	68.7%	61.8%	61.8%	1.5
3108	HVAC	Central Air Conditioner 18 SEER	Efficient Products	MF	NC	422	22%	94	0.34	18	\$620	75%	65%	65%	CAC-4	79%	0%	76.3%	71.0%	71.0%	1.5
3109	HVAC	Smart Thermostat - Heat pump baseline	Efficient Products	SF	Retrofit	6,061	8%	514	0.19	11	\$250	100%	35%	35%	TSTAT-1	13%	62%	76.8%	31.3%	31.3%	4.4
3110	HVAC	Smart Thermostat - Heat pump baseline	Efficient Products	SF	Retrofit	6,061	8%	514	0.19	11	\$250	100%	35%	35%	TSTAT-1	13%	62%	76.8%	31.3%	31.3%	4.4
3111	HVAC	Smart Thermostat - Heat pump baseline	Efficient Products	SF	Retrofit	6,061	8%	514	0.19	11	\$250	100%	35%	35%	TSTAT-4	13%	62%	83.9%	31.3%	31.3%	4.4
3112	HVAC	Smart Thermostat - Heat pump baseline	Efficient Products	SF	Retrofit	6,061	8%	514	0.19	11	\$250	100%	35%	35%	TSTAT-4	13%	62%	83.9%	31.3%	31.3%	4.4
3113	HVAC	Smart Thermostat - Heat pump baseline	IQW	SF	Retrofit	6,061	8%	514	0.19	11	\$250	100%	100%	100%	TSTAT-4	13%	62%	83.9%	83.9%	83.9%	1.5
3114	HVAC	Smart Thermostat - Heat pump baseline	Efficient Products	SF	NC	6,061	8%	514	0.19	11	\$250	100%	35%	35%	TSTAT-7	42%	0%	90.0%	58.5%	58.5%	4.4
3115	HVAC	Smart Thermostat - Heat pump baseline	Efficient Products	MF	Retrofit	2,573	8%	218	0.13	11	\$250	75%	35%	35%	TSTAT-10	13%	39%	64.5%	27.4%	27.4%	2.5
3116	HVAC	Smart Thermostat - Heat pump baseline	Efficient Products	MF	Retrofit	2,573	8%	218	0.13	11	\$250	75%	35%	35%	TSTAT-10	13%	39%	64.5%	27.4%	27.4%	2.5
3117	HVAC	Smart Thermostat - Heat pump baseline	Multifamily	MF	Retrofit	2,573	8%	218	0.13	11	\$250	100%	100%	100%	TSTAT-10	13%	39%	74.5%	74.5%	74.5%	0.9
3118	HVAC	Smart Thermostat - Heat pump baseline	Efficient Products	MF	Retrofit	2,573	8%	218	0.13	11	\$250	100%	35%	35%	TSTAT-13	13%	39%	69.8%	24.8%	24.8%	2.5
3119	HVAC	Smart Thermostat - Heat pump baseline	Efficient Products	MF	Retrofit	2,573	8%	218	0.13	11	\$250	100%	35%	35%	TSTAT-13	13%	39%	69.8%	24.8%	24.8%	2.5
3120	HVAC	Smart Thermostat - Heat pump baseline	Multifamily	MF	Retrofit	2,573	8%	218	0.13	11	\$250	100%	100%	100%	TSTAT-13	13%	39%	69.8%	69.8%	69.8%	0.9
3121	HVAC	Smart Thermostat - Heat pump baseline	IQW	MF	Retrofit	2,573	8%	218	0.13	11	\$250	100%	100%	100%	TSTAT-13	13%	39%	69.8%	69.8%	69.8%	0.9
3122	HVAC	Smart Thermostat - Heat pump baseline	Efficient Products	MF	NC	2,573	8%	218	0.13	11	\$250	75%	35%	35%	TSTAT-16	74%	0%	76.3%	52.1%	52.1%	2.5
3123	HVAC	Smart Thermostat - Furnace baseline	Efficient Products	SF	Retrofit	11,926	8%	1,013	0.19	11	\$250	100%	35%	35%	TSTAT-2	26%	62%	76.8%	31.3%	31.3%	6.3
3124	HVAC	Smart Thermostat - Furnace baseline	Efficient Products	SF	Retrofit	11,926	8%	1,013	0.19	11	\$250	100%	35%	35%	TSTAT-2	26%	62%	76.8%	31.3%	31.3%	6.3
3125	HVAC	Smart Thermostat - Furnace baseline	Efficient Products	SF	Retrofit	11,926	8%	1,013	0.19	11	\$250	100%	35%	35%	TSTAT-5	26%	62%	83.9%	31.3%	31.3%	6.3
3126	HVAC	Smart Thermostat - Furnace baseline	Efficient Products	SF	Retrofit	11,926	8%	1,013	0.19	11	\$250	100%	35%	35%	TSTAT-5	26%	62%	83.9%	31.3%	31.3%	6.3
3127	HVAC	Smart Thermostat - Furnace baseline	IQW	SF	Retrofit	11,926	8%	1,013	0.19	11	\$250	100%	100%	100%	TSTAT-5	26%	62%	83.9%	83.9%	83.9%	2.2
3128	HVAC	Smart Thermostat - Furnace baseline	Efficient Products	SF	NC	11,926	8%	1,013	0.19	11	\$250	100%	35%	35%	TSTAT-8	0%	0%	0.0%	0.0%	0.0%	6.3
3129	HVAC	Smart Thermostat - Furnace baseline	Efficient Products	MF	Retrofit	4,166	8%	354	0.13	11	\$250	100%	35%	35%	TSTAT-11	50%	39%	74.5%	27.4%	27.4%	3.0
3130	HVAC	Smart Thermostat - Furnace baseline	Efficient Products	MF	Retrofit	4,166	8%	354	0.13	11	\$250	100%	35%	35%	TSTAT-11	50%	39%	74.5%	27.4%	27.4%	3.0
3131	HVAC	Smart Thermostat - Furnace baseline	Multifamily	MF	Retrofit	4,166	8%	354	0.13	11	\$250	100%	100%	100%	TSTAT-11	50%	39%	74.5%	74.5%	74.5%	1.0
3132	HVAC	Smart Thermostat - Furnace baseline	Efficient Products	MF	Retrofit	4,166	8%	354	0.13	11	\$250	100%	35%	35%	TSTAT-14	50%	39%	69.8%	24.8%	24.8%	3.0
3133	HVAC	Smart Thermostat - Furnace baseline	Efficient Products	MF	Retrofit	4,166	8%	354	0.13	11	\$250	100%	35%	35%	TSTAT-14	50%	39%	69.8%	24.8%	24.8%	3.0
3134	HVAC	Smart Thermostat - Furnace baseline	Multifamily	MF	Retrofit	4,166	8%	354	0.13	11	\$250	100%	100%	100%	TSTAT-14	50%	39%	69.8%	69.8%	69.8%	1.0
3135	HVAC	Smart Thermostat - Furnace baseline	IQW	MF	Retrofit	4,166	8%	354	0.13	11	\$250	100%	100%	100%	TSTAT-14	50%	39%	69.8%	69.8%	69.8%	1.0
3136	HVAC	Smart Thermostat - Furnace baseline	Efficient Products	MF	NC	4,166	8%	354	0.13	11	\$250	100%	35%	35%	TSTAT-17	0%	0%	0.0%	0.0%	0.0%	3.0
3137	HVAC	Smart Thermostat - Gas/CAC baseline	Efficient Products	SF	Retrofit	1,368	8%	115	0.19	11	\$250	100%	35%	35%	TSTAT-3	53%	62%	76.8%	31.3%	31.3%	3.0
3138	HVAC	Smart Thermostat - Gas/CAC baseline	Efficient Products	SF	Retrofit	1,368	8%	115	0.19	11	\$250	100%	35%	35%	TSTAT-3	53%	62%	76.8%	31.3%	31.3%	3.0
3139	HVAC	Smart Thermostat - Gas/CAC baseline	Efficient Products	SF	Retrofit	1,368	8%	115	0.19	11	\$250	100%	35%	35%	TSTAT-6	53%	62%	83.9%	31.3%	31.3%	3.0
3140	HVAC	Smart Thermostat - Gas/CAC baseline	Efficient Products	SF	Retrofit	1,368	8%	115	0.19	11	\$250	100%	35%	35%	TSTAT-6	53%	62%	83.9%	31.3%	31.3%	3.0
3141	HVAC	Smart Thermostat - Gas/CAC baseline	IQW	SF	Retrofit	1,368	8%	115	0.19	11	\$250	100%	100%	100%	TSTAT-6	53%	62%	83.9%	83.9%	83.9%	1.0
3142	HVAC	Smart Thermostat - Gas/CAC baseline	Efficient Products	SF	NC	1,368	8%	115	0.19	11	\$250	100%	35%	35%	TSTAT-9	53%	0%	90.0%	58.5%	58.5%	3.0
3143	HVAC	Smart Thermostat - Gas/CAC baseline	Efficient Products	MF	Retrofit	530	8%	45	0.13	11	\$250	50%	35%	35%	TSTAT-12	21%	39%	45.7%	27.4%	27.4%	1.8
3144	HVAC	Smart Thermostat - Gas/CAC baseline	Efficient Products	MF	Retrofit	530	8%	45	0.13	11	\$250	50%	35%	35%	TSTAT-12	21%	39%	45.7%	27.4%	27.4%	1.8
3145	HVAC	Smart Thermostat - Gas/CAC baseline	Multifamily	MF	Retrofit	530	8%	45	0.13	11	\$250	100%	100%	100%	TSTAT-12	21%	39%	74.5%	74.5%	74.5%	0.6
3146	HVAC	Smart Thermostat - Gas/CAC baseline	Efficient Products	MF	Retrofit	530	8%	45	0.13	11	\$250	100%	35%	35%	TSTAT-15	21%	39%	69.8%	24.8%	24.8%	1.8
3147	HVAC	Smart Thermostat - Gas/CAC baseline	Efficient Products	MF	Retrofit	530	8%	45	0.13	11	\$250	100%	35%	35%	TSTAT-15	21%	39%	69.8%	24.8%	24.8%	1.8

Appendix B: Residential Measure Assumptions

Measure #	End-Use	Measure Name	Program	Home Type	Replacement Type	Base Annual Electric	% Elec Savings	Per Unit Elec Savings	Per Unit Summer kW	EE EUL	Measure Cost	MAP Incentive (%)	RAP Incentive (%)	PP Incentive (%)	End Use Measure Group	Base Saturation	EE Saturation	MAP Adoption Rate	RAP Adoption Rate	PP Adoption Rate	UCT Score
3148	HVAC	Smart Thermostat - Gas/CAC baseline	Multifamily	MF	Retrofit	530	8%	45	0.13	11	\$250	100%	100%	100%	TSTAT-15	21%	39%	69.8%	69.8%	69.8%	0.6
3149	HVAC	Smart Thermostat - Gas/CAC baseline	IQW	MF	Retrofit	530	8%	45	0.13	11	\$250	100%	100%	100%	TSTAT-15	21%	39%	69.8%	69.8%	69.8%	0.6
3150	HVAC	Smart Thermostat - Gas/CAC baseline	Efficient Products	MF	NC	530	8%	45	0.13	11	\$250	50%	35%	35%	TSTAT-18	21%	0%	64.4%	52.1%	52.1%	1.8
3151	HVAC	PTHP Variable Speed SEER 17 11.9 HPSF Upgrade from PTHP Baseline SEER 10.5 HPSF 7.7	Efficient Products	SF	MO	6,061	36%	2,170	1.15	15	\$1,434	100%	80%	80%	HP-1	13%	48%	86.8%	76.8%	76.8%	2.2
3152	HVAC	PTHP Variable Speed SEER 17 11.9 HPSF Upgrade from PTHP Baseline SEER 10.5 HPSF 7.7	Efficient Products	SF	NC	6,061	36%	2,170	1.15	15	\$1,434	100%	80%	80%	HP-2	42%	0%	90.0%	82.4%	82.4%	2.2
3153	HVAC	PTHP Variable Speed SEER 17 11.9 HPSF Upgrade from PTHP Baseline SEER 10.5 HPSF 7.7	Efficient Products	MF	MO	2,573	36%	923	0.77	15	\$1,434	100%	80%	80%	HP-3	13%	48%	77.9%	70.5%	70.5%	1.3
3154	HVAC	PTHP Variable Speed SEER 17 11.9 HPSF Upgrade from PTHP Baseline SEER 10.5 HPSF 7.7	Efficient Products	MF	NC	2,573	36%	923	0.77	15	\$1,434	100%	80%	80%	HP-4	74%	0%	83.3%	77.6%	77.6%	1.3
3155	HVAC	PTHP Variable Speed SEER 17 11.9 HPSF Upgrade from PTAC SEER 10.5 Electric Resistance Heat	Efficient Products	SF	MO	11,926	68%	8,165	1.15	15	\$1,434	100%	80%	80%	HP-5	26%	48%	86.8%	76.8%	76.8%	4.3
3156	HVAC	PTHP Variable Speed SEER 17 11.9 HPSF Upgrade from PTAC SEER 10.5 Electric Resistance Heat	Efficient Products	SF	NC	11,926	68%	8,165	1.15	15	\$1,434	100%	80%	80%	HP-6	0%	0%	0.0%	0.0%	0.0%	4.3
3157	HVAC	PTHP Variable Speed SEER 17 11.9 HPSF Upgrade from PTAC SEER 10.5 Electric Resistance Heat	Efficient Products	MF	MO	4,166	68%	2,838	0.77	15	\$1,434	100%	80%	80%	HP-7	50%	48%	77.9%	70.5%	70.5%	1.9
3158	HVAC	PTHP Variable Speed SEER 17 11.9 HPSF Upgrade from PTAC SEER 10.5 Electric Resistance Heat	Efficient Products	MF	NC	4,166	68%	2,838	0.77	15	\$1,434	100%	80%	80%	HP-8	0%	0%	0.0%	0.0%	0.0%	1.9
3159	HVAC	Filter whistle - Heat pump baseline	School Education	SF	Retrofit	6,061	1%	53	0.03	3	\$3	100%	100%	100%	WHISTLE-1	13%	54%	80.2%	80.2%	80.2%	5.3
3160	HVAC	Filter whistle - Heat pump baseline	Efficient Products	SF	Retrofit	6,061	2%	137	0.07	3	\$3	100%	100%	100%	WHISTLE-1	13%	54%	80.2%	80.2%	80.2%	13.6
3161	HVAC	Filter whistle - Heat pump baseline	School Education	SF	Retrofit	6,061	1%	53	0.03	3	\$3	100%	100%	100%	WHISTLE-4	13%	54%	86.3%	86.3%	86.3%	5.3
3162	HVAC	Filter whistle - Heat pump baseline	Efficient Products	SF	Retrofit	6,061	2%	137	0.07	3	\$3	100%	100%	100%	WHISTLE-4	13%	54%	86.3%	86.3%	86.3%	13.6
3163	HVAC	Filter whistle - Heat pump baseline	IQW	SF	Retrofit	6,061	2%	137	0.07	3	\$3	100%	100%	100%	WHISTLE-4	13%	54%	86.3%	86.3%	86.3%	13.6
3164	HVAC	Filter whistle - Heat pump baseline	School Education	SF	NC	6,061	1%	53	0.03	3	\$3	100%	100%	100%	WHISTLE-7	13%	0%	90.0%	90.0%	90.0%	5.3
3165	HVAC	Filter whistle - Heat pump baseline	School Education	MF	Retrofit	2,573	2%	53	0.03	3	\$3	100%	100%	100%	WHISTLE-10	13%	54%	68.1%	68.1%	68.1%	5.3
3166	HVAC	Filter whistle - Heat pump baseline	Efficient Products	MF	Retrofit	2,573	5%	137	0.07	3	\$3	100%	100%	100%	WHISTLE-10	13%	54%	68.1%	68.1%	68.1%	13.5
3167	HVAC	Filter whistle - Heat pump baseline	Multifamily	MF	Retrofit	2,573	5%	137	0.07	3	\$3	100%	100%	100%	WHISTLE-10	13%	54%	68.1%	68.1%	68.1%	13.5
3168	HVAC	Filter whistle - Heat pump baseline	School Education	MF	Retrofit	2,573	2%	53	0.03	3	\$3	100%	100%	100%	WHISTLE-13	13%	54%	62.2%	62.2%	62.2%	5.3
3169	HVAC	Filter whistle - Heat pump baseline	Efficient Products	MF	Retrofit	2,573	5%	137	0.07	3	\$3	100%	100%	100%	WHISTLE-13	13%	54%	62.2%	62.2%	62.2%	13.5
3170	HVAC	Filter whistle - Heat pump baseline	Multifamily	MF	Retrofit	2,573	5%	137	0.07	3	\$3	100%	100%	100%	WHISTLE-13	13%	54%	62.2%	62.2%	62.2%	13.5
3171	HVAC	Filter whistle - Heat pump baseline	IQW	MF	Retrofit	2,573	5%	137	0.07	3	\$3	100%	100%	100%	WHISTLE-13	13%	54%	62.2%	62.2%	62.2%	13.5
3172	HVAC	Filter whistle - Heat pump baseline	School Education	MF	NC	2,573	2%	53	0.03	3	\$3	100%	100%	100%	WHISTLE-16	13%	0%	83.3%	83.3%	83.3%	5.3
3173	HVAC	Filter whistle - Furnace baseline	School Education	SF	Retrofit	11,926	0%	53	0.03	3	\$3	100%	100%	100%	WHISTLE-2	26%	54%	80.2%	80.2%	80.2%	5.3
3174	HVAC	Filter whistle - Furnace baseline	Efficient Products	SF	Retrofit	11,926	1%	137	0.07	3	\$3	100%	100%	100%	WHISTLE-2	26%	54%	80.2%	80.2%	80.2%	13.6
3175	HVAC	Filter whistle - Furnace baseline	School Education	SF	Retrofit	11,926	0%	53	0.03	3	\$3	100%	100%	100%	WHISTLE-5	26%	54%	86.3%	86.3%	86.3%	5.3
3176	HVAC	Filter whistle - Furnace baseline	Efficient Products	SF	Retrofit	11,926	1%	137	0.07	3	\$3	100%	100%	100%	WHISTLE-5	26%	54%	86.3%	86.3%	86.3%	13.6
3177	HVAC	Filter whistle - Furnace baseline	IQW	SF	Retrofit	11,926	1%	137	0.07	3	\$3	100%	100%	100%	WHISTLE-5	26%	54%	86.3%	86.3%	86.3%	13.6
3178	HVAC	Filter whistle - Furnace baseline	School Education	SF	NC	11,926	0%	53	0.03	3	\$3	100%	100%	100%	WHISTLE-8	0%	0%	0.0%	0.0%	0.0%	5.3
3179	HVAC	Filter whistle - Furnace baseline	School Education	MF	Retrofit	4,166	1%	53	0.03	3	\$3	100%	100%	100%	WHISTLE-11	50%	54%	68.1%	68.1%	68.1%	5.3
3180	HVAC	Filter whistle - Furnace baseline	Efficient Products	MF	Retrofit	4,166	3%	137	0.07	3	\$3	100%	100%	100%	WHISTLE-11	50%	54%	68.1%	68.1%	68.1%	13.5
3181	HVAC	Filter whistle - Furnace baseline	Multifamily	MF	Retrofit	4,166	3%	137	0.07	3	\$3	100%	100%	100%	WHISTLE-11	50%	54%	68.1%	68.1%	68.1%	13.5
3182	HVAC	Filter whistle - Furnace baseline	School Education	MF	Retrofit	4,166	1%	53	0.03	3	\$3	100%	100%	100%	WHISTLE-14	50%	54%	62.2%	62.2%	62.2%	5.3
3183	HVAC	Filter whistle - Furnace baseline	Efficient Products	MF	Retrofit	4,166	3%	137	0.07	3	\$3	100%	100%	100%	WHISTLE-14	50%	54%	62.2%	62.2%	62.2%	13.5
3184	HVAC	Filter whistle - Furnace baseline	Multifamily	MF	Retrofit	4,166	3%	137	0.07	3	\$3	100%	100%	100%	WHISTLE-14	50%	54%	62.2%	62.2%	62.2%	13.5
3185	HVAC	Filter whistle - Furnace baseline	IQW	MF	Retrofit	4,166	3%	137	0.07	3	\$3	100%	100%	100%	WHISTLE-14	50%	54%	62.2%	62.2%	62.2%	13.5
3186	HVAC	Filter whistle - Furnace baseline	School Education	MF	NC	4,166	1%	53	0.03	3	\$3	100%	100%	100%	WHISTLE-17	0%	0%	0.0%	0.0%	0.0%	5.3
3187	HVAC	Filter whistle - Gas/CAC baseline	School Education	SF	Retrofit	1,368	1%	14	0.03	3	\$3	100%	100%	100%	WHISTLE-3	53%	54%	80.2%	80.2%	80.2%	3.8
3188	HVAC	Filter whistle - Gas/CAC baseline	Efficient Products	SF	Retrofit	1,368	3%	37	0.07	3	\$3	100%	100%	100%	WHISTLE-3	53%	54%	80.2%	80.2%	80.2%	9.7
3189	HVAC	Filter whistle - Gas/CAC baseline	School Education	SF	Retrofit	1,368	1%	14	0.03	3	\$3	100%	100%	100%	WHISTLE-6	53%	54%	86.3%	86.3%	86.3%	3.8
3190	HVAC	Filter whistle - Gas/CAC baseline	Efficient Products	SF	Retrofit	1,368	3%	37	0.07	3	\$3	100%	100%	100%	WHISTLE-6	53%	54%	86.3%	86.3%	86.3%	9.7
3191	HVAC	Filter whistle - Gas/CAC baseline	IQW	SF	Retrofit	1,368	3%	37	0.07	3	\$3	100%	100%	100%	WHISTLE-6	53%	54%	86.3%	86.3%	86.3%	9.7
3192	HVAC	Filter whistle - Gas/CAC baseline	School Education	SF	NC	1,368	1%	14	0.03	3	\$3	100%	100%	100%	WHISTLE-9	53%	0%	90.0%	90.0%	90.0%	3.8
3193	HVAC	Filter whistle - Gas/CAC baseline	School Education	MF	Retrofit	530	3%	14	0.03	3	\$3	100%	100%	100%	WHISTLE-12	21%	54%	68.1%	68.1%	68.1%	3.8
3194	HVAC	Filter whistle - Gas/CAC baseline	Efficient Products	MF	Retrofit	530	7%	37	0.07	3	\$3	100%	100%	100%	WHISTLE-12	21%	54%	68.1%	68.1%	68.1%	9.6
3195	HVAC	Filter whistle - Gas/CAC baseline	Multifamily	MF	Retrofit	530	7%	37	0.07	3	\$3	100%	100%	100%	WHISTLE-12	21%	54%	68.1%	68.1%	68.1%	9.6
3196	HVAC	Filter whistle - Gas/CAC baseline	School Education	MF	Retrofit	530	3%	14	0.03	3	\$3	100%	100%	100%	WHISTLE-15	21%	54%	62.2%	62.2%	62.2%	3.8
3197	HVAC	Filter whistle - Gas/CAC baseline	Efficient Products	MF	Retrofit	530	7%	37	0.07	3	\$3	100%	100%	100%	WHISTLE-15	21%	54%	62.2%	62.2%	62.2%	9.6
3198	HVAC	Filter whistle - Gas/CAC baseline	Multifamily	MF	Retrofit	530	7%	37	0.07	3	\$3	100%	100%	100%	WHISTLE-15	21%	54%	62.2%	62.2%	62.2%	9.6

Appendix B: Residential Measure Assumptions

Measure #	End-Use	Measure Name	Program	Home Type	Replacement Type	Base Annual Electric	% Elec Savings	Per Unit Elec Savings	Per Unit Summer kW	EE EUL	Measure Cost	MAP Incentive (%)	RAP Incentive (%)	PP Incentive (%)	End Use Measure Group	Base Saturation	EE Saturation	MAP Adoption Rate	RAP Adoption Rate	PP Adoption Rate	UCT Score
3199	HVAC	Filter whistle - Gas/CAC baseline	IQW	MF	Retrofit	530	7%	37	0.07	3	\$3	100%	100%	100%	WHISTLE-15	21%	54%	62.2%	62.2%	62.2%	9.6
3200	HVAC	Filter whistle - Gas/CAC baseline	School Education	MF	NC	530	3%	14	0.03	3	\$3	100%	100%	100%	WHISTLE-18	21%	0%	83.3%	83.3%	83.3%	3.8
3201	HVAC	ENERGY STAR Room Air Conditioner	Efficient Products	SF	MO	259	9%	24	0.07	12	\$40	100%	63%	63%	RAC-1	17%	49%	86.7%	65.3%	65.3%	3.9
3202	HVAC	ENERGY STAR Room Air Conditioner	Efficient Products	SF	NC	259	9%	24	0.07	12	\$40	100%	63%	63%	RAC-2	17%	0%	90.0%	73.8%	73.8%	3.9
3203	HVAC	ENERGY STAR Room Air Conditioner	Efficient Products	MF	MO	259	9%	24	0.07	12	\$40	100%	63%	63%	RAC-3	12%	49%	77.9%	60.4%	60.4%	3.9
3204	HVAC	ENERGY STAR Room Air Conditioner	Efficient Products	MF	NC	259	9%	24	0.07	12	\$40	100%	63%	63%	RAC-4	12%	0%	83.3%	70.1%	70.1%	3.9
3205	HVAC	Smart Room AC	Efficient Products	SF	MO	259	3%	8	0.02	12	\$40	75%	63%	63%	RAC-1	17%	49%	74.3%	65.3%	65.3%	1.3
3206	HVAC	Smart Room AC	Efficient Products	SF	NC	259	3%	8	0.02	12	\$40	75%	63%	63%	RAC-2	17%	0%	80.6%	73.8%	73.8%	1.3
3207	HVAC	Smart Room AC	Efficient Products	MF	MO	259	3%	8	0.02	12	\$40	75%	63%	63%	RAC-3	12%	49%	68.6%	60.4%	60.4%	1.3
3208	HVAC	Smart Room AC	Efficient Products	MF	NC	259	3%	8	0.02	12	\$40	75%	63%	63%	RAC-4	12%	0%	76.3%	70.1%	70.1%	1.3
3209	HVAC	Room AC Recycling	Appliance Recycling	SF	Recycle	227	100%	227	0.21	4	\$20	100%	100%	100%	RACR-1	17%	0%	90.0%	90.0%	90.0%	6.6
3210	HVAC	Room AC Recycling	Appliance Recycling	MF	Recycle	227	100%	227	0.21	4	\$20	100%	100%	100%	RACR-2	14%	0%	83.3%	83.3%	83.3%	6.7
3211	HVAC	Smart Vents/Sensors - Heat pump baseline	Efficient Products	SF	Retrofit	6,061	5%	303	0.11	15	\$1,625	80%	80%	80%	SVS-1	13%	10%	80.6%	80.6%	80.6%	0.2
3212	HVAC	Smart Vents/Sensors - Heat pump baseline	Efficient Products	SF	NC	6,061	5%	303	0.11	15	\$1,625	80%	80%	80%	SVS-2	42%	0%	82.4%	82.4%	82.4%	0.2
3213	HVAC	Smart Vents/Sensors - Heat pump baseline	Efficient Products	MF	Retrofit	2,573	5%	129	0.08	15	\$1,040	80%	80%	80%	SVS-3	13%	10%	75.3%	75.3%	75.3%	0.2
3214	HVAC	Smart Vents/Sensors - Heat pump baseline	Efficient Products	MF	NC	2,573	5%	129	0.08	15	\$1,040	80%	80%	80%	SVS-4	74%	0%	77.6%	77.6%	77.6%	0.2
3215	HVAC	Smart Vents/Sensors - Furnace baseline	Efficient Products	SF	Retrofit	11,926	5%	596	0.11	15	\$1,625	80%	80%	80%	SVS-5	26%	10%	80.6%	80.6%	80.6%	0.3
3216	HVAC	Smart Vents/Sensors - Furnace baseline	Efficient Products	SF	NC	11,926	5%	596	0.11	15	\$1,625	80%	80%	80%	SVS-6	0%	0%	0.0%	0.0%	0.0%	0.3
3217	HVAC	Smart Vents/Sensors - Furnace baseline	Efficient Products	MF	Retrofit	4,166	5%	208	0.08	15	\$1,040	80%	80%	80%	SVS-7	50%	10%	75.3%	75.3%	75.3%	0.2
3218	HVAC	Smart Vents/Sensors - Furnace baseline	Efficient Products	MF	NC	4,166	5%	208	0.08	15	\$1,040	80%	80%	80%	SVS-8	0%	0%	0.0%	0.0%	0.0%	0.2
3219	HVAC	Smart Vents/Sensors - Gas/CAC baseline	Efficient Products	SF	Retrofit	1,368	5%	68	0.11	15	\$1,625	80%	80%	80%	SVS-9	53%	10%	80.6%	80.6%	80.6%	0.1
3220	HVAC	Smart Vents/Sensors - Gas/CAC baseline	Efficient Products	SF	NC	1,368	5%	68	0.11	15	\$1,625	80%	80%	80%	SVS-10	53%	0%	82.4%	82.4%	82.4%	0.1
3221	HVAC	Smart Vents/Sensors - Gas/CAC baseline	Efficient Products	MF	Retrofit	530	5%	26	0.08	15	\$1,040	80%	80%	80%	SVS-11	21%	10%	75.3%	75.3%	75.3%	0.1
3222	HVAC	Smart Vents/Sensors - Gas/CAC baseline	Efficient Products	MF	NC	530	5%	26	0.08	15	\$1,040	80%	80%	80%	SVS-12	21%	0%	77.6%	77.6%	77.6%	0.1
3223	HVAC	Whole House Attic Fan	Efficient Products	SF	Retrofit	1,081	18%	195	0.41	15	\$711	80%	80%	80%	AF-1	80%	9%	80.8%	80.8%	80.8%	1.2
3224	HVAC	Whole House Attic Fan	Efficient Products	SF	NC	1,081	18%	195	0.41	15	\$711	80%	80%	80%	AF-2	80%	0%	82.4%	82.4%	82.4%	1.2
3225	HVAC	Whole House Attic Fan	Efficient Products	MF	Retrofit	1,081	7%	76	0.27	15	\$711	80%	80%	80%	AF-3	80%	9%	75.5%	75.5%	75.5%	0.8
3226	HVAC	Whole House Attic Fan	Efficient Products	MF	NC	1,081	7%	76	0.27	15	\$711	80%	80%	80%	AF-4	80%	0%	77.6%	77.6%	77.6%	0.8
3227	HVAC	Attic Fan	Efficient Products	SF	Retrofit	422	21%	87	0.18	15	\$125	100%	80%	80%	AF-1	79%	7%	89.3%	81.2%	81.2%	3.0
3228	HVAC	Attic Fan	Efficient Products	SF	NC	422	21%	87	0.18	15	\$125	100%	80%	80%	AF-2	79%	0%	90.0%	82.4%	82.4%	3.0
3229	HVAC	Attic Fan	Efficient Products	MF	Retrofit	422	8%	34	0.12	15	\$125	100%	80%	80%	AF-3	79%	7%	82.1%	76.1%	76.1%	1.9
3230	HVAC	Attic Fan	Efficient Products	MF	NC	422	8%	34	0.12	15	\$125	100%	80%	80%	AF-4	79%	0%	83.3%	77.6%	77.6%	1.9
3231	HVAC	ENERGY STAR Bath Vent Fan	Efficient Products	SF	Retrofit	49	61%	30	0.02	19	\$44	100%	46%	46%	BATH FAN-1	100%	9%	89.0%	61.7%	61.7%	2.7
3232	HVAC	ENERGY STAR Bath Vent Fan	Efficient Products	SF	NC	49	61%	30	0.02	19	\$44	100%	46%	46%	BATH FAN-2	100%	0%	90.0%	65.0%	65.0%	2.7
3233	HVAC	ENERGY STAR Bath Vent Fan	Efficient Products	MF	Retrofit	49	61%	30	0.02	19	\$44	100%	46%	46%	BATH FAN-3	100%	9%	81.7%	57.2%	57.2%	2.7
3234	HVAC	ENERGY STAR Bath Vent Fan	Efficient Products	MF	NC	49	61%	30	0.02	19	\$44	100%	46%	46%	BATH FAN-4	100%	0%	83.3%	60.8%	60.8%	2.7
3235	HVAC	Energy Recovery Ventilator - Heat Pump	Efficient Products	SF	Retrofit	6,061	55%	3,317	0.26	15	\$3,000	100%	100%	100%	ERV-1	13%	0%	90.0%	90.0%	90.0%	0.6
3236	HVAC	Energy Recovery Ventilator - Electric Resistance	Efficient Products	SF	Retrofit	11,926	37%	4,396	0.34	15	\$3,000	75%	100%	100%	ERV-2	26%	0%	80.6%	90.0%	90.0%	0.7
3237	HVAC	Energy Recovery Ventilator - Heat Pump	Efficient Products	SF	NC	6,061	55%	3,317	0.26	15	\$3,000	100%	100%	100%	ERV-3	42%	0%	90.0%	90.0%	90.0%	0.6
3238	HVAC	Energy Recovery Ventilator - Electric Resistance	Efficient Products	SF	NC	11,926	37%	4,396	0.34	15	\$3,000	75%	100%	100%	ERV-4	0%	0%	0.0%	0.0%	0.0%	0.7
3239	HVAC	Energy Recovery Ventilator - Heat Pump	Efficient Products	MF	Retrofit	2,573	71%	1,815	0.14	15	\$3,000	100%	100%	100%	ERV-5	13%	0%	83.3%	83.3%	83.3%	0.3
3240	HVAC	Energy Recovery Ventilator - Electric Resistance	Efficient Products	MF	Retrofit	4,166	58%	2,404	0.19	15	\$3,000	100%	100%	100%	ERV-6	50%	0%	83.3%	83.3%	83.3%	0.4
3241	HVAC	Energy Recovery Ventilator - Heat Pump	Efficient Products	MF	NC	2,573	71%	1,815	0.14	15	\$3,000	100%	100%	100%	ERV-7	74%	0%	83.3%	83.3%	83.3%	0.3
3242	HVAC	Energy Recovery Ventilator - Electric Resistance	Efficient Products	MF	NC	4,166	58%	2,404	0.19	15	\$3,000	100%	100%	100%	ERV-8	0%	0%	0.0%	0.0%	0.0%	0.4
4001	Lighting	LED Standard	School Education	SF	MO	37	62%	23	0.00	10	\$4	100%	100%	100%	LED-1	2667%	61%	75.0%	75.0%	75.0%	2.8
4002	Lighting	LED Standard	School Education	SF	MO	37	62%	23	0.00	10	\$4	100%	100%	100%	LED-2	2667%	61%	60.4%	58.7%	58.7%	2.8
4003	Lighting	LED Standard	CBL	SF	MO	37	43%	16	0.00	10	\$2	100%	59%	59%	LED-2	2667%	61%	60.4%	54.8%	54.8%	5.7
4004	Lighting	LED Standard	IQW	SF	MO	37	77%	29	0.00	10	\$2	100%	100%	100%	LED-2	2667%	61%	60.4%	58.7%	58.7%	6.5
4005	Lighting	LED Standard	School Education	MF	MO	37	62%	23	0.00	10	\$4	100%	100%	100%	LED-3	1599%	61%	60.4%	58.8%	58.8%	2.6
4006	Lighting	LED Standard	School Education	MF	MO	37	62%	23	0.00	10	\$4	100%	100%	100%	LED-4	1599%	61%	60.4%	57.5%	57.5%	2.6
4007	Lighting	LED Standard	CBL	MF	MO	37	43%	16	0.00	10	\$2	100%	59%	59%	LED-4	1599%	61%	60.4%	54.8%	54.8%	5.3
4008	Lighting	LED Standard	IQW	MF	MO	37	77%	29	0.00	10	\$2	100%	100%	100%	LED-4	1599%	61%	60.4%	57.5%	57.5%	6.1
4009	Lighting	LED Reflector	Efficient Products	SF	MO	65	75%	49	0.04	10	\$5	100%	40%	40%	REFL-1	951%	61%	75.0%	54.8%	54.8%	28.5
4010	Lighting	LED Reflector	School Education	SF	MO	65	75%	49	0.04	10	\$5	100%	40%	40%	REFL-1	951%	61%	75.0%	54.8%	54.8%	28.5
4011	Lighting	LED Reflector	Efficient Products	SF	MO	65	75%	49	0.04	10	\$5	100%	40%	40%	REFL-2	951%	61%	60.4%	54.8%	54.8%	28.5
4012	Lighting	LED Reflector	School Education	SF	MO	65	75%	49	0.04	10	\$5	100%	40%	40%	REFL-2	951%	61%	60.4%	54.8%	54.8%	28.5
4013	Lighting	LED Reflector	IQW	SF	MO	65	75%	49	0.04	10	\$5	100%	100%	100%	REFL-2	951%	61%	60.4%	58.7%	58.7%	11.4
4014	Lighting	LED Reflector	Efficient Products	SF	NC	65	75%	49	0.04	10	\$5	100%	40%	40%	REFL-3	951%	0%	81.8%	49.4%	49.4%	28.5
4015	Lighting	LED Reflector	Efficient Products	MF	MO	65	75%	49	0.04	10	\$5	100%	40%	40%	REFL-4	570%	61%	60.4%	54.8%	54.8%	28.1
4016	Lighting	LED Reflector	School Education	MF	MO	65	75%	49	0.04	10	\$5	100%	40%	40%	REFL-4	570%	61%	60.4%	54.8%	54.8%	28.1
4017	Lighting	LED Reflector	Multifamily	MF	MO	65	75%	49	0.04	10	\$5	100%	100%	100%	REFL-4	570%	61%	60.4%	58.8%	58.8%	11.2
4018	Lighting	LED Reflector	Efficient Products	MF	MO	65	75%	49	0.04	10	\$5	100%	40%	40%	REFL-5	570%	61%	60.4%	54.8%	54.8%	28.1
4019	Lighting	LED Reflector	School Education	MF	MO	65	75%	49	0.04	10	\$5	100%	40%	40%	REFL-5	570%	61%	60.4%	54.8%	54.8%	28.1

Appendix B: Residential Measure Assumptions

Measure #	End-Use	Measure Name	Program	Home Type	Replacement Type	Base Annual Electric	% Elec Savings	Per Unit Elec Savings	Per Unit Summer kW	EE EUL	Measure Cost	MAP Incentive (%)	RAP Incentive (%)	PP Incentive (%)	End Use Measure Group	Base Saturation	EE Saturation	MAP Adoption Rate	RAP Adoption Rate	PP Adoption Rate	UCT Score
4020	Lighting	LED Reflector	Multifamily	MF	MO	65	75%	49	0.04	10	\$5	100%	100%	100%	REFL-5	570%	61%	60.4%	57.5%	57.5%	11.2
4021	Lighting	LED Reflector	IQW	MF	MO	65	75%	49	0.04	10	\$5	100%	100%	100%	REFL-5	570%	61%	60.4%	57.5%	57.5%	11.2
4022	Lighting	LED Reflector	Efficient Products	MF	NC	65	75%	49	0.04	10	\$5	100%	40%	40%	REFL-6	570%	0%	71.2%	43.6%	43.6%	28.1
4023	Lighting	LED Specialty	Efficient Products	SF	MO	44	75%	33	0.02	10	\$3	100%	44%	44%	SPEC-1	573%	61%	75.0%	54.8%	54.8%	22.2
4024	Lighting	LED Specialty	Efficient Products	SF	MO	44	75%	33	0.02	10	\$3	100%	44%	44%	SPEC-2	573%	61%	60.4%	54.8%	54.8%	22.2
4025	Lighting	LED Specialty	IQW	SF	MO	44	75%	33	0.02	10	\$2	100%	100%	100%	SPEC-2	573%	61%	60.4%	58.7%	58.7%	14.8
4026	Lighting	LED Specialty	Efficient Products	SF	NC	44	75%	33	0.02	10	\$3	100%	44%	44%	SPEC-3	573%	0%	81.8%	52.5%	52.5%	22.2
4027	Lighting	LED Specialty	Efficient Products	MF	MO	44	75%	33	0.02	10	\$3	100%	44%	44%	SPEC-4	344%	61%	60.4%	54.8%	54.8%	21.8
4028	Lighting	LED Specialty	Multifamily	MF	MO	44	75%	33	0.02	10	\$2	100%	100%	100%	SPEC-4	344%	61%	60.4%	58.8%	58.8%	14.5
4029	Lighting	LED Specialty	Efficient Products	MF	MO	44	75%	33	0.02	10	\$3	100%	44%	44%	SPEC-5	344%	61%	60.4%	54.8%	54.8%	21.8
4030	Lighting	LED Specialty	Multifamily	MF	MO	44	75%	33	0.02	10	\$2	100%	100%	100%	SPEC-5	344%	61%	60.4%	57.5%	57.5%	14.5
4031	Lighting	LED Specialty	IQW	MF	MO	44	75%	33	0.02	10	\$2	100%	100%	100%	SPEC-5	344%	61%	60.4%	57.5%	57.5%	14.5
4032	Lighting	LED Specialty	Efficient Products	MF	NC	44	75%	33	0.02	10	\$3	100%	44%	44%	SPEC-6	344%	0%	71.2%	45.4%	45.4%	21.8
4033	Lighting	Exterior LED Lamp	IQW	SF	MO	127	43%	55	0.00	7	\$2	100%	100%	100%	EXT LED-1	466%	61%	60.4%	58.7%	58.7%	7.1
4034	Lighting	Exterior LED Lamp	Multifamily	MF	MO	127	43%	55	0.00	7	\$2	100%	100%	100%	EXT LED-2	252%	61%	60.4%	58.8%	58.8%	7.2
4035	Lighting	Exterior LED Lamp	Multifamily	MF	MO	127	43%	55	0.00	7	\$2	100%	100%	100%	EXT LED-3	252%	61%	60.4%	57.5%	57.5%	7.2
4036	Lighting	Exterior LED Lamp	IQW	MF	MO	127	43%	55	0.00	7	\$2	100%	100%	100%	EXT LED-3	252%	61%	60.4%	57.5%	57.5%	7.2
4037	Lighting	LED Nightlights	Efficient Products	SF	MO	15	93%	14	0.00	8	\$3	100%	100%	100%	NIGHT-1	14%	61%	75.0%	75.0%	75.0%	1.2
4038	Lighting	LED Nightlights	School Education	SF	MO	15	26%	4	0.00	8	\$3	100%	100%	100%	NIGHT-1	14%	61%	75.0%	75.0%	75.0%	0.3
4039	Lighting	LED Nightlights	Efficient Products	SF	MO	15	93%	14	0.00	8	\$3	100%	100%	100%	NIGHT-2	14%	61%	60.4%	58.7%	58.7%	1.2
4040	Lighting	LED Nightlights	School Education	SF	MO	15	26%	4	0.00	8	\$3	100%	100%	100%	NIGHT-2	14%	61%	60.4%	58.7%	58.7%	0.3
4041	Lighting	LED Nightlights	IQW	SF	MO	15	93%	14	0.00	8	\$3	100%	100%	100%	NIGHT-2	14%	61%	60.4%	58.7%	58.7%	1.2
4042	Lighting	LED Nightlights	Efficient Products	SF	NC	15	93%	14	0.00	8	\$3	100%	100%	100%	NIGHT-3	14%	0%	81.8%	81.8%	81.8%	1.2
4043	Lighting	LED Nightlights	Efficient Products	MF	MO	15	93%	14	0.00	8	\$3	100%	100%	100%	NIGHT-4	8%	61%	60.4%	58.8%	58.8%	1.1
4044	Lighting	LED Nightlights	School Education	MF	MO	15	26%	4	0.00	8	\$3	100%	100%	100%	NIGHT-4	8%	61%	60.4%	58.8%	58.8%	0.3
4045	Lighting	LED Nightlights	Multifamily	MF	MO	15	93%	14	0.00	8	\$3	100%	100%	100%	NIGHT-4	8%	61%	60.4%	58.8%	58.8%	1.1
4046	Lighting	LED Nightlights	Efficient Products	MF	MO	15	93%	14	0.00	8	\$3	100%	100%	100%	NIGHT-5	8%	61%	60.4%	57.5%	57.5%	1.1
4047	Lighting	LED Nightlights	School Education	MF	MO	15	26%	4	0.00	8	\$3	100%	100%	100%	NIGHT-5	8%	61%	60.4%	57.5%	57.5%	0.3
4048	Lighting	LED Nightlights	Multifamily	MF	MO	15	93%	14	0.00	8	\$3	100%	100%	100%	NIGHT-5	8%	61%	60.4%	57.5%	57.5%	1.1
4049	Lighting	LED Nightlights	IQW	MF	MO	15	93%	14	0.00	8	\$3	100%	100%	100%	NIGHT-5	8%	61%	60.4%	57.5%	57.5%	1.1
4050	Lighting	LED Nightlights	Efficient Products	MF	NC	15	93%	14	0.00	8	\$3	100%	100%	100%	NIGHT-6	8%	0%	71.2%	71.2%	71.2%	1.1
4051	Lighting	Ceiling Fan	Efficient Products	SF	MO	110	75%	82	0.00	10	\$46	54%	54%	54%	LED-1	92%	61%	60.4%	54.8%	54.8%	1.0
4052	Lighting	Ceiling Fan	Efficient Products	SF	NC	110	75%	82	0.00	10	\$46	54%	54%	54%	LED-5	92%	0%	59.9%	59.9%	59.9%	1.0
4053	Lighting	Ceiling Fan	Efficient Products	MF	MO	110	75%	82	0.00	10	\$46	54%	54%	54%	LED-3	98%	61%	60.4%	54.8%	54.8%	1.0
4054	Lighting	Ceiling Fan	Efficient Products	MF	NC	110	75%	82	0.00	10	\$46	54%	54%	54%	LED-6	98%	0%	50.5%	50.5%	50.5%	1.0
4055	Lighting	LED 3-Way Bulb	Efficient Products	SF	MO	11	75%	9	0.00	10	\$3	100%	50%	50%	LED-1	2667%	61%	75.0%	54.8%	54.8%	2.5
4056	Lighting	LED 3-Way Bulb	Efficient Products	SF	MO	11	75%	9	0.00	10	\$3	100%	50%	50%	LED-2	2667%	61%	60.4%	54.8%	54.8%	2.5
4057	Lighting	LED 3-Way Bulb	IQW	SF	MO	11	75%	8	0.00	10	\$3	100%	50%	50%	LED-2	2667%	61%	60.4%	54.8%	54.8%	4.6
4058	Lighting	LED 3-Way Bulb	Efficient Products	SF	NC	11	75%	9	0.00	10	\$3	100%	50%	50%	LED-5	2667%	0%	81.8%	57.9%	57.9%	2.5
4059	Lighting	LED 3-Way Bulb	Efficient Products	MF	MO	11	75%	9	0.00	10	\$3	100%	50%	50%	LED-3	1599%	61%	60.4%	54.8%	54.8%	2.3
4060	Lighting	LED 3-Way Bulb	Multifamily	MF	MO	35	75%	27	0.00	10	\$3	100%	50%	50%	LED-3	1599%	61%	60.4%	54.8%	54.8%	7.9
4061	Lighting	LED 3-Way Bulb	Efficient Products	MF	MO	11	75%	9	0.00	10	\$3	100%	50%	50%	LED-4	1599%	61%	60.4%	54.8%	54.8%	2.3
4062	Lighting	LED 3-Way Bulb	Multifamily	MF	MO	35	75%	27	0.00	10	\$3	100%	50%	50%	LED-4	1599%	61%	60.4%	54.8%	54.8%	7.9
4063	Lighting	LED 3-Way Bulb	IQW	MF	MO	11	75%	8	0.00	10	\$3	100%	50%	50%	LED-4	1599%	61%	60.4%	54.8%	54.8%	4.5
4064	Lighting	LED 3-Way Bulb	Efficient Products	MF	NC	11	75%	9	0.00	10	\$3	100%	50%	50%	LED-6	1599%	0%	71.2%	48.4%	48.4%	2.3
4065	Lighting	Linear LED	Efficient Products	SF	MO	23	44%	10	0.01	9	\$7	100%	80%	80%	LINEAR-1	179%	61%	73.9%	60.8%	60.8%	3.0
4066	Lighting	Linear LED	Efficient Products	SF	NC	23	44%	10	0.01	9	\$3	100%	80%	80%	LINEAR-2	179%	0%	81.8%	72.7%	72.7%	8.4
4067	Lighting	Linear LED	Efficient Products	MF	MO	23	44%	10	0.01	9	\$7	100%	80%	80%	LINEAR-3	107%	61%	60.4%	54.8%	54.8%	3.0
4068	Lighting	Linear LED	Efficient Products	MF	NC	23	44%	10	0.01	9	\$3	100%	80%	80%	LINEAR-4	107%	0%	71.2%	63.7%	63.7%	8.3
4069	Lighting	Smart LED	Efficient Products	SF	MO	19	10%	2	0.00	10	\$2	80%	80%	80%	LED-1	2667%	61%	60.8%	60.8%	60.8%	0.4
4070	Lighting	Smart LED	Efficient Products	SF	NC	19	10%	2	0.00	10	\$2	80%	80%	80%	LED-3	2667%	0%	72.7%	72.7%	72.7%	0.4
4071	Lighting	Smart LED	Efficient Products	MF	MO	19	10%	2	0.00	10	\$2	80%	80%	80%	LED-4	1599%	61%	60.4%	54.8%	54.8%	0.4
4072	Lighting	Smart LED	Efficient Products	MF	NC	19	10%	2	0.00	10	\$2	80%	80%	80%	LED-6	1599%	0%	63.7%	63.7%	63.7%	0.4
4073	Lighting	LED Fixture	Efficient Products	SF	MO	82	59%	49	0.06	15	\$26	100%	80%	80%	LED-1	2096%	61%	73.9%	60.8%	60.8%	5.2
4074	Lighting	LED Fixture	Efficient Products	SF	NC	82	59%	49	0.06	15	\$3	100%	80%	80%	LED-3	2096%	0%	81.8%	72.7%	72.7%	52.3
4075	Lighting	LED Fixture	Efficient Products	MF	MO	82	59%	49	0.06	15	\$26	100%	80%	80%	LED-4	1256%	61%	60.4%	54.8%	54.8%	5.2
4076	Lighting	LED Fixture	Efficient Products	MF	NC	82	59%	49	0.06	15	\$3	100%	80%	80%	LED-6	1256%	0%	71.2%	63.7%	63.7%	51.8
4077	Lighting	Occupancy Sensor	Efficient Products	SF	Retrofit	124	30%	37	0.05	10	\$30	100%	80%	80%	OCC-1	1048%	31%	74.8%	62.1%	62.1%	2.6
4078	Lighting	Occupancy Sensor	Efficient Products	SF	NC	124	30%	37	0.05	10	\$30	100%	80%	80%	OCC-2	1048%	0%	81.8%	72.7%	72.7%	2.6
4079	Lighting	Occupancy Sensor	Efficient Products	MF	Retrofit	124	30%	37	0.05	10	\$30	100%	80%	80%	OCC-3	628%	31%	60.1%	49.6%	49.6%	2.5
4080	Lighting	Occupancy Sensor	Efficient Products	MF	NC	124	30%	37	0.05	10	\$30	100%	80%	80%	OCC-4	628%	0%	71.2%	63.7%	63.7%	2.5
4081	Lighting	Smart Lighting Switch	Efficient Products	SF	Retrofit	124	17%	21	0.05	10	\$43	100%	47%	47%	OCC-1	1048%	31%	74.8%	37.9%	37.9%	2.8
4082	Lighting	Smart Lighting Switch	Efficient Products	SF	NC	124	17%	21	0.05	10	\$43	100%	47%	47%	OCC-2	1048%	0%	81.8%	55.2%	55.2%	2.8

Appendix B: Residential Measure Assumptions

Measure #	End-Use	Measure Name	Program	Home Type	Replacement Type	Base Annual Electric	% Elec Savings	Per Unit Elec Savings	Per Unit Summer kW	EE EUL	Measure Cost	MAP Incentive (%)	RAP Incentive (%)	PP Incentive (%)	End Use Measure Group	Base Saturation	EE Saturation	MAP Adoption Rate	RAP Adoption Rate	PP Adoption Rate	UCT Score
4083	Lighting	Smart Lighting Switch	Efficient Products	MF	Retrofit	124	17%	21	0.05	10	\$43	100%	47%	47%	OCC-3	628%	31%	60.1%	26.4%	26.4%	2.8
4084	Lighting	Smart Lighting Switch	Efficient Products	MF	NC	124	17%	21	0.05	10	\$43	100%	47%	47%	OCC-4	628%	0%	71.2%	46.9%	46.9%	2.8
4085	Lighting	Exterior Lighting Controls	Efficient Products	SF	Retrofit	146	44%	65	0.03	10	\$30	100%	80%	80%	ELC-1	233%	35%	73.4%	60.1%	60.1%	2.0
4086	Lighting	Exterior Lighting Controls	Efficient Products	SF	NC	146	44%	65	0.03	10	\$30	100%	80%	80%	ELC-2	233%	0%	81.8%	72.7%	72.7%	2.0
4087	Lighting	Exterior Lighting Controls	Efficient Products	MF	Retrofit	146	44%	65	0.03	10	\$30	100%	80%	80%	ELC-3	126%	35%	58.0%	46.9%	46.9%	2.0
4088	Lighting	Exterior Lighting Controls	Efficient Products	MF	NC	146	44%	65	0.03	10	\$30	100%	80%	80%	ELC-4	126%	0%	71.2%	63.7%	63.7%	2.0
4089	Lighting	ENERGY STAR LED Trim Kits	Efficient Products	SF	MO	18	70%	13	0.00	10	\$5	100%	100%	100%	REFL-1	951%	61%	75.0%	75.0%	75.0%	1.2
4090	Lighting	ENERGY STAR LED Trim Kits	Efficient Products	SF	MO	18	70%	13	0.00	10	\$5	100%	100%	100%	REFL-2	951%	61%	60.4%	58.7%	58.7%	1.2
4091	Lighting	ENERGY STAR LED Trim Kits	IQW	SF	MO	66	70%	46	0.01	10	\$5	100%	100%	100%	REFL-2	951%	61%	60.4%	58.7%	58.7%	4.1
4092	Lighting	ENERGY STAR LED Trim Kits	Efficient Products	SF	NC	18	70%	13	0.00	10	\$5	100%	100%	100%	REFL-3	951%	0%	81.8%	81.8%	81.8%	1.2
4093	Lighting	ENERGY STAR LED Trim Kits	Efficient Products	MF	MO	18	70%	13	0.00	10	\$5	100%	100%	100%	REFL-4	570%	61%	60.4%	58.8%	58.8%	1.2
4094	Lighting	ENERGY STAR LED Trim Kits	Multifamily	MF	MO	66	70%	46	0.01	10	\$5	100%	100%	100%	REFL-4	570%	61%	60.4%	58.8%	58.8%	3.9
4095	Lighting	ENERGY STAR LED Trim Kits	Efficient Products	MF	MO	18	70%	13	0.00	10	\$5	100%	100%	100%	REFL-5	570%	61%	60.4%	57.5%	57.5%	1.2
4096	Lighting	ENERGY STAR LED Trim Kits	Multifamily	MF	MO	66	70%	46	0.01	10	\$5	100%	100%	100%	REFL-5	570%	61%	60.4%	57.5%	57.5%	3.9
4097	Lighting	ENERGY STAR LED Trim Kits	IQW	MF	MO	66	70%	46	0.01	10	\$5	100%	100%	100%	REFL-5	570%	61%	60.4%	57.5%	57.5%	3.9
4098	Lighting	ENERGY STAR LED Trim Kits	Efficient Products	MF	NC	18	70%	13	0.00	10	\$5	100%	100%	100%	REFL-6	570%	0%	71.2%	71.2%	71.2%	1.2
5001	Pool/Pump	Variable Speed Pool Pump	Efficient Products	SF	MO	1,167	26%	308	0.22	7	\$314	75%	64%	64%	VSP-1	6%	31%	65.2%	58.0%	58.0%	1.2
5002	Pool/Pump	Variable Speed Pool Pump	Efficient Products	SF	NC	1,167	26%	308	0.22	7	\$314	75%	64%	64%	VSP-2	6%	0%	70.5%	64.5%	64.5%	1.2
5003	Pool/Pump	Variable Speed Pool Pump	Efficient Products	MF	MO	1,167	26%	308	0.22	7	\$314	75%	64%	64%	VSP-3	2%	31%	55.0%	47.2%	47.2%	1.2
5004	Pool/Pump	Variable Speed Pool Pump	Efficient Products	MF	NC	1,167	26%	308	0.22	7	\$314	75%	64%	64%	VSP-4	2%	0%	61.9%	55.4%	55.4%	1.2
5005	Pool/Pump	Pool Timer	Efficient Products	SF	MO	1,167	40%	467	0.00	2	\$25	100%	80%	80%	PTIMER-1	6%	31%	78.5%	67.7%	67.7%	2.0
5006	Pool/Pump	Pool Timer	Efficient Products	SF	NC	1,167	40%	467	0.00	2	\$25	100%	80%	80%	PTIMER-2	6%	0%	81.8%	72.7%	72.7%	2.0
5007	Pool/Pump	Pool Timer	Efficient Products	MF	MO	1,167	40%	467	0.00	2	\$25	100%	80%	80%	PTIMER-3	2%	31%	66.0%	57.0%	57.0%	2.0
5008	Pool/Pump	Pool Timer	Efficient Products	MF	NC	1,167	40%	467	0.00	2	\$25	100%	80%	80%	PTIMER-4	2%	0%	71.2%	63.7%	63.7%	2.0
5009	Pool/Pump	Pool Heater	Efficient Products	SF	MO	2,364	80%	1,892	0.00	8	\$1,250	80%	80%	80%	PHEATER-1	6%	21%	69.4%	69.4%	69.4%	0.5
5010	Pool/Pump	Pool Heater	Efficient Products	SF	NC	2,364	80%	1,892	0.00	8	\$1,250	80%	80%	80%	PHEATER-2	6%	0%	72.7%	72.7%	72.7%	0.5
5011	Pool/Pump	Pool Heater	Efficient Products	MF	MO	2,364	80%	1,892	0.00	8	\$1,250	80%	80%	80%	PHEATER-3	2%	21%	59.4%	59.4%	59.4%	0.5
5012	Pool/Pump	Pool Heater	Efficient Products	MF	NC	2,364	80%	1,892	0.00	8	\$1,250	80%	80%	80%	PHEATER-4	2%	0%	63.7%	63.7%	63.7%	0.5
5013	Pool/Pump	Well Pump	Efficient Products	SF	MO	411	33%	136	0.02	20	\$110	80%	80%	80%	WELL-1	9%	31%	67.7%	67.7%	67.7%	1.0
5014	Pool/Pump	Well Pump	Efficient Products	SF	NC	411	33%	136	0.02	20	\$110	80%	80%	80%	WELL-2	9%	0%	72.7%	72.7%	72.7%	1.0
5015	Pool/Pump	Well Pump	Efficient Products	MF	MO	411	33%	136	0.02	20	\$110	80%	80%	80%	WELL-3	5%	31%	57.0%	57.0%	57.0%	1.0
5016	Pool/Pump	Well Pump	Efficient Products	MF	NC	411	33%	136	0.02	20	\$110	80%	80%	80%	WELL-4	5%	0%	63.7%	63.7%	63.7%	1.0
6001	New Construction	Gold Star HERS 67- All Electric	Efficient Products	SF	NC	14,512	33%	4,789	0.55	25	\$3,319	100%	80%	80%	NC-1	45%	0%	87.7%	78.5%	78.5%	1.3
6002	New Construction	Platinum Star HERS 60 Gas & Electric	Efficient Products	SF	NC	9,819	40%	3,928	0.45	25	\$3,049	80%	80%	80%	NC-2	55%	0%	78.5%	78.5%	78.5%	1.2
6003	New Construction	Gold Star HERS 67- Gas & Electric	Efficient Products	SF	NC	9,819	33%	3,240	0.37	25	\$3,319	80%	80%	80%	NC-2	45%	0%	78.5%	78.5%	78.5%	0.9
6004	New Construction	Silver Star HERS 75 - Gas & Electric	Efficient Products	SF	NC	9,819	25%	2,455	0.28	25	\$3,049	80%	80%	80%	NC-2	55%	0%	78.5%	78.5%	78.5%	0.7
6005	New Construction	Gold Star HERS 67- All Electric	Efficient Products	MF	NC	10,414	33%	3,437	0.39	25	\$3,319	80%	80%	80%	NC-3	77%	0%	61.2%	61.2%	61.2%	1.0
6006	New Construction	Platinum Star HERS 60 Gas & Electric	Efficient Products	MF	NC	8,371	40%	3,348	0.38	25	\$3,049	80%	80%	80%	NC-4	23%	0%	61.2%	61.2%	61.2%	1.0
6007	New Construction	Gold Star HERS 67- Gas & Electric	Efficient Products	MF	NC	8,371	33%	2,762	0.32	25	\$3,319	80%	80%	80%	NC-4	77%	0%	61.2%	61.2%	61.2%	0.8
6008	New Construction	Silver Star HERS 75 - Gas & Electric	Efficient Products	MF	NC	8,371	25%	2,093	0.24	25	\$3,049	80%	80%	80%	NC-4	23%	0%	61.2%	61.2%	61.2%	0.6
7001	Plug Loads	Smart Power Strips - Tier 1	Efficient Products	SF	Retrofit	466	12%	57	0.01	7	\$10	100%	80%	80%	STRIP-1	178%	14%	79.1%	68.6%	68.6%	2.3
7002	Plug Loads	Smart Power Strips - Tier 1	Efficient Products	SF	NC	466	12%	57	0.01	7	\$10	100%	80%	80%	STRIP-2	178%	0%	81.8%	72.7%	72.7%	2.3
7003	Plug Loads	Smart Power Strips - Tier 1	Efficient Products	MF	Retrofit	466	12%	57	0.01	7	\$10	100%	80%	80%	STRIP-3	139%	10%	80.0%	69.9%	69.9%	2.2
7004	Plug Loads	Smart Power Strips - Tier 1	Efficient Products	MF	NC	466	12%	57	0.01	7	\$10	100%	80%	80%	STRIP-4	139%	0%	81.8%	72.7%	72.7%	2.2
7005	Plug Loads	Smart Power Strips - Tier 2	Efficient Products	SF	MO	466	29%	136	0.02	7	\$15	100%	100%	100%	STRIP-5	100%	14%	79.6%	79.6%	79.6%	3.4
7006	Plug Loads	Smart Power Strips - Tier 2	Efficient Products	SF	MO	466	29%	136	0.02	7	\$15	100%	100%	100%	STRIP-6	100%	14%	66.4%	66.4%	66.4%	3.4
7007	Plug Loads	Smart Power Strips - Tier 2	IQW	SF	MO	466	29%	136	0.02	7	\$70	100%	35%	35%	STRIP-6	100%	14%	66.4%	24.2%	24.2%	2.1
7008	Plug Loads	Smart Power Strips - Tier 2	Efficient Products	SF	NC	466	29%	136	0.02	7	\$15	100%	100%	100%	STRIP-7	100%	0%	81.8%	81.8%	81.8%	3.4
7009	Plug Loads	Smart Power Strips - Tier 2	Efficient Products	MF	MO	466	29%	136	0.02	7	\$15	100%	100%	100%	STRIP-8	100%	10%	68.0%	68.0%	68.0%	3.4
7010	Plug Loads	Smart Power Strips - Tier 2	Multifamily	MF	MO	466	29%	136	0.02	7	\$70	75%	35%	35%	STRIP-8	100%	10%	57.6%	34.8%	34.8%	2.1
7011	Plug Loads	Smart Power Strips - Tier 2	Efficient Products	MF	MO	466	29%	136	0.02	7	\$15	100%	100%	100%	STRIP-9	100%	10%	67.1%	67.1%	67.1%	3.4
7012	Plug Loads	Smart Power Strips - Tier 2	Multifamily	MF	MO	466	29%	136	0.02	7	\$70	100%	35%	35%	STRIP-9	100%	10%	67.1%	32.3%	32.3%	2.1
7013	Plug Loads	Smart Power Strips - Tier 2	IQW	MF	MO	466	29%	136	0.02	7	\$70	100%	35%	35%	STRIP-9	100%	10%	67.1%	32.3%	32.3%	2.1
7014	Plug Loads	Smart Power Strips - Tier 2	Efficient Products	MF	NC	466	29%	136	0.02	7	\$15	100%	100%	100%	STRIP-10	100%	0%	71.2%	71.2%	71.2%	3.4
7015	Plug Loads	Smart Television	Efficient Products	SF	MO	83	20%	17	0.00	6	\$0	100%	100%	100%	T V-1	270%	61%	53.7%	53.7%	53.7%	0.1
7016	Plug Loads	Smart Television	Efficient Products	SF	NC	83	20%	17	0.00	6	\$0	100%	100%	100%	T V-2	270%	0%	81.8%	81.8%	81.8%	0.1
7017	Plug Loads	Smart Television	Efficient Products	MF	MO	83	20%	17	0.00	6	\$0	100%	100%	100%	T V-3	207%	61%	30.0%	26.9%	26.9%	0.1
7018	Plug Loads	Smart Television	Efficient Products	MF	NC	83	20%	17	0.00	6	\$0	100%	100%	100%	T V-4	207%	0%	71.2%	71.2%	71.2%	0.1
7019	Plug Loads	Smart Outlets	Efficient Products	SF	Retrofit	466	6%	28	0.00	7	\$50	80%	80%	80%	SO-1	100%	14%	68.6%	68.6%	68.6%	0.2
7020	Plug Loads	Smart Outlets	Efficient Products	SF	NC	466	6%	28	0.00	7	\$50	80%	80%	80%	SO-2	100%	0%	72.7%	72.7%	72.7%	0.2
7021	Plug Loads	Smart Outlets	Efficient Products	MF	Retrofit	466	6%	28	0.00	7	\$50	80%	80%	80%	SO-3	100%	10%	60.0%	60.0%	60.0%	0.2
7022	Plug Loads	Smart Outlets	Efficient Products	MF	NC	466	6%	28	0.00	7	\$50	80%	80%	80%	SO-4	100%	0%	63.7%	63.7%	63.7%	0.2
8001	Shell	Advanced Walls - Heat pump	Efficient Products	SF	Retrofit	6,061	10%	606	0.23	20	\$2,470	80%	80%	80%	WALL-1	13%	96%	80.0%	77.1%	77.1%	0.3

Appendix B: Residential Measure Assumptions

Measure #	End-Use	Measure Name	Program	Home Type	Replacement Type	Base Annual Electric	% Elec Savings	Per Unit Elec Savings	Per Unit Summer kW	EE EUL	Measure Cost	MAP Incentive (%)	RAP Incentive (%)	PP Incentive (%)	End Use Measure Group	Base Saturation	EE Saturation	MAP Adoption Rate	RAP Adoption Rate	PP Adoption Rate	UCT Score
8002	Shell	Advanced Walls - Heat pump	Efficient Products	MF	Retrofit	2,573	10%	257	0.23	20	\$1,581	80%	80%	80%	WALL-7	13%	96%	80.0%	77.1%	77.1%	0.4
8003	Shell	Advanced Walls - Electric furnace	Efficient Products	SF	Retrofit	11,926	10%	1,193	0.23	20	\$2,470	80%	80%	80%	WALL-2	26%	96%	80.0%	77.1%	77.1%	0.5
8004	Shell	Advanced Walls - Electric furnace	Efficient Products	MF	Retrofit	4,166	10%	417	0.23	20	\$1,581	80%	80%	80%	WALL-9	50%	96%	80.0%	77.1%	77.1%	0.5
8005	Shell	Advanced Walls - Gas Heating	Efficient Products	SF	Retrofit	1,368	10%	137	0.23	20	\$2,470	80%	80%	80%	WALL-3	53%	96%	80.0%	77.1%	77.1%	0.2
8006	Shell	Advanced Walls - Gas Heating	Efficient Products	MF	Retrofit	530	10%	53	0.23	20	\$1,581	80%	80%	80%	WALL-11	21%	96%	80.0%	77.1%	77.1%	0.3
8007	Shell	Air Sealing Average Sealing - Heat pump	Efficient Products	SF	Retrofit	6,061	4%	238	0.05	20	\$200	100%	100%	100%	AIR SEAL-1	13%	75%	65.7%	65.7%	65.7%	1.0
8008	Shell	Air Sealing Average Sealing - Heat pump	IQW	SF	Retrofit	6,061	4%	238	0.05	20	\$200	100%	100%	100%	AIR SEAL-2	13%	75%	46.0%	38.3%	38.3%	1.0
8009	Shell	Air Sealing Average Sealing - Heat pump	Efficient Products	MF	Retrofit	2,573	6%	153	0.05	20	\$200	100%	100%	100%	AIR SEAL-3	13%	94%	72.3%	68.4%	68.4%	0.8
8010	Shell	Air Sealing Average Sealing - Heat pump	IQW	MF	Retrofit	2,573	6%	153	0.05	20	\$200	100%	100%	100%	AIR SEAL-4	13%	94%	72.3%	68.4%	68.4%	0.8
8011	Shell	Air Sealing Inadequate Sealing - Heat pump	Efficient Products	SF	Retrofit	6,061	17%	1,003	0.05	20	\$200	100%	100%	100%	AIR SEAL-5	13%	84%	54.4%	53.7%	53.7%	2.8
8012	Shell	Air Sealing Inadequate Sealing - Heat pump	IQW	SF	Retrofit	6,061	17%	1,003	0.05	20	\$200	100%	100%	100%	AIR SEAL-6	13%	84%	54.4%	47.9%	47.9%	2.8
8013	Shell	Air Sealing Inadequate Sealing - Heat pump	Efficient Products	MF	Retrofit	2,573	25%	642	0.05	20	\$200	100%	100%	100%	AIR SEAL-7	13%	78%	48.3%	41.0%	41.0%	2.0
8014	Shell	Air Sealing Inadequate Sealing - Heat pump	IQW	MF	Retrofit	2,573	25%	642	0.05	20	\$200	100%	100%	100%	AIR SEAL-8	13%	78%	48.3%	41.0%	41.0%	2.0
8015	Shell	Air Sealing Poor Sealing - Heat pump	Efficient Products	SF	Retrofit	6,061	29%	1,768	0.05	20	\$200	100%	100%	100%	AIR SEAL-9	13%	94%	74.2%	70.5%	70.5%	4.6
8016	Shell	Air Sealing Poor Sealing - Heat pump	IQW	SF	Retrofit	6,061	29%	1,768	0.05	20	\$200	100%	100%	100%	AIR SEAL-10	13%	94%	74.2%	70.5%	70.5%	4.6
8017	Shell	Air Sealing Poor Sealing - Heat pump	Efficient Products	MF	Retrofit	2,573	44%	1,132	0.05	20	\$200	100%	100%	100%	AIR SEAL-11	13%	49%	48.3%	48.3%	48.3%	3.1
8018	Shell	Air Sealing Poor Sealing - Heat pump	IQW	MF	Retrofit	2,573	44%	1,132	0.05	20	\$200	100%	100%	100%	AIR SEAL-12	13%	49%	37.5%	37.5%	37.5%	3.1
8019	Shell	Air Sealing Average Sealing - Electric furnace	Efficient Products	SF	Retrofit	11,926	4%	444	0.05	20	\$200	100%	100%	100%	AIR SEAL-13	26%	75%	65.7%	65.7%	65.7%	1.5
8020	Shell	Air Sealing Average Sealing - Electric furnace	IQW	SF	Retrofit	11,926	4%	444	0.05	20	\$200	100%	100%	100%	AIR SEAL-14	26%	75%	46.0%	38.3%	38.3%	1.5
8021	Shell	Air Sealing Average Sealing - Electric furnace	Efficient Products	MF	Retrofit	4,166	7%	284	0.05	20	\$200	100%	100%	100%	AIR SEAL-15	50%	94%	72.3%	68.4%	68.4%	1.1
8022	Shell	Air Sealing Average Sealing - Electric furnace	IQW	MF	Retrofit	4,166	7%	284	0.05	20	\$200	100%	100%	100%	AIR SEAL-16	50%	94%	72.3%	68.4%	68.4%	1.1
8023	Shell	Air Sealing Inadequate Sealing - Electric furnace	Efficient Products	SF	Retrofit	11,926	16%	1,869	0.05	20	\$200	100%	100%	100%	AIR SEAL-17	26%	84%	54.4%	53.7%	53.7%	4.8
8024	Shell	Air Sealing Inadequate Sealing - Electric furnace	IQW	SF	Retrofit	11,926	16%	1,869	0.05	20	\$200	100%	100%	100%	AIR SEAL-18	26%	84%	54.4%	47.9%	47.9%	4.8
8025	Shell	Air Sealing Inadequate Sealing - Electric furnace	Efficient Products	MF	Retrofit	4,166	29%	1,196	0.05	20	\$200	100%	100%	100%	AIR SEAL-19	50%	78%	48.3%	41.0%	41.0%	3.2
8026	Shell	Air Sealing Inadequate Sealing - Electric furnace	IQW	MF	Retrofit	4,166	29%	1,196	0.05	20	\$200	100%	100%	100%	AIR SEAL-20	50%	78%	48.3%	41.0%	41.0%	3.2
8027	Shell	Air Sealing Poor Sealing - Electric furnace	Efficient Products	SF	Retrofit	11,926	28%	3,293	0.05	20	\$200	100%	100%	100%	AIR SEAL-21	26%	94%	74.2%	70.5%	70.5%	8.1
8028	Shell	Air Sealing Poor Sealing - Electric furnace	IQW	SF	Retrofit	11,926	28%	3,293	0.05	20	\$200	100%	100%	100%	AIR SEAL-22	26%	94%	74.2%	70.5%	70.5%	8.1
8029	Shell	Air Sealing Poor Sealing - Electric furnace	Efficient Products	MF	Retrofit	4,166	51%	2,108	0.05	20	\$200	100%	100%	100%	AIR SEAL-23	50%	49%	48.3%	48.3%	48.3%	5.3
8030	Shell	Air Sealing Poor Sealing - Electric furnace	IQW	MF	Retrofit	4,166	51%	2,108	0.05	20	\$200	100%	100%	100%	AIR SEAL-24	50%	49%	37.5%	37.5%	37.5%	5.3
8031	Shell	Air Sealing - Average Sealing - Gas Heating	Efficient Products	SF	Retrofit	1,368	3%	41	0.05	20	\$200	100%	100%	100%	AIR SEAL-25	53%	75%	65.7%	65.7%	65.7%	0.5
8032	Shell	Air Sealing - Average Sealing - Gas Heating	IQW	SF	Retrofit	1,368	3%	41	0.05	20	\$200	100%	100%	100%	AIR SEAL-26	53%	75%	46.0%	38.3%	38.3%	0.5
8033	Shell	Air Sealing - Average Sealing - Gas Heating	Efficient Products	MF	Retrofit	530	8%	41	0.05	20	\$200	100%	100%	100%	AIR SEAL-27	21%	94%	72.3%	68.4%	68.4%	0.6
8034	Shell	Air Sealing - Average Sealing - Gas Heating	IQW	MF	Retrofit	530	8%	41	0.05	20	\$100	200%	100%	100%	AIR SEAL-28	21%	94%	72.3%	68.4%	68.4%	0.6
8035	Shell	Air Sealing - Inadequate Sealing - Gas Heating	Efficient Products	SF	Retrofit	1,368	3%	41	0.05	20	\$200	100%	100%	100%	AIR SEAL-29	53%	84%	54.4%	53.7%	53.7%	0.5
8036	Shell	Air Sealing - Inadequate Sealing - Gas Heating	IQW	SF	Retrofit	1,368	3%	41	0.05	20	\$200	100%	100%	100%	AIR SEAL-30	53%	84%	54.4%	47.9%	47.9%	0.5
8037	Shell	Air Sealing - Inadequate Sealing - Gas Heating	Efficient Products	MF	Retrofit	530	8%	41	0.05	20	\$200	100%	100%	100%	AIR SEAL-31	21%	78%	48.3%	41.0%	41.0%	0.6
8038	Shell	Air Sealing - Inadequate Sealing - Gas Heating	IQW	MF	Retrofit	530	8%	41	0.05	20	\$200	100%	100%	100%	AIR SEAL-32	21%	78%	48.3%	41.0%	41.0%	0.6
8039	Shell	Air Sealing - Poor Sealing - Gas Heating	Efficient Products	SF	Retrofit	1,368	3%	42	0.05	20	\$200	100%	100%	100%	AIR SEAL-33	53%	94%	74.2%	70.5%	70.5%	0.5
8040	Shell	Air Sealing - Poor Sealing - Gas Heating	IQW	SF	Retrofit	1,368	3%	42	0.05	20	\$200	100%	100%	100%	AIR SEAL-34	53%	94%	74.2%	70.5%	70.5%	0.5
8041	Shell	Air Sealing - Poor Sealing - Gas Heating	Efficient Products	MF	Retrofit	530	8%	41	0.05	20	\$200	100%	100%	100%	AIR SEAL-35	21%	49%	48.3%	48.3%	48.3%	0.6
8042	Shell	Air Sealing - Poor Sealing - Gas Heating	IQW	MF	Retrofit	530	8%	41	0.05	20	\$200	100%	100%	100%	AIR SEAL-36	21%	49%	37.5%	37.5%	37.5%	0.6
8043	Shell	Attic Insulation - Average Insulation - Heat pump	Efficient Products	SF	Retrofit	6,061	3%	183	0.07	20	\$898	33%	33%	33%	ATTIC-1	13%	77%	47.7%	40.2%	40.2%	0.7
8044	Shell	Attic Insulation - Average Insulation - Heat pump	IQW	SF	Retrofit	6,061	3%	183	0.07	20	\$898	49%	49%	49%	ATTIC-2	13%	77%	47.7%	40.2%	40.2%	0.5
8045	Shell	Attic Insulation - Average Insulation - Heat pump	Efficient Products	MF	Retrofit	2,573	3%	83	0.04	20	\$575	52%	52%	52%	ATTIC-3	13%	96%	80.6%	77.8%	77.8%	0.4
8046	Shell	Attic Insulation - Average Insulation - Heat pump	IQW	MF	Retrofit	2,573	3%	83	0.04	20	\$575	76%	76%	76%	ATTIC-4	13%	96%	80.6%	77.8%	77.8%	0.3
8047	Shell	Attic Insulation - Inadequate Insulation - Heat pump	Efficient Products	SF	Retrofit	6,061	7%	404	0.15	20	\$1,597	25%	25%	25%	ATTIC-5	13%	71%	44.0%	36.0%	36.0%	1.2
8048	Shell	Attic Insulation - Inadequate Insulation - Heat pump	IQW	SF	Retrofit	6,061	7%	404	0.15	20	\$1,597	97%	97%	97%	ATTIC-6	13%	71%	44.0%	36.0%	36.0%	0.3
8049	Shell	Attic Insulation - Inadequate Insulation - Heat pump	Efficient Products	MF	Retrofit	2,573	7%	177	0.10	20	\$1,022	39%	39%	39%	ATTIC-7	13%	73%	45.2%	37.4%	37.4%	0.6
8050	Shell	Attic Insulation - Inadequate Insulation - Heat pump	IQW	MF	Retrofit	2,573	7%	177	0.10	20	\$1,022	151%	100%	100%	ATTIC-8	13%	73%	45.2%	37.4%	37.4%	0.2
8051	Shell	Attic Insulation - Poor Insulation - Heat pump	Efficient Products	SF	Retrofit	6,061	11%	665	0.27	20	\$1,597	50%	35%	35%	ATTIC-9	13%	90%	63.2%	57.9%	57.9%	1.4
8052	Shell	Attic Insulation - Poor Insulation - Heat pump	IQW	SF	Retrofit	6,061	11%	665	0.27	20	\$1,597	100%	97%	97%	ATTIC-10	13%	90%	63.2%	57.9%	57.9%	0.5
8053	Shell	Attic Insulation - Poor Insulation - Heat pump	Efficient Products	MF	Retrofit	2,573	11%	291	0.17	20	\$1,022	100%	39%	39%	ATTIC-11	13%	38%	55.8%	24.6%	24.6%	1.1
8054	Shell	Attic Insulation - Poor Insulation - Heat pump	IQW	MF	Retrofit	2,573	11%	291	0.17	20	\$1,022	151%	100%	100%	ATTIC-12	13%	38%	46.5%	46.5%	46.5%	0.3
8055	Shell	Attic Insulation - Average Insulation - Electric furnace	Efficient Products	SF	Retrofit	11,926	3%	357	0.08	20	\$898	33%	33%	33%	ATTIC-13	26%	77%	47.7%	40.2%	40.2%	1.0

Appendix B: Residential Measure Assumptions

Measure #	End-Use	Measure Name	Program	Home Type	Replacement Type	Base Annual Electric	% Elec Savings	Per Unit Elec Savings	Per Unit Summer kW	EE EUL	Measure Cost	MAP Incentive (%)	RAP Incentive (%)	PP Incentive (%)	End Use Measure Group	Base Saturation	EE Saturation	MAP Adoption Rate	RAP Adoption Rate	PP Adoption Rate	UCT Score
8056	Shell	Attic Insulation - Average Insulation - Electric furnace	IQW	SF	Retrofit	11,926	3%	357	0.08	20	\$898	50%	49%	49%	ATTIC-14	26%	77%	47.7%	40.2%	40.2%	0.7
8057	Shell	Attic Insulation - Average Insulation - Electric furnace	Efficient Products	MF	Retrofit	4,166	4%	168	0.06	20	\$575	52%	52%	52%	ATTIC-15	50%	96%	80.6%	77.8%	77.8%	0.6
8058	Shell	Attic Insulation - Average Insulation - Electric furnace	IQW	MF	Retrofit	4,166	4%	168	0.06	20	\$575	76%	76%	76%	ATTIC-16	50%	96%	80.6%	77.8%	77.8%	0.4
8059	Shell	Attic Insulation - Inadequate Insulation - Electric furnace	Efficient Products	SF	Retrofit	11,926	7%	795	0.18	20	\$1,597	100%	35%	35%	ATTIC-17	26%	71%	68.6%	36.0%	36.0%	1.2
8060	Shell	Attic Insulation - Inadequate Insulation - Electric furnace	IQW	SF	Retrofit	11,926	7%	795	0.18	20	\$1,597	97%	97%	97%	ATTIC-18	26%	71%	44.0%	36.0%	36.0%	0.4
8061	Shell	Attic Insulation - Inadequate Insulation - Electric furnace	Efficient Products	MF	Retrofit	4,166	8%	325	0.12	20	\$1,022	100%	39%	39%	ATTIC-19	50%	73%	45.2%	37.4%	37.4%	0.9
8062	Shell	Attic Insulation - Inadequate Insulation - Electric furnace	IQW	MF	Retrofit	4,166	8%	325	0.12	20	\$1,022	151%	100%	100%	ATTIC-20	50%	73%	45.2%	37.4%	37.4%	0.2
8063	Shell	Attic Insulation - Poor Insulation - Electric furnace	Efficient Products	SF	Retrofit	11,926	11%	1,367	0.32	20	\$1,597	75%	35%	35%	ATTIC-21	26%	90%	63.2%	57.9%	57.9%	2.2
8064	Shell	Attic Insulation - Poor Insulation - Electric furnace	IQW	SF	Retrofit	11,926	11%	1,367	0.32	20	\$1,597	100%	97%	97%	ATTIC-22	26%	90%	63.2%	57.9%	57.9%	0.8
8065	Shell	Attic Insulation - Poor Insulation - Electric furnace	Efficient Products	MF	Retrofit	4,166	13%	526	0.21	20	\$1,022	50%	39%	39%	ATTIC-23	50%	38%	34.1%	24.6%	24.6%	1.5
8066	Shell	Attic Insulation - Poor Insulation - Electric furnace	IQW	MF	Retrofit	4,166	13%	526	0.21	20	\$1,022	151%	100%	100%	ATTIC-24	50%	38%	46.5%	46.5%	46.5%	0.4
8067	Shell	Attic Insulation - Average Insulation - Gas Heating	Efficient Products	SF	Retrofit	1,368	2%	29	0.05	20	\$898	33%	33%	33%	ATTIC-25	53%	77%	47.7%	40.2%	40.2%	0.4
8068	Shell	Attic Insulation - Average Insulation - Gas Heating	IQW	SF	Retrofit	1,368	2%	29	0.05	20	\$898	49%	49%	49%	ATTIC-26	53%	77%	47.7%	40.2%	40.2%	0.3
8069	Shell	Attic Insulation - Average Insulation - Gas Heating	Efficient Products	MF	Retrofit	530	8%	42	0.12	20	\$575	52%	52%	52%	ATTIC-27	21%	96%	80.6%	77.8%	77.8%	0.8
8070	Shell	Attic Insulation - Average Insulation - Gas Heating	IQW	MF	Retrofit	530	8%	42	0.12	20	\$575	100%	76%	76%	ATTIC-28	21%	96%	80.6%	77.8%	77.8%	0.5
8071	Shell	Attic Insulation - Inadequate Insulation - Gas Heating	Efficient Products	SF	Retrofit	1,368	4%	55	0.11	20	\$1,597	25%	25%	25%	ATTIC-29	53%	71%	44.0%	36.0%	36.0%	0.5
8072	Shell	Attic Insulation - Inadequate Insulation - Gas Heating	IQW	SF	Retrofit	1,368	4%	55	0.11	20	\$1,597	97%	97%	97%	ATTIC-30	53%	71%	44.0%	36.0%	36.0%	0.1
8073	Shell	Attic Insulation - Inadequate Insulation - Gas Heating	Efficient Products	MF	Retrofit	530	10%	51	0.15	20	\$1,022	39%	39%	39%	ATTIC-31	21%	73%	45.2%	37.4%	37.4%	0.7
8074	Shell	Attic Insulation - Inadequate Insulation - Gas Heating	IQW	MF	Retrofit	530	10%	51	0.15	20	\$1,022	151%	100%	100%	ATTIC-32	21%	73%	45.2%	37.4%	37.4%	0.2
8075	Shell	Attic Insulation - Poor Insulation - Gas Heating	Efficient Products	SF	Retrofit	1,368	8%	105	0.21	20	\$1,597	25%	25%	25%	ATTIC-33	53%	90%	63.2%	57.9%	57.9%	1.1
8076	Shell	Attic Insulation - Poor Insulation - Gas Heating	IQW	SF	Retrofit	1,368	8%	105	0.21	20	\$1,597	97%	97%	97%	ATTIC-34	53%	90%	63.2%	57.9%	57.9%	0.3
8077	Shell	Attic Insulation - Poor Insulation - Gas Heating	Efficient Products	MF	Retrofit	530	13%	67	0.20	20	\$1,022	50%	39%	39%	ATTIC-35	21%	38%	34.1%	24.6%	24.6%	1.0
8078	Shell	Attic Insulation - Poor Insulation - Gas Heating	IQW	MF	Retrofit	530	13%	67	0.20	20	\$1,022	151%	100%	100%	ATTIC-36	21%	38%	46.5%	46.5%	46.5%	0.3
8079	Shell	Duct Sealing - Average Sealing - Heat pump	Efficient Products	SF	Retrofit	6,061	6%	364	0.17	20	\$450	111%	100%	100%	DUCT-1	13%	78%	62.1%	62.1%	62.1%	0.9
8080	Shell	Duct Sealing - Average Sealing - Heat pump	IQW	SF	Retrofit	6,061	6%	364	0.17	20	\$450	100%	100%	100%	DUCT-2	13%	78%	48.5%	41.2%	41.2%	1.0
8081	Shell	Duct Sealing - Average Sealing - Heat pump	Efficient Products	MF	Retrofit	2,573	8%	212	0.13	20	\$288	174%	100%	100%	DUCT-3	13%	97%	83.0%	80.6%	80.6%	0.7
8082	Shell	Duct Sealing - Average Sealing - Heat pump	IQW	MF	Retrofit	2,573	8%	212	0.13	20	\$288	156%	100%	100%	DUCT-4	13%	97%	83.0%	80.6%	80.6%	0.7
8083	Shell	Duct Sealing - Inadequate Sealing - Heat pump	Efficient Products	SF	Retrofit	6,061	11%	649	0.30	20	\$450	111%	100%	100%	DUCT-5	13%	73%	67.5%	67.5%	67.5%	1.7
8084	Shell	Duct Sealing - Inadequate Sealing - Heat pump	IQW	SF	Retrofit	6,061	11%	649	0.30	20	\$450	100%	100%	100%	DUCT-6	13%	73%	44.8%	36.9%	36.9%	1.9
8085	Shell	Duct Sealing - Inadequate Sealing - Heat pump	Efficient Products	MF	Retrofit	2,573	16%	421	0.27	20	\$288	174%	100%	100%	DUCT-7	13%	78%	48.2%	40.8%	40.8%	1.3
8086	Shell	Duct Sealing - Inadequate Sealing - Heat pump	IQW	MF	Retrofit	2,573	16%	421	0.27	20	\$288	156%	100%	100%	DUCT-8	13%	78%	48.2%	40.8%	40.8%	1.5
8087	Shell	Duct Sealing/Insulation - Poor Sealing - Heat pump	Efficient Products	SF	Retrofit	6,061	15%	921	0.43	20	\$450	111%	100%	100%	DUCT-9	13%	90%	64.1%	59.0%	59.0%	2.4
8088	Shell	Duct Sealing/Insulation - Poor Sealing - Heat pump	IQW	SF	Retrofit	6,061	15%	921	0.43	20	\$450	100%	100%	100%	DUCT-10	13%	90%	64.1%	59.0%	59.0%	2.7
8089	Shell	Duct Sealing/Insulation - Poor Sealing - Heat pump	Efficient Products	MF	Retrofit	2,573	41%	1,043	0.70	20	\$288	174%	100%	100%	DUCT-11	13%	48%	48.7%	48.7%	48.7%	3.4
8090	Shell	Duct Sealing/Insulation - Poor Sealing - Heat pump	IQW	MF	Retrofit	2,573	41%	1,043	0.70	20	\$288	156%	100%	100%	DUCT-12	13%	48%	38.0%	38.0%	38.0%	3.8
8091	Shell	Duct Sealing - Average Sealing - Electric furnace	Efficient Products	SF	Retrofit	11,926	6%	716	0.18	20	\$450	111%	100%	100%	DUCT-13	26%	78%	62.1%	62.1%	62.1%	1.3
8092	Shell	Duct Sealing - Average Sealing - Electric furnace	IQW	SF	Retrofit	11,926	6%	716	0.18	20	\$450	100%	100%	100%	DUCT-14	26%	78%	48.5%	41.2%	41.2%	1.4
8093	Shell	Duct Sealing - Average Sealing - Electric furnace	Efficient Products	MF	Retrofit	4,166	8%	333	0.14	20	\$288	174%	100%	100%	DUCT-15	50%	97%	83.0%	80.6%	80.6%	0.8
8094	Shell	Duct Sealing - Average Sealing - Electric furnace	IQW	MF	Retrofit	4,166	8%	333	0.14	20	\$288	156%	100%	100%	DUCT-16	50%	97%	83.0%	80.6%	80.6%	0.9
8095	Shell	Duct Sealing - Inadequate Sealing - Electric furnace	Efficient Products	SF	Retrofit	11,926	11%	1,276	0.32	20	\$450	111%	100%	100%	DUCT-17	26%	73%	67.5%	67.5%	67.5%	2.3
8096	Shell	Duct Sealing - Inadequate Sealing - Electric furnace	IQW	SF	Retrofit	11,926	11%	1,276	0.32	20	\$450	100%	100%	100%	DUCT-18	26%	73%	44.8%	36.9%	36.9%	2.6
8097	Shell	Duct Sealing - Inadequate Sealing - Electric furnace	Efficient Products	MF	Retrofit	4,166	13%	561	0.24	20	\$288	174%	100%	100%	DUCT-19	50%	78%	48.2%	40.8%	40.8%	1.4
8098	Shell	Duct Sealing - Inadequate Sealing - Electric furnace	IQW	MF	Retrofit	4,166	13%	561	0.24	20	\$288	156%	100%	100%	DUCT-20	50%	78%	48.2%	40.8%	40.8%	1.5
8099	Shell	Duct Sealing/Insulation - Poor Sealing - Electric furnace	Efficient Products	SF	Retrofit	11,926	15%	1,813	0.46	20	\$450	111%	100%	100%	DUCT-21	26%	90%	64.1%	59.0%	59.0%	3.3

Appendix B: Residential Measure Assumptions

Measure #	End-Use	Measure Name	Program	Home Type	Replacement Type	Base Annual Electric	% Elec Savings	Per Unit Elec Savings	Per Unit Summer kW	EE EUL	Measure Cost	MAP Incentive (%)	RAP Incentive (%)	PP Incentive (%)	End Use Measure Group	Base Saturation	EE Saturation	MAP Adoption Rate	RAP Adoption Rate	PP Adoption Rate	UCT Score
8100	Shell	Duct Sealing/Insulation - Poor Sealing - Electric furnace	IQW	SF	Retrofit	11,926	15%	1,813	0.46	20	\$450	100%	100%	100%	DUCT-22	26%	90%	64.1%	59.0%	59.0%	3.7
8101	Shell	Duct Sealing/Insulation - Poor Sealing - Electric furnace	Efficient Products	MF	Retrofit	4,166	33%	1,394	0.63	20	\$288	174%	100%	100%	DUCT-23	50%	48%	48.7%	48.7%	48.7%	3.5
8102	Shell	Duct Sealing/Insulation - Poor Sealing - Electric furnace	IQW	MF	Retrofit	4,166	33%	1,394	0.63	20	\$288	100%	100%	100%	DUCT-24	50%	48%	38.0%	38.0%	38.0%	3.9
8103	Shell	Duct Sealing - Average Sealing - Gas Heating	Efficient Products	SF	Retrofit	1,368	5%	65	0.14	20	\$450	111%	100%	100%	DUCT-25	53%	78%	62.1%	62.1%	62.1%	0.6
8104	Shell	Duct Sealing - Average Sealing - Gas Heating	IQW	SF	Retrofit	1,368	5%	65	0.14	20	\$450	100%	100%	100%	DUCT-26	53%	78%	48.5%	41.2%	41.2%	0.6
8105	Shell	Duct Sealing - Average Sealing - Gas Heating	Efficient Products	MF	Retrofit	530	26%	136	0.44	20	\$288	174%	100%	100%	DUCT-27	21%	97%	83.0%	80.6%	80.6%	1.7
8106	Shell	Duct Sealing - Average Sealing - Gas Heating	IQW	MF	Retrofit	530	26%	136	0.44	20	\$288	100%	100%	100%	DUCT-28	21%	97%	83.0%	80.6%	80.6%	1.9
8107	Shell	Duct Sealing - Inadequate Sealing - Gas Heating	Efficient Products	SF	Retrofit	1,368	7%	91	0.20	20	\$450	111%	100%	100%	DUCT-29	53%	73%	67.5%	67.5%	67.5%	0.8
8108	Shell	Duct Sealing - Inadequate Sealing - Gas Heating	IQW	SF	Retrofit	1,368	7%	91	0.20	20	\$450	100%	100%	100%	DUCT-30	53%	73%	44.8%	36.9%	36.9%	0.9
8109	Shell	Duct Sealing - Inadequate Sealing - Gas Heating	Efficient Products	MF	Retrofit	530	20%	107	0.37	20	\$288	174%	100%	100%	DUCT-31	21%	78%	48.2%	40.8%	40.8%	1.4
8110	Shell	Duct Sealing - Inadequate Sealing - Gas Heating	IQW	MF	Retrofit	530	20%	107	0.37	20	\$288	100%	100%	100%	DUCT-32	21%	78%	48.2%	40.8%	40.8%	1.6
8111	Shell	Duct Sealing/Insulation - Poor Sealing - Gas Heating	Efficient Products	SF	Retrofit	1,368	15%	206	0.46	20	\$450	111%	100%	100%	DUCT-33	53%	90%	64.1%	59.0%	59.0%	1.8
8112	Shell	Duct Sealing/Insulation - Poor Sealing - Gas Heating	IQW	SF	Retrofit	1,368	15%	206	0.46	20	\$450	100%	100%	100%	DUCT-34	53%	90%	64.1%	59.0%	59.0%	2.0
8113	Shell	Duct Sealing/Insulation - Poor Sealing - Gas Heating	Efficient Products	MF	Retrofit	530	48%	254	0.94	20	\$288	174%	100%	100%	DUCT-35	21%	48%	48.7%	48.7%	48.7%	3.6
8114	Shell	Duct Sealing/Insulation - Poor Sealing - Gas Heating	IQW	MF	Retrofit	530	48%	254	0.94	20	\$288	100%	100%	100%	DUCT-36	21%	48%	38.0%	38.0%	38.0%	4.0
8115	Shell	Wall Insulation - Heat pump	Efficient Products	SF	Retrofit	6,061	9%	527	0.04	20	\$1,235	80%	80%	80%	WALL-1	13%	96%	80.0%	77.1%	77.1%	0.3
8116	Shell	Wall Insulation - Heat pump	IQW	SF	Retrofit	6,061	9%	527	0.04	20	\$1,235	258%	100%	100%	WALL-2	13%	96%	80.0%	77.1%	77.1%	0.1
8117	Shell	Wall Insulation - Heat pump	Efficient Products	MF	Retrofit	2,573	13%	337	0.03	20	\$790	80%	80%	80%	WALL-7	13%	96%	80.0%	77.1%	77.1%	0.3
8118	Shell	Wall Insulation - Heat pump	IQW	MF	Retrofit	2,573	13%	337	0.03	20	\$790	100%	100%	100%	WALL-8	13%	96%	80.0%	77.1%	77.1%	0.3
8119	Shell	Wall Insulation - Electric furnace	Efficient Products	SF	Retrofit	11,926	7%	859	0.04	20	\$1,235	80%	80%	80%	WALL-3	26%	96%	80.0%	77.1%	77.1%	0.5
8120	Shell	Wall Insulation - Electric furnace	IQW	SF	Retrofit	11,926	7%	859	0.04	20	\$1,235	258%	100%	100%	WALL-4	26%	96%	80.0%	77.1%	77.1%	0.1
8121	Shell	Wall Insulation - Electric furnace	Efficient Products	MF	Retrofit	4,166	13%	550	0.03	20	\$790	80%	80%	80%	WALL-9	50%	96%	80.0%	77.1%	77.1%	0.5
8122	Shell	Wall Insulation - Electric furnace	IQW	MF	Retrofit	4,166	13%	550	0.03	20	\$790	100%	100%	100%	WALL-10	50%	96%	80.0%	77.1%	77.1%	0.4
8123	Shell	Wall Insulation - Gas Heating	Efficient Products	SF	Retrofit	1,368	3%	43	0.04	20	\$1,235	80%	80%	80%	WALL-5	53%	96%	80.0%	77.1%	77.1%	0.1
8124	Shell	Wall Insulation - Gas Heating	IQW	SF	Retrofit	1,368	3%	43	0.04	20	\$1,235	258%	100%	100%	WALL-6	53%	96%	80.0%	77.1%	77.1%	0.0
8125	Shell	Wall Insulation - Gas Heating	Efficient Products	MF	Retrofit	530	5%	27	0.03	20	\$790	80%	80%	80%	WALL-11	21%	96%	80.0%	77.1%	77.1%	0.1
8126	Shell	Wall Insulation - Gas Heating	IQW	MF	Retrofit	530	5%	27	0.03	20	\$790	100%	100%	100%	WALL-12	21%	96%	80.0%	77.1%	77.1%	0.1
8127	Shell	Basement Sidewall Insulation - Heat pump	Efficient Products	SF	Retrofit	6,061	8%	515	-0.02	20	\$1,204	80%	80%	80%	BASEMENT-	13%	49%	61.5%	61.5%	61.5%	0.2
8128	Shell	Basement Sidewall Insulation - Heat pump	Efficient Products	MF	Retrofit	2,573	13%	329	-0.01	20	\$1,204	80%	80%	80%	BASEMENT-	13%	33%	44.7%	44.7%	44.7%	0.1
8129	Shell	Basement Sidewall Insulation - Electric furnace	Efficient Products	SF	Retrofit	11,926	8%	907	-0.02	20	\$1,204	80%	80%	80%	BASEMENT-	26%	49%	61.5%	61.5%	61.5%	0.4
8130	Shell	Basement Sidewall Insulation - Electric furnace	Efficient Products	MF	Retrofit	4,166	14%	580	-0.01	20	\$1,204	80%	80%	80%	BASEMENT+	50%	33%	44.7%	44.7%	44.7%	0.3
8131	Shell	Basement Sidewall Insulation - Gas Heating	Efficient Products	SF	Retrofit	1,368	-2%	-26	-0.02	20	\$1,204	80%	80%	80%	BASEMENT+	53%	49%	61.5%	61.5%	61.5%	0.0
8132	Shell	Basement Sidewall Insulation - Gas Heating	Efficient Products	MF	Retrofit	530	-3%	-16	-0.01	20	\$1,204	80%	80%	80%	BASEMENT+	21%	33%	44.7%	44.7%	44.7%	0.0
8133	Shell	Floor Insulation Above Crawlspace - Heat pump	Efficient Products	SF	Retrofit	6,061	3%	210	-0.01	20	\$1,204	80%	80%	80%	FLOOR-1	13%	12%	76.0%	76.0%	76.0%	0.1
8134	Shell	Floor Insulation Above Crawlspace - Heat pump	Efficient Products	MF	Retrofit	2,573	5%	134	-0.01	20	\$1,204	80%	80%	80%	FLOOR-2	13%	6%	59.0%	59.0%	59.0%	0.1
8135	Shell	Floor Insulation Above Crawlspace - Electric furnace	Efficient Products	SF	Retrofit	11,926	3%	355	0.00	20	\$1,204	80%	80%	80%	FLOOR-3	26%	12%	76.0%	76.0%	76.0%	0.2
8136	Shell	Floor Insulation Above Crawlspace - Electric furnace	Efficient Products	MF	Retrofit	4,166	5%	227	0.00	20	\$1,204	80%	80%	80%	FLOOR-4	50%	6%	59.0%	59.0%	59.0%	0.1
8137	Shell	Floor Insulation Above Crawlspace - Gas Heating	Efficient Products	SF	Retrofit	1,368	-2%	-21	0.00	20	\$1,204	80%	80%	80%	FLOOR-5	53%	12%	76.0%	76.0%	76.0%	0.0
8138	Shell	Floor Insulation Above Crawlspace - Gas Heating	Efficient Products	MF	Retrofit	530	-2%	-13	0.00	20	\$1,204	80%	80%	80%	FLOOR-6	21%	6%	59.0%	59.0%	59.0%	0.0
8139	Shell	Radiant Barrier - Heat pump	Efficient Products	SF	Retrofit	6,061	13%	804	0.11	25	\$720	80%	80%	80%	RB-1	13%	16%	76.4%	76.4%	76.4%	1.1
8140	Shell	Radiant Barrier - Heat pump	Efficient Products	SF	Retrofit	6,061	13%	804	0.11	25	\$720	100%	80%	80%	RB-2	13%	16%	64.3%	48.4%	48.4%	1.1
8141	Shell	Radiant Barrier - Heat pump	Efficient Products	MF	Retrofit	2,573	20%	515	0.07	25	\$720	80%	80%	80%	RB-3	13%	4%	60.6%	60.6%	60.6%	0.7
8142	Shell	Radiant Barrier - Heat pump	Efficient Products	MF	Retrofit	2,573	20%	515	0.07	25	\$720	100%	80%	80%	RB-4	13%	4%	63.5%	47.6%	47.6%	0.7
8143	Shell	Radiant Barrier - Electric furnace	Efficient Products	SF	Retrofit	11,926	7%	804	0.11	25	\$720	80%	80%	80%	RB-5	26%	16%	76.4%	76.4%	76.4%	1.1
8144	Shell	Radiant Barrier - Electric furnace	Efficient Products	SF	Retrofit	11,926	7%	804	0.11	25	\$720	100%	80%	80%	RB-6	26%	16%	64.3%	48.4%	48.4%	1.1
8145	Shell	Radiant Barrier - Electric furnace	Efficient Products	MF	Retrofit	4,166	12%	515	0.07	25	\$720	80%	80%	80%	RB-7	50%	4%	60.6%	60.6%	60.6%	0.7
8146	Shell	Radiant Barrier - Electric furnace	Efficient Products	MF	Retrofit	4,166	12%	515	0.07	25	\$720	100%	80%	80%	RB-8	50%	4%	63.5%	47.6%	47.6%	0.7
8147	Shell	ENERGY STAR Door - Heat pump	Efficient Products	SF	Retrofit	6,061	5%	319	0.02	20	\$1,275	80%	80%	80%	DOOR-1	13%	49%	61.7%	61.7%	61.7%	0.2
8148	Shell	ENERGY STAR Door - Heat pump	Efficient Products	MF	Retrofit	2,573	8%	204	0.01	20	\$1,275	80%	80%	80%	DOOR-2	13%	11%	56.8%	56.8%	56.8%	0.1
8149	Shell	ENERGY STAR Door - Electric furnace	Efficient Products	SF	Retrofit	11,926	2%	197	0.01	20	\$1,275	80%	80%	80%	DOOR-3	26%	49%	61.7%	61.7%	61.7%	0.1
8150	Shell	ENERGY STAR Door - Electric furnace	Efficient Products	MF	Retrofit	4,166	3%	126	0.01	20	\$1,275	80%	80%	80%	DOOR-4	50%	11%	56.8%	56.8%	56.8%	0.1
8151	Shell	ENERGY STAR Door - Gas Heating	Efficient Products	SF	Retrofit	1,368	2%	21	0.02	20	\$1,275	80%	80%	80%	DOOR-5	53%	49%	61.7%	61.7%	61.7%	0.0
8152	Shell	ENERGY STAR Door - Gas Heating	Efficient Products	MF	Retrofit	530	3%	14	0.01	20	\$1,275	80%	80%	80%	DOOR-6	21%	11%	56.8%	56.8%	56.8%	0.0
8153	Shell	ENERGY STAR Windows - Heat pump	Efficient Products	SF	Retrofit	6,061	5%	329	0.20	20	\$11,300	80%	80%	80%	ES WIND-1	13%	17%	74.7%	74.7%	74.7%	0.1

Appendix B: Residential Measure Assumptions

Measure #	End-Use	Measure Name	Program	Home Type	Replacement Type	Base Annual Electric	% Elec Savings	Per Unit Elec Savings	Per Unit Summer kW	EE EUL	Measure Cost	MAP Incentive (%)	RAP Incentive (%)	PP Incentive (%)	End Use Measure Group	Base Saturation	EE Saturation	MAP Adoption Rate	RAP Adoption Rate	PP Adoption Rate	UCT Score
8154	Shell	ENERGY STAR Windows - Heat pump	Efficient Products	MF	Retrofit	2,573	8%	211	0.13	20	\$7,232	80%	80%	80%	ES WIND-2	13%	17%	54.3%	54.3%	54.3%	0.1
8155	Shell	ENERGY STAR Windows - Electric furnace	Efficient Products	SF	Retrofit	11,926	4%	502	0.20	20	\$11,300	80%	80%	80%	ES WIND-3	26%	17%	74.7%	74.7%	74.7%	0.1
8156	Shell	ENERGY STAR Windows - Electric furnace	Efficient Products	MF	Retrofit	4,166	8%	322	0.13	20	\$7,232	80%	80%	80%	ES WIND-4	50%	17%	54.3%	54.3%	54.3%	0.1
8157	Shell	ENERGY STAR Windows - Gas Heating	Efficient Products	SF	Retrofit	1,368	9%	129	0.20	20	\$11,300	80%	80%	80%	ES WIND-5	53%	17%	74.7%	74.7%	74.7%	0.0
8158	Shell	ENERGY STAR Windows - Gas Heating	Efficient Products	MF	Retrofit	530	16%	83	0.13	20	\$7,232	80%	80%	80%	ES WIND-6	21%	17%	54.3%	54.3%	54.3%	0.0
8159	Shell	Smart Window Coverings - Film/Transformer - Heat pump	Efficient Products	SF	Retrofit	6,061	16%	939	0.35	7	\$6,780	80%	80%	80%	ES WIND-1	13%	18%	74.4%	74.4%	74.4%	0.1
8160	Shell	Smart Window Coverings - Film/Transformer - Heat pump	Efficient Products	MF	Retrofit	2,573	16%	399	0.23	7	\$4,339	80%	80%	80%	ES WIND-2	13%	7%	58.4%	58.4%	58.4%	0.1
8161	Shell	Smart Window Coverings - Film/Transformer - Electric furnace	Efficient Products	SF	Retrofit	11,926	16%	1,849	0.35	7	\$6,780	80%	80%	80%	ES WIND-3	26%	18%	74.4%	74.4%	74.4%	0.1
8162	Shell	Smart Window Coverings - Film/Transformer - Electric furnace	Efficient Products	MF	Retrofit	4,166	16%	646	0.23	7	\$4,339	80%	80%	80%	ES WIND-4	50%	7%	58.4%	58.4%	58.4%	0.1
8163	Shell	Smart Window Coverings - Film/Transformer - Gas Heating	Efficient Products	SF	Retrofit	1,368	16%	212	0.35	7	\$6,780	80%	80%	80%	ES WIND-5	53%	18%	74.4%	74.4%	74.4%	0.1
8164	Shell	Smart Window Coverings - Film/Transformer - Gas Heating	Efficient Products	MF	Retrofit	530	16%	82	0.23	7	\$4,339	80%	80%	80%	ES WIND-6	21%	7%	58.4%	58.4%	58.4%	0.1
8165	Shell	Thin Triple Windows - Heat pump	Efficient Products	SF	Retrofit	6,061	37%	2,247	0.67	40	\$12,964	80%	80%	80%	ES WIND-1	13%	17%	74.7%	74.7%	74.7%	0.3
8166	Shell	Thin Triple Windows - Heat pump	Efficient Products	MF	Retrofit	2,573	56%	1,439	0.43	40	\$8,297	80%	80%	80%	ES WIND-2	13%	17%	54.3%	54.3%	54.3%	0.3
8167	Shell	Thin Triple Windows - Electric furnace	Efficient Products	SF	Retrofit	11,926	18%	2,182	0.67	40	\$12,964	80%	80%	80%	ES WIND-3	26%	17%	74.7%	74.7%	74.7%	0.3
8168	Shell	Thin Triple Windows - Electric furnace	Efficient Products	MF	Retrofit	4,166	34%	1,397	0.43	40	\$8,297	80%	80%	80%	ES WIND-4	50%	17%	54.3%	54.3%	54.3%	0.3
8169	Shell	Thin Triple Windows - Gas heating	Efficient Products	SF	Retrofit	1,368	31%	425	0.67	40	\$12,964	80%	80%	80%	ES WIND-5	53%	17%	74.7%	74.7%	74.7%	0.2
8170	Shell	Thin Triple Windows - Gas heating	Efficient Products	MF	Retrofit	530	51%	272	0.43	40	\$8,297	80%	80%	80%	ES WIND-6	21%	17%	54.3%	54.3%	54.3%	0.2
9001	Water Heating	Heat Pump Water Heater-electric resistance heat	Efficient Products	SF	MO	2,942	17%	503	0.02	15	\$1,199	50%	50%	50%	HPWH-1	29%	6%	52.2%	52.2%	52.2%	0.4
9002	Water Heating	Heat Pump Water Heater-electric resistance heat	Efficient Products	SF	NC	2,942	17%	503	0.02	15	\$1,199	50%	50%	50%	HPWH-2	29%	0%	53.5%	53.5%	53.5%	0.4
9003	Water Heating	Heat Pump Water Heater-electric resistance heat	Efficient Products	MF	MO	3,045	19%	570	0.03	15	\$1,199	50%	50%	50%	HPWH-3	61%	21%	44.5%	44.5%	44.5%	0.4
9004	Water Heating	Heat Pump Water Heater-electric resistance heat	Efficient Products	MF	NC	3,045	19%	570	0.03	15	\$1,199	50%	50%	50%	HPWH-4	61%	0%	50.3%	50.3%	50.3%	0.4
9005	Water Heating	Heat Pump Water Heater-heat pump heat	Efficient Products	SF	MO	2,942	44%	1,301	0.06	15	\$1,199	50%	50%	50%	HPWH-5	5%	6%	52.2%	52.2%	52.2%	1.0
9006	Water Heating	Heat Pump Water Heater-heat pump heat	Efficient Products	SF	NC	2,942	44%	1,301	0.06	15	\$1,199	50%	50%	50%	HPWH-6	5%	0%	53.5%	53.5%	53.5%	1.0
9007	Water Heating	Heat Pump Water Heater-heat pump heat	Efficient Products	MF	MO	3,045	45%	1,368	0.06	15	\$1,199	50%	50%	50%	HPWH-7	6%	21%	44.5%	44.5%	44.5%	1.0
9008	Water Heating	Heat Pump Water Heater-heat pump heat	Efficient Products	MF	NC	3,045	45%	1,368	0.06	15	\$1,199	50%	50%	50%	HPWH-8	6%	0%	50.3%	50.3%	50.3%	1.0
9009	Water Heating	Heat Pump Water Heater-gas heat	Efficient Products	SF	MO	2,942	71%	2,080	0.10	15	\$1,199	75%	50%	50%	HPWH-9	16%	6%	67.6%	52.2%	52.2%	1.6
9010	Water Heating	Heat Pump Water Heater-gas heat	Efficient Products	SF	NC	2,942	71%	2,080	0.10	15	\$1,199	75%	50%	50%	HPWH-10	16%	0%	68.5%	53.5%	53.5%	1.6
9011	Water Heating	Heat Pump Water Heater-gas heat	Efficient Products	MF	MO	3,045	70%	2,147	0.10	15	\$1,199	75%	50%	50%	HPWH-11	13%	21%	55.7%	44.5%	44.5%	1.6
9012	Water Heating	Heat Pump Water Heater-gas heat	Efficient Products	MF	NC	3,045	70%	2,147	0.10	15	\$1,199	75%	50%	50%	HPWH-12	13%	0%	60.3%	50.3%	50.3%	1.6
9013	Water Heating	Smart Water Heater - Tank Controls and Sensors - electric resistance heat	Efficient Products	SF	MO	2,942	15%	441	0.02	13	\$120	100%	80%	80%	HPWH-1	29%	6%	77.8%	69.5%	69.5%	1.9
9014	Water Heating	Smart Water Heater - Tank Controls and Sensors - electric resistance heat	Efficient Products	SF	NC	2,942	15%	441	0.02	13	\$120	100%	80%	80%	HPWH-2	29%	0%	78.4%	70.3%	70.3%	1.9
9015	Water Heating	Smart Water Heater - Tank Controls and Sensors - electric resistance heat	Efficient Products	MF	MO	3,045	15%	457	0.02	13	\$120	100%	80%	80%	HPWH-3	61%	21%	66.2%	57.7%	57.7%	2.0
9016	Water Heating	Smart Water Heater - Tank Controls and Sensors - electric resistance heat	Efficient Products	MF	NC	3,045	15%	457	0.02	13	\$120	100%	80%	80%	HPWH-4	61%	0%	69.8%	62.1%	62.1%	2.0
9017	Water Heating	Smart Water Heater - Tank Controls and Sensors - heat pump heat	Efficient Products	SF	MO	2,942	15%	441	0.02	13	\$120	100%	80%	80%	HPWH-5	5%	6%	77.8%	69.5%	69.5%	1.9
9018	Water Heating	Smart Water Heater - Tank Controls and Sensors - heat pump heat	Efficient Products	SF	NC	2,942	15%	441	0.02	13	\$120	100%	80%	80%	HPWH-6	5%	0%	78.4%	70.3%	70.3%	1.9
9019	Water Heating	Smart Water Heater - Tank Controls and Sensors - heat pump heat	Efficient Products	MF	MO	3,045	15%	457	0.02	13	\$120	100%	80%	80%	HPWH-7	6%	21%	66.2%	57.7%	57.7%	2.0
9020	Water Heating	Smart Water Heater - Tank Controls and Sensors - heat pump heat	Efficient Products	MF	NC	3,045	15%	457	0.02	13	\$120	100%	80%	80%	HPWH-8	6%	0%	69.8%	62.1%	62.1%	2.0
9021	Water Heating	Smart Water Heater - Tank Controls and Sensors - gas heat	Efficient Products	SF	MO	2,942	15%	441	0.02	13	\$120	100%	80%	80%	HPWH-9	16%	6%	77.8%	69.5%	69.5%	1.9
9022	Water Heating	Smart Water Heater - Tank Controls and Sensors - gas heat	Efficient Products	SF	NC	2,942	15%	441	0.02	13	\$120	100%	80%	80%	HPWH-10	16%	0%	78.4%	70.3%	70.3%	1.9
9023	Water Heating	Smart Water Heater - Tank Controls and Sensors - gas heat	Efficient Products	MF	MO	3,045	15%	457	0.02	13	\$120	100%	80%	80%	HPWH-11	13%	21%	66.2%	57.7%	57.7%	2.0
9024	Water Heating	Smart Water Heater - Tank Controls and Sensors - gas heat	Efficient Products	MF	NC	3,045	15%	457	0.02	13	\$120	100%	80%	80%	HPWH-12	13%	0%	69.8%	62.1%	62.1%	2.0
9025	Water Heating	Thermostatic Restrictor Shower Valve	Efficient Products	SF	Retrofit	2,942	2%	65	0.00	10	\$30	80%	80%	80%	TRSV-1	106%	14%	65.9%	65.9%	65.9%	0.9
9026	Water Heating	Thermostatic Restrictor Shower Valve	Efficient Products	SF	NC	2,942	2%	65	0.00	10	\$30	80%	80%	80%	TRSV-2	106%	0%	70.3%	70.3%	70.3%	0.9
9027	Water Heating	Thermostatic Restrictor Shower Valve	Efficient Products	MF	Retrofit	3,045	3%	93	0.00	10	\$30	100%	80%	80%	TRSV-3	98%	5%	68.3%	60.3%	60.3%	1.3
9028	Water Heating	Thermostatic Restrictor Shower Valve	Efficient Products	MF	NC	3,045	3%	93	0.00	10	\$30	100%	80%	80%	TRSV-4	98%	0%	69.8%	62.1%	62.1%	1.3
9029	Water Heating	Water Heater Timer	Efficient Products	SF	Retrofit	2,942	5%	147	0.02	2	\$60	80%	80%	80%	WHT-1	50%	0%	70.2%	70.2%	70.2%	0.3
9030	Water Heating	Water Heater Timer	Efficient Products	SF	NC	2,942	5%	147	0.02	2	\$60	80%	80%	80%	WHT-2	50%	0%	70.3%	70.3%	70.3%	0.3
9031	Water Heating	Water Heater Timer	Efficient Products	MF	Retrofit	3,045	5%	152	0.02	2	\$60	80%	80%	80%	WHT-3	79%	1%	61.8%	61.8%	61.8%	0.3

Appendix B: Residential Measure Assumptions

Measure #	End-Use	Measure Name	Program	Home Type	Replacement Type	Base Annual Electric	% Elec Savings	Per Unit Elec Savings	Per Unit Summer kW	EE EUL	Measure Cost	MAP Incentive (%)	RAP Incentive (%)	PP Incentive (%)	End Use Measure Group	Base Saturation	EE Saturation	MAP Adoption Rate	RAP Adoption Rate	PP Adoption Rate	UCT Score
9032	Water Heating	Water Heater Timer	Efficient Products	MF	NC	3,045	5%	152	0.02	2	\$60	80%	80%	80%	WHT-4	79%	0%	62.1%	62.1%	62.1%	0.3
9033	Water Heating	Drain water Heat Recovery	Efficient Products	SF	Retrofit	2,942	14%	422	0.04	30	\$742	80%	80%	80%	DWHR-1	50%	1%	70.1%	70.1%	70.1%	0.5
9034	Water Heating	Drain water Heat Recovery	Efficient Products	SF	NC	2,942	14%	422	0.04	30	\$742	80%	80%	80%	DWHR-2	50%	0%	70.3%	70.3%	70.3%	0.5
9035	Water Heating	Drain water Heat Recovery	Efficient Products	MF	Retrofit	3,045	14%	437	0.05	30	\$742	80%	80%	80%	DWHR-3	79%	1%	61.8%	61.8%	61.8%	0.6
9036	Water Heating	Drain water Heat Recovery	Efficient Products	MF	NC	3,045	14%	437	0.05	30	\$742	80%	80%	80%	DWHR-4	79%	0%	62.1%	62.1%	62.1%	0.6
9037	Water Heating	Shower Timer	Efficient Products	SF	Retrofit	2,942	0%	13	0.00	2	\$5	80%	80%	80%	ST-1	106%	5%	68.9%	68.9%	68.9%	0.2
9038	Water Heating	Shower Timer	Efficient Products	SF	NC	2,942	0%	13	0.00	2	\$5	80%	80%	80%	ST-2	106%	0%	70.3%	70.3%	70.3%	0.5
9039	Water Heating	Shower Timer	Efficient Products	MF	Retrofit	3,045	0%	13	0.00	2	\$5	80%	80%	80%	ST-3	98%	5%	60.3%	60.3%	60.3%	0.5
9040	Water Heating	Shower Timer	Efficient Products	MF	NC	3,045	0%	13	0.00	2	\$5	80%	80%	80%	ST-4	98%	0%	62.1%	62.1%	62.1%	0.5
9041	Water Heating	Low Flow Showerhead 1.5 gpm	Efficient Products	SF	Retrofit	2,942	12%	339	0.03	10	\$5	100%	100%	100%	LFSH-1	106%	17%	75.5%	75.5%	75.5%	30.2
9042	Water Heating	Low Flow Showerhead 1.5 gpm	School Education	SF	Retrofit	2,942	5%	135	0.01	10	\$5	100%	100%	100%	LFSH-1	106%	17%	75.5%	75.5%	75.5%	12.0
9043	Water Heating	Low Flow Showerhead 1.5 gpm	Efficient Products	SF	Retrofit	2,942	12%	339	0.03	10	\$5	100%	100%	100%	LFSH-2	106%	17%	62.5%	62.5%	62.5%	30.2
9044	Water Heating	Low Flow Showerhead 1.5 gpm	School Education	SF	Retrofit	2,942	5%	135	0.01	10	\$5	100%	100%	100%	LFSH-2	106%	17%	62.5%	62.5%	62.5%	12.0
9045	Water Heating	Low Flow Showerhead 1.5 gpm	IQW	SF	Retrofit	2,942	12%	339	0.03	10	\$19	100%	100%	100%	LFSH-2	106%	17%	62.5%	62.5%	62.5%	7.3
9046	Water Heating	Low Flow Showerhead 1.5 gpm	Efficient Products	SF	NC	2,942	12%	339	0.03	10	\$5	100%	100%	100%	LFSH-3	106%	0%	78.4%	78.4%	78.4%	30.2
9047	Water Heating	Low Flow Showerhead 1.5 gpm	Efficient Products	MF	Retrofit	3,045	11%	339	0.04	10	\$5	100%	100%	100%	LFSH-4	98%	17%	64.2%	64.2%	64.2%	31.8
9048	Water Heating	Low Flow Showerhead 1.5 gpm	School Education	MF	Retrofit	3,045	4%	135	0.02	10	\$5	100%	100%	100%	LFSH-4	98%	17%	64.2%	64.2%	64.2%	12.6
9049	Water Heating	Low Flow Showerhead 1.5 gpm	Multifamily	MF	Retrofit	3,045	10%	313	0.04	10	\$19	100%	35%	35%	LFSH-4	98%	17%	64.2%	29.7%	29.7%	20.4
9050	Water Heating	Low Flow Showerhead 1.5 gpm	Efficient Products	MF	Retrofit	3,045	11%	339	0.04	10	\$5	100%	100%	100%	LFSH-5	98%	17%	65.0%	65.0%	65.0%	31.8
9051	Water Heating	Low Flow Showerhead 1.5 gpm	School Education	MF	Retrofit	3,045	4%	135	0.02	10	\$5	100%	100%	100%	LFSH-5	98%	17%	65.0%	65.0%	65.0%	12.6
9052	Water Heating	Low Flow Showerhead 1.5 gpm	Multifamily	MF	Retrofit	3,045	10%	313	0.04	10	\$19	100%	100%	100%	LFSH-5	98%	17%	65.0%	65.0%	65.0%	7.1
9053	Water Heating	Low Flow Showerhead 1.5 gpm	IQW	MF	Retrofit	3,045	11%	339	0.04	10	\$19	100%	100%	100%	LFSH-5	98%	17%	65.0%	65.0%	65.0%	7.7
9054	Water Heating	Low Flow Showerhead 1.5 gpm	Efficient Products	MF	NC	3,045	11%	339	0.04	10	\$5	100%	100%	100%	LFSH-6	98%	0%	69.8%	69.8%	69.8%	31.8
9055	Water Heating	Kitchen Faucet Aerator 1.5 gpm	Efficient Products	SF	Retrofit	2,942	6%	177	0.03	10	\$2	100%	100%	100%	KITCH-1	50%	20%	74.7%	74.7%	74.7%	45.0
9056	Water Heating	Kitchen Faucet Aerator 1.5 gpm	School Education	SF	Retrofit	2,942	3%	102	0.02	10	\$2	100%	100%	100%	KITCH-1	50%	20%	74.7%	74.7%	74.7%	26.0
9057	Water Heating	Kitchen Faucet Aerator 1.5 gpm	Efficient Products	SF	Retrofit	2,942	6%	177	0.03	10	\$2	100%	100%	100%	KITCH-2	50%	20%	61.2%	61.2%	61.2%	45.0
9058	Water Heating	Kitchen Faucet Aerator 1.5 gpm	School Education	SF	Retrofit	2,942	3%	102	0.02	10	\$2	100%	100%	100%	KITCH-2	50%	20%	61.2%	61.2%	61.2%	26.0
9059	Water Heating	Kitchen Faucet Aerator 1.5 gpm	IQW	SF	Retrofit	2,942	6%	177	0.03	10	\$2	100%	100%	100%	KITCH-2	50%	20%	61.2%	61.2%	61.2%	45.0
9060	Water Heating	Kitchen Faucet Aerator 1.5 gpm	Efficient Products	SF	NC	2,942	6%	177	0.03	10	\$2	100%	100%	100%	KITCH-3	50%	0%	78.4%	78.4%	78.4%	45.0
9061	Water Heating	Kitchen Faucet Aerator 1.5 gpm	Efficient Products	MF	Retrofit	3,045	6%	177	0.04	10	\$2	100%	100%	100%	KITCH-4	79%	6%	68.1%	68.1%	68.1%	49.0
9062	Water Heating	Kitchen Faucet Aerator 1.5 gpm	School Education	MF	Retrofit	3,045	3%	102	0.02	10	\$2	100%	100%	100%	KITCH-4	79%	6%	68.1%	68.1%	68.1%	28.3
9063	Water Heating	Kitchen Faucet Aerator 1.5 gpm	Multifamily	MF	Retrofit	3,045	4%	123	0.03	10	\$2	100%	100%	100%	KITCH-4	79%	6%	68.1%	68.1%	68.1%	34.0
9064	Water Heating	Kitchen Faucet Aerator 1.5 gpm	Efficient Products	MF	Retrofit	3,045	6%	177	0.04	10	\$2	100%	100%	100%	KITCH-5	79%	6%	68.9%	68.9%	68.9%	49.0
9065	Water Heating	Kitchen Faucet Aerator 1.5 gpm	School Education	MF	Retrofit	3,045	3%	102	0.02	10	\$2	100%	100%	100%	KITCH-5	79%	6%	68.9%	68.9%	68.9%	28.3
9066	Water Heating	Kitchen Faucet Aerator 1.5 gpm	Multifamily	MF	Retrofit	3,045	4%	123	0.03	10	\$2	100%	100%	100%	KITCH-5	79%	6%	68.9%	68.9%	68.9%	34.0
9067	Water Heating	Kitchen Faucet Aerator 1.5 gpm	IQW	MF	Retrofit	3,045	6%	177	0.04	10	\$2	100%	100%	100%	KITCH-5	79%	6%	68.9%	68.9%	68.9%	49.0
9068	Water Heating	Kitchen Faucet Aerator 1.5 gpm	Efficient Products	MF	NC	3,045	6%	177	0.04	10	\$2	100%	100%	100%	KITCH-6	79%	0%	69.8%	69.8%	69.8%	49.0
9069	Water Heating	Bathroom Aerator 1.0 gpm	Efficient Products	SF	Retrofit	2,942	1%	33	0.05	10	\$2	100%	100%	100%	BATH-1	88%	20%	74.7%	74.7%	74.7%	29.5
9070	Water Heating	Bathroom Aerator 1.0 gpm	School Education	SF	Retrofit	2,942	0%	13	0.02	10	\$2	100%	100%	100%	BATH-1	88%	20%	74.7%	74.7%	74.7%	11.8
9071	Water Heating	Bathroom Aerator 1.0 gpm	Efficient Products	SF	Retrofit	2,942	1%	33	0.05	10	\$2	100%	100%	100%	BATH-2	88%	20%	61.2%	61.2%	61.2%	29.5
9072	Water Heating	Bathroom Aerator 1.0 gpm	School Education	SF	Retrofit	2,942	0%	13	0.02	10	\$2	100%	100%	100%	BATH-2	88%	20%	61.2%	61.2%	61.2%	11.8
9073	Water Heating	Bathroom Aerator 1.0 gpm	IQW	SF	Retrofit	2,942	1%	33	0.05	10	\$2	100%	100%	100%	BATH-2	88%	20%	61.2%	61.2%	61.2%	29.5
9074	Water Heating	Bathroom Aerator 1.0 gpm	Efficient Products	SF	NC	2,942	1%	33	0.05	10	\$2	100%	100%	100%	BATH-3	88%	0%	78.4%	78.4%	78.4%	29.5
9075	Water Heating	Bathroom Aerator 1.0 gpm	Efficient Products	MF	Retrofit	3,045	1%	33	0.03	10	\$2	100%	100%	100%	BATH-4	81%	6%	68.1%	68.1%	68.1%	21.3
9076	Water Heating	Bathroom Aerator 1.0 gpm	School Education	MF	Retrofit	3,045	0%	13	0.01	10	\$2	100%	100%	100%	BATH-4	81%	6%	68.1%	68.1%	68.1%	8.5
9077	Water Heating	Bathroom Aerator 1.0 gpm	Multifamily	MF	Retrofit	3,045	1%	33	0.03	10	\$2	100%	100%	100%	BATH-4	81%	6%	68.1%	68.1%	68.1%	21.0
9078	Water Heating	Bathroom Aerator 1.0 gpm	Efficient Products	MF	Retrofit	3,045	1%	33	0.03	10	\$2	100%	100%	100%	BATH-5	81%	6%	68.9%	68.9%	68.9%	21.3
9079	Water Heating	Bathroom Aerator 1.0 gpm	School Education	MF	Retrofit	3,045	0%	13	0.01	10	\$2	100%	100%	100%	BATH-5	81%	6%	68.9%	68.9%	68.9%	8.5
9080	Water Heating	Bathroom Aerator 1.0 gpm	Multifamily	MF	Retrofit	3,045	1%	33	0.03	10	\$2	100%	100%	100%	BATH-5	81%	6%	68.9%	68.9%	68.9%	21.0
9081	Water Heating	Bathroom Aerator 1.0 gpm	IQW	MF	Retrofit	3,045	1%	33	0.03	10	\$2	100%	100%	100%	BATH-5	81%	6%	68.9%	68.9%	68.9%	21.3
9082	Water Heating	Bathroom Aerator 1.0 gpm	Efficient Products	MF	NC	3,045	1%	33	0.03	10	\$2	100%	100%	100%	BATH-6	81%	0%	69.8%	69.8%	69.8%	21.3
9083	Water Heating	Pipe Wrap	Efficient Products	SF	Retrofit	2,942	1%	42	0.00	15	\$9	100%	35%	35%	WRAP-1	50%	10%	77.2%	38.7%	38.7%	7.4
9084	Water Heating	Pipe Wrap	School Education	SF	Retrofit	2,942	1%	22	0.00	15	\$9	100%	100%	100%	WRAP-1	50%	10%	77.2%	77.2%	77.2%	1.4
9085	Water Heating	Pipe Wrap	School Education	SF	Retrofit	2,942	1%	22	0.00	15	\$9	100%	100%	100%	WRAP-2	50%	10%	65.1%	65.1%	65.1%	1.4
9086	Water Heating	Pipe Wrap	IQW	SF	Retrofit	2,942	1%	22	0.00	15	\$9	100%	100%	100%	WRAP-2	50%	10%	65.1%	65.1%	65.1%	1.4
9087	Water Heating	Pipe Wrap	Efficient Products	SF	Retrofit	2,942	1%	42	0.00	15	\$9	100%	35%	35%	WRAP-2	79%	5%	66.7%	37.3%	37.3%	7.3
9088	Water Heating	Pipe Wrap	Efficient Products	MF	Retrofit	3,045	1%	42	0.00	15	\$9	100%	35%	35%	WRAP-3	79%	5%	68.3%	37.6%	37.6%	7.3
9089	Water Heating	Pipe Wrap	School Education	MF	Retrofit	3,045	1%	22	0.00	15	\$9	100%	100%	100%	WRAP-3	79%	5%	68.3%	68.3%	68.3%	1.4
9090	Water Heating	Pipe Wrap	School Education	MF	Retrofit	3,045	1%	22	0.00	15	\$9	100%	100%	100%	WRAP-4	79%	5%	69.0%	69.0%	69.0%	1.4
9091	Water Heating	Pipe Wrap	IQW	MF	Retrofit	3,045	1%	22	0.00	15	\$9	100%	100%	100%	WRAP-4	79%	5%	69.0%	69.0%	69.0%	1.4
9092	Water Heating	Pipe Wrap	Efficient Products	MF	Retrofit	3,045	1%	42	0.00	15	\$9	100%	35%	35%	WRAP-4	79%	5%	69.0%	40.5%	40.5%	7.3
9093	Water Heating	Water Heater Temperature Setback	School Education	SF	Retrofit	2,942	3%	83	0.01	2	\$10	100%	100%	100%	WHTS-1	50%	24%	73.6%	73.6%	73.6%	0.9
9094	Water Heating	Water Heater Temperature Setback	School Education	SF	Retrofit	2,942	3%	83	0.01	2	\$10	100%	100%	100%	WHTS-2	50%	24%	59.5%	59.5%	59.5%	0.9

Appendix B: Residential Measure Assumptions

Measure #	End-Use	Measure Name	Program	Home Type	Replacement Type	Base Annual Electric	% Elec Savings	Per Unit Elec Savings	Per Unit Summer kW	EE EUL	Measure Cost	MAP Incentive (%)	RAP Incentive (%)	PP Incentive (%)	End Use Measure Group	Base Saturation	EE Saturation	MAP Adoption Rate	RAP Adoption Rate	PP Adoption Rate	UCT Score
9095	Water Heating	Water Heater Temperature Setback	IQW	SF	Retrofit	2,942	3%	83	0.01	2	\$10	100%	100%	100%	WHTS-2	50%	24%	59.5%	59.5%	59.5%	0.9
9096	Water Heating	Water Heater Temperature Setback	School Education	MF	Retrofit	3,045	3%	83	0.01	2	\$10	100%	100%	100%	WHTS-3	79%	6%	68.1%	68.1%	68.1%	0.9
9097	Water Heating	Water Heater Temperature Setback	School Education	MF	Retrofit	3,045	3%	83	0.01	2	\$10	100%	100%	100%	WHTS-4	79%	6%	68.9%	68.9%	68.9%	0.9
9098	Water Heating	Water Heater Temperature Setback	IQW	MF	Retrofit	3,045	3%	83	0.01	2	\$10	100%	100%	100%	WHTS-4	79%	6%	68.9%	68.9%	68.9%	0.9

Appendix C. C&I Sector Measure Detail

Appendix C: C&I Measure Assumptions

Measure #	End-Use	Measure Name	Program	Building Type	Replacement Type	Base (Existing) Annual Electric	Base (Standard) Annual Electric	% Elec Savings	Per Unit Elec Savings	Per Unit Summer kW	EE EUL	Measure Cost	MAP Incentive (%)	RAP Incentive (%)	PP Incentive (%)	End Use Measure Group	Base Saturation	EE Saturation	MAP Adoption Rate	RAP Adoption Rate	PP Adoption Rate	UCT Score
1	CompressedAir	Efficient Air Compressors (VSD)	Biz-Prescriptive	Assembly	ROB	1,583	1,583	21%	329	0.00	13	\$127	100%	47%	47%	1	100%	33%	83.4%	69.0%	69.0%	5.2
2	CompressedAir	Efficient Air Nozzles	Biz-Prescriptive	Assembly	ROB	1,480	1,480	50%	740	0.00	15	\$50	100%	40%	40%	2	35%	33%	83.4%	78.4%	78.4%	22.7
3	CompressedAir	AODD Pump Controls	Biz-Custom	Assembly	Retro	103,919	103,919	35%	36,372	0.00	10	\$1,150	100%	50%	50%	3	10%	33%	83.4%	81.4%	81.4%	28.9
4	CompressedAir	Compressed Air - Custom	Biz-Custom	Assembly	Retro	5	5	20%	1	0.00	10	\$0	100%	38%	38%	4	50%	33%	83.4%	69.6%	69.6%	5.7
5	CompressedAir	Retro-commissioning_Compressed Air Optimization	Biz-Custom RCx	Assembly	Retro	3	3	30%	1	0.00	5	\$0	100%	80%	80%	5	50%	33%	83.4%	78.1%	78.1%	1.5
6	Cooking	Commercial Combination Oven (Electric)	Biz-Prescriptive	Assembly	ROB	38,561	38,561	48%	18,432	0.00	12	\$16,884	50%	6%	6%	1	18%	53%	67.1%	62.4%	62.4%	10.5
7	Cooking	Commercial Electric Convection Oven	Biz-Prescriptive	Assembly	ROB	12,193	12,193	15%	1,879	0.00	12	\$1,706	50%	23%	23%	1	18%	53%	67.1%	62.4%	62.4%	2.9
8	Cooking	Commercial Electric Griddle	Biz-Prescriptive	Assembly	ROB	17,056	17,056	15%	2,596	0.00	12	\$3,604	25%	22%	22%	2	14%	17%	41.9%	33.6%	33.6%	1.4
9	Cooking	Commercial Electric Steam Cooker	Biz-Prescriptive	Assembly	ROB	19,549	19,549	67%	13,162	0.00	12	\$3,300	100%	27%	27%	3	6%	45%	79.2%	71.0%	71.0%	9.0
10	Cooking	Dishwasher Low Temp Door (Energy Star)	Biz-Prescriptive	Assembly	ROB	39,306	39,306	44%	17,369	0.00	15	\$662	100%	76%	76%	4	26%	61%	79.2%	78.5%	78.5%	16.4
11	Cooking	Dishwasher High Temp Door (Energy Star)	Biz-Prescriptive	Assembly	ROB	26,901	26,901	32%	8,586	0.00	15	\$995	100%	50%	50%	4	26%	61%	79.2%	75.0%	75.0%	8.1
12	Cooking	Energy efficient electric fryer	Biz-Prescriptive	Assembly	ROB	18,955	18,955	17%	3,274	0.00	12	\$1,500	75%	5%	5%	5	27%	24%	72.2%	45.6%	45.6%	17.0
13	Cooking	Insulated Holding Cabinets (Full Size)	Biz-Custom	Assembly	ROB	13,697	13,697	68%	9,314	0.00	12	\$1,200	100%	62%	62%	6	3%	16%	79.2%	75.7%	75.7%	5.3
14	Cooking	Insulated Holding Cabinets (Half-Size)	Biz-Custom	Assembly	ROB	4,383	4,383	60%	2,630	0.00	12	\$1,500	50%	14%	14%	6	3%	16%	58.5%	42.3%	42.3%	5.3
15	Cooling	Air Conditioner - 13 IEER (5-20 Tons)	Biz-Prescriptive	Assembly	ROB	922	922	6%	57	0.00	15	\$63	100%	79%	79%	1	20%	20%	83.4%	68.5%	68.5%	2.1
16	Cooling	Air Conditioner - 14 IEER (5-20 Tons)	Biz-Prescriptive	Assembly	ROB	922	922	13%	118	0.00	15	\$127	100%	39%	39%	1	20%	20%	83.4%	46.9%	46.9%	4.4
17	Cooling	Air Conditioner - 17 IEER (5-20 Tons)	Biz-Prescriptive	Assembly	ROB	922	922	28%	260	0.00	15	\$127	100%	39%	39%	1	20%	20%	83.4%	65.5%	65.5%	9.6
18	Cooling	Air Conditioner - 21 IEER (5-20 Tons)	Biz-Prescriptive	Assembly	ROB	922	922	42%	386	0.00	15	\$127	100%	39%	39%	1	20%	20%	83.4%	69.9%	69.9%	14.2
19	Cooling	Air Conditioner - 12.1 IEER (20+ Tons)	Biz-Prescriptive	Assembly	ROB	986	986	6%	57	0.00	15	\$50	100%	100%	100%	2	20%	20%	83.4%	83.4%	83.4%	2.1
20	Cooling	Air Conditioner - 13 IEER (20+ Tons)	Biz-Prescriptive	Assembly	ROB	986	986	12%	121	0.00	15	\$50	100%	100%	100%	2	20%	20%	83.4%	83.4%	83.4%	4.5
21	Cooling	Air Conditioner - 14.3 IEER (20+ Tons)	Biz-Prescriptive	Assembly	ROB	986	986	20%	200	0.00	15	\$50	100%	100%	100%	2	20%	20%	83.4%	83.4%	83.4%	7.4
22	Cooling	Air Conditioner - 21 IEER (20+ Tons)	Biz-Prescriptive	Assembly	ROB	986	986	46%	451	0.00	15	\$50	100%	100%	100%	2	20%	20%	83.4%	83.4%	83.4%	16.6
23	Cooling	Comprehensive Rooftop Unit Quality Maintenance (AC Tune-up)	Biz-Custom	Assembly	Retro	937	937	7%	66	0.00	3	\$5	100%	50%	50%	3	39%	50%	83.4%	80.1%	80.1%	11.8
24	Cooling	Air Side Economizer	Biz-Custom	Assembly	Retro	922	922	20%	184	0.00	10	\$84	50%	18%	18%	4	39%	20%	56.4%	44.4%	44.4%	3.8
25	Cooling	Advanced Rooftop Controls	Biz-Prescriptive	Assembly	Retro	937	937	9%	85	0.00	10	\$98	26%	26%	26%	5	39%	20%	44.0%	36.0%	36.0%	1.0
26	Cooling	HVAC Occupancy Controls	Biz-Custom	Assembly	ROB	2,900	2,900	20%	580	0.00	15	\$537	75%	9%	9%	6	39%	20%	63.2%	36.0%	36.0%	11.3
27	Cooling	Air Conditioner - 16 SEER (<5 Tons)	Biz-Prescriptive	Assembly	ROB	803	803	13%	100	0.00	15	\$50	100%	100%	100%	7	29%	20%	83.4%	83.4%	83.4%	3.7
28	Cooling	Air Conditioner - 17 SEER (<5 Tons)	Biz-Prescriptive	Assembly	ROB	803	803	18%	142	0.00	15	\$206	100%	24%	24%	7	29%	20%	83.4%	36.9%	36.9%	5.2
29	Cooling	Air Conditioner - 18 SEER(<5 Tons)	Biz-Prescriptive	Assembly	ROB	803	803	22%	178	0.00	15	\$206	100%	24%	24%	7	29%	20%	83.4%	41.9%	41.9%	6.6
30	Cooling	Air Conditioner - 21 SEER(<5 Tons)	Biz-Prescriptive	Assembly	ROB	803	803	33%	268	0.00	15	\$253	100%	20%	20%	7	29%	20%	83.4%	44.5%	44.5%	9.9
31	Cooling	Smart Thermostat	Biz-Prescriptive	Assembly	ROB	803	803	14%	114	0.00	11	\$175	50%	26%	26%	8	29%	12%	38.4%	30.9%	30.9%	2.1
32	Cooling	PTAC - <7,000 Btu/h - lodging	Biz-Prescriptive	Assembly	ROB	945	945	8%	80	0.00	8	\$84	75%	42%	42%	9	0%	20%	66.3%	47.0%	47.0%	2.4
33	Cooling	PTAC - 7,000 to 15,000 Btu/h - lodging	Biz-Prescriptive	Assembly	ROB	1,036	1,036	7%	75	0.00	8	\$84	75%	42%	42%	10	0%	20%	65.5%	46.1%	46.1%	2.3
34	Cooling	PTAC - >15,000 Btu/h - lodging	Biz-Prescriptive	Assembly	ROB	1,184	1,184	10%	113	0.00	8	\$84	100%	42%	42%	11	0%	20%	83.4%	56.7%	56.7%	3.4
35	Cooling	Air Cooled Chiller	Biz-Prescriptive	Assembly	ROB	821	821	6%	46	0.00	23	\$126	100%	40%	40%	12	32%	15%	83.4%	32.6%	32.6%	2.9
36	Cooling	Chiller Tune-up	Biz-Custom	Assembly	Retro	937	937	7%	66	0.00	3	\$5	100%	50%	50%	13	32%	50%	83.4%	80.1%	80.1%	11.8
37	Cooling	HVAC/Chiller Custom	Biz-Custom	Assembly	Retro	5	5	20%	1	0.00	20	\$1	100%	6%	6%	14	100%	20%	83.4%	36.0%	36.0%	28.4
38	Cooling	Window Film	Biz-Custom	Assembly	Retro	6,000	6,000	4%	264	0.00	10	\$154	100%	14%	14%	15	100%	20%	83.4%	47.5%	47.5%	11.9
39	Cooling	Triple Pane Windows	Biz-Custom	Assembly	ROB	6,000	6,000	6%	360	0.00	25	\$700	75%	4%	4%	15	100%	20%	48.2%	36.0%	36.0%	22.0
40	Cooling	Energy Recovery Ventilator	Biz-Custom	Assembly	Retro	986	986	34%	334	0.00	15	\$1,500	2%	2%	2%	16	100%	2%	31.4%	22.6%	22.6%	13.3
41	Heating	Heat Pump - 16 SEER (<5 Tons)	Biz-Prescriptive	Assembly	ROB	2,979	2,979	3%	96	0.00	16	\$87	100%	57%	57%	1	37%	20%	83.4%	60.0%	60.0%	1.9
42	Heating	Heat Pump - 17 SEER (<5 Tons)	Biz-Prescriptive	Assembly	ROB	2,979	2,979	8%	230	0.00	16	\$442	25%	11%	11%	1	37%	20%	44.0%	36.0%	36.0%	3.9
43	Heating	Heat Pump - 18 SEER(<5 Tons)	Biz-Prescriptive	Assembly	ROB	2,979	2,979	11%	332	0.00	16	\$507	50%	10%	10%	1	37%	20%	44.0%	36.0%	36.0%	5.5
44	Heating	Heat Pump - 21 SEER(<5 Tons)	Biz-Prescriptive	Assembly	ROB	2,979	2,979	16%	482	0.00	16	\$507	75%	10%	10%	1	37%	20%	65.3%	37.4%	37.4%	8.4
45	Heating	Geothermal HP - SEER 20.3 (<5 Tons)	Biz-Prescriptive	Assembly	ROB	2,979	2,979	22%	642	0.00	25	\$2,576	14%	14%	14%	1	37%	20%	44.0%	36.0%	36.0%	1.7
46	Heating	Geothermal HP - SEER 21.5 (<5 Tons)	Biz-Prescriptive	Assembly	ROB	2,979	2,979	26%	772	0.00	25	\$2,576	25%	14%	14%	1	37%	20%	44.0%	36.0%	36.0%	2.0
47	Heating	Geothermal HP - SEER 23.1 (<5 Tons)	Biz-Prescriptive	Assembly	ROB	2,979	2,979	31%	925	0.00	25	\$2,576	25%	14%	14%	1	37%	20%	44.0%	36.0%	36.0%	2.4
48	Heating	Geothermal HP - SEER 29.3 (<5 Tons)	Biz-Prescriptive	Assembly	ROB	2,979	2,979	46%	1,372	0.00	25	\$2,576	25%	14%	14%	1	37%	20%	44.0%	36.0%	36.0%	3.1
49	Heating	Heat Pump - 14.0 IEER COP 3.6 (65,000-134,000 Btu/hr)	Biz-Prescriptive	Assembly	ROB	3,550	3,550	10%	352	0.00	16	\$100	100%	50%	50%	2	25%	20%	83.4%	78.9%	78.9%	20.6
50	Heating	Heat Pump - 15.0 IEER COP 3.8 (65,000-134,000 Btu/hr)	Biz-Prescriptive	Assembly	ROB	3,550	3,550	15%	531	0.00	16	\$136	100%	37%	37%	2	25%	20%	83.4%	76.7%	76.7%	23.3
51	Heating	Heat Pump - 14.5 IEER COP 3.5 (135,000-239,000 Btu/hr)	Biz-Prescriptive	Assembly	ROB	3,681	3,681	12%	442	0.00	16	\$100	100%	35%	35%	2	25%	20%	83.4%	78.2%	78.2%	33.2
52	Heating	Heat Pump - 15.5 IEER COP 3.7 (135,000-239,000 Btu/hr)	Biz-Prescriptive	Assembly	ROB	3,681	3,681	17%	625	0.00	16	\$139	100%	25%	25%	2	25%	20%	83.4%	76.1%	76.1%	37.0
53	Heating	Geothermal HP - SEER 20.3 (5-20 Tons)	Biz-Prescriptive	Assembly	ROB	3,249	3,249	28%	912	0.00	25	\$2,576	25%	14%	14%	2	25%	20%	44.0%	36.0%	36.0%	3.5
54	Heating	Geothermal HP - SEER 21.5 (5-20 Tons)	Biz-Prescriptive	Assembly	ROB	3,249	3,249	32%	1,042	0.00	25	\$2,576	50%	14%	14%	2	25%	20%	44.0%	36.0%	36.0%	3.8
55	Heating	Geothermal HP - SEER 23.1 (5-20 Tons)	Biz-Prescriptive	Assembly	ROB	3,368	3,368	39%	1,314	0.00	25	\$2,576	50%	14%	14%	2	25%	20%	44.0%	36.0%	36.0%	4.3
56	Heating	Geothermal HP - SEER 29.3 (5-20 Tons)	Biz-Prescriptive	Assembly	ROB	3,368	3,368	52%	1,761	0.00	25	\$2,576	50%	14%	14%	2	25%	20%	44.0%	36.0%	36.0%	5.0
57	Heating	Variable Refrigerant Flow Heat Pump	Biz-Custom	Assembly	ROB	2,712	2,712	8%	214	0.00	16	\$224	100%	16%	16%	2	25%	2%	83.4%	46.9%	46.9%	8.9
58	Heating	Heat Pump - 12 IEER 3.4 COP (>239,000 Btu/hr)	Biz-Prescriptive	Assembly	ROB	3,776	3,776	8%	303	0.00	16	\$100	100%	35%	35%	3	25%	20%	83.4%	76.7%	76.7%	25.9
59	Heating	Heat Pump - 13 IEER 3.6 COP (>239,000 Btu/hr)	Biz-Prescriptive	Assembly	ROB	3,776	3,776	14%	516	0.00	16	\$175	100%	20%	20%	3	25%	20%	83.4%	72.5%	72.5%	30.9
60	Heating	Geothermal HP - SEER 20.3 (20+ Tons)	Biz-Prescriptive	Assembly	ROB	3,681	3,681	36%	1,344	0.00	25	\$2,576	75%	14%	14%	3	25%	20%	63.1%	36.0%	36.0%	6.6
61	Heating	Geothermal HP - SEER 21.5 (20+ Tons)	Biz-Prescriptive	Assembly	ROB	3,681	3,681	40%	1,474	0.00	25	\$2,576	75%	14%	14%	3	25%	20%	62.1%	36.0%	36.0%	6.9
62	Heating	Geothermal HP - SEER 23.1 (20+ Tons)	Biz-Prescriptive	Assembly	ROB	3,681	3,681	44%	1,627	0.00	25	\$2,576	75%	14%	14%	3	25%	20%	63.1%	36.0%	36.0%	7.

Appendix C: C&I Measure Assumptions

Measure #	End-Use	Measure Name	Program	Building Type	Replacement Type	Base (Existing) Annual Electric	Base (Standard) Annual Electric	% Elec Savings	Per Unit Elec Savings	Per Unit Summer kW	EE EUL	Measure Cost	MAP Incentive (%)	RAP Incentive (%)	PP Incentive (%)	End Use Measure Group	Base Saturation	EE Saturation	MAP Adoption Rate	RAP Adoption Rate	PP Adoption Rate	UCT Score
66	Heating	PTHP - >15,000 Btuh - Lodging	Biz-Prescriptive	Assembly	ROB	3,860	3,860	10%	367	0.00	8	\$84	100%	48%	48%	6	0%	10%	83.4%	76.9%	76.9%	8.9
67	Heating	PTHP - 7,000 to 15,000 Btuh - Lodging	Biz-Prescriptive	Assembly	ROB	3,597	3,597	5%	190	0.00	8	\$84	100%	48%	48%	7	0%	10%	83.4%	71.9%	71.9%	4.5
68	HotWater	Hot Pump Water Heater	Biz-Prescriptive	Assembly	ROB	3,027	3,027	67%	2,027	0.00	15	\$1,115	100%	49%	49%	1	100%	0%	75.5%	57.8%	57.8%	2.2
69	HotWater	Hot Water Pipe Insulation	Biz-Custom	Assembly	Retro	3,027	3,027	2%	61	0.00	20	\$60	50%	8%	8%	2	100%	80%	84.0%	84.0%	84.0%	8.3
70	HotWater	Faucet Aerator	Biz-Prescriptive	Assembly	Retro	389	389	32%	126	0.00	10	\$8	100%	100%	100%	3	20%	90%	93.0%	92.0%	92.0%	10.0
71	HotWater	Low Flow Pre-Rinse Sprayers	Biz-Custom	Assembly	ROB	18,059	18,059	54%	9,789	0.00	5	\$75	100%	100%	100%	4	20%	80%	86.0%	84.0%	84.0%	21.8
72	HotWater	ENERGY STAR Commercial Washing Machines	Biz-Prescriptive	Assembly	ROB	1,552	1,552	43%	671	0.00	7	\$250	50%	18%	18%	5	25%	32%	60.6%	45.9%	45.9%	3.6
73	InteriorLighting	LED T8 Tube Replacement	Biz-Prescriptive Light	Assembly	Retro	80	80	45%	36	0.00	15	\$3	100%	100%	100%	1	56%	38%	85.0%	85.0%	85.0%	9.7
74	InteriorLighting	LED troffer retrofit kit, 2'X2' and 2'X4'	Biz-Prescriptive Light	Assembly	Retro	181	181	50%	91	0.00	15	\$70	100%	43%	43%	1	56%	38%	85.0%	50.2%	50.2%	2.5
75	InteriorLighting	LED troffer, 2'X2' and 2'X4'	Biz-Prescriptive Light	Assembly	Retro	181	181	50%	91	0.00	15	\$70	100%	79%	79%	1	56%	38%	85.0%	72.2%	72.2%	1.3
76	InteriorLighting	Bi-Level Lighting Fixture – Stairwells, Hallways	Biz-Custom Light	Assembly	Retro	181	181	74%	135	0.00	10	\$274	29%	29%	29%	2	6%	38%	56.4%	47.4%	47.4%	0.7
77	InteriorLighting	LED high bay fixture	Biz-Prescriptive Light	Assembly	Retro	1,687	1,687	68%	1,147	0.00	15	\$330	100%	45%	45%	3	2%	19%	85.0%	72.9%	72.9%	6.2
78	InteriorLighting	LED Mogul-base HID Lamp Replacing High Bay HID	Biz-Prescriptive Light	Assembly	Retro	1,687	1,687	66%	1,119	0.00	15	\$330	100%	45%	45%	3	2%	19%	85.0%	72.6%	72.6%	6.1
79	InteriorLighting	LED low bay fixture	Biz-Prescriptive Light	Assembly	Retro	359	359	61%	218	0.00	15	\$75	100%	100%	100%	4	2%	19%	85.0%	85.0%	85.0%	2.4
80	InteriorLighting	LED Mogul-base HID Lamp Replacing Low Bay HID	Biz-Prescriptive Light	Assembly	Retro	359	359	59%	211	0.00	15	\$75	100%	100%	100%	4	2%	19%	85.0%	85.0%	85.0%	2.3
81	InteriorLighting	LED Screw-In Lamps (Directional)	Biz-Prescriptive Light	Assembly	ROB	150	150	86%	128	0.00	10	\$1	100%	100%	100%	5	4%	13%	85.0%	85.0%	85.0%	88.2
82	InteriorLighting	LED downlight fixture	Biz-Prescriptive Light	Assembly	Retro	124	124	68%	84	0.00	15	\$27	100%	37%	37%	6	31%	13%	85.0%	69.2%	69.2%	6.9
83	InteriorLighting	LED Screw-In Lamps (Omnidirectional & Decorative)	Biz-Prescriptive Light	Assembly	ROB	113	113	81%	92	0.00	10	\$1	100%	100%	100%	6	31%	13%	85.0%	85.0%	85.0%	62.9
84	InteriorLighting	Delamp Fluorescent Fixture Average Lamp Wattage 28W	Biz-Prescriptive Light	Assembly	Retro	67	67	100%	67	0.00	11	\$4	100%	25%	25%	7	56%	0%	85.0%	81.7%	81.7%	43.1
85	InteriorLighting	Occupancy Sensors	Biz-Prescriptive Light	Assembly	Retro	305	305	30%	91	0.00	10	\$65	50%	20%	20%	8	95%	10%	40.5%	29.9%	29.9%	2.7
86	InteriorLighting	Daylighting Controls	Biz-Prescriptive Light	Assembly	Retro	390	390	30%	117	0.00	10	\$58	100%	34%	34%	8	95%	10%	85.0%	65.4%	65.4%	5.2
87	InteriorLighting	Dual Occupancy & Daylighting Controls	Biz-Custom Light	Assembly	Retro	174	174	44%	77	0.00	10	\$75	50%	26%	26%	8	95%	10%	39.9%	31.2%	31.2%	2.4
88	InteriorLighting	Central Lighting Monitoring & Controls (non-networked)	Biz-Custom Light	Assembly	Retro	41,703	41,703	20%	8,341	0.00	12	\$3,700	75%	18%	18%	8	95%	10%	71.5%	37.1%	37.1%	4.2
89	InteriorLighting	Network Lighting Controls - Wireless (WiFi)	Biz-Prescriptive Light	Assembly	Retro	1	1	49%	1	0.00	15	\$1	75%	42%	42%	8	95%	10%	68.3%	40.0%	40.0%	2.3
90	InteriorLighting	Luminaire Level Lighting Controls w/ HVAC Control	Biz-Custom Light	Assembly	Retro	174	174	65%	113	0.00	15	\$90	100%	21%	21%	8	65%	10%	85.0%	34.7%	34.7%	4.9
91	InteriorLighting	LED Exit Sign - 4 Watt Fixture (2 lamp)	Biz-Prescriptive Light	Assembly	Retro	69	69	43%	29	0.00	5	\$33	31%	31%	31%	9	1%	75%	82.5%	80.0%	80.0%	0.7
92	InteriorLighting	Lighting - Custom	Biz-Custom Light	Assembly	Retro	4	4	25%	1	0.00	15	\$0	100%	50%	50%	10	100%	0%	85.0%	79.8%	79.8%	11.5
93	ExteriorLighting	LED wallpack (existing W<250)	Biz-Prescriptive Light	Assembly	Retro	856	856	66%	567	0.00	12	\$248	50%	46%	46%	1	12%	44%	60.8%	55.2%	55.2%	1.6
94	ExteriorLighting	LED parking lot fixture (existing W2<250)	Biz-Prescriptive Light	Assembly	Retro	1,589	1,589	60%	959	0.00	12	\$756	25%	20%	20%	2	11%	44%	60.8%	55.2%	55.2%	2.0
95	ExteriorLighting	LED parking lot fixture (existing W<250)	Biz-Prescriptive Light	Assembly	Retro	856	856	66%	567	0.00	12	\$248	50%	30%	30%	3	11%	44%	60.8%	55.2%	55.2%	2.4
96	ExteriorLighting	LED outdoor pole decorative fixture (existing W250)	Biz-Prescriptive Light	Assembly	Retro	1,589	1,589	60%	959	0.00	12	\$756	25%	20%	20%	4	11%	44%	60.8%	55.2%	55.2%	2.0
97	ExteriorLighting	LED parking garage fixture (existing W2<250)	Biz-Prescriptive Light	Assembly	Retro	3,235	3,235	60%	1,953	0.00	6	\$756	25%	13%	13%	5	11%	44%	60.8%	55.2%	55.2%	3.6
98	ExteriorLighting	LED parking garage fixture (existing W<250)	Biz-Prescriptive Light	Assembly	Retro	1,742	1,742	66%	1,154	0.00	6	\$248	75%	32%	32%	6	11%	44%	78.8%	67.1%	67.1%	2.7
99	ExteriorLighting	LED Mogul-base HID Lamp Replacing Exterior HID (existing W250)	Biz-Prescriptive Light	Assembly	Retro	1,589	1,589	60%	959	0.00	12	\$756	25%	20%	20%	7	11%	44%	60.8%	55.2%	55.2%	2.0
100	ExteriorLighting	LED Mogul-base HID Lamp Replacing Exterior HID (existing W<250)	Biz-Prescriptive Light	Assembly	Retro	856	856	66%	567	0.00	12	\$248	50%	30%	30%	8	11%	44%	60.8%	55.2%	55.2%	2.4
101	ExteriorLighting	Bi-Level Lighting Fixture – Garages	Biz-Prescriptive Light	Assembly	Retro	181	181	69%	125	0.00	10	\$274	29%	29%	29%	9	11%	44%	60.8%	52.7%	52.7%	0.4
102	ExteriorLighting	LED fuel pump canopy fixture (existing W<250)	Biz-Prescriptive Light	Assembly	Retro	0	0	0%	0	0.00	12	\$0	0%	0%	0%	10	0%	44%	85.0%	85.0%	85.0%	0.0
103	ExteriorLighting	LED fuel pump canopy fixture (existing W2<250)	Biz-Prescriptive Light	Assembly	Retro	0	0	0%	0	0.00	12	\$0	0%	0%	0%	11	0%	44%	85.0%	85.0%	85.0%	0.0
104	Miscellaneous	Vending Machine Controller - Non-Refrigerated	Biz-Prescriptive	Assembly	Retro	385	385	61%	237	0.00	5	\$233	17%	17%	17%	1	5%	30%	51.0%	44.0%	44.0%	1.0
105	Miscellaneous	Miscellaneous Custom	Biz-Custom	Assembly	Retro	7	7	2%	0	0.00	10	\$0	100%	50%	50%	2	45%	10%	85.0%	66.0%	66.0%	3.3
106	Miscellaneous	Kitchen Exhaust Hood Demand Ventilation Control System	Biz-Custom	Assembly	ROB	9,932	9,932	50%	4,966	0.00	20	\$1,180	100%	34%	34%	3	31%	10%	85.0%	69.9%	69.9%	8.8
107	Miscellaneous	High Efficiency Hand Dryers	Biz-Custom	Assembly	Retro	262	262	83%	217	0.00	10	\$483	25%	4%	4%	4	5%	10%	37.0%	25.1%	25.1%	10.2
108	Miscellaneous	Ozone Commercial Laundry	Biz-Custom	Assembly	Retro	2,984	2,984	25%	746	0.00	10	\$20,310	0%	0%	0%	5	0%	2%	31.4%	17.2%	17.2%	3.6
109	Miscellaneous	ENERGY STAR Uninterrupted Power Supply	Biz-Custom	Assembly	ROB	3,096	3,096	3%	85	0.00	15	\$59	75%	12%	12%	6	20%	70%	79.0%	76.0%	76.0%	8.0
110	Motors	Cogged V-Belt	Biz-Custom	Assembly	Retro	17,237	17,237	3%	534	0.00	15	\$384	75%	11%	11%	1	50%	10%	66.9%	40.6%	40.6%	8.5
111	Motors	Pump and Fan Variable Frequency Drive Controls (Pumps)	Biz-Custom	Assembly	Retro	1,902	1,902	38%	731	0.00	15	\$200	100%	30%	30%	2	100%	10%	83.4%	66.4%	66.4%	8.6
112	Motors	Power Drive Systems	Biz-Custom	Assembly	Retro	4	4	23%	1	0.00	15	\$0	100%	31%	31%	2	100%	10%	83.4%	66.3%	66.3%	8.0
113	Motors	Switch Reluctance Motors	Biz-Custom	Assembly	Retro	33,406	33,406	31%	10,222	0.00	15	\$869	100%	100%	100%	2	100%	1%	83.4%	83.4%	83.4%	5.8
114	Motors	Escalators Motor Efficiency Controllers	Biz-Custom	Assembly	Retro	7,500	7,500	20%	1,500	0.00	10	\$5,000	2%	2%	2%	3	0%	10%	37.0%	28.0%	28.0%	7.1
115	Office_NonPC	Energy Star Printer/Copier/Fax	Biz-Custom	Assembly	ROB	551	551	40%	223	0.00	6	\$0	0%	0%	0%	1	30%	90%	93.0%	92.0%	92.0%	0.0
116	Office_NonPC	Smart Power Strip – Commercial Use	Biz-Custom	Assembly	Retro	1,086	1,086	10%	109	0.00	7	\$50	25%	17%	17%	2	35%	15%	40.5%	36.1%	36.1%	2.8
117	Office_NonPC	Plug Load Occupancy Sensor	Biz-Custom	Assembly	Retro	1,126	1,126	15%	169	0.00	8	\$70	50%	19%	19%	2	35%	15%	57.7%	38.8%	38.8%	3.1
118	Office_PC	Electrically Commutated Plug Fans in data centers	Biz-Custom	Assembly	Retro	86,783	86,783	18%	15,778	0.00	15	\$480	100%	50%	50%	1	65%	20%	85.0%	83.6%	83.6%	36.6
119	Office_PC	Energy Star Server	Biz-Custom	Assembly	ROB	1,621	1,621	23%	368	0.00	8	\$118	100%	25%	25%	1	65%	25%	85.0%	59.7%	59.7%	4.4
120	Office_PC	Server Virtualization	Biz-Custom	Assembly	Retro	2	2	45%	1	0.00	8	\$0	100%	50%	50%	1	65%	25%	85.0%	75.5%	75.5%	3.1
121	Office_PC	High Efficiency CRAC unit	Biz-Custom	Assembly	ROB	541	541	30%	162	0.00	15	\$63	100%	21%	21%	2	65%	20%	85.0%	51.4%	51.4%	7.3
122	Office_PC	Computer Room Air Conditioner Economizer	Biz-Custom	Assembly	Retro	418	418	86%	358	0.00	15	\$82	100%	35%	35%	2	65%	20%	85.0%	66.6%	66.6%	4.8
123	Office_PC	Data Center Hot/Cold Aisle Configuration	Biz-Custom	Assembly	Retro	4	4	25%	1	0.00	15	\$0	100%	50%	50%	3	3%	10%	85.0%	77.4%	77.4%	7.0
124	Office_PC	Energy Star Laptop	Biz-Custom	Assembly	ROB	126	126	33%	41	0.00	4	\$0	0%	0%	0%	4	11%	85%	89.5%	88.0%	88.0%	0.0
125	Office_PC	Energy Star Monitor	Biz-Custom	Assembly	ROB	72	72	21%	15	0.00	4	\$0	0%	0%	0%	5	25%	85%	89.5%	88.0%	88.0%	0.0
126	Refrigeration	Strip Curtains	Biz-Prescriptive	Assembly	Retro	0	0	0%	0	0.00	4	\$0	0%	0%	0%	1	11%	30%	79.2%	79.2%	79.2%	0.0

Appendix C: C&I Measure Assumptions

Measure #	End-Use	Measure Name	Program	Building Type	Replacement Type	Base (Existing) Annual Electric	Base (Standard) Annual Electric	% Elec Savings	Per Unit Elec Savings	Per Unit Summer kW	EE EUL	Measure Cost	MAP Incentive (%)	RAP Incentive (%)	PP Incentive (%)	End Use Measure Group	Base Saturation	EE Saturation	MAP Adoption Rate	RAP Adoption Rate	PP Adoption Rate	UCT Score
127	Refrigeration	Bare Suction Line	Biz-Custom	Assembly	Retro	23	23	93%	21	0.00	15	\$4	100%	42%	42%	2	0%	50%	79.2%	72.6%	72.6%	7.0
128	Refrigeration	Floating Head Pressure Controls	Biz-Custom	Assembly	Retro	1,112	1,112	25%	278	0.00	15	\$431	25%	5%	5%	3	7%	25%	47.5%	39.9%	39.9%	4.9
129	Refrigeration	Saturated Suction Controls	Biz-Custom	Assembly	Retro	831	831	50%	416	0.00	15	\$559	75%	6%	6%	4	2%	10%	66.6%	28.1%	28.1%	12.8
130	Refrigeration	Compressor Retrofit	Biz-Custom	Assembly	Retro	813	813	20%	163	0.00	15	\$477	25%	3%	3%	5	25%	25%	47.5%	39.9%	39.9%	12.9
131	Refrigeration	Electronically Commutated (EC) Walk-In Evaporator Fan Motor	Biz-Prescriptive	Assembly	Retro	2,440	2,440	65%	1,586	0.00	15	\$305	100%	13%	13%	6	7%	80%	86.0%	84.0%	84.0%	22.1
132	Refrigeration	Evaporator Fan Motor Controls	Biz-Prescriptive	Assembly	Retro	1,912	1,912	25%	478	0.00	13	\$162	100%	62%	62%	7	7%	25%	79.2%	71.9%	71.9%	2.5
133	Refrigeration	Variable Speed Condenser Fan	Biz-Custom	Assembly	Retro	2,960	2,960	50%	1,480	0.00	15	\$1,170	25%	10%	10%	8	9%	25%	47.5%	40.0%	40.0%	4.9
134	Refrigeration	Refrigeration Economizer	Biz-Custom	Assembly	Retro	7	7	2%	0	0.00	10	\$0	100%	50%	50%	9	35%	10%	79.2%	69.2%	69.2%	3.3
135	Refrigeration	Anti-Sweat Heater Controls MT	Biz-Prescriptive	Assembly	Retro	579	579	59%	338	0.00	10	\$100	100%	100%	100%	10	12%	25%	79.2%	79.2%	79.2%	1.2
136	Refrigeration	Auto Door Closer, Cooler	Biz-Prescriptive	Assembly	Retro	471,500	471,500	0%	943	0.00	8	\$157	100%	70%	70%	11	9%	50%	79.2%	75.9%	75.9%	3.3
137	Refrigeration	Display Case Door Retrofit, Medium Temp	Biz-Custom	Assembly	Retro	1,584	1,584	36%	578	0.00	12	\$686	25%	7%	7%	11	3%	25%	47.5%	40.0%	40.0%	6.7
138	Refrigeration	Electronically Commutated (EC) Reach-In Evaporator Fan Motor	Biz-Prescriptive	Assembly	Retro	2,440	2,440	65%	1,586	0.00	15	\$305	100%	13%	13%	12	2%	80%	86.0%	84.0%	84.0%	22.1
139	Refrigeration	Q-Sync Motor for Walk-In and Reach-In Evaporator Fan Motor	Biz-Custom	Assembly	Retro	1,911	1,911	26%	504	0.00	10	\$96	100%	42%	42%	12	2%	2%	79.2%	72.7%	72.7%	5.2
140	Refrigeration	Energy Star Reach-In Refrigerator, Glass Doors	Biz-Prescriptive	Assembly	ROB	2,140	2,140	29%	629	0.00	12	\$1,239	6%	6%	6%	13	12%	54%	67.8%	63.2%	63.2%	4.2
141	Refrigeration	Energy Star Reach-In Refrigerator, Solid Doors	Biz-Prescriptive	Assembly	ROB	1,410	1,410	20%	281	0.00	12	\$1,211	6%	6%	6%	14	12%	54%	67.8%	63.2%	63.2%	1.8
142	Refrigeration	Anti-Sweat Heater Controls LT	Biz-Prescriptive	Assembly	ROB	2,016	2,016	68%	1,361	0.00	10	\$100	100%	100%	100%	15	4%	25%	79.2%	79.2%	79.2%	4.7
143	Refrigeration	Auto Door Closer, Freezer	Biz-Prescriptive	Assembly	Retro	419,455	419,455	1%	2,307	0.00	8	\$157	100%	70%	70%	16	4%	50%	79.2%	77.8%	77.8%	7.8
144	Refrigeration	Display Case Door Retrofit, Low Temp	Biz-Custom	Assembly	ROB	2,922	2,922	50%	1,453	0.00	12	\$686	100%	17%	17%	16	4%	25%	79.2%	50.9%	50.9%	6.7
145	Refrigeration	Energy Star Reach-In Freezer, Glass Doors	Biz-Prescriptive	Assembly	ROB	6,374	6,374	20%	1,275	0.00	12	\$1,651	28%	28%	28%	17	4%	54%	67.8%	63.2%	63.2%	1.3
146	Refrigeration	Energy Star Reach-In Freezer, Solid Doors	Biz-Prescriptive	Assembly	ROB	4,522	4,522	7%	305	0.00	12	\$1,521	13%	13%	13%	18	4%	54%	67.8%	63.2%	63.2%	0.7
147	Refrigeration	Refrigeration - Custom	Biz-Custom	Assembly	ROB	7	7	2%	0	0.00	10	\$0	100%	50%	50%	19	90%	25%	79.2%	69.2%	69.2%	3.3
148	Refrigeration	Retro-commissioning_Refrigerator Optimization	Biz-Custom RCx	Assembly	Retro	3	3	30%	1	0.00	5	\$0	100%	80%	80%	20	90%	25%	79.2%	76.5%	76.5%	1.5
149	Refrigeration	Energy Star Ice Machine	Biz-Prescriptive	Assembly	ROB	6,993	6,993	10%	721	0.00	15	\$1,426	25%	18%	18%	21	4%	44%	60.8%	55.1%	55.1%	1.5
150	Refrigeration	Vending Machine Controller - Refrigerated	Biz-Prescriptive	Assembly	Retro	1,586	1,586	34%	537	0.00	5	\$245	25%	16%	16%	22	2%	30%	51.0%	45.6%	45.6%	2.3
151	Refrigeration	LED Refrigerated Display Case Lighting Average 6W/LF	Biz-Prescriptive	Assembly	Retro	273	273	89%	243	0.00	9	\$11	100%	45%	45%	23	7%	66%	79.2%	77.7%	77.7%	24.1
152	Refrigeration	LED Refrigerated Display Case Lighting Controls	Biz-Prescriptive	Assembly	Retro	522	522	27%	141	0.00	10	\$14	100%	30%	30%	24	7%	13%	79.2%	75.2%	75.2%	18.9
153	Ventilation	Demand Controlled Ventilation	Biz-Custom	Assembly	Retro	1,698	1,698	20%	340	0.00	15	\$227	100%	12%	12%	1	100%	17%	83.4%	42.5%	42.5%	8.7
154	Ventilation	Pump and Fan Variable Frequency Drive Controls (Fans)	Biz-Prescriptive	Assembly	Retro	1,902	1,902	38%	731	0.00	15	\$200	100%	29%	29%	2	100%	17%	83.4%	66.3%	66.3%	8.8
155	WholeBldg_HVAC	HVAC - Energy Management System	Biz-Custom RCx	Assembly	Retro	7	7	15%	1	0.00	15	\$0	100%	50%	50%	1	100%	20%	83.4%	73.0%	73.0%	7.5
156	WholeBldg_HVAC	Guest room energy management system	Biz-Prescriptive	Assembly	Retro	0	0	0%	0	0.00	15	\$260	0%	77%	77%	2	100%	20%	83.4%	83.4%	83.4%	0.0
157	WholeBldg_HVAC	Retro-commissioning_Bld Optimization	Biz-Custom RCx	Assembly	Retro	7	7	15%	1	0.00	15	\$0	100%	50%	50%	3	100%	0%	83.4%	73.0%	73.0%	7.5
158	WholeBuilding	WholeBldg - Com RET	Biz-Custom	Assembly	Retro	7	7	15%	1	0.00	12	\$0	100%	50%	50%	1	100%	0%	83.4%	73.0%	73.0%	6.4
159	WholeBuilding	WholeBldg - Custom (Other)	Biz-Custom	Assembly	Retro	5	5	20%	1	0.00	12	\$0	100%	50%	50%	2	100%	0%	83.4%	73.0%	73.0%	6.4
160	WholeBuilding	Power Distribution Equipment Upgrades (Transformers)	Biz-Custom	Assembly	Retro	1,150	1,150	1%	6	0.00	30	\$8	75%	4%	4%	3	100%	20%	59.6%	36.0%	36.0%	21.2
161	WholeBldg_NC	WholeBldg - Com NC	Biz-Custom	Assembly	NC	4	4	25%	1	0.00	12	\$0	100%	50%	50%	1	100%	60%	83.4%	72.1%	72.1%	5.7
162	Behavioral	COM Competitions	Biz-Custom	Assembly	Retro	53	53	2%	1	0.00	2	\$0	100%	48%	48%	1	100%	0%	90.0%	90.0%	90.0%	3.7
163	Behavioral	Business Energy Reports	Biz-Custom	Assembly	Retro	0	0	0%	0	0.00	2	\$0	0%	100%	100%	1	100%	0%	90.0%	90.0%	90.0%	0.0
164	Behavioral	Building Benchmarking	Biz-Custom	Assembly	Retro	0	0	0%	0	0.00	2	\$0	0%	77%	77%	1	100%	0%	90.0%	90.0%	90.0%	0.0
165	Behavioral	Strategic Energy Management	Biz-Custom SEM	Assembly	Retro	0	0	0%	0	0.00	2	\$0	0%	7%	7%	1	100%	0%	90.0%	90.0%	90.0%	0.0
166	Behavioral	BEIMS	Biz-Custom	Assembly	Retro	20	20	5%	1	0.00	2	\$0	39%	39%	39%	1	100%	2%	90.0%	90.0%	90.0%	0.4
167	Behavioral	Building Operator Certification	Biz-Custom	Assembly	Retro	10	10	3%	0	0.00	3	\$0	23%	23%	23%	1	100%	2%	90.0%	90.0%	90.0%	0.9
168	CompressedAir	Efficient Air Compressors (VSD)	Biz-Prescriptive	Education	ROB	1,583	1,583	21%	329	0.00	13	\$127	100%	47%	47%	1	100%	33%	83.4%	69.0%	69.0%	5.2
169	CompressedAir	Efficient Air Nozzles	Biz-Prescriptive	Education	ROB	1,480	1,480	50%	740	0.00	15	\$50	100%	40%	40%	2	35%	33%	83.4%	78.4%	78.4%	22.7
170	CompressedAir	AODD Pump Controls	Biz-Custom	Education	Retro	103,919	103,919	35%	36,372	0.00	10	\$1,150	100%	50%	50%	3	10%	33%	83.4%	81.4%	81.4%	28.9
171	CompressedAir	Compressed Air - Custom	Biz-Custom	Education	Retro	5	5	20%	1	0.00	10	\$0	100%	38%	38%	4	50%	33%	83.4%	69.6%	69.6%	5.7
172	CompressedAir	Retro-commissioning_Compressed Air Optimization	Biz-Custom RCx	Education	Retro	3	3	30%	1	0.00	5	\$0	100%	80%	80%	5	50%	33%	83.4%	78.1%	78.1%	1.5
173	Cooking	Commercial Combination Oven (Electric)	Biz-Prescriptive	Education	ROB	38,561	38,561	48%	18,432	0.00	12	\$16,884	50%	6%	6%	1	18%	53%	67.1%	62.4%	62.4%	10.9
174	Cooking	Commercial Electric Convection Oven	Biz-Prescriptive	Education	ROB	12,193	12,193	15%	1,879	0.00	12	\$1,706	50%	23%	23%	1	18%	53%	67.1%	62.4%	62.4%	3.0
175	Cooking	Commercial Electric Griddle	Biz-Prescriptive	Education	ROB	17,056	17,056	15%	2,596	0.00	12	\$3,604	25%	22%	22%	2	14%	17%	41.9%	33.6%	33.6%	1.5
176	Cooking	Commercial Electric Steam Cooker	Biz-Prescriptive	Education	ROB	19,549	19,549	67%	13,162	0.00	12	\$3,300	100%	27%	27%	3	6%	45%	79.2%	71.0%	71.0%	9.3
177	Cooking	Dishwasher Low Temp Door (Energy Star)	Biz-Prescriptive	Education	ROB	39,306	39,306	44%	17,369	0.00	15	\$662	100%	76%	76%	4	26%	61%	79.2%	78.5%	78.5%	17.3
178	Cooking	Dishwasher High Temp Door (Energy Star)	Biz-Prescriptive	Education	ROB	26,901	26,901	32%	8,586	0.00	15	\$995	100%	50%	50%	4	26%	61%	79.2%	75.0%	75.0%	8.6
179	Cooking	Energy efficient electric fryer	Biz-Prescriptive	Education	ROB	18,955	18,955	17%	3,274	0.00	12	\$1,500	75%	5%	5%	5	27%	24%	72.2%	45.6%	45.6%	17.9
180	Cooking	Insulated Holding Cabinets (Full Size)	Biz-Custom	Education	ROB	13,697	13,697	68%	9,314	0.00	12	\$1,200	100%	62%	62%	6	3%	16%	79.2%	75.7%	75.7%	5.5
181	Cooking	Insulated Holding Cabinets (Half-Size)	Biz-Custom	Education	ROB	4,383	4,383	60%	2,630	0.00	12	\$1,500	75%	14%	14%	6	3%	16%	71.0%	42.3%	42.3%	5.5
182	Cooling	Air Conditioner - 13 IEER (5-20 Tons)	Biz-Prescriptive	Education	ROB	899	899	6%	55	0.00	15	\$63	100%	79%	79%	1	24%	20%	83.4%	68.7%	68.7%	2.0
183	Cooling	Air Conditioner - 14 IEER (5-20 Tons)	Biz-Prescriptive	Education	ROB	899	899	13%	116	0.00	15	\$127	100%	39%	39%	1	24%	20%	83.4%	47.2%	47.2%	4.3
184	Cooling	Air Conditioner - 17 IEER (5-20 Tons)	Biz-Prescriptive	Education	ROB	899	899	28%	254	0.00	15	\$127	100%	39%	39%	1	24%	20%	83.4%	65.7%	65.7%	9.4
185	Cooling	Air Conditioner - 21 IEER (5-20 Tons)	Biz-Prescriptive	Education	ROB	899	899	42%	377	0.00	15	\$127	100%	39%	39%	1	24%	20%	83.4%	70.1%	70.1%	13.9
186	Cooling	Air Conditioner - 12.1 IEER (20+ Tons)	Biz-Prescriptive	Education	ROB	962	962	6%	56	0.00	15	\$50	100%	100%	100%	2	24%	20%	83.4%	83.4%	83.4%	2.1
187	Cooling	Air Conditioner - 13 IEER (20+ Tons)	Biz-Prescriptive	Education	ROB	962	962	12%	118	0.00	15	\$50	100%	100%	100%	2	24%	20%	83.4%	83.4%	83.4%	4.4
188	Cooling	Air Conditioner - 14.3 IEER (20+ Tons)	Biz-Prescriptive	Education	ROB	962	962	20%	195	0.00	15	\$50	100%	100%	100%	2	24%	20%	83.4%	83.4%	83.4%	7.2
189	Cooling	Air Conditioner - 21 IEER (20+ Tons)	Biz-Prescriptive	Education	ROB	962	962	46%	440	0.00	15	\$50	100%	100%	100%	2	24%	20%	83.4%	83.4%	83.4%	16.3
190	Cooling	Comprehensive Rooftop Unit Quality Maintenance (AC Tune-up)	Biz-Custom	Education	Retro	914	914	7%	64	0.00	3	\$5	100%	50%	50%	3	49%	50%	83.4%	80.1%	80.1%	11.4

Appendix C: C&I Measure Assumptions

Measure #	End-Use	Measure Name	Program	Building Type	Replacement Type	Base (Existing) Annual Electric	Base (Standard) Annual Electric	% Elec Savings	Per Unit Elec Savings	Per Unit Summer kW	EE EUL	Measure Cost	MAP Incentive (%)	RAP Incentive (%)	PP Incentive (%)	End Use Measure Group	Base Saturation	EE Saturation	MAP Adoption Rate	RAP Adoption Rate	PP Adoption Rate	UCT Score
191	Cooling	Air Side Economizer	Biz-Custom	Education	Retro	899	899	20%	180	0.00	10	\$84	50%	17%	17%	4	49%	20%	55.7%	43.8%	43.8%	3.4
192	Cooling	Advanced Rooftop Controls	Biz-Prescriptive	Education	ROB	914	914	12%	107	0.00	10	\$98	26%	26%	26%	5	49%	20%	44.0%	36.0%	36.0%	1.2
193	Cooling	HVAC Occupancy Controls	Biz-Custom	Education	ROB	1,113	1,113	20%	223	0.00	15	\$537	3%	3%	3%	6	49%	20%	44.0%	36.0%	36.0%	4.6
194	Cooling	Air Conditioner - 16 SEER (<5 Tons)	Biz-Prescriptive	Education	ROB	783	783	13%	98	0.00	15	\$50	100%	100%	100%	7	3%	20%	83.4%	83.4%	83.4%	3.6
195	Cooling	Air Conditioner - 17 SEER (<5 Tons)	Biz-Prescriptive	Education	ROB	783	783	18%	138	0.00	15	\$206	100%	24%	24%	7	3%	20%	83.4%	37.4%	37.4%	5.1
196	Cooling	Air Conditioner - 18 SEER (<5 Tons)	Biz-Prescriptive	Education	ROB	783	783	22%	174	0.00	15	\$206	100%	24%	24%	7	3%	20%	83.4%	42.3%	42.3%	6.4
197	Cooling	Air Conditioner - 21 SEER (<5 Tons)	Biz-Prescriptive	Education	ROB	783	783	33%	261	0.00	15	\$253	100%	20%	20%	7	3%	20%	83.4%	44.8%	44.8%	9.7
198	Cooling	Smart Thermostat	Biz-Prescriptive	Education	ROB	783	783	14%	111	0.00	11	\$175	50%	26%	26%	8	3%	12%	38.4%	30.9%	30.9%	2.1
199	Cooling	PTAC - <7,000 Btuh - lodging	Biz-Prescriptive	Education	ROB	921	921	8%	78	0.00	8	\$84	75%	42%	42%	9	0%	20%	66.5%	47.2%	47.2%	2.3
200	Cooling	PTAC - 7,000 to 15,000 Btuh - lodging	Biz-Prescriptive	Education	ROB	1,011	1,011	7%	73	0.00	8	\$84	75%	42%	42%	10	0%	20%	65.7%	46.3%	46.3%	2.2
201	Cooling	PTAC - >15,000 Btuh - lodging	Biz-Prescriptive	Education	ROB	1,154	1,154	10%	110	0.00	8	\$84	100%	42%	42%	11	0%	20%	83.4%	57.2%	57.2%	3.3
202	Cooling	Air Cooled Chiller	Biz-Prescriptive	Education	ROB	800	800	6%	45	0.00	23	\$126	100%	40%	40%	12	49%	15%	83.4%	32.9%	32.9%	2.8
203	Cooling	Chiller Tune-up	Biz-Custom	Education	Retro	914	914	7%	64	0.00	3	\$5	100%	50%	50%	13	49%	50%	83.4%	80.1%	80.1%	11.4
204	Cooling	HVAC/Chiller Custom	Biz-Custom	Education	Retro	5	5	20%	1	0.00	20	\$1	100%	6%	6%	14	100%	20%	83.4%	36.0%	36.0%	28.0
205	Cooling	Window Film	Biz-Custom	Education	Retro	6,000	6,000	4%	264	0.00	10	\$154	100%	14%	14%	15	100%	20%	83.4%	47.8%	47.8%	11.6
206	Cooling	Triple Pane Windows	Biz-Custom	Education	ROB	6,000	6,000	6%	360	0.00	25	\$700	75%	4%	4%	15	100%	20%	49.0%	36.0%	36.0%	21.5
207	Cooling	Energy Recovery Ventilator	Biz-Custom	Education	Retro	962	962	15%	148	0.00	15	\$1,500	1%	1%	1%	16	100%	2%	31.4%	22.6%	22.6%	23.4
208	Heating	Heat Pump - 16 SEER (<5 Tons)	Biz-Prescriptive	Education	ROB	2,638	2,638	3%	88	0.00	16	\$87	100%	57%	57%	1	4%	20%	83.4%	58.0%	58.0%	1.8
209	Heating	Heat Pump - 17 SEER (<5 Tons)	Biz-Prescriptive	Education	ROB	2,638	2,638	8%	208	0.00	16	\$442	25%	11%	11%	1	4%	20%	44.0%	36.0%	36.0%	3.7
210	Heating	Heat Pump - 18 SEER (<5 Tons)	Biz-Prescriptive	Education	ROB	2,638	2,638	11%	299	0.00	16	\$507	50%	10%	10%	1	4%	20%	44.0%	36.0%	36.0%	5.2
211	Heating	Heat Pump - 21 SEER (<5 Tons)	Biz-Prescriptive	Education	ROB	2,638	2,638	17%	438	0.00	16	\$507	75%	10%	10%	1	4%	20%	64.0%	36.0%	36.0%	8.0
212	Heating	Geothermal HP - SEER 20.3 (<5 Tons)	Biz-Prescriptive	Education	ROB	2,638	2,638	22%	572	0.00	25	\$2,576	14%	14%	14%	1	4%	20%	44.0%	36.0%	36.0%	1.6
213	Heating	Geothermal HP - SEER 21.5 (<5 Tons)	Biz-Prescriptive	Education	ROB	2,638	2,638	26%	688	0.00	25	\$2,576	25%	14%	14%	1	4%	20%	44.0%	36.0%	36.0%	1.9
214	Heating	Geothermal HP - SEER 23.1 (<5 Tons)	Biz-Prescriptive	Education	ROB	2,638	2,638	31%	823	0.00	25	\$2,576	25%	14%	14%	1	4%	20%	44.0%	36.0%	36.0%	2.2
215	Heating	Geothermal HP - SEER 29.3 (<5 Tons)	Biz-Prescriptive	Education	ROB	2,638	2,638	46%	1,218	0.00	25	\$2,576	25%	14%	14%	1	4%	20%	44.0%	36.0%	36.0%	2.9
216	Heating	Heat Pump - 14.0 IEER COP 3.6 (65,000-134,000 Btu/hr)	Biz-Prescriptive	Education	ROB	3,149	3,149	10%	317	0.00	16	\$100	100%	50%	50%	2	41%	20%	83.4%	78.5%	78.5%	20.3
217	Heating	Heat Pump - 15.0 IEER COP 3.8 (65,000-134,000 Btu/hr)	Biz-Prescriptive	Education	ROB	3,149	3,149	15%	477	0.00	16	\$136	100%	37%	37%	2	41%	20%	83.4%	76.2%	76.2%	22.9
218	Heating	Heat Pump - 14.5 IEER COP 3.5 (135,000-239,000 Btu/hr)	Biz-Prescriptive	Education	ROB	3,267	3,267	12%	403	0.00	16	\$100	100%	35%	35%	2	41%	20%	83.4%	77.8%	77.8%	32.7
219	Heating	Heat Pump - 15.5 IEER COP 3.7 (135,000-239,000 Btu/hr)	Biz-Prescriptive	Education	ROB	3,267	3,267	17%	566	0.00	16	\$139	100%	25%	25%	2	41%	20%	83.4%	75.6%	75.6%	36.3
220	Heating	Geothermal HP - SEER 20.3 (5-20 Tons)	Biz-Prescriptive	Education	ROB	2,881	2,881	28%	815	0.00	25	\$2,576	25%	14%	14%	2	41%	20%	44.0%	36.0%	36.0%	3.3
221	Heating	Geothermal HP - SEER 21.5 (5-20 Tons)	Biz-Prescriptive	Education	ROB	2,881	2,881	32%	930	0.00	25	\$2,576	25%	14%	14%	2	41%	20%	44.0%	36.0%	36.0%	3.6
222	Heating	Geothermal HP - SEER 23.1 (5-20 Tons)	Biz-Prescriptive	Education	ROB	2,996	2,996	39%	1,181	0.00	25	\$2,576	50%	14%	14%	2	41%	20%	44.0%	36.0%	36.0%	4.1
223	Heating	Geothermal HP - SEER 29.3 (5-20 Tons)	Biz-Prescriptive	Education	ROB	2,996	2,996	53%	1,576	0.00	25	\$2,576	50%	14%	14%	2	41%	20%	44.0%	36.0%	36.0%	4.8
224	Heating	Variable Refrigerant Flow Heat Pump	Biz-Custom	Education	ROB	2,409	2,409	9%	209	0.00	16	\$224	100%	16%	16%	2	41%	2%	83.4%	46.1%	46.1%	8.8
225	Heating	Heat Pump - 12 IEER 3.4 COP (>239,000 Btu/hr)	Biz-Prescriptive	Education	ROB	3,359	3,359	8%	276	0.00	16	\$100	100%	35%	35%	3	41%	20%	83.4%	76.2%	76.2%	25.6
226	Heating	Heat Pump - 13 IEER 3.6 COP (>239,000 Btu/hr)	Biz-Prescriptive	Education	ROB	3,359	3,359	14%	467	0.00	16	\$175	100%	20%	20%	3	41%	20%	83.4%	71.9%	71.9%	30.4
227	Heating	Geothermal HP - SEER 20.3 (20+ Tons)	Biz-Prescriptive	Education	ROB	3,267	3,267	37%	1,201	0.00	25	\$2,576	75%	14%	14%	3	41%	20%	58.9%	36.0%	36.0%	6.4
228	Heating	Geothermal HP - SEER 21.5 (20+ Tons)	Biz-Prescriptive	Education	ROB	3,267	3,267	40%	1,316	0.00	25	\$2,576	75%	14%	14%	3	41%	20%	60.1%	36.0%	36.0%	6.7
229	Heating	Geothermal HP - SEER 23.1 (20+ Tons)	Biz-Prescriptive	Education	ROB	3,267	3,267	44%	1,451	0.00	25	\$2,576	75%	14%	14%	3	41%	20%	61.4%	36.0%	36.0%	7.0
230	Heating	Geothermal HP - SEER 29.3 (20+ Tons)	Biz-Prescriptive	Education	ROB	3,267	3,267	57%	1,846	0.00	25	\$2,576	100%	14%	14%	3	41%	20%	83.4%	36.0%	36.0%	7.7
231	Heating	Mini Split Ductless Heat Pump Cold Climate (Tiers & sizes TBD)	Biz-Prescriptive	Education	ROB	2,638	2,638	17%	438	0.00	16	\$224	100%	16%	16%	4	13%	20%	83.4%	55.1%	55.1%	11.5
232	Heating	PTHP - <7,000 Btuh - lodging	Biz-Custom	Education	ROB	2,939	2,939	3%	75	0.00	8	\$84	75%	48%	48%	5	0%	10%	69.9%	59.3%	59.3%	1.8
233	Heating	PTHP - >15,000 Btuh - lodging	Biz-Prescriptive	Education	ROB	3,432	3,432	10%	358	0.00	8	\$84	100%	48%	48%	6	0%	10%	83.4%	76.5%	76.5%	8.8
234	Heating	PTHP - 7,000 to 15,000 Btuh - lodging	Biz-Prescriptive	Education	ROB	3,185	3,185	6%	186	0.00	8	\$84	100%	48%	48%	7	0%	10%	83.4%	71.4%	71.4%	4.5
235	HotWater	Heat Pump Water Heater	Biz-Prescriptive	Education	ROB	5,042	5,042	67%	3,377	0.00	15	\$1,115	100%	49%	49%	1	100%	9%	75.5%	68.0%	68.0%	3.6
236	HotWater	Hot Water Pipe Insulation	Biz-Custom	Education	Retro	5,042	5,042	2%	101	0.00	20	\$60	100%	13%	13%	2	100%	80%	86.0%	84.0%	84.0%	8.2
237	HotWater	Faucet Aerator	Biz-Prescriptive	Education	Retro	467	467	32%	151	0.00	10	\$8	100%	100%	100%	3	20%	90%	93.0%	92.0%	92.0%	12.8
238	HotWater	Low Flow Pre-Rinse Sprayers	Biz-Custom	Education	ROB	18,059	18,059	54%	9,789	0.00	5	\$75	100%	100%	100%	4	20%	80%	86.0%	84.0%	84.0%	21.1
239	HotWater	ENERGY STAR Commercial Washing Machines	Biz-Prescriptive	Education	ROB	1,552	1,552	43%	671	0.00	7	\$250	50%	18%	18%	5	25%	32%	61.4%	47.9%	47.9%	3.5
240	InteriorLighting	LED T8 Tube Replacement	Biz-Prescriptive Light	Education	Retro	116	116	45%	52	0.00	15	\$3	100%	100%	100%	1	77%	38%	85.0%	85.0%	85.0%	13.9
241	InteriorLighting	LED troffer retrofit kit, 2'X2' and 2'X4'	Biz-Prescriptive Light	Education	Retro	262	262	50%	131	0.00	15	\$70	100%	43%	43%	1	77%	38%	85.0%	59.8%	59.8%	3.5
242	InteriorLighting	LED troffer, 2'X2' and 2'X4'	Biz-Prescriptive Light	Education	Retro	262	262	50%	131	0.00	15	\$70	100%	79%	79%	1	77%	38%	85.0%	76.3%	76.3%	1.9
243	InteriorLighting	Bi-Level Lighting Fixture - Stairwells, Hallways	Biz-Custom Light	Education	Retro	262	262	74%	195	0.00	10	\$274	29%	29%	29%	2	9%	38%	56.4%	50.0%	50.0%	0.9
244	InteriorLighting	LED high bay fixture	Biz-Prescriptive Light	Education	Retro	2,440	2,440	68%	1,660	0.00	15	\$330	100%	45%	45%	3	1%	19%	85.0%	76.8%	76.8%	8.9
245	InteriorLighting	LED Mogul-base HID Lamp Replacing High Bay HID	Biz-Prescriptive Light	Education	Retro	2,440	2,440	66%	1,619	0.00	15	\$330	100%	45%	45%	3	1%	19%	85.0%	76.6%	76.6%	8.7
246	InteriorLighting	LED low bay fixture	Biz-Prescriptive Light	Education	Retro	520	520	61%	316	0.00	15	\$75	100%	100%	100%	4	1%	19%	85.0%	85.0%	85.0%	3.4
247	InteriorLighting	LED Mogul-base HID Lamp Replacing Low Bay HID	Biz-Prescriptive Light	Education	Retro	520	520	59%	305	0.00	15	\$75	100%	100%	100%	4	1%	19%	85.0%	85.0%	85.0%	3.3
248	InteriorLighting	LED Screw-In Lamps (Directional)	Biz-Prescriptive Light	Education	ROB	229	229	86%	197	0.00	6	\$1	100%	100%	100%	5	2%	13%	85.0%	85.0%	85.0%	85.1
249	InteriorLighting	LED downlight fixture	Biz-Prescriptive Light	Education	Retro	180	180	68%	121	0.00	15	\$27	100%	37%	37%	6	11%	13%	85.0%	74.2%	74.2%	9.8
250	InteriorLighting	LED Screw-In Lamps (Omnidirectional & Decorative)	Biz-Prescriptive Light	Education	ROB	173	173	81%	140	0.00	6	\$1	100%	100%	100%	6	11%	13%	85.0%	85.0%	85.0%	60.7
251	InteriorLighting	DeLamp Fluorescent Fixture Average Lamp Wattage 28W	Biz-Prescriptive Light	Education	Retro	97	97	100%	97	0.00	11	\$4	100%	25%	25%	7	77%	0%	85.0%	82.7%	82.7%	61.6
252	InteriorLighting	Occupancy Sensors	Biz-Prescriptive Light	Education	Retro	440	440	30%	132	0.00	10	\$65	50%	20%	20%	8	95%	10				

Appendix C: C&I Measure Assumptions

Measure #	End-Use	Measure Name	Program	Building Type	Replacement Type	Base (Existing) Annual Electric	Base (Standard) Annual Electric	% Elec Savings	Per Unit Elec Savings	Per Unit Summer kW	EE EUL	Measure Cost	MAP Incentive (%)	RAP Incentive (%)	PP Incentive (%)	End Use Measure Group	Base Saturation	EE Saturation	MAP Adoption Rate	RAP Adoption Rate	PP Adoption Rate	UCT Score
255	InteriorLighting	Central Lighting Monitoring & Controls (non-networked)	Biz-Custom Light	Education	Retro	41,703	41,703	20%	8,341	0.00	12	\$3,700	50%	18%	18%	8	95%	10%	55.0%	37.1%	37.1%	4.1
256	InteriorLighting	Network Lighting Controls - Wireless (WiFi)	Biz-Prescriptive Light	Education	Retro	3	3	49%	1	0.00	15	\$0	100%	63%	63%	8	95%	10%	85.0%	75.7%	75.7%	3.7
257	InteriorLighting	Luminaire Level Lighting Controls w/ HVAC Control	Biz-Custom Light	Education	Retro	337	337	65%	219	0.00	15	\$90	100%	21%	21%	8	87%	10%	85.0%	53.3%	53.3%	8.1
258	InteriorLighting	LED Exit Sign - 4 Watt Fixture (2 lamp)	Biz-Prescriptive Light	Education	Retro	66	66	43%	28	0.00	5	\$33	31%	31%	31%	9	1%	75%	82.5%	80.0%	80.0%	0.7
259	InteriorLighting	Lighting - Custom	Biz-Custom Light	Education	Retro	4	4	25%	1	0.00	15	\$0	100%	50%	50%	10	100%	0%	85.0%	79.3%	79.3%	9.9
260	ExteriorLighting	LED wallpack (existing W<250)	Biz-Prescriptive Light	Education	Retro	856	856	66%	567	0.00	12	\$248	75%	46%	46%	1	12%	44%	71.7%	55.2%	55.2%	1.7
261	ExteriorLighting	LED parking lot fixture (existing W<250)	Biz-Prescriptive Light	Education	Retro	1,589	1,589	60%	959	0.00	12	\$756	25%	20%	20%	2	11%	44%	60.8%	55.2%	55.2%	2.2
262	ExteriorLighting	LED parking lot fixture (existing W<250)	Biz-Prescriptive Light	Education	Retro	856	856	66%	567	0.00	12	\$248	75%	30%	30%	3	11%	44%	71.7%	55.2%	55.2%	2.6
263	ExteriorLighting	LED outdoor pole decorative fixture (existing W<250)	Biz-Prescriptive Light	Education	Retro	1,589	1,589	60%	959	0.00	12	\$756	25%	20%	20%	4	11%	44%	60.8%	55.2%	55.2%	2.2
264	ExteriorLighting	LED parking garage fixture (existing W<250)	Biz-Prescriptive Light	Education	Retro	3,235	3,235	60%	1,953	0.00	6	\$756	50%	13%	13%	5	11%	44%	60.8%	55.2%	55.2%	4.0
265	ExteriorLighting	LED parking garage fixture (existing W<250)	Biz-Prescriptive Light	Education	Retro	1,742	1,742	66%	1,154	0.00	6	\$248	75%	32%	32%	6	11%	44%	78.8%	67.1%	67.1%	3.0
266	ExteriorLighting	LED Mogul-base HID Lamp Replacing Exterior HID (existing W<250)	Biz-Prescriptive Light	Education	Retro	1,589	1,589	60%	959	0.00	12	\$756	25%	20%	20%	7	11%	44%	60.8%	55.2%	55.2%	2.2
267	ExteriorLighting	LED Mogul-base HID Lamp Replacing Exterior HID (existing W<250)	Biz-Prescriptive Light	Education	Retro	856	856	66%	567	0.00	12	\$248	75%	30%	30%	8	11%	44%	71.7%	55.2%	55.2%	2.6
268	ExteriorLighting	Bi-Level Lighting Fixture – Garages	Biz-Prescriptive Light	Education	Retro	262	262	69%	181	0.00	10	\$274	29%	29%	29%	9	11%	44%	60.8%	53.6%	53.6%	0.7
269	ExteriorLighting	LED fuel pump canopy fixture (existing W<250)	Biz-Prescriptive Light	Education	Retro	0	0	0%	0	0.00	12	\$0	0%	0%	0%	10	0%	44%	85.0%	85.0%	85.0%	0.0
270	ExteriorLighting	LED fuel pump canopy fixture (existing W<250)	Biz-Prescriptive Light	Education	Retro	0	0	0%	0	0.00	12	\$0	0%	0%	0%	11	0%	44%	85.0%	85.0%	85.0%	0.0
271	Miscellaneous	Vending Machine Controller - Non-Refrigerated	Biz-Prescriptive	Education	Retro	385	385	61%	237	0.00	5	\$233	17%	17%	17%	1	5%	30%	51.0%	44.0%	44.0%	1.0
272	Miscellaneous	Miscellaneous Custom	Biz-Custom	Education	Retro	7	7	2%	0	0.00	10	\$0	100%	50%	50%	2	0%	10%	85.0%	65.5%	65.5%	3.3
273	Miscellaneous	Kitchen Exhaust Hood Demand Ventilation Control System	Biz-Custom	Education	ROB	9,932	9,932	50%	4,966	0.00	20	\$1,181	100%	34%	34%	3	42%	10%	85.0%	69.9%	69.9%	9.1
274	Miscellaneous	High Efficiency Hand Dryers	Biz-Custom	Education	Retro	2,093	2,093	83%	1,737	0.00	10	\$483	100%	29%	29%	4	5%	10%	85.0%	70.0%	70.0%	7.9
275	Miscellaneous	Ozone Commercial Laundry	Biz-Custom	Education	Retro	2,984	2,984	25%	746	0.00	10	\$20,310	0%	0%	0%	5	0%	2%	31.4%	17.2%	17.2%	3.6
276	Miscellaneous	ENERGY STAR Uninterrupted Power Supply	Biz-Custom	Education	ROB	3,096	3,096	3%	85	0.00	15	\$59	75%	12%	12%	6	20%	70%	79.0%	76.0%	76.0%	7.9
277	Motors	Cogged V-Belt	Biz-Custom	Education	Retro	17,237	17,237	3%	534	0.00	15	\$384	75%	11%	11%	1	50%	10%	66.9%	40.6%	40.6%	8.3
278	Motors	Pump and Fan Variable Frequency Drive Controls (Pumps)	Biz-Custom	Education	Retro	1,902	1,902	38%	731	0.00	15	\$200	100%	30%	30%	2	100%	10%	83.4%	66.3%	66.3%	8.4
279	Motors	Power Drive Systems	Biz-Custom	Education	Retro	4	4	23%	1	0.00	15	\$0	100%	31%	31%	2	100%	10%	83.4%	66.3%	66.3%	7.8
280	Motors	Switch Reluctance Motors	Biz-Custom	Education	Retro	33,406	33,406	31%	10,222	0.00	15	\$869	100%	100%	100%	2	100%	1%	83.4%	83.4%	83.4%	5.6
281	Motors	Escalators Motor Efficiency Controllers	Biz-Custom	Education	Retro	7,500	7,500	20%	1,500	0.00	10	\$5,000	2%	2%	2%	3	0%	10%	37.0%	28.0%	28.0%	7.0
282	Office_NonPC	Energy Star Printer/Copier/Fax	Biz-Custom	Education	ROB	551	551	40%	223	0.00	6	\$0	0%	0%	0%	1	30%	90%	93.0%	92.0%	92.0%	0.0
283	Office_NonPC	Smart Power Strip – Commercial Use	Biz-Custom	Education	Retro	1,086	1,086	10%	109	0.00	7	\$50	25%	17%	17%	2	35%	15%	40.5%	36.1%	36.1%	2.7
284	Office_NonPC	Plug Load Occupancy Sensor	Biz-Custom	Education	Retro	1,126	1,126	15%	169	0.00	8	\$70	50%	19%	19%	2	35%	15%	57.7%	38.8%	38.8%	3.0
285	Office_PC	Electrically Commutated Plug Fans in data centers	Biz-Custom	Education	Retro	86,783	86,783	18%	15,778	0.00	15	\$480	100%	50%	50%	1	65%	20%	85.0%	83.6%	83.6%	36.1
286	Office_PC	Energy Star Server	Biz-Custom	Education	ROB	1,621	1,621	23%	368	0.00	8	\$118	100%	25%	25%	1	65%	25%	85.0%	59.5%	59.5%	4.3
287	Office_PC	Server Virtualization	Biz-Custom	Education	Retro	2	2	45%	1	0.00	8	\$0	100%	50%	50%	1	65%	25%	85.0%	75.5%	75.5%	3.0
288	Office_PC	High Efficiency CRAC unit	Biz-Custom	Education	ROB	541	541	30%	162	0.00	15	\$63	100%	21%	21%	2	65%	20%	85.0%	51.1%	51.1%	7.2
289	Office_PC	Computer Room Air Conditioner Economizer	Biz-Custom	Education	Retro	418	418	86%	358	0.00	15	\$82	100%	35%	35%	2	65%	20%	85.0%	66.6%	66.6%	4.8
290	Office_PC	Data Center Hot/Cold Aisle Configuration	Biz-Custom	Education	Retro	4	4	25%	1	0.00	15	\$0	100%	50%	50%	3	3%	10%	85.0%	77.3%	77.3%	6.9
291	Office_PC	Energy Star Laptop	Biz-Custom	Education	ROB	126	126	33%	41	0.00	4	\$0	0%	0%	0%	4	11%	85%	89.5%	88.0%	88.0%	0.0
292	Office_PC	Energy Star Monitor	Biz-Custom	Education	ROB	72	72	21%	15	0.00	4	\$0	0%	0%	0%	5	25%	85%	89.5%	88.0%	88.0%	0.0
293	Refrigeration	Strip Curtains	Biz-Prescriptive	Education	Retro	0	0	0%	0	0.00	4	\$0	0%	0%	0%	1	11%	30%	79.2%	79.2%	79.2%	0.0
294	Refrigeration	Bare Suction Line	Biz-Custom	Education	Retro	23	23	93%	21	0.00	15	\$4	100%	42%	42%	2	0%	50%	79.2%	72.6%	72.6%	6.9
295	Refrigeration	Floating Head Pressure Controls	Biz-Custom	Education	Retro	1,112	1,112	25%	278	0.00	15	\$431	5%	5%	5%	3	7%	25%	47.5%	39.9%	39.9%	4.8
296	Refrigeration	Saturated Suction Controls	Biz-Custom	Education	Retro	831	831	50%	416	0.00	15	\$559	75%	6%	6%	4	2%	10%	66.6%	28.1%	28.1%	12.8
297	Refrigeration	Compressor Retrofit	Biz-Custom	Education	Retro	813	813	20%	163	0.00	15	\$477	25%	3%	3%	5	25%	25%	47.5%	39.9%	39.9%	12.9
298	Refrigeration	Electronically Commutated (EC) Walk-In Evaporator Fan Motor	Biz-Prescriptive	Education	Retro	2,440	2,440	65%	1,586	0.00	15	\$305	100%	13%	13%	6	7%	80%	86.0%	84.0%	84.0%	22.1
299	Refrigeration	Evaporator Fan Motor Controls	Biz-Prescriptive	Education	Retro	1,912	1,912	25%	478	0.00	13	\$162	100%	62%	62%	7	7%	25%	79.2%	71.9%	71.9%	2.5
300	Refrigeration	Variable Speed Condenser Fan	Biz-Custom	Education	Retro	2,960	2,960	50%	1,480	0.00	15	\$1,170	25%	10%	10%	8	9%	25%	47.5%	40.0%	40.0%	4.8
301	Refrigeration	Refrigeration Economizer	Biz-Custom	Education	Retro	7	7	2%	0	0.00	10	\$0	100%	50%	50%	9	35%	10%	79.2%	69.3%	69.3%	3.3
302	Refrigeration	Anti-Sweat Heater Controls MT	Biz-Prescriptive	Education	Retro	579	579	59%	338	0.00	10	\$100	100%	100%	100%	10	12%	75%	82.5%	80.0%	80.0%	1.2
303	Refrigeration	Auto Door Closer, Cooler	Biz-Prescriptive	Education	Retro	471,500	471,500	0%	943	0.00	8	\$157	100%	70%	70%	11	9%	50%	79.2%	75.9%	75.9%	3.2
304	Refrigeration	Display Case Door Retrofit, Medium Temp	Biz-Custom	Education	Retro	1,584	1,584	36%	578	0.00	12	\$686	25%	7%	7%	11	3%	25%	47.5%	40.0%	40.0%	6.6
305	Refrigeration	Electronically Commutated (EC) Reach-In Evaporator Fan Motor	Biz-Prescriptive	Education	Retro	2,440	2,440	65%	1,586	0.00	15	\$305	100%	13%	13%	12	2%	80%	86.0%	84.0%	84.0%	22.1
306	Refrigeration	Q-Sync Motor for Walk-In and Reach-In Evaporator Fan Motor	Biz-Custom	Education	Retro	1,911	1,911	26%	504	0.00	10	\$96	100%	42%	42%	12	2%	2%	79.2%	72.7%	72.7%	5.2
307	Refrigeration	Energy Star Reach-In Refrigerator, Glass Doors	Biz-Prescriptive	Education	ROB	2,140	2,140	29%	629	0.00	12	\$1,239	6%	6%	6%	13	12%	54%	67.8%	63.2%	63.2%	4.2
308	Refrigeration	Energy Star Reach-In Refrigerator, Solid Doors	Biz-Prescriptive	Education	ROB	1,410	1,410	20%	281	0.00	12	\$1,211	6%	6%	6%	14	12%	54%	67.8%	63.2%	63.2%	1.8
309	Refrigeration	Anti-Sweat Heater Controls LT	Biz-Prescriptive	Education	Retro	2,016	2,016	68%	1,361	0.00	10	\$100	100%	100%	100%	15	4%	75%	82.5%	80.0%	80.0%	4.7
310	Refrigeration	Auto Door Closer, Freezer	Biz-Prescriptive	Education	Retro	419,455	419,455	1%	2,307	0.00	8	\$157	100%	70%	70%	16	4%	50%	79.2%	77.8%	77.8%	7.7
311	Refrigeration	Display Case Door Retrofit, Low Temp	Biz-Custom	Education	Retro	2,922	2,922	50%	1,453	0.00	12	\$686	100%	17%	17%	16	4%	25%	79.2%	50.9%	50.9%	6.6
312	Refrigeration	Energy Star Reach-In Freezer, Glass Doors	Biz-Prescriptive	Education	ROB	6,374	6,374	20%	1,275	0.00	12	\$1,651	28%	28%	28%	17	4%	54%	67.8%	63.2%	63.2%	1.3
313	Refrigeration	Energy Star Reach-In Freezer, Solid Doors	Biz-Prescriptive	Education	ROB	4,522	4,522	7%	305	0.00	12	\$1,521	13%	13%	13%	18	4%	54%	67.8%	63.2%	63.2%	0.7
314	Refrigeration	Refrigeration - Custom	Biz-Custom	Education	ROB	7	7	2%	0	0.00	10	\$0	100%	50%	50%	19	90%	25%	79.2%	69.3%	69.3%	3.3
315	Refrigeration	Retro-commissioning_Refrigerator Optimization	Biz-Custom RCx	Education	Retro	3	3	30%	1	0.00	5	\$0	100%	80%	80%	20	90%	25%	79.2%	76.5%	76.5%	1.5

Appendix C: C&I Measure Assumptions

Measure #	End-Use	Measure Name	Program	Building Type	Replacement Type	Base (Existing) Annual Electric	Base (Standard) Annual Electric	% Elec Savings	Per Unit Elec Savings	Per Unit Summer kW	EE EUL	Measure Cost	MAP Incentive (%)	RAP Incentive (%)	PP Incentive (%)	End Use Measure Group	Base Saturation	EE Saturation	MAP Adoption Rate	RAP Adoption Rate	PP Adoption Rate	UCT Score
316	Refrigeration	Energy Star Ice Machine	Biz-Prescriptive	Education	ROB	6,993	6,993	10%	721	0.00	15	\$1,426	25%	18%	18%	21	4%	44%	60.8%	55.1%	55.1%	1.5
317	Refrigeration	Vending Machine Controller - Refrigerated	Biz-Prescriptive	Education	ROB	1,586	1,586	34%	537	0.00	5	\$245	25%	16%	16%	22	3%	30%	51.0%	45.6%	45.6%	2.2
318	Refrigeration	LED Refrigerated Display Case Lighting Average 6W/LF	Biz-Prescriptive	Education	Retro	273	273	89%	243	0.00	9	\$11	100%	45%	45%	23	7%	66%	79.2%	77.7%	77.7%	24.0
319	Refrigeration	LED Refrigerated Display Case Lighting Controls	Biz-Prescriptive	Education	Retro	522	522	27%	141	0.00	10	\$14	100%	30%	30%	24	7%	13%	79.2%	75.2%	75.2%	18.9
320	Ventilation	Demand Controlled Ventilation	Biz-Custom	Education	Retro	2,223	2,223	20%	445	0.00	15	\$227	100%	16%	16%	1	100%	24%	47.1%	47.1%	47.1%	8.1
321	Ventilation	Pump and Fan Variable Frequency Drive Controls (Fans)	Biz-Prescriptive	Education	Retro	1,902	1,902	38%	731	0.00	15	\$200	100%	30%	30%	2	100%	24%	83.4%	66.4%	66.4%	8.4
322	WholeBldg_HVAC	HVAC - Energy Management System	Biz-Custom RCx	Education	Retro	7	7	15%	1	0.00	15	\$0	100%	50%	50%	1	100%	20%	83.4%	73.0%	73.0%	7.5
323	WholeBldg_HVAC	Guest room energy management system	Biz-Prescriptive	Education	Retro	0	0	0%	0	0.00	15	\$260	0%	77%	77%	2	100%	20%	83.4%	83.4%	83.4%	0.0
324	WholeBldg_HVAC	Retro-commissioning_Bld Optimization	Biz-Custom RCx	Education	Retro	7	7	15%	1	0.00	15	\$0	100%	50%	50%	3	100%	0%	83.4%	73.0%	73.0%	7.5
325	WholeBuilding	WholeBldg - Com RET	Biz-Custom	Education	Retro	7	7	15%	1	0.00	12	\$0	100%	50%	50%	1	100%	0%	83.4%	73.0%	73.0%	6.4
326	WholeBuilding	WholeBldg - Custom (Other)	Biz-Custom	Education	Retro	5	5	20%	1	0.00	12	\$0	100%	50%	50%	2	100%	0%	83.4%	73.0%	73.0%	6.4
327	WholeBuilding	Power Distribution Equipment Upgrades (Transformers)	Biz-Custom	Education	Retro	1,150	1,150	1%	6	0.00	30	\$8	75%	4%	4%	3	100%	20%	59.3%	36.0%	36.0%	21.1
328	WholeBldg_NC	WholeBldg - Com NC	Biz-Custom	Education	NC	4	4	25%	1	0.00	12	\$0	100%	50%	50%	1	100%	60%	83.4%	72.1%	72.1%	5.7
329	Behavioral	COM Competitions	Biz-Custom	Education	Retro	0	0	0%	0	0.00	2	\$0	0%		48%	1	100%	0%	90.0%	90.0%	90.0%	0.0
330	Behavioral	Business Energy Reports	Biz-Custom	Education	Retro	0	0	0%	0	0.00	2	\$0	0%		100%	1	100%	0%	90.0%	90.0%	90.0%	0.0
331	Behavioral	Building Benchmarking	Biz-Custom	Education	Retro	83	83	1%	1	0.00	2	\$0	77%	77%	77%	1	100%	0%	90.0%	90.0%	90.0%	0.4
332	Behavioral	Strategic Energy Management	Biz-Custom SEM	Education	Retro	33	33	3%	1	0.00	5	\$0	50%	7%	7%	1	100%	0%	90.0%	90.0%	90.0%	8.4
333	Behavioral	BEIMS	Biz-Custom	Education	Retro	43	43	2%	1	0.00	2	\$0	39%	39%	39%	1	100%	2%	90.0%	90.0%	90.0%	0.4
334	Behavioral	Building Operator Certification	Biz-Custom	Education	Retro	41	41	3%	1	0.00	3	\$0	97%	97%	97%	1	100%	2%	90.0%	90.0%	90.0%	0.9
335	CompressedAir	Efficient Air Compressors (VSD)	Biz-Prescriptive	Food Sales	ROB	1,583	1,583	21%	329	0.00	13	\$127	100%	47%	47%	1	100%	33%	83.4%	69.0%	69.0%	5.2
336	CompressedAir	Efficient Air Nozzles	Biz-Prescriptive	Food Sales	Retro	1,480	1,480	50%	740	0.00	15	\$50	100%	40%	40%	2	35%	33%	83.4%	78.4%	78.4%	22.7
337	CompressedAir	AODD Pump Controls	Biz-Custom	Food Sales	Retro	103,919	103,919	35%	36,372	0.00	10	\$1,150	100%	50%	50%	3	10%	33%	83.4%	81.4%	81.4%	28.9
338	CompressedAir	Compressed Air - Custom	Biz-Custom	Food Sales	Retro	5	5	20%	1	0.00	10	\$0	100%	38%	38%	4	50%	33%	83.4%	69.6%	69.6%	5.7
339	CompressedAir	Retro-commissioning_Compressed Air Optimization	Biz-Custom RCx	Food Sales	Retro	3	3	30%	1	0.00	5	\$0	100%	80%	80%	5	50%	33%	83.4%	78.1%	78.1%	1.5
340	Cooking	Commercial Combination Oven (Electric)	Biz-Prescriptive	Food Sales	ROB	38,561	38,561	48%	18,432	0.00	12	\$16,884	50%	6%	6%	1	18%	53%	67.1%	62.4%	62.4%	10.5
341	Cooking	Commercial Electric Convection Oven	Biz-Prescriptive	Food Sales	ROB	12,193	12,193	15%	1,879	0.00	12	\$1,706	50%	23%	23%	1	18%	53%	67.1%	62.4%	62.4%	2.9
342	Cooking	Commercial Electric Griddle	Biz-Prescriptive	Food Sales	ROB	17,056	17,056	15%	2,596	0.00	12	\$3,604	25%	22%	22%	2	14%	17%	41.9%	33.6%	33.6%	1.4
343	Cooking	Commercial Electric Steam Cooker	Biz-Prescriptive	Food Sales	ROB	19,549	19,549	67%	13,162	0.00	12	\$3,300	100%	27%	27%	3	6%	45%	79.2%	71.0%	71.0%	9.0
344	Cooking	Dishwasher Low Temp Door (Energy Star)	Biz-Prescriptive	Food Sales	ROB	39,306	39,306	44%	17,369	0.00	15	\$662	100%	76%	76%	4	26%	61%	79.2%	78.5%	78.5%	16.4
345	Cooking	Dishwasher High Temp Door (Energy Star)	Biz-Prescriptive	Food Sales	ROB	26,901	26,901	32%	8,586	0.00	15	\$995	100%	50%	50%	4	26%	61%	79.2%	75.0%	75.0%	8.1
346	Cooking	Energy efficient electric fryer	Biz-Prescriptive	Food Sales	ROB	18,955	18,955	17%	3,274	0.00	12	\$1,500	75%	5%	5%	5	27%	24%	72.2%	45.6%	45.6%	17.0
347	Cooking	Insulated Holding Cabinets (Full Size)	Biz-Custom	Food Sales	ROB	13,697	13,697	68%	9,314	0.00	12	\$1,200	100%	62%	62%	6	3%	16%	79.2%	75.7%	75.7%	5.2
348	Cooking	Insulated Holding Cabinets (Half-Size)	Biz-Custom	Food Sales	ROB	4,383	4,383	60%	2,630	0.00	12	\$1,500	50%	14%	14%	6	3%	16%	58.5%	42.3%	42.3%	5.2
349	Cooling	Air Conditioner - 13 IEER (5-20 Tons)	Biz-Prescriptive	Food Sales	ROB	1,132	1,132	6%	70	0.00	15	\$63	100%	79%	79%	1	17%	20%	83.4%	69.0%	69.0%	2.2
350	Cooling	Air Conditioner - 14 IEER (5-20 Tons)	Biz-Prescriptive	Food Sales	ROB	1,132	1,132	13%	146	0.00	15	\$127	100%	39%	39%	1	17%	20%	83.4%	47.6%	47.6%	4.5
351	Cooling	Air Conditioner - 17 IEER (5-20 Tons)	Biz-Prescriptive	Food Sales	ROB	1,132	1,132	28%	320	0.00	15	\$127	100%	39%	39%	1	17%	20%	83.4%	66.1%	66.1%	9.9
352	Cooling	Air Conditioner - 21 IEER (5-20 Tons)	Biz-Prescriptive	Food Sales	ROB	1,132	1,132	42%	474	0.00	15	\$127	100%	39%	39%	1	17%	20%	83.4%	70.3%	70.3%	14.7
353	Cooling	Air Conditioner - 12.1 IEER (20+ Tons)	Biz-Prescriptive	Food Sales	ROB	1,212	1,212	6%	70	0.00	15	\$50	100%	100%	100%	2	17%	20%	83.4%	83.4%	83.4%	2.2
354	Cooling	Air Conditioner - 13 IEER (20+ Tons)	Biz-Prescriptive	Food Sales	ROB	1,212	1,212	12%	149	0.00	15	\$50	100%	100%	100%	2	17%	20%	83.4%	83.4%	83.4%	4.6
355	Cooling	Air Conditioner - 14.3 IEER (20+ Tons)	Biz-Prescriptive	Food Sales	ROB	1,212	1,212	20%	246	0.00	15	\$50	100%	100%	100%	2	17%	20%	83.4%	83.4%	83.4%	7.6
356	Cooling	Air Conditioner - 21 IEER (20+ Tons)	Biz-Prescriptive	Food Sales	ROB	1,212	1,212	46%	554	0.00	15	\$50	100%	100%	100%	2	17%	20%	83.4%	83.4%	83.4%	17.2
357	Cooling	Comprehensive Rooftop Unit Quality Maintenance (AC Tune-up)	Biz-Custom	Food Sales	Retro	1,151	1,151	7%	81	0.00	3	\$5	100%	50%	50%	3	34%	50%	83.4%	80.2%	80.2%	12.1
358	Cooling	Air Side Economizer	Biz-Custom	Food Sales	Retro	1,132	1,132	20%	226	0.00	10	\$84	75%	22%	22%	4	34%	20%	70.4%	48.9%	48.9%	3.5
359	Cooling	Advanced Rooftop Controls	Biz-Prescriptive	Food Sales	Retro	1,151	1,151	6%	68	0.00	10	\$98	26%	26%	26%	5	34%	20%	44.0%	36.0%	36.0%	0.8
360	Cooling	HVAC Occupancy Controls	Biz-Custom	Food Sales	ROB	2,900	2,900	20%	580	0.00	15	\$537	75%	9%	9%	6	34%	20%	62.6%	36.0%	36.0%	11.0
361	Cooling	Air Conditioner - 16 SEER (<5 Tons)	Biz-Prescriptive	Food Sales	ROB	987	987	13%	123	0.00	15	\$50	100%	100%	100%	7	31%	20%	83.4%	83.4%	83.4%	3.8
362	Cooling	Air Conditioner - 17 SEER (<5 Tons)	Biz-Prescriptive	Food Sales	ROB	987	987	18%	174	0.00	15	\$206	100%	24%	24%	7	31%	20%	83.4%	38.0%	38.0%	5.4
363	Cooling	Air Conditioner - 18 SEER (<5 Tons)	Biz-Prescriptive	Food Sales	ROB	987	987	22%	219	0.00	15	\$206	100%	24%	24%	7	31%	20%	83.4%	42.8%	42.8%	6.8
364	Cooling	Air Conditioner - 21 SEER (<5 Tons)	Biz-Prescriptive	Food Sales	ROB	987	987	33%	329	0.00	15	\$253	100%	20%	20%	7	31%	20%	83.4%	45.3%	45.3%	10.2
365	Cooling	Smart Thermostat	Biz-Prescriptive	Food Sales	ROB	987	987	14%	140	0.00	11	\$175	50%	26%	26%	8	31%	12%	40.2%	32.4%	32.4%	2.3
366	Cooling	PTAC - <7,000 Btuh - lodging	Biz-Prescriptive	Food Sales	ROB	1,161	1,161	8%	98	0.00	8	\$84	100%	42%	42%	9	34%	20%	83.4%	47.7%	47.7%	2.5
367	Cooling	PTAC - 7,000 to 15,000 Btuh - lodging	Biz-Prescriptive	Food Sales	ROB	1,273	1,273	7%	92	0.00	8	\$84	75%	42%	42%	10	34%	20%	66.2%	46.9%	46.9%	2.3
368	Cooling	PTAC - >15,000 Btuh - lodging	Biz-Prescriptive	Food Sales	ROB	1,454	1,454	10%	138	0.00	8	\$84	100%	42%	42%	11	34%	20%	83.4%	58.2%	58.2%	3.5
369	Cooling	Air Cooled Chiller	Biz-Prescriptive	Food Sales	ROB	1,008	1,008	6%	57	0.00	23	\$126	100%	40%	40%	12	0%	15%	83.4%	32.9%	32.9%	2.9
370	Cooling	Chiller Tune-up	Biz-Custom	Food Sales	Retro	1,151	1,151	7%	81	0.00	3	\$5	100%	50%	50%	13	0%	50%	83.4%	80.2%	80.2%	12.1
371	Cooling	HVAC/Chiller Custom	Biz-Custom	Food Sales	Retro	5	5	20%	1	0.00	20	\$1	100%	6%	6%	14	100%	20%	83.4%	36.0%	36.0%	28.1
372	Cooling	Window Film	Biz-Custom	Food Sales	Retro	6,000	6,000	4%	264	0.00	10	\$154	100%	14%	14%	15	100%	20%	83.4%	46.7%	46.7%	11.7
373	Cooling	Triple Pane Windows	Biz-Custom	Food Sales	ROB	6,000	6,000	6%	360	0.00	25	\$700	75%	4%	4%	15	100%	20%	47.2%	36.0%	36.0%	21.7
374	Cooling	Energy Recovery Ventilator	Biz-Custom	Food Sales	Retro	1,212	1,212	8%	96	0.00	15	\$1,500	1%	1%	1%	16	100%	2%	31.4%	22.6%	22.6%	14.0
375	Heating	Heat Pump - 16 SEER (<5 Tons)	Biz-Prescriptive	Food Sales	ROB	2,781	2,781	4%	99	0.00	16	\$87	100%	57%	57%	1	36%	20%	83.4%	57.3%	57.3%	1.9
376	Heating	Heat Pump - 17 SEER (<5 Tons)	Biz-Prescriptive	Food Sales	ROB	2,781	2,781	8%	227	0.00	16	\$442	25%	11%	11%	1	36%	20%	44.0%	36.0%	36.0%	3.8
377	Heating	Heat Pump - 18 SEER (<5 Tons)	Biz-Prescriptive	Food Sales	ROB	2,781	2,781	12%	326	0.00	16	\$507	50%	10%	10%	1	36%	20%	44.0%	36.0%	36.0%	5.4
378	Heating	Heat Pump - 21 SEER (<5 Tons)	Biz-Prescriptive	Food Sales	ROB	2,781	2,781	17%	486	0.00	16	\$507	75%	10%	10%	1	36%	20%	63.7%	36.0%	36.0%	8.4
379	Heating	Geothermal HP - SEER 20.3 (<5 Tons)	Biz-Prescriptive	Food Sales	ROB	2,781	2,781	22%	612	0.00	25											

Appendix C: C&I Measure Assumptions

Measure #	End-Use	Measure Name	Program	Building Type	Replacement Type	Base (Existing) Annual Electric	Base (Standard) Annual Electric	% Elec Savings	Per Unit Elec Savings	Per Unit Summer kW	EE EUL	Measure Cost	MAP Incentive (%)	RAP Incentive (%)	PP Incentive (%)	End Use Measure Group	Base Saturation	EE Saturation	MAP Adoption Rate	RAP Adoption Rate	PP Adoption Rate	UCT Score
382	Heating	Geothermal HP - SEER 29.3 (<5 Tons)	Biz-Prescriptive	Food Sales	ROB	2,781	2,781	46%	1,289	0.00	25	\$2,576	25%	14%	14%	1	36%	20%	44.0%	36.0%	36.0%	3.0
383	Heating	Heat Pump - 14.0 IEER COP 3.6 (65,000-134,000 Btu/hr)	Biz-Prescriptive	Food Sales	ROB	3,331	3,331	10%	346	0.00	16	\$100	100%	50%	50%	2	20%	20%	83.4%	77.8%	77.8%	20.5
384	Heating	Heat Pump - 15.0 IEER COP 3.8 (65,000-134,000 Btu/hr)	Biz-Prescriptive	Food Sales	ROB	3,331	3,331	16%	517	0.00	16	\$136	100%	37%	37%	2	20%	20%	83.4%	75.2%	75.2%	23.2
385	Heating	Heat Pump - 14.5 IEER COP 3.5 (135,000-239,000 Btu/hr)	Biz-Prescriptive	Food Sales	ROB	3,460	3,460	13%	452	0.00	16	\$100	100%	35%	35%	2	20%	20%	83.4%	77.0%	77.0%	33.3
386	Heating	Heat Pump - 15.5 IEER COP 3.7 (135,000-239,000 Btu/hr)	Biz-Prescriptive	Food Sales	ROB	3,460	3,460	18%	624	0.00	16	\$139	100%	25%	25%	2	20%	20%	83.4%	74.6%	74.6%	36.9
387	Heating	Geothermal HP - SEER 20.3 (5-20 Tons)	Biz-Prescriptive	Food Sales	ROB	3,043	3,043	29%	875	0.00	25	\$2,576	25%	14%	14%	2	20%	20%	44.0%	36.0%	36.0%	3.4
388	Heating	Geothermal HP - SEER 21.5 (5-20 Tons)	Biz-Prescriptive	Food Sales	ROB	3,043	3,043	33%	996	0.00	25	\$2,576	50%	14%	14%	2	20%	20%	44.0%	36.0%	36.0%	3.7
389	Heating	Geothermal HP - SEER 23.1 (5-20 Tons)	Biz-Prescriptive	Food Sales	ROB	3,189	3,189	40%	1,283	0.00	25	\$2,576	50%	14%	14%	2	20%	20%	44.0%	36.0%	36.0%	4.2
390	Heating	Geothermal HP - SEER 29.3 (5-20 Tons)	Biz-Prescriptive	Food Sales	ROB	3,189	3,189	53%	1,697	0.00	25	\$2,576	50%	14%	14%	2	20%	20%	44.0%	36.0%	36.0%	4.9
391	Heating	Variable Refrigerant Flow Heat Pump	Biz-Custom	Food Sales	ROB	2,558	2,558	10%	263	0.00	16	\$224	100%	16%	16%	2	20%	2%	83.4%	45.8%	45.8%	9.4
392	Heating	Heat Pump - 12 IEER 3.4 COP (>239,000 Btu/hr)	Biz-Prescriptive	Food Sales	ROB	3,576	3,576	9%	309	0.00	16	\$100	100%	35%	35%	3	20%	20%	83.4%	75.1%	75.1%	26.0
393	Heating	Heat Pump - 13 IEER 3.6 COP (>239,000 Btu/hr)	Biz-Prescriptive	Food Sales	ROB	3,576	3,576	14%	515	0.00	16	\$175	100%	20%	20%	3	20%	20%	83.4%	71.0%	71.0%	30.9
394	Heating	Geothermal HP - SEER 20.3 (20+ Tons)	Biz-Prescriptive	Food Sales	ROB	3,460	3,460	37%	1,291	0.00	25	\$2,576	75%	14%	14%	3	20%	20%	56.6%	36.0%	36.0%	6.5
395	Heating	Geothermal HP - SEER 21.5 (20+ Tons)	Biz-Prescriptive	Food Sales	ROB	3,460	3,460	41%	1,412	0.00	25	\$2,576	75%	14%	14%	3	20%	20%	58.0%	36.0%	36.0%	6.8
396	Heating	Geothermal HP - SEER 23.1 (20+ Tons)	Biz-Prescriptive	Food Sales	ROB	3,460	3,460	45%	1,554	0.00	25	\$2,576	75%	14%	14%	3	20%	20%	59.5%	36.0%	36.0%	7.1
397	Heating	Geothermal HP - SEER 29.3 (20+ Tons)	Biz-Prescriptive	Food Sales	ROB	3,460	3,460	57%	1,968	0.00	25	\$2,576	100%	14%	14%	3	20%	20%	83.4%	36.0%	36.0%	7.8
398	Heating	Mini Split Ductless Heat Pump Cold Climate (Tiers & sizes TBD)	Biz-Prescriptive	Food Sales	ROB	2,781	2,781	17%	486	0.00	16	\$224	100%	16%	16%	4	14%	20%	83.4%	54.4%	54.4%	12.0
399	Heating	PTHP - <7,000 Btu/h - lodging	Biz-Custom	Food Sales	ROB	3,085	3,085	3%	95	0.00	8	\$84	75%	48%	48%	5	3%	10%	69.6%	58.5%	58.5%	1.9
400	Heating	PTHP - >15,000 Btu/h - lodging	Biz-Prescriptive	Food Sales	ROB	3,646	3,646	12%	451	0.00	8	\$84	100%	48%	48%	6	3%	10%	83.4%	76.3%	76.3%	9.3
401	Heating	PTHP - 7,000 to 15,000 Btu/h - lodging	Biz-Prescriptive	Food Sales	ROB	3,357	3,357	7%	234	0.00	8	\$84	100%	48%	48%	7	3%	10%	83.4%	71.2%	71.2%	4.8
402	HotWater	Heat Pump Water Heater	Biz-Prescriptive	Food Sales	ROB	4,687	4,687	67%	3,139	0.00	15	\$1,115	100%	49%	49%	1	100%	0%	75.5%	64.2%	64.2%	3.3
403	HotWater	Hot Water Pipe Insulation	Biz-Custom	Food Sales	Retro	4,687	4,687	2%	94	0.00	20	\$60	100%	12%	12%	2	100%	80%	86.0%	84.0%	84.0%	8.1
404	HotWater	Laundry Aerator	Biz-Prescriptive	Food Sales	Retro	284	284	32%	92	0.00	10	\$8	100%	100%	100%	3	20%	90%	93.0%	92.0%	92.0%	5.0
405	HotWater	Low Flow Pre-Rinse Sprayers	Biz-Custom	Food Sales	ROB	18,059	18,059	54%	9,789	0.00	5	\$75	100%	100%	100%	4	20%	80%	86.0%	84.0%	84.0%	20.5
406	HotWater	ENERGY STAR Commercial Washing Machines	Biz-Prescriptive	Food Sales	ROB	1,552	1,552	43%	671	0.00	7	\$250	50%	18%	18%	5	25%	32%	60.4%	45.6%	45.6%	3.4
407	InteriorLighting	LED T8 Tube Replacement	Biz-Prescriptive Light	Food Sales	Retro	197	197	45%	88	0.00	9	\$3	100%	100%	100%	1	80%	38%	85.0%	85.0%	85.0%	13.1
408	InteriorLighting	LED troffer retrofit kit, 2'X2' and 2'X4'	Biz-Prescriptive Light	Food Sales	Retro	445	445	50%	223	0.00	9	\$70	100%	43%	43%	1	80%	38%	85.0%	68.8%	68.8%	3.3
409	InteriorLighting	LED troffer, 2'X2' and 2'X4'	Biz-Prescriptive Light	Food Sales	Retro	445	445	50%	223	0.00	9	\$70	100%	79%	79%	1	80%	38%	85.0%	79.3%	79.3%	1.8
410	InteriorLighting	Bi-Level Lighting Fixture – Stairwells, Hallways	Biz-Custom Light	Food Sales	Retro	445	445	74%	331	0.00	10	\$274	29%	29%	29%	2	9%	38%	56.4%	50.2%	50.2%	1.4
411	InteriorLighting	LED high bay fixture	Biz-Prescriptive Light	Food Sales	Retro	4,147	4,147	68%	2,821	0.00	9	\$330	100%	45%	45%	3	0%	19%	85.0%	79.6%	79.6%	8.4
412	InteriorLighting	LED Mogul-base HID Lamp Replacing High Bay HID	Biz-Prescriptive Light	Food Sales	Retro	4,147	4,147	66%	2,751	0.00	9	\$330	100%	45%	45%	3	0%	19%	85.0%	79.4%	79.4%	8.2
413	InteriorLighting	LED low bay fixture	Biz-Prescriptive Light	Food Sales	Retro	883	883	61%	537	0.00	9	\$75	100%	100%	100%	4	0%	19%	85.0%	85.0%	85.0%	3.2
414	InteriorLighting	LED Mogul-base HID Lamp Replacing Low Bay HID	Biz-Prescriptive Light	Food Sales	Retro	883	883	59%	519	0.00	9	\$75	100%	100%	100%	4	0%	19%	85.0%	85.0%	85.0%	3.1
415	InteriorLighting	LED Screw-In Lamps (Directional)	Biz-Prescriptive Light	Food Sales	ROB	308	308	86%	264	0.00	4	\$1	100%	100%	100%	5	1%	13%	85.0%	85.0%	85.0%	70.7
416	InteriorLighting	LED downlight fixture	Biz-Prescriptive Light	Food Sales	Retro	306	306	68%	206	0.00	9	\$27	100%	37%	37%	6	10%	13%	85.0%	78.0%	78.0%	9.2
417	InteriorLighting	LED Screw-In Lamps (Omnidirectional & Decorative)	Biz-Prescriptive Light	Food Sales	ROB	233	233	81%	188	0.00	4	\$1	100%	100%	100%	6	10%	13%	85.0%	85.0%	85.0%	50.4
418	InteriorLighting	DeLamp Fluorescent Fixture Average Lamp Wattage 28W	Biz-Prescriptive Light	Food Sales	Retro	164	164	100%	164	0.00	11	\$4	100%	25%	25%	7	80%	0%	85.0%	83.5%	83.5%	84.9
419	InteriorLighting	Occupancy Sensors	Biz-Prescriptive Light	Food Sales	Retro	749	749	30%	225	0.00	10	\$65	100%	20%	20%	8	95%	10%	85.0%	55.5%	55.5%	5.6
420	InteriorLighting	Daylighting Controls	Biz-Prescriptive Light	Food Sales	Retro	959	959	30%	288	0.00	10	\$58	100%	34%	34%	8	95%	10%	85.0%	73.5%	73.5%	7.4
421	InteriorLighting	Dual Occupancy & Daylighting Controls	Biz-Custom Light	Food Sales	Retro	428	428	44%	188	0.00	10	\$75	100%	26%	26%	8	95%	10%	85.0%	55.7%	55.7%	4.6
422	InteriorLighting	Central Lighting Monitoring & Controls (non-networked)	Biz-Custom Light	Food Sales	Retro	41,703	41,703	20%	8,341	0.00	12	\$3,700	50%	18%	18%	8	95%	10%	55.0%	37.1%	37.1%	4.2
423	InteriorLighting	Network Lighting Controls - Wireless (WiFi)	Biz-Prescriptive Light	Food Sales	Retro	4	4	49%	2	0.00	15	\$1	100%	42%	42%	8	95%	10%	85.0%	66.9%	66.9%	4.4
424	InteriorLighting	Luminaire Level Lighting Controls w/ HVAC Control	Biz-Custom Light	Food Sales	Retro	428	428	65%	278	0.00	15	\$90	100%	21%	21%	8	89%	10%	85.0%	60.8%	60.8%	9.6
425	InteriorLighting	LED Exit Sign - 4 Watt Fixture (2 lamp)	Biz-Prescriptive Light	Food Sales	Retro	64	64	43%	28	0.00	5	\$33	31%	31%	31%	9	1%	75%	82.5%	80.0%	80.0%	0.7
426	InteriorLighting	Lighting - Custom	Biz-Custom Light	Food Sales	Retro	4	4	25%	1	0.00	15	\$0	100%	50%	50%	10	100%	0%	85.0%	79.0%	79.0%	9.2
427	ExteriorLighting	LED wallpack (existing W<250)	Biz-Prescriptive Light	Food Sales	Retro	856	856	66%	567	0.00	12	\$248	75%	46%	46%	1	12%	44%	71.7%	55.2%	55.2%	1.7
428	ExteriorLighting	LED parking lot fixture (existing W<250)	Biz-Prescriptive Light	Food Sales	Retro	1,589	1,589	60%	959	0.00	12	\$756	25%	20%	20%	2	11%	44%	60.8%	55.2%	55.2%	2.2
429	ExteriorLighting	LED parking lot fixture (existing W<250)	Biz-Prescriptive Light	Food Sales	Retro	856	856	66%	567	0.00	12	\$248	75%	30%	30%	3	11%	44%	71.7%	55.2%	55.2%	2.6
430	ExteriorLighting	LED outdoor pole decorative fixture (existing W<250)	Biz-Prescriptive Light	Food Sales	Retro	1,589	1,589	60%	959	0.00	12	\$756	25%	20%	20%	4	11%	44%	60.8%	55.2%	55.2%	2.2
431	ExteriorLighting	LED parking garage fixture (existing W<250)	Biz-Prescriptive Light	Food Sales	Retro	3,235	3,235	60%	1,953	0.00	6	\$756	50%	13%	13%	5	11%	44%	60.8%	55.2%	55.2%	3.9
432	ExteriorLighting	LED parking garage fixture (existing W<250)	Biz-Prescriptive Light	Food Sales	Retro	1,742	1,742	66%	1,154	0.00	6	\$248	75%	32%	32%	6	11%	44%	78.8%	67.1%	67.1%	2.9
433	ExteriorLighting	LED Mogul-base HID Lamp Replacing Exterior HID (existing W<250)	Biz-Prescriptive Light	Food Sales	Retro	1,589	1,589	60%	959	0.00	12	\$756	25%	20%	20%	7	11%	44%	60.8%	55.2%	55.2%	2.2
434	ExteriorLighting	LED Mogul-base HID Lamp Replacing Exterior HID (existing W<250)	Biz-Prescriptive Light	Food Sales	Retro	856	856	66%	567	0.00	12	\$248	75%	30%	30%	8	11%	44%	71.7%	55.2%	55.2%	2.6
435	ExteriorLighting	Bi-Level Lighting Fixture – Garages	Biz-Prescriptive Light	Food Sales	Retro	445	445	69%	307	0.00	10	\$274	29%	29%	29%	9	11%	44%	60.8%	55.2%	55.2%	1.1
436	ExteriorLighting	LED fuel pump canopy fixture (existing W<250)	Biz-Prescriptive Light																			

Appendix C: C&I Measure Assumptions

Measure #	End-Use	Measure Name	Program	Building Type	Replacement Type	Base (Existing) Annual Electric	Base (Standard) Annual Electric	% Elec Savings	Per Unit Elec Savings	Per Unit Summer kW	EE EUL	Measure Cost	MAP Incentive (%)	RAP Incentive (%)	PP Incentive (%)	End Use Measure Group	Base Saturation	EE Saturation	MAP Adoption Rate	RAP Adoption Rate	PP Adoption Rate	UCT Score
441	Miscellaneous	High Efficiency Hand Dryers	Biz-Custom	Food Sales	Retro	3,819	3,819	83%	3,170	0.00	10	\$483	100%	53%	53%	4	5%	10%	85.0%	78.9%	78.9%	6.1
442	Miscellaneous	Ozone Commercial Laundry	Biz-Custom	Food Sales	Retro	2,984	2,984	25%	746	0.00	10	\$20,310	0%	0%	0%	5	0%	2%	31.4%	17.2%	17.2%	3.7
443	Miscellaneous	ENERGY STAR Uninterrupted Power Supply	Biz-Custom	Food Sales	ROB	3,096	3,096	3%	85	0.00	15	\$59	75%	12%	12%	6	20%	70%	79.0%	76.0%	76.0%	8.0
444	Motors	Cogged V-Belt	Biz-Custom	Food Sales	Retro	19,471	19,471	3%	604	0.00	15	\$384	100%	13%	13%	1	50%	10%	83.4%	42.6%	42.6%	8.0
445	Motors	Pump and Fan Variable Frequency Drive Controls (Pumps)	Biz-Custom	Food Sales	Retro	1,902	1,902	38%	731	0.00	15	\$200	100%	30%	30%	2	100%	10%	83.4%	66.1%	66.1%	8.5
446	Motors	Power Drive Systems	Biz-Custom	Food Sales	Retro	4	4	23%	1	0.00	15	\$0	100%	31%	31%	2	100%	10%	83.4%	65.9%	65.9%	7.5
447	Motors	Switch Reluctance Motors	Biz-Custom	Food Sales	Retro	37,735	37,735	31%	11,547	0.00	15	\$981	100%	100%	100%	2	100%	1%	83.4%	83.4%	83.4%	5.6
448	Motors	Escalators Motor Efficiency Controllers	Biz-Custom	Food Sales	Retro	7,500	7,500	20%	1,500	0.00	10	\$5,000	2%	2%	2%	3	0%	10%	37.0%	28.0%	28.0%	7.1
449	Office_NonPC	Energy Star Printer/Copier/Fax	Biz-Custom	Food Sales	ROB	551	551	40%	223	0.00	6	\$0	0%			1	30%	90%	93.0%	92.0%	92.0%	0.0
450	Office_NonPC	Smart Power Strip – Commercial Use	Biz-Custom	Food Sales	Retro	1,086	1,086	10%	109	0.00	7	\$50	25%	17%	17%	2	35%	15%	40.5%	36.1%	36.1%	2.8
451	Office_NonPC	Plug Load Occupancy Sensor	Biz-Custom	Food Sales	Retro	1,126	1,126	15%	169	0.00	8	\$70	50%	19%	19%	2	35%	15%	57.7%	38.8%	38.8%	3.1
452	Office_PC	Electrically Commutated Plug Fans in data centers	Biz-Custom	Food Sales	Retro	86,783	86,783	18%	15,778	0.00	15	\$480	100%	50%	50%	1	65%	20%	85.0%	83.6%	83.6%	36.4
453	Office_PC	Energy Star Server	Biz-Custom	Food Sales	ROB	1,621	1,621	23%	368	0.00	8	\$118	100%	25%	25%	1	65%	25%	85.0%	59.8%	59.8%	4.4
454	Office_PC	Server Virtualization	Biz-Custom	Food Sales	Retro	2	2	45%	1	0.00	8	\$0	100%	50%	50%	1	65%	25%	85.0%	75.5%	75.5%	3.1
455	Office_PC	High Efficiency CRAC unit	Biz-Custom	Food Sales	ROB	541	541	30%	162	0.00	15	\$63	100%	21%	21%	2	65%	20%	85.0%	51.4%	51.4%	7.2
456	Office_PC	Computer Room Air Conditioner Economizer	Biz-Custom	Food Sales	Retro	418	418	86%	358	0.00	15	\$82	100%	35%	35%	2	65%	20%	85.0%	66.6%	66.6%	4.8
457	Office_PC	Data Center Hot/Cold Aisle Configuration	Biz-Custom	Food Sales	Retro	4	4	25%	1	0.00	15	\$0	100%	50%	50%	3	3%	10%	85.0%	77.4%	77.4%	6.9
458	Office_PC	Energy Star Laptop	Biz-Custom	Food Sales	ROB	126	126	33%	41	0.00	4	\$0	0%			4	11%	85%	89.5%	88.0%	88.0%	0.0
459	Office_PC	Energy Star Monitor	Biz-Custom	Food Sales	Retro	72	72	21%	15	0.00	4	\$0	0%			5	25%	85%	89.5%	88.0%	88.0%	0.0
460	Refrigeration	Strip Curtains	Biz-Prescriptive	Food Sales	Retro	412	412	50%	206	0.00	4	\$10	100%	59%	59%	1	16%	30%	79.2%	77.8%	77.8%	6.6
461	Refrigeration	Bare Suction Line	Biz-Custom	Food Sales	Retro	23	23	93%	21	0.00	15	\$4	100%	42%	42%	2	1%	50%	79.2%	72.7%	72.7%	6.9
462	Refrigeration	Floating Head Pressure Controls	Biz-Custom	Food Sales	Retro	1,112	1,112	25%	278	0.00	15	\$431	5%	5%	5%	3	11%	25%	47.5%	39.9%	39.9%	4.8
463	Refrigeration	Saturated Suction Controls	Biz-Custom	Food Sales	Retro	831	831	50%	416	0.00	15	\$559	75%	6%	6%	4	2%	10%	68.0%	28.8%	28.8%	12.8
464	Refrigeration	Compressor Retrofit	Biz-Custom	Food Sales	Retro	813	813	20%	163	0.00	15	\$477	25%	3%	3%	5	37%	25%	47.5%	39.9%	39.9%	12.9
465	Refrigeration	Electronically Commutated (EC) Walk-In Evaporator Fan Motor	Biz-Prescriptive	Food Sales	Retro	2,440	2,440	65%	1,586	0.00	15	\$305	100%	13%	13%	6	10%	80%	86.0%	84.0%	84.0%	22.0
466	Refrigeration	Evaporator Fan Motor Controls	Biz-Prescriptive	Food Sales	Retro	1,912	1,912	25%	478	0.00	13	\$162	100%	62%	62%	7	10%	25%	79.2%	72.1%	72.1%	2.5
467	Refrigeration	Variable Speed Condenser Fan	Biz-Custom	Food Sales	Retro	2,960	2,960	50%	1,480	0.00	15	\$1,170	25%	10%	10%	8	14%	25%	47.5%	40.0%	40.0%	4.8
468	Refrigeration	Refrigeration Economizer	Biz-Custom	Food Sales	Retro	7	7	2%	0	0.00	10	\$0	100%	50%	50%	9	52%	10%	79.2%	69.9%	69.9%	3.3
469	Refrigeration	Anti-Sweat Heater Controls MT	Biz-Prescriptive	Food Sales	Retro	579	579	59%	338	0.00	10	\$100	100%	100%	100%	10	8%	75%	82.5%	80.0%	80.0%	1.2
470	Refrigeration	Auto Door Closer, Cooler	Biz-Prescriptive	Food Sales	Retro	471,500	471,500	0%	943	0.00	8	\$157	100%	70%	70%	11	6%	50%	79.2%	76.0%	76.0%	3.2
471	Refrigeration	Display Case Door Retrofit, Medium Temp	Biz-Custom	Food Sales	Retro	1,584	1,584	36%	578	0.00	12	\$686	25%	7%	7%	11	2%	25%	47.5%	40.0%	40.0%	6.6
472	Refrigeration	Electronically Commutated (EC) Reach-In Evaporator Fan Motor	Biz-Prescriptive	Food Sales	Retro	2,440	2,440	65%	1,586	0.00	15	\$305	100%	13%	13%	12	1%	80%	86.0%	84.0%	84.0%	22.0
473	Refrigeration	Q-Sync Motor for Walk-In and Reach-In Evaporator Fan Motor	Biz-Custom	Food Sales	Retro	1,911	1,911	26%	504	0.00	10	\$96	100%	42%	42%	12	1%	2%	79.2%	72.8%	72.8%	5.2
474	Refrigeration	Energy Star Reach-In Refrigerator, Glass Doors	Biz-Prescriptive	Food Sales	ROB	2,140	2,140	29%	629	0.00	12	\$1,239	6%	6%	6%	13	8%	54%	67.8%	63.2%	63.2%	4.2
475	Refrigeration	Energy Star Reach-In Refrigerator, Solid Doors	Biz-Prescriptive	Food Sales	ROB	1,410	1,410	20%	281	0.00	12	\$1,211	6%	6%	6%	14	8%	54%	67.8%	63.2%	63.2%	1.8
476	Refrigeration	Anti-Sweat Heater Controls LT	Biz-Prescriptive	Food Sales	Retro	2,016	2,016	68%	1,361	0.00	10	\$100	100%	100%	100%	15	3%	75%	82.5%	80.0%	80.0%	4.7
477	Refrigeration	Auto Door Closer, Freezer	Biz-Prescriptive	Food Sales	Retro	419,455	419,455	1%	2,307	0.00	8	\$157	100%	70%	70%	16	3%	50%	79.2%	77.9%	77.9%	7.7
478	Refrigeration	Display Case Door Retrofit, Low Temp	Biz-Custom	Food Sales	Retro	2,922	2,922	50%	1,453	0.00	12	\$686	100%	17%	17%	16	3%	25%	47.5%	51.7%	51.7%	6.6
479	Refrigeration	Energy Star Reach-In Freezer, Glass Doors	Biz-Prescriptive	Food Sales	ROB	6,374	6,374	20%	1,275	0.00	12	\$1,651	28%	28%	28%	17	3%	54%	67.8%	63.2%	63.2%	1.3
480	Refrigeration	Energy Star Reach-In Freezer, Solid Doors	Biz-Prescriptive	Food Sales	ROB	4,522	4,522	7%	305	0.00	12	\$1,521	13%	13%	13%	18	3%	54%	67.8%	63.2%	63.2%	0.7
481	Refrigeration	Refrigeration - Custom	Biz-Custom	Food Sales	ROB	7	7	2%	0	0.00	10	\$0	100%	50%	50%	19	90%	25%	79.2%	69.9%	69.9%	3.3
482	Refrigeration	Retro-commissioning_Refrigerator Optimization	Biz-Custom RCx	Food Sales	Retro	3	3	30%	1	0.00	5	\$0	100%	80%	80%	20	90%	25%	79.2%	76.5%	76.5%	1.5
483	Refrigeration	Energy Star Ice Machine	Biz-Prescriptive	Food Sales	ROB	6,993	6,993	10%	721	0.00	15	\$1,426	25%	18%	18%	21	0%	44%	60.8%	55.1%	55.1%	1.5
484	Refrigeration	Vending Machine Controller - Refrigerated	Biz-Prescriptive	Food Sales	Retro	1,586	1,586	34%	537	0.00	5	\$245	25%	16%	16%	22	0%	30%	51.0%	45.6%	45.6%	2.2
485	Refrigeration	LED Refrigerated Display Case Lighting Average 6W/LF	Biz-Prescriptive	Food Sales	Retro	273	273	89%	243	0.00	9	\$11	100%	45%	45%	23	5%	66%	79.2%	77.8%	77.8%	24.0
486	Refrigeration	LED Refrigerated Display Case Lighting Controls	Biz-Prescriptive	Food Sales	Retro	522	522	27%	141	0.00	10	\$14	100%	30%	30%	24	5%	13%	79.2%	75.4%	75.4%	18.9
487	Ventilation	Demand Controlled Ventilation	Biz-Custom	Food Sales	Retro	2,658	2,658	20%	532	0.00	15	\$227	100%	19%	19%	1	100%	22%	83.4%	59.6%	59.6%	11.4
488	Ventilation	Pump and Fan Variable Frequency Drive Controls (Fans)	Biz-Prescriptive	Food Sales	Retro	1,902	1,902	38%	731	0.00	15	\$200	100%	30%	30%	2	100%	22%	83.4%	66.4%	66.4%	8.5
489	WholeBldg_HVAC	HVAC - Energy Management System	Biz-Custom RCx	Food Sales	Retro	7	7	15%	1	0.00	15	\$0	100%	50%	50%	1	100%	20%	83.4%	72.9%	72.9%	7.6
490	WholeBldg_HVAC	Guest room energy management system	Biz-Prescriptive	Food Sales	Retro	0	0	0%	0	0.00	15	\$260	0%	77%	77%	2	100%	20%	83.4%	83.4%	83.4%	0.0
491	WholeBldg_HVAC	Retro-commissioning_Bld Optimization	Biz-Custom RCx	Food Sales	Retro	7	7	15%	1	0.00	15	\$0	100%	50%	50%	3	100%	0%	83.4%	72.9%	72.9%	7.6
492	WholeBuilding	WholeBldg - Com RET	Biz-Custom	Food Sales	Retro	7	7	15%	1	0.00	12	\$0	100%	50%	50%	1	100%	0%	83.4%	72.9%	72.9%	6.5
493	WholeBuilding	WholeBldg - Custom (Other)	Biz-Custom	Food Sales	Retro	5	5	20%	1	0.00	12	\$0	100%	50%	50%	2	100%	0%	83.4%	72.9%	72.9%	6.5
494	WholeBuilding	Power Distribution Equipment Upgrades (Transformers)	Biz-Custom	Food Sales	Retro	1,150	1,150	1%	6	0.00	30	\$8	75%	4%	4%	3	100%	20%	58.9%	36.0%	36.0%	21.2
495	WholeBldg_NC	WholeBldg - Com NC	Biz-Custom	Food Sales	NC	4	4	25%	1	0.00	12	\$0	100%	50%	50%	1	100%	60%	83.4%	72.0%	72.0%	5.7
496	Behavioral	COM Competitions	Biz-Custom	Food Sales	RET	0	0	0%	0	0.00	2	\$0	0%	48%	48%	1	100%	0%	90.0%	90.0%	90.0%	0.0
497	Behavioral	Business Energy Reports	Biz-Custom	Food Sales	RET	0	0	0%	0	0.00	2	\$0	0%	100%	100%	1	100%	0%	90.0%	90.0%	90.0%	0.0
498	Behavioral	Building Benchmarking	Biz-Custom	Food Sales	RET	0	0	0%	0	0.00	2	\$0	0%	77%	77%	1	100%	0%	90.0%	90.0%	90.0%	0.0
499	Behavioral	Strategic Energy Management	Biz-Custom SEM	Food Sales	RET	0	0	0%	0	0.00	5	\$0	0%	7%	7%	1	100%	0%	90.0%	90.0%	90.0%	0.0
500	Behavioral	BEIMS	Biz-Custom	Food Sales	RET	20	20	5%	1	0.00	2	\$0	39%	39%	39%	1	100%	2%	90.0%	90.0%	90.0%	0.4
501	Behavioral	Building Operator Certification	Biz-Custom	Food Sales	RET	10	10	2%	0	0.00	3	\$0	23%	23%	23%	1	100%	2%	90.0%	90.0%	90.0%	0.9
502	CompressedAir	Efficient Air Compressors (VSD)	Biz-Prescriptive	Food Service	ROB	1,583	1,583	21%	329	0.00	13	\$127	100%	47%	47%	1	100%	33%	83.4%	69.0%	69.0%	5.2
503	CompressedAir	Efficient Air Nozzles	Biz-Prescriptive	Food Service	RET	1,480	1,480	50%	740	0.00	15	\$50	100%	40%	40%	2	35%	33%	83.4%	78.4%	78.4%	22.7
504	CompressedAir	AODD Pump Controls	Biz-Custom	Food Service	Retro	103,919	103,919	35%	36,372	0.00	10	\$1,150	100%	50%	50%	3	10%	33%	83.4%	81.4%	81.4%	28.9

Appendix C: C&I Measure Assumptions

Measure #	End-Use	Measure Name	Program	Building Type	Replacement Type	Base (Existing) Annual Electric	Base (Standard) Annual Electric	% Elec Savings	Per Unit Elec Savings	Per Unit Summer kW	EE EUL	Measure Cost	MAP Incentive (%)	RAP Incentive (%)	PP Incentive (%)	End Use Measure Group	Base Saturation	EE Saturation	MAP Adoption Rate	RAP Adoption Rate	PP Adoption Rate	UCT Score
505	CompressedAir	Compressed Air - Custom	Biz-Custom	Food Service	Retro	5	5	20%	1	0.00	10	\$0	100%	38%	38%	4	50%	33%	83.4%	69.6%	69.6%	5.7
506	CompressedAir	Retro-commissioning_Compresed Air Optimization	Biz-Custom RCx	Food Service	Retro	3	3	30%	1	0.00	5	\$0	100%	80%	80%	5	50%	33%	83.4%	78.1%	78.1%	1.5
507	Cooking	Commercial Combination Oven (Electric)	Biz-Prescriptive	Food Service	ROB	38,561	38,561	48%	18,432	0.00	12	\$16,884	50%	6%	6%	1	18%	53%	67.1%	62.4%	62.4%	10.5
508	Cooking	Commercial Electric Convection Oven	Biz-Prescriptive	Food Service	ROB	12,193	12,193	15%	1,879	0.00	12	\$1,706	50%	23%	23%	1	18%	53%	67.1%	62.4%	62.4%	2.9
509	Cooking	Commercial Electric Griddle	Biz-Prescriptive	Food Service	ROB	17,056	17,056	15%	2,596	0.00	12	\$3,604	25%	22%	22%	2	14%	17%	41.9%	33.6%	33.6%	1.4
510	Cooking	Commercial Electric Steam Cooker	Biz-Prescriptive	Food Service	ROB	19,549	19,549	67%	13,162	0.00	12	\$3,300	100%	27%	27%	3	6%	45%	79.2%	71.0%	71.0%	9.0
511	Cooking	Dishwasher Low Temp Door (Energy Star)	Biz-Prescriptive	Food Service	ROB	39,306	39,306	44%	17,369	0.00	15	\$662	100%	76%	76%	4	26%	61%	79.2%	78.5%	78.5%	16.4
512	Cooking	Dishwasher High Temp Door (Energy Star)	Biz-Prescriptive	Food Service	ROB	26,901	26,901	32%	8,586	0.00	15	\$995	100%	50%	50%	4	26%	61%	79.2%	75.0%	75.0%	8.1
513	Cooking	Energy efficient electric fryer	Biz-Prescriptive	Food Service	ROB	18,955	18,955	17%	3,274	0.00	12	\$1,500	75%	5%	5%	5	27%	24%	72.2%	45.6%	45.6%	17.0
514	Cooking	Insulated Holding Cabinets (Full Size)	Biz-Custom	Food Service	ROB	13,697	13,697	68%	9,314	0.00	12	\$1,200	100%	62%	62%	6	3%	16%	79.2%	75.7%	75.7%	5.3
515	Cooking	Insulated Holding Cabinets (Half-Size)	Biz-Custom	Food Service	ROB	4,383	4,383	60%	2,630	0.00	12	\$1,500	50%	14%	14%	6	3%	16%	58.5%	42.3%	42.3%	5.3
516	Cooling	Air Conditioner - 13 IEER (5-20 Tons)	Biz-Prescriptive	Food Service	ROB	1,252	1,252	6%	77	0.00	15	\$63	100%	79%	79%	1	18%	20%	83.4%	69.9%	69.9%	2.3
517	Cooling	Air Conditioner - 14 IEER (5-20 Tons)	Biz-Prescriptive	Food Service	ROB	1,252	1,252	13%	161	0.00	15	\$127	100%	39%	39%	1	18%	20%	83.4%	50.6%	50.6%	4.7
518	Cooling	Air Conditioner - 17 IEER (5-20 Tons)	Biz-Prescriptive	Food Service	ROB	1,252	1,252	28%	354	0.00	15	\$127	100%	39%	39%	1	18%	20%	83.4%	67.3%	67.3%	10.3
519	Cooling	Air Conditioner - 21 IEER (5-20 Tons)	Biz-Prescriptive	Food Service	ROB	1,252	1,252	42%	525	0.00	15	\$127	100%	39%	39%	1	18%	20%	83.4%	71.1%	71.1%	15.4
520	Cooling	Air Conditioner - 12.1 IEER (20+ Tons)	Biz-Prescriptive	Food Service	ROB	1,340	1,340	6%	78	0.00	15	\$50	100%	100%	100%	2	18%	20%	83.4%	83.4%	83.4%	2.3
521	Cooling	Air Conditioner - 13 IEER (20+ Tons)	Biz-Prescriptive	Food Service	ROB	1,340	1,340	12%	165	0.00	15	\$50	100%	100%	100%	2	18%	20%	83.4%	83.4%	83.4%	4.8
522	Cooling	Air Conditioner - 14.3 IEER (20+ Tons)	Biz-Prescriptive	Food Service	ROB	1,340	1,340	20%	272	0.00	15	\$50	100%	100%	100%	2	18%	20%	83.4%	83.4%	83.4%	8.0
523	Cooling	Air Conditioner - 21 IEER (20+ Tons)	Biz-Prescriptive	Food Service	ROB	1,340	1,340	46%	613	0.00	15	\$50	100%	100%	100%	2	18%	20%	83.4%	83.4%	83.4%	17.9
524	Cooling	Comprehensive Rooftop Unit Quality Maintenance (AC Tune-up)	Biz-Custom	Food Service	Retro	1,273	1,273	7%	89	0.00	3	\$5	100%	50%	50%	3	36%	50%	83.4%	80.5%	80.5%	12.8
525	Cooling	Air Side Economizer	Biz-Custom	Food Service	Retro	1,252	1,252	20%	250	0.00	10	\$84	75%	24%	24%	4	36%	20%	71.2%	53.1%	53.1%	3.8
526	Cooling	Advanced Rooftop Controls	Biz-Prescriptive	Food Service	Retro	1,273	1,273	2%	26	0.00	10	\$98	26%	26%	26%	5	36%	20%	44.0%	36.0%	36.0%	0.3
527	Cooling	HVAC Occupancy Controls	Biz-Custom	Food Service	ROB	2,900	2,900	20%	580	0.00	15	\$537	75%	9%	9%	6	36%	20%	63.0%	36.0%	36.0%	11.3
528	Cooling	Air Conditioner - 16 SEER (<5 Tons)	Biz-Prescriptive	Food Service	ROB	1,091	1,091	13%	136	0.00	15	\$50	100%	100%	100%	7	28%	20%	83.4%	83.4%	83.4%	4.0
529	Cooling	Air Conditioner - 17 SEER (<5 Tons)	Biz-Prescriptive	Food Service	ROB	1,091	1,091	18%	193	0.00	15	\$206	100%	24%	24%	7	28%	20%	83.4%	40.2%	40.2%	5.6
530	Cooling	Air Conditioner - 18 SEER (<5 Tons)	Biz-Prescriptive	Food Service	ROB	1,091	1,091	22%	242	0.00	15	\$206	100%	24%	24%	7	28%	20%	83.4%	44.5%	44.5%	7.1
531	Cooling	Air Conditioner - 21 SEER (<5 Tons)	Biz-Prescriptive	Food Service	ROB	1,091	1,091	33%	364	0.00	15	\$253	100%	20%	20%	7	28%	20%	83.4%	46.8%	46.8%	10.6
532	Cooling	Smart Thermostat	Biz-Prescriptive	Food Service	ROB	1,091	1,091	14%	155	0.00	11	\$175	50%	26%	26%	8	28%	12%	42.2%	33.7%	33.7%	2.4
533	Cooling	PTAC - <7,000 Btu/h - Lodging	Biz-Prescriptive	Food Service	ROB	1,284	1,284	8%	109	0.00	8	\$84	100%	42%	42%	9	0%	20%	83.4%	51.0%	51.0%	2.6
534	Cooling	PTAC - 7,000 to 15,000 Btu/h - Lodging	Biz-Prescriptive	Food Service	ROB	1,408	1,408	7%	102	0.00	8	\$84	100%	42%	42%	10	0%	20%	83.4%	49.0%	49.0%	2.4
535	Cooling	PTAC - >15,000 Btu/h - Lodging	Biz-Prescriptive	Food Service	ROB	1,608	1,608	10%	153	0.00	8	\$84	100%	42%	42%	11	0%	20%	83.4%	60.6%	60.6%	3.7
536	Cooling	Air Cooled Chiller	Biz-Prescriptive	Food Service	ROB	1,115	1,115	6%	63	0.00	23	\$126	100%	40%	40%	12	36%	15%	83.4%	34.1%	34.1%	3.0
537	Cooling	Chiller Tune-up	Biz-Custom	Food Service	Retro	1,273	1,273	7%	89	0.00	3	\$5	100%	50%	50%	3	36%	50%	83.4%	80.5%	80.5%	12.8
538	Cooling	HVAC/Chiller Custom	Biz-Custom	Food Service	Retro	5	5	20%	1	0.00	20	\$1	100%	6%	6%	14	100%	20%	83.4%	36.0%	36.0%	28.4
539	Cooling	Window Film	Biz-Custom	Food Service	Retro	6,000	6,000	4%	264	0.00	10	\$154	100%	14%	14%	15	100%	20%	83.4%	47.2%	47.2%	11.9
540	Cooling	Triple Pane Windows	Biz-Custom	Food Service	ROB	6,000	6,000	6%	360	0.00	25	\$700	75%	4%	4%	15	100%	20%	47.7%	36.0%	36.0%	22.0
541	Cooling	Energy Recovery Ventilator	Biz-Custom	Food Service	Retro	1,340	1,340	0%	0	0.00	15	\$1,500	0%	0%	0%	16	100%	2%	83.4%	83.4%	83.4%	0.0
542	Heating	Heat Pump - 16 SEER (<5 Tons)	Biz-Prescriptive	Food Service	ROB	2,626	2,626	4%	99	0.00	16	\$87	100%	57%	57%	1	34%	20%	83.4%	59.3%	59.3%	1.9
543	Heating	Heat Pump - 17 SEER (<5 Tons)	Biz-Prescriptive	Food Service	ROB	2,626	2,626	8%	222	0.00	16	\$442	25%	11%	11%	1	34%	20%	44.0%	36.0%	36.0%	3.8
544	Heating	Heat Pump - 18 SEER (<5 Tons)	Biz-Prescriptive	Food Service	ROB	2,626	2,626	12%	319	0.00	16	\$507	50%	10%	10%	1	34%	20%	44.0%	36.0%	36.0%	5.4
545	Heating	Heat Pump - 21 SEER (<5 Tons)	Biz-Prescriptive	Food Service	ROB	2,626	2,626	18%	484	0.00	16	\$507	75%	10%	10%	1	34%	20%	64.7%	36.3%	36.3%	8.4
546	Heating	Geothermal HP - SEER 20.3 (<5 Tons)	Biz-Prescriptive	Food Service	ROB	2,626	2,626	22%	587	0.00	25	\$2,576	14%	14%	14%	1	34%	20%	44.0%	36.0%	36.0%	1.7
547	Heating	Geothermal HP - SEER 21.5 (<5 Tons)	Biz-Prescriptive	Food Service	ROB	2,626	2,626	27%	701	0.00	25	\$2,576	25%	14%	14%	1	34%	20%	44.0%	36.0%	36.0%	1.9
548	Heating	Geothermal HP - SEER 23.1 (<5 Tons)	Biz-Prescriptive	Food Service	ROB	2,626	2,626	32%	835	0.00	25	\$2,576	25%	14%	14%	1	34%	20%	44.0%	36.0%	36.0%	2.2
549	Heating	Geothermal HP - SEER 29.3 (<5 Tons)	Biz-Prescriptive	Food Service	ROB	2,626	2,626	47%	1,223	0.00	25	\$2,576	25%	14%	14%	1	34%	20%	44.0%	36.0%	36.0%	2.9
550	Heating	Heat Pump - 14.0 IEER COP 3.6 (65,000-134,000 Btu/hr)	Biz-Prescriptive	Food Service	ROB	3,157	3,157	11%	339	0.00	16	\$100	100%	50%	50%	2	22%	20%	83.4%	78.5%	78.5%	20.5
551	Heating	Heat Pump - 15.0 IEER COP 3.8 (65,000-134,000 Btu/hr)	Biz-Prescriptive	Food Service	ROB	3,157	3,157	16%	503	0.00	16	\$136	100%	37%	37%	2	22%	20%	83.4%	76.1%	76.1%	23.1
552	Heating	Heat Pump - 14.5 IEER COP 3.5 (135,000-239,000 Btu/hr)	Biz-Prescriptive	Food Service	ROB	3,283	3,283	14%	453	0.00	16	\$100	100%	35%	35%	2	22%	20%	83.4%	77.8%	77.8%	33.3
553	Heating	Heat Pump - 15.5 IEER COP 3.7 (135,000-239,000 Btu/hr)	Biz-Prescriptive	Food Service	ROB	3,283	3,283	19%	617	0.00	16	\$139	100%	25%	25%	2	22%	20%	83.4%	75.6%	75.6%	36.9
554	Heating	Geothermal HP - SEER 20.3 (5-20 Tons)	Biz-Prescriptive	Food Service	ROB	2,881	2,881	29%	842	0.00	25	\$2,576	25%	14%	14%	2	22%	20%	44.0%	36.0%	36.0%	3.4
555	Heating	Geothermal HP - SEER 21.5 (5-20 Tons)	Biz-Prescriptive	Food Service	ROB	2,881	2,881	33%	956	0.00	25	\$2,576	25%	14%	14%	2	22%	20%	44.0%	36.0%	36.0%	3.6
556	Heating	Geothermal HP - SEER 23.1 (5-20 Tons)	Biz-Prescriptive	Food Service	ROB	3,042	3,042	41%	1,250	0.00	25	\$2,576	50%	14%	14%	2	22%	20%	44.0%	36.0%	36.0%	4.2
557	Heating	Geothermal HP - SEER 29.3 (5-20 Tons)	Biz-Prescriptive	Food Service	ROB	3,042	3,042	54%	1,638	0.00	25	\$2,576	50%	14%	14%	2	22%	20%	44.0%	36.0%	36.0%	4.9
558	Heating	Variable Refrigerant Flow Heat Pump	Biz-Custom	Food Service	ROB	2,433	2,433	12%	291	0.00	16	\$224	100%	16%	16%	2	22%	2%	83.4%	47.9%	47.9%	9.8
559	Heating	Heat Pump - 12 IEER 3.4 COP (>239																				

Appendix C: C&I Measure Assumptions

Measure #	End-Use	Measure Name	Program	Building Type	Replacement Type	Base (Existing) Annual Electric	Base (Standard) Annual Electric	% Elec Savings	Per Unit Elec Savings	Per Unit Summer kW	EE EUL	Measure Cost	MAP Incentive (%)	RAP Incentive (%)	PP Incentive (%)	End Use Measure Group	Base Saturation	EE Saturation	MAP Adoption Rate	RAP Adoption Rate	PP Adoption Rate	UCT Score
570	HotWater	Hot Water Pipe Insulation	Biz-Custom	Food Service	Retro	5,521	5,521	2%	110	0.00	20	\$60	100%	15%	15%	2	100%	80%	86.0%	84.0%	84.0%	8.4
571	HotWater	Faucet Aerator	Biz-Prescriptive	Food Service	Retro	973	973	32%	315	0.00	10	\$8	100%	100%	100%	3	20%	90%	93.0%	92.0%	92.0%	17.1
572	HotWater	Low Flow Pre-Rinse Sprayers	Biz-Custom	Food Service	ROB	18,059	18,059	54%	9,789	0.00	5	\$75	100%	100%	100%	4	20%	80%	86.0%	84.0%	84.0%	22.1
573	HotWater	ENERGY STAR Commercial Washing Machines	Biz-Prescriptive	Food Service	ROB	1,552	1,552	43%	671	0.00	7	\$250	50%	18%	18%	5	25%	32%	60.3%	45.6%	45.6%	3.7
574	InteriorLighting	LED T8 Tube Replacement	Biz-Prescriptive Light	Food Service	Retro	206	206	45%	92	0.00	9	\$3	100%	100%	100%	1	52%	38%	85.0%	85.0%	85.0%	14.2
575	InteriorLighting	LED troffer retrofit kit, 2'X2' and 2'X4'	Biz-Prescriptive Light	Food Service	Retro	467	467	50%	234	0.00	9	\$70	100%	43%	43%	1	52%	38%	85.0%	69.8%	69.8%	3.6
576	InteriorLighting	LED troffer, 2'X2' and 2'X4'	Biz-Prescriptive Light	Food Service	Retro	467	467	50%	234	0.00	9	\$70	100%	79%	79%	1	52%	38%	85.0%	79.6%	79.6%	2.0
577	InteriorLighting	Bi-Level Lighting Fixture – Stairwells, Hallways	Biz-Custom Light	Food Service	Retro	467	467	74%	347	0.00	10	\$274	29%	29%	29%	2	6%	38%	56.4%	50.2%	50.2%	1.4
578	InteriorLighting	LED high bay fixture	Biz-Prescriptive Light	Food Service	Retro	4,346	4,346	68%	2,957	0.00	9	\$330	100%	45%	45%	3	0%	19%	85.0%	79.9%	79.9%	9.1
579	InteriorLighting	LED Mogul-base HID Lamp Replacing High Bay HID	Biz-Prescriptive Light	Food Service	Retro	4,346	4,346	66%	2,883	0.00	9	\$330	100%	45%	45%	3	0%	19%	85.0%	79.8%	79.8%	8.9
580	InteriorLighting	LED low bay fixture	Biz-Prescriptive Light	Food Service	Retro	926	926	61%	563	0.00	9	\$75	100%	100%	100%	4	0%	19%	85.0%	85.0%	85.0%	3.5
581	InteriorLighting	LED Mogul-base HID Lamp Replacing Low Bay HID	Biz-Prescriptive Light	Food Service	Retro	926	926	59%	543	0.00	9	\$75	100%	100%	100%	4	0%	19%	85.0%	85.0%	85.0%	3.3
582	InteriorLighting	LED Screw-In Lamps (Directional)	Biz-Prescriptive Light	Food Service	ROB	415	415	86%	356	0.00	4	\$1	100%	100%	100%	5	4%	13%	85.0%	85.0%	85.0%	87.6
583	InteriorLighting	LED downlight fixture	Biz-Prescriptive Light	Food Service	Retro	320	320	68%	216	0.00	9	\$27	100%	37%	37%	6	38%	13%	85.0%	78.4%	78.4%	10.0
584	InteriorLighting	LED Screw-In Lamps (Omnidirectional & Decorative)	Biz-Prescriptive Light	Food Service	ROB	314	314	81%	254	0.00	4	\$1	100%	100%	100%	6	38%	13%	85.0%	85.0%	85.0%	62.4
585	InteriorLighting	DeLamp Fluorescent Fixture Average Lamp Wattage 28W	Biz-Prescriptive Light	Food Service	Retro	172	172	100%	172	0.00	11	\$4	100%	25%	25%	7	52%	0%	85.0%	83.6%	83.6%	91.5
586	InteriorLighting	Occupancy Sensors	Biz-Prescriptive Light	Food Service	Retro	785	785	30%	235	0.00	10	\$65	100%	20%	20%	8	95%	10%	85.0%	57.0%	57.0%	5.9
587	InteriorLighting	Daylighting Controls	Biz-Prescriptive Light	Food Service	Retro	1,005	1,005	30%	301	0.00	10	\$58	100%	34%	34%	8	95%	10%	85.0%	73.6%	73.6%	7.3
588	InteriorLighting	Dual Occupancy & Daylighting Controls	Biz-Custom Light	Food Service	Retro	448	448	44%	197	0.00	10	\$75	100%	26%	26%	8	95%	10%	85.0%	58.0%	58.0%	5.0
589	InteriorLighting	Central Lighting Monitoring & Controls (non-networked)	Biz-Custom Light	Food Service	Retro	41,703	41,703	20%	8,341	0.00	12	\$3,700	75%	18%	18%	8	95%	10%	71.5%	37.1%	37.1%	4.2
590	InteriorLighting	Network Lighting Controls - Wireless (WiFi)	Biz-Prescriptive Light	Food Service	Retro	4	4	49%	2	0.00	15	\$1	100%	42%	42%	8	95%	10%	85.0%	68.0%	68.0%	4.8
591	InteriorLighting	Luminaire Level Lighting Controls w/ HVAC Control	Biz-Custom Light	Food Service	Retro	448	448	65%	291	0.00	15	\$90	100%	21%	21%	8	58%	10%	85.0%	62.7%	62.7%	10.4
592	InteriorLighting	LED Exit Sign - 4 Watt Fixture (2 lamp)	Biz-Prescriptive Light	Food Service	Retro	66	66	43%	28	0.00	5	\$33	31%	31%	31%	9	1%	75%	82.5%	80.0%	80.0%	0.7
593	InteriorLighting	Lighting - Custom	Biz-Custom Light	Food Service	Retro	4	4	25%	1	0.00	15	\$0	100%	50%	50%	10	100%	0%	85.0%	79.1%	79.1%	9.5
594	ExteriorLighting	LED wallpack (existing W<250)	Biz-Prescriptive Light	Food Service	Retro	856	856	66%	567	0.00	12	\$248	50%	46%	46%	1	12%	44%	60.8%	55.2%	55.2%	1.6
595	ExteriorLighting	LED parking lot fixture (existing W<250)	Biz-Prescriptive Light	Food Service	Retro	1,589	1,589	60%	959	0.00	12	\$756	25%	20%	20%	2	11%	44%	60.8%	55.2%	55.2%	2.0
596	ExteriorLighting	LED parking lot fixture (existing W<250)	Biz-Prescriptive Light	Food Service	Retro	856	856	66%	567	0.00	12	\$248	50%	30%	30%	3	11%	44%	60.8%	55.2%	55.2%	2.4
597	ExteriorLighting	LED outdoor pole decorative fixture (existing W<250)	Biz-Prescriptive Light	Food Service	Retro	1,589	1,589	60%	959	0.00	12	\$756	25%	20%	20%	4	11%	44%	60.8%	55.2%	55.2%	2.0
598	ExteriorLighting	LED parking garage fixture (existing W<250)	Biz-Prescriptive Light	Food Service	Retro	3,235	3,235	60%	1,953	0.00	6	\$756	25%	13%	13%	5	11%	44%	60.8%	55.2%	55.2%	3.7
599	ExteriorLighting	LED parking garage fixture (existing W<250)	Biz-Prescriptive Light	Food Service	Retro	1,742	1,742	66%	1,154	0.00	6	\$248	75%	32%	32%	6	11%	44%	78.8%	67.1%	67.1%	2.7
600	ExteriorLighting	LED Mogul-base HID Lamp Replacing Exterior HID (existing W<250)	Biz-Prescriptive Light	Food Service	Retro	1,589	1,589	60%	959	0.00	12	\$756	25%	20%	20%	7	11%	44%	60.8%	55.2%	55.2%	2.0
601	ExteriorLighting	LED Mogul-base HID Lamp Replacing Exterior HID (existing W<250)	Biz-Prescriptive Light	Food Service	Retro	856	856	66%	567	0.00	12	\$248	50%	30%	30%	8	11%	44%	60.8%	55.2%	55.2%	2.4
602	ExteriorLighting	Bi-Level Lighting Fixture – Garages	Biz-Prescriptive Light	Food Service	Retro	467	467	69%	322	0.00	10	\$274	29%	29%	29%	9	11%	44%	60.8%	55.2%	55.2%	1.1
603	ExteriorLighting	LED fuel pump canopy fixture (existing W<250)	Biz-Prescriptive Light	Food Service	Retro	0	0	0%	0	0.00	12	\$0	0%	0%	0%	10	0%	44%	85.0%	85.0%	85.0%	0.0
604	ExteriorLighting	LED fuel pump canopy fixture (existing W<250)	Biz-Prescriptive Light	Food Service	Retro	0	0	0%	0	0.00	12	\$0	0%	0%	0%	11	0%	44%	85.0%	85.0%	85.0%	0.0
605	Miscellaneous	Vending Machine Controller - Non-Refrigerated	Biz-Prescriptive	Food Service	Retro	385	385	61%	237	0.00	5	\$233	17%	17%	17%	1	5%	30%	51.0%	44.0%	44.0%	1.0
606	Miscellaneous	Miscellaneous Custom	Biz-Custom	Food Service	Retro	7	7	2%	0	0.00	10	\$0	100%	50%	50%	2	30%	10%	85.0%	64.5%	64.5%	3.3
607	Miscellaneous	Kitchen Exhaust Hood Demand Ventilation Control System	Biz-Custom	Food Service	ROB	9,932	9,932	50%	4,966	0.00	20	\$1,183	100%	34%	34%	3	18%	10%	85.0%	69.8%	69.8%	8.8
608	Miscellaneous	High Efficiency Hand Dryers	Biz-Custom	Food Service	Retro	1,909	1,909	83%	1,585	0.00	10	\$483	100%	26%	26%	4	5%	10%	85.0%	64.5%	64.5%	6.1
609	Miscellaneous	Ozone Commercial Laundry	Biz-Custom	Food Service	Retro	2,984	2,984	25%	746	0.00	10	\$20,310	0%	0%	0%	5	0%	2%	31.4%	17.2%	17.2%	3.6
610	Miscellaneous	ENERGY STAR Uninterrupted Power Supply	Biz-Custom	Food Service	ROB	3,096	3,096	3%	85	0.00	15	\$59	75%	12%	12%	6	20%	70%	79.0%	76.0%	76.0%	8.0
611	Motors	Cogged V-Belt	Biz-Custom	Food Service	Retro	17,237	17,237	3%	534	0.00	15	\$384	75%	11%	11%	1	50%	10%	66.9%	40.6%	40.6%	8.5
612	Motors	Pump and Fan Variable Frequency Drive Controls (Pumps)	Biz-Custom	Food Service	Retro	1,902	1,902	38%	731	0.00	15	\$200	100%	30%	30%	2	100%	10%	83.4%	66.7%	66.7%	8.5
613	Motors	Power Drive Systems	Biz-Custom	Food Service	Retro	4	4	23%	1	0.00	15	\$0	100%	31%	31%	2	100%	10%	83.4%	66.3%	66.3%	8.0
614	Motors	Switch Reluctance Motors	Biz-Custom	Food Service	Retro	33,406	33,406	31%	10,222	0.00	15	\$869	100%	100%	100%	2	100%	1%	83.4%	83.4%	83.4%	5.8
615	Motors	Escalators Motor Efficiency Controllers	Biz-Custom	Food Service	Retro	7,500	7,500	20%	1,500	0.00	10	\$5,000	2%	2%	2%	3	0%	10%	37.0%	28.0%	28.0%	7.1
616	Office_NonPC	Energy Star Printer/Copier/Fax	Biz-Custom	Food Service	ROB	551	551	40%	223	0.00	6	\$0	0%	0%	0%	1	30%	90%	93.0%	92.0%	92.0%	0.0
617	Office_NonPC	Smart Power Strip – Commercial Use	Biz-Custom	Food Service	Retro	1,086	1,086	10%	109	0.00	7	\$50	25%	17%	17%	2	35%	15%	40.5%	36.1%	36.1%	2.7
618	Office_NonPC	Plug Load Occupancy Sensor	Biz-Custom	Food Service	Retro	1,126	1,126	15%	169	0.00	8	\$70	50%	19%	19%	2	35%	15%	57.7%	38.8%	38.8%	3.0
619	Office_PC	Electrically Commutated Plug Fans in data centers	Biz-Custom	Food Service	Retro	86,783	86,783	18%	15,778	0.00	15	\$480	100%	50%	50%	1	65%	20%	85.0%	83.6%	83.6%	36.2
620	Office_PC	Energy Star Server	Biz-Custom	Food Service	ROB	1,621	1,621	23%	368	0.00	8	\$118	100%	25%	25%	1	65%	25%	85.0%	59.8%	59.8%	4.3
621	Office_PC	Server Virtualization	Biz-Custom	Food Service	Retro	2	2	45%	1	0.00	8	\$0	100%	50%	50%	1	65%	25%	85.0%	75.5%	75.5%	3.0
622	Office_PC	High Efficiency CRAC unit	Biz-Custom	Food Service	ROB	541	541	30%	162	0.00	15	\$63	100%	21%	21%	2	65%	20%	85.0%	51.4%	51.4%	7.2
623	Office_PC	Computer Room Air Conditioner Economizer	Biz-Custom	Food Service	Retro	418	418	86%	358	0.00	15	\$82	100%	35%	35%	2	65%	20%	85.0%	66.6%	66.6%	4.8
624	Office_PC	Data Center Hot/Cold Aisle Configuration	Biz-Custom	Food Service	Retro	4	4	25%	1	0.00	15	\$0	100%	50%	50%	3	3%	10%	85.0%	77.4%	77.4%	6.9
625	Office_PC	Energy Star Laptop	Biz-Custom	Food Service	ROB	126	126	33%	41	0.00	4	\$0	0%	0%	0%	4	11%	85%	89.5%	88.0%	88.0%	0.0
626	Office_PC	Energy Star Monitor	Biz-Custom	Food Service	ROB	72	72	21%	15	0.00	4	\$0	0%	0%	0%	5	25%	85%	89.5%	88.0%	88.0%	0.0
627	Refrigeration	Strip Curtains	Biz-Prescriptive	Food Service	Retro	88	88	50%	44	0.00	4	\$10	75%	59%	59%	1	6%	30%	75.2%	73.2%	73.2%	1.4
628	Refrigeration	Bare Suction Line	Biz-Custom	Food Service	Retro	23	23	93%	21	0.00	15	\$4	100%	42%	42%	2	0%	50%	79.2%	72.6%	72.6%	7.0
629	Refrigeration	Floating Head Pressure Controls	Biz-Custom	Food Service	Retro	1,112	1,112	25%	278	0.00	15	\$431	25%	5%	5%	3	4%	25%	47.5%	39.9%	39.9%	4.9
630	Refrigeration	Saturated Suction Controls	Biz-Custom	Food Service	Retro	831	831	50%	416	0.00	15	\$559	75%	6%	6%	4	2%	10%	66.5%	28.1%	28.1%	12.8

Appendix C: C&I Measure Assumptions

Measure #	End-Use	Measure Name	Program	Building Type	Replacement Type	Base (Existing) Annual Electric	Base (Standard) Annual Electric	% Elec Savings	Per Unit Elec Savings	Per Unit Summer kW	EE EUL	Measure Cost	MAP Incentive (%)	RAP Incentive (%)	PP Incentive (%)	End Use Measure Group	Base Saturation	EE Saturation	MAP Adoption Rate	RAP Adoption Rate	PP Adoption Rate	UCT Score
631	Refrigeration	Compressor Retrofit	Biz-Custom	Food Service	Retro	813	813	20%	163	0.00	15	\$477	25%	3%	3%	5	13%	25%	47.5%	39.9%	39.9%	12.9
632	Refrigeration	Electronically Commutated (EC) Walk-In Evaporator Fan Motor	Biz-Prescriptive	Food Service	Retro	2,440	2,440	65%	1,586	0.00	15	\$305	100%	13%	13%	6	4%	80%	86.0%	84.0%	84.0%	22.1
633	Refrigeration	Evaporator Fan Motor Controls	Biz-Custom	Food Service	Retro	1,912	1,912	25%	478	0.00	13	\$162	100%	62%	62%	7	4%	25%	79.2%	71.9%	71.9%	2.5
634	Refrigeration	Variable Speed Condenser Fan	Biz-Custom	Food Service	Retro	2,960	2,960	50%	1,480	0.00	15	\$1,170	25%	10%	10%	8	5%	25%	47.5%	40.0%	40.0%	4.9
635	Refrigeration	Refrigeration Economizer	Biz-Custom	Food Service	Retro	7	7	2%	0	0.00	10	\$0	100%	50%	50%	9	18%	10%	79.2%	69.2%	69.2%	3.3
636	Refrigeration	Anti-Sweat Heater Controls MT	Biz-Prescriptive	Food Service	Retro	579	579	59%	338	0.00	10	\$100	100%	100%	100%	10	18%	75%	82.5%	80.0%	80.0%	1.2
637	Refrigeration	Auto Door Closer, Cooler	Biz-Prescriptive	Food Service	Retro	471,500	471,500	0%	943	0.00	8	\$157	100%	70%	70%	11	13%	50%	79.2%	75.9%	75.9%	3.3
638	Refrigeration	Display Case Door Retrofit, Medium Temp	Biz-Custom	Food Service	Retro	1,584	1,584	36%	578	0.00	12	\$686	25%	7%	7%	11	5%	25%	47.5%	40.0%	40.0%	6.7
639	Refrigeration	Electronically Commutated (EC) Reach-In Evaporator Fan Motor	Biz-Prescriptive	Food Service	Retro	2,440	2,440	65%	1,586	0.00	15	\$305	100%	13%	13%	12	3%	80%	86.0%	84.0%	84.0%	22.1
640	Refrigeration	Q-Sync Motor for Walk-In and Reach-In Evaporator Fan Motor	Biz-Custom	Food Service	Retro	1,911	1,911	26%	504	0.00	10	\$96	100%	42%	42%	12	3%	2%	79.2%	72.7%	72.7%	5.2
641	Refrigeration	Energy Star Reach-In Refrigerator, Glass Doors	Biz-Prescriptive	Food Service	ROB	2,140	2,140	29%	629	0.00	12	\$1,239	6%	6%	6%	13	18%	54%	67.8%	63.2%	63.2%	4.2
642	Refrigeration	Energy Star Reach-In Refrigerator, Solid Doors	Biz-Prescriptive	Food Service	ROB	1,410	1,410	20%	281	0.00	12	\$1,211	6%	6%	6%	14	18%	54%	67.8%	63.2%	63.2%	1.8
643	Refrigeration	Anti-Sweat Heater Controls LT	Biz-Prescriptive	Food Service	Retro	2,016	2,016	68%	1,361	0.00	10	\$100	100%	100%	100%	15	6%	75%	82.5%	80.0%	80.0%	4.7
644	Refrigeration	Auto Door Closer, Freezer	Biz-Prescriptive	Food Service	Retro	419,455	419,455	1%	2,307	0.00	8	\$157	100%	70%	70%	16	6%	50%	79.2%	77.8%	77.8%	7.7
645	Refrigeration	Display Case Door Retrofit, Low Temp	Biz-Custom	Food Service	Retro	2,922	2,922	50%	1,453	0.00	12	\$686	100%	17%	17%	16	6%	25%	79.2%	50.8%	50.8%	6.7
646	Refrigeration	Energy Star Reach-In Freezer, Glass Doors	Biz-Prescriptive	Food Service	ROB	6,374	6,374	20%	1,275	0.00	12	\$1,651	28%	28%	28%	17	6%	54%	67.8%	63.2%	63.2%	1.3
647	Refrigeration	Energy Star Reach-In Freezer, Solid Doors	Biz-Prescriptive	Food Service	ROB	4,522	4,522	7%	305	0.00	12	\$1,521	13%	13%	13%	18	6%	54%	67.8%	63.2%	63.2%	0.7
648	Refrigeration	Refrigeration - Custom	Biz-Custom	Food Service	ROB	7	7	2%	0	0.00	10	\$0	100%	50%	50%	19	90%	25%	79.2%	69.2%	69.2%	3.3
649	Refrigeration	Retro-commissioning_Refrigerator Optimization	Biz-Custom RCx	Food Service	Retro	3	3	30%	1	0.00	5	\$0	100%	80%	80%	20	90%	25%	79.2%	76.5%	76.5%	1.5
650	Refrigeration	Energy Star Ice Machine	Biz-Prescriptive	Food Service	ROB	6,993	6,993	10%	721	0.00	15	\$1,426	25%	18%	18%	21	4%	44%	60.8%	55.1%	55.1%	1.5
651	Refrigeration	Vending Machine Controller - Refrigerated	Biz-Prescriptive	Food Service	Retro	1,586	1,586	34%	537	0.00	5	\$245	25%	16%	16%	22	0%	30%	51.0%	45.6%	45.6%	2.3
652	Refrigeration	LED Refrigerated Display Case Lighting Average 6W/LF	Biz-Prescriptive	Food Service	Retro	273	273	89%	243	0.00	9	\$11	100%	45%	45%	23	11%	66%	79.2%	77.7%	77.7%	24.1
653	Refrigeration	LED Refrigerated Display Case Lighting Controls	Biz-Prescriptive	Food Service	Retro	522	522	27%	141	0.00	10	\$14	100%	30%	30%	24	11%	13%	79.2%	75.2%	75.2%	18.9
654	Ventilation	Demand Controlled Ventilation	Biz-Custom	Food Service	Retro	2,669	2,669	20%	534	0.00	15	\$227	100%	19%	19%	1	100%	18%	83.4%	50.1%	50.1%	7.1
655	Ventilation	Pump and Fan Variable Frequency Drive Controls (Fans)	Biz-Prescriptive	Food Service	Retro	1,902	1,902	38%	731	0.00	15	\$200	100%	30%	30%	2	100%	18%	83.4%	66.4%	66.4%	8.6
656	WholeBldg_HVAC	HVAC - Energy Management System	Biz-Custom RCx	Food Service	Retro	7	7	15%	1	0.00	15	\$0	100%	50%	50%	1	100%	20%	83.4%	72.9%	72.9%	7.5
657	WholeBldg_HVAC	Guest room energy management system	Biz-Prescriptive	Food Service	Retro	0	0	0%	0	0.00	15	\$260	0%	77%	77%	2	100%	20%	83.4%	83.4%	83.4%	0.0
658	WholeBldg_HVAC	Retro-commissioning_Bld Optimization	Biz-Custom RCx	Food Service	Retro	7	7	15%	1	0.00	15	\$0	100%	50%	50%	3	100%	0%	83.4%	72.9%	72.9%	7.5
659	WholeBuilding	WholeBldg - Com RET	Biz-Custom	Food Service	Retro	7	7	15%	1	0.00	12	\$0	100%	50%	50%	1	100%	0%	83.4%	72.9%	72.9%	6.4
660	WholeBuilding	WholeBldg - Custom (Other)	Biz-Custom	Food Service	Retro	5	5	20%	1	0.00	12	\$0	100%	50%	50%	2	100%	0%	83.4%	72.9%	72.9%	6.4
661	WholeBuilding	Power Distribution Equipment Upgrades (Transformers)	Biz-Custom	Food Service	Retro	1,150	1,150	1%	6	0.00	30	\$8	75%	4%	4%	3	100%	20%	58.8%	36.0%	36.0%	21.1
662	WholeBldg_NC	WholeBldg - Com NC	Biz-Custom	Food Service	NC	4	4	25%	1	0.00	12	\$0	100%	50%	50%	1	100%	60%	83.4%	71.9%	71.9%	5.7
663	Behavioral	COM Competitions	Biz-Custom	Food Service	Retro	53	53	2%	1	0.00	2	\$0	100%	48%	48%	1	100%	0%	90.0%	90.0%	90.0%	3.7
664	Behavioral	Business Energy Reports	Biz-Custom	Food Service	Retro	0	0	0%	0	0.00	2	\$0	0%	100%	100%	1	100%	0%	90.0%	90.0%	90.0%	0.0
665	Behavioral	Building Benchmarking	Biz-Custom	Food Service	Retro	0	0	0%	0	0.00	2	\$0	0%	77%	77%	1	100%	0%	90.0%	90.0%	90.0%	0.0
666	Behavioral	Strategic Energy Management	Biz-Custom SEM	Food Service	Retro	0	0	0%	0	0.00	5	\$0	0%	7%	7%	1	100%	0%	90.0%	90.0%	90.0%	0.0
667	Behavioral	BEIMS	Biz-Custom	Food Service	Retro	20	20	5%	1	0.00	2	\$0	39%	39%	39%	1	100%	2%	90.0%	90.0%	90.0%	0.4
668	Behavioral	Building Operator Certification	Biz-Custom	Food Service	Retro	40	40	3%	1	0.00	3	\$0	95%	95%	95%	1	100%	2%	90.0%	90.0%	90.0%	0.9
669	CompressedAir	Efficient Air Compressors (VSD)	Biz-Prescriptive	Health	ROB	1,583	1,583	21%	329	0.00	13	\$127	100%	47%	47%	1	100%	33%	83.4%	69.0%	69.0%	5.2
670	CompressedAir	Efficient Air Nozzles	Biz-Prescriptive	Health	Retro	1,480	1,480	50%	740	0.00	15	\$50	100%	40%	40%	2	35%	33%	83.4%	78.4%	78.4%	22.7
671	CompressedAir	AODD Pump Controls	Biz-Custom	Health	Retro	103,919	103,919	35%	36,372	0.00	10	\$1,150	100%	50%	50%	3	10%	33%	83.4%	81.4%	81.4%	28.9
672	CompressedAir	Compressed Air - Custom	Biz-Custom	Health	Retro	5	5	20%	1	0.00	10	\$0	100%	38%	38%	4	50%	33%	83.4%	69.6%	69.6%	5.7
673	CompressedAir	Retro-commissioning_Compressed Air Optimization	Biz-Custom RCx	Health	Retro	3	3	30%	1	0.00	5	\$0	100%	80%	80%	5	50%	33%	83.4%	78.1%	78.1%	1.5
674	Cooking	Commercial Combination Oven (Electric)	Biz-Prescriptive	Health	ROB	38,561	38,561	48%	18,432	0.00	12	\$16,884	50%	6%	6%	1	18%	53%	67.1%	62.4%	62.4%	10.5
675	Cooking	Commercial Electric Convection Oven	Biz-Prescriptive	Health	ROB	12,193	12,193	15%	1,879	0.00	12	\$1,706	50%	23%	23%	1	18%	53%	67.1%	62.4%	62.4%	2.9
676	Cooking	Commercial Electric Griddle	Biz-Prescriptive	Health	ROB	17,056	17,056	15%	2,596	0.00	12	\$3,604	25%	22%	22%	2	14%	17%	41.9%	33.6%	33.6%	1.4
677	Cooking	Commercial Electric Steam Cooker	Biz-Prescriptive	Health	ROB	19,549	19,549	67%	13,162	0.00	12	\$3,300	100%	27%	27%	3	6%	45%	79.2%	71.0%	71.0%	9.0
678	Cooking	Dishwasher Low Temp Door (Energy Star)	Biz-Prescriptive	Health	ROB	39,306	39,306	44%	17,369	0.00	15	\$662	100%	76%	76%	4	26%	61%	79.2%	78.5%	78.5%	16.4
679	Cooking	Dishwasher High Temp Door (Energy Star)	Biz-Prescriptive	Health	ROB	26,901	26,901	32%	8,586	0.00	15	\$995	100%	50%	50%	4	26%	61%	79.2%	75.0%	75.0%	8.1
680	Cooking	Energy efficient electric fryer	Biz-Prescriptive	Health	ROB	18,955	18,955	17%	3,274	0.00	12	\$1,500	75%	5%	5%	5	27%	24%	72.2%	45.6%	45.6%	16.9
681	Cooking	Insulated Holding Cabinets (Full Size)	Biz-Custom	Health	ROB	13,697	13,697	68%	9,314	0.00	12	\$1,200	100%	62%	62%	6	3%	16%	79.2%	75.7%	75.7%	5.2
682	Cooking	Insulated Holding Cabinets (Half-Size)	Biz-Custom	Health	ROB	4,383	4,383	60%	2,630	0.00	12	\$1,500	50%	14%	14%	6	3%	16%	58.5%	42.3%	42.3%	5.2
683	Cooling	Air Conditioner - 13 IEER (5-20 Tons)	Biz-Prescriptive	Health	ROB	2,226	2,226	6%	137	0.00	15	\$63	100%	79%	79%	1	25%	20%	83.4%	72.9%	72.9%	2.7
684	Cooling	Air Conditioner - 14 IEER (5-20 Tons)	Biz-Prescriptive	Health	ROB	2,226	2,226	13%	286	0.00	15	\$127	100%	39%	39%	1	25%	20%	83.4%	61.5%	61.5%	5.7
685	Cooling	Air Conditioner - 17 IEER (5-20 Tons)	Biz-Prescriptive	Health	ROB	2,226	2,226	28%	628	0.00	15	\$127	100%	39%	39%	1	25%	20%	83.4%	71.1%	71.1%	12.5
686	Cooling	Air Conditioner - 21 IEER (5-20 Tons)	Biz-Prescriptive	Health	ROB	2,226	2,226	42%	933	0.00	15	\$127	100%	39%	39%	1	25%	20%	83.4%	73.9%	73.9%	18.5
687	Cooling	Air Conditioner - 12.1 IEER (20+ Tons)	Biz-Prescriptive	Health	ROB	2,382	2,382	6%	138	0.00	15	\$50	100%	100%	100%	2	25%	20%	83.4%	83.4%	83.4%	2.7
688	Cooling	Air Conditioner - 13 IEER (20+ Tons)	Biz-Prescriptive	Health	ROB	2,382	2,382	12%	293	0.00	15	\$50	100%	100%	100%	2	25%	20%	83.4%	83.4%	83.4%	5.8
689	Cooling	Air Conditioner - 14.3 IEER (20+ Tons)	Biz-Prescriptive	Health	ROB	2,382	2,382	20%	483	0.00	15	\$50	100%	100%	100%	2	25%	20%	83.4%	83.4%	83.4%	9.6
690	Cooling	Air Conditioner - 21 IEER (20+ Tons)	Biz-Prescriptive	Health	ROB	2,382	2,382	46%	1,089	0.00	15	\$50	100%	100%	100%	2	25%	20%	83.4%	83.4%	83.4%	21.6
691	Cooling	Comprehensive Rooftop Unit Quality Maintenance (AC Tune-up)	Biz-Custom	Health	Retro	2,263	2,263	7%	158	0.00	3	\$5	100%	50%	50%	3	50%	50%	83.4%	81.5%	81.5%	15.5
692	Cooling	Air Side Economizer	Biz-Custom	Health	Retro	2,226	2,226	20%	445	0.00	10	\$84	100%	42%	42%	4	50%	20%	83.4%	68.9%	68.9%	3.7
693	Cooling	Advanced Rooftop Controls	Biz-Prescriptive	Health	Retro	2,263	2,263	0%	0	0.00	10	\$98	0%	0%	0%	5	50%	20%	83.4%	83.4%	83.4%	0.0
694	Cooling	HVAC Occupancy Controls	Biz-Custom	Health	ROB	1,150	1,150	20%	230	0.00	15											

Appendix C: C&I Measure Assumptions

Measure #	End-Use	Measure Name	Program	Building Type	Replacement Type	Base (Existing) Annual Electric	Base (Standard) Annual Electric	% Elec Savings	Per Unit Elec Savings	Per Unit Summer kW	EE EUL	Measure Cost	MAP Incentive (%)	RAP Incentive (%)	PP Incentive (%)	End Use Measure Group	Base Saturation	EE Saturation	MAP Adoption Rate	RAP Adoption Rate	PP Adoption Rate	UCT Score
695	Cooling	Air Conditioner - 16 SEER (<5 Tons)	Biz-Prescriptive	Health	ROB	1,940	1,940	13%	242	0.00	15	\$50	100%	100%	100%	7	0%	20%	83.4%	83.4%	83.4%	4.8
696	Cooling	Air Conditioner - 17 SEER (<5 Tons)	Biz-Prescriptive	Health	ROB	1,940	1,940	18%	342	0.00	15	\$206	100%	24%	24%	7	0%	20%	83.4%	47.1%	47.1%	6.8
697	Cooling	Air Conditioner - 18 SEER(<5 Tons)	Biz-Prescriptive	Health	ROB	1,940	1,940	22%	431	0.00	15	\$206	100%	24%	24%	7	0%	20%	83.4%	53.7%	53.7%	8.5
698	Cooling	Air Conditioner - 21 SEER(<5 Tons)	Biz-Prescriptive	Health	ROB	1,940	1,940	33%	647	0.00	15	\$253	100%	20%	20%	7	0%	20%	83.4%	57.8%	57.8%	12.8
699	Cooling	Smart Thermostat	Biz-Prescriptive	Health	ROB	1,940	1,940	14%	275	0.00	11	\$175	75%	26%	26%	8	0%	12%	66.7%	43.6%	43.6%	3.3
700	Cooling	PTAC -- <7,000 Btuh - lodging	Biz-Prescriptive	Health	ROB	2,282	2,282	8%	193	0.00	8	\$84	100%	42%	42%	9	0%	20%	83.4%	62.1%	62.1%	3.2
701	Cooling	PTAC - 7,000 to 15,000 Btuh - lodging	Biz-Prescriptive	Health	ROB	2,503	2,503	7%	182	0.00	8	\$84	100%	42%	42%	10	0%	20%	83.4%	60.7%	60.7%	3.0
702	Cooling	PTAC - >15,000 Btuh - lodging	Biz-Prescriptive	Health	ROB	2,858	2,858	10%	272	0.00	8	\$84	100%	42%	42%	11	0%	20%	83.4%	67.0%	67.0%	4.5
703	Cooling	Air Cooled Chiller	Biz-Prescriptive	Health	ROB	1,982	1,982	6%	111	0.00	23	\$126	100%	40%	40%	12	50%	15%	83.4%	42.1%	42.1%	3.5
704	Cooling	Chiller Tune-up	Biz-Custom	Health	Retro	2,263	2,263	7%	158	0.00	3	\$5	100%	50%	50%	13	50%	50%	83.4%	81.5%	81.5%	15.5
705	Cooling	HVAC/Chiller Custom	Biz-Custom	Health	Retro	5	5	20%	1	0.00	20	\$1	100%	6%	6%	14	100%	20%	83.4%	36.0%	36.0%	28.3
706	Cooling	Window Film	Biz-Custom	Health	Retro	6,000	6,000	4%	264	0.00	10	\$154	100%	14%	14%	15	100%	20%	83.4%	47.7%	47.7%	11.9
707	Cooling	Triple Pane Windows	Biz-Custom	Health	ROB	6,000	6,000	6%	360	0.00	25	\$700	75%	4%	4%	15	100%	20%	48.8%	36.0%	36.0%	21.9
708	Cooling	Energy Recovery Ventilator	Biz-Custom	Health	Retro	2,382	2,382	42%	1,003	0.00	15	\$1,500	100%	5%	5%	16	100%	2%	83.4%	31.4%	31.4%	19.8
709	Heating	Heat Pump - 16 SEER (<5 Tons)	Biz-Prescriptive	Health	ROB	3,285	3,285	4%	146	0.00	16	\$87	100%	57%	57%	1	0%	20%	83.4%	66.4%	66.4%	2.3
710	Heating	Heat Pump - 17 SEER (<5 Tons)	Biz-Prescriptive	Health	ROB	3,285	3,285	9%	307	0.00	16	\$442	50%	11%	11%	1	0%	20%	44.0%	36.0%	36.0%	4.5
711	Heating	Heat Pump - 18 SEER(<5 Tons)	Biz-Prescriptive	Health	ROB	3,285	3,285	13%	439	0.00	16	\$507	50%	10%	10%	1	0%	20%	46.4%	36.0%	36.0%	6.4
712	Heating	Heat Pump - 21 SEER(<5 Tons)	Biz-Prescriptive	Health	ROB	3,285	3,285	21%	694	0.00	16	\$507	100%	10%	10%	1	0%	20%	83.4%	44.5%	44.5%	10.2
713	Heating	Geothermal HP - SEER 20.3 (<5 Tons)	Biz-Prescriptive	Health	ROB	3,285	3,285	23%	768	0.00	25	\$2,576	25%	14%	14%	1	0%	20%	44.0%	36.0%	36.0%	1.9
714	Heating	Geothermal HP - SEER 21.5 (<5 Tons)	Biz-Prescriptive	Health	ROB	3,285	3,285	28%	908	0.00	25	\$2,576	25%	14%	14%	1	0%	20%	44.0%	36.0%	36.0%	2.2
715	Heating	Geothermal HP - SEER 23.1 (<5 Tons)	Biz-Prescriptive	Health	ROB	3,285	3,285	33%	1,073	0.00	25	\$2,576	25%	14%	14%	1	0%	20%	44.0%	36.0%	36.0%	2.6
716	Heating	Geothermal HP - SEER 29.3 (<5 Tons)	Biz-Prescriptive	Health	ROB	3,285	3,285	47%	1,549	0.00	25	\$2,576	25%	14%	14%	1	0%	20%	44.0%	36.0%	36.0%	3.4
717	Heating	Heat Pump - 14.0 IEER COP 3.6 (65,000-134,000 Btu/hr)	Biz-Prescriptive	Health	ROB	3,991	3,991	12%	467	0.00	16	\$100	100%	50%	50%	2	29%	20%	83.4%	80.2%	80.2%	21.6
718	Heating	Heat Pump - 15.0 IEER COP 3.8 (65,000-134,000 Btu/hr)	Biz-Prescriptive	Health	ROB	3,991	3,991	17%	680	0.00	16	\$136	100%	37%	37%	2	29%	20%	83.4%	78.6%	78.6%	24.6
719	Heating	Heat Pump - 14.5 IEER COP 3.5 (135,000-239,000 Btu/hr)	Biz-Prescriptive	Health	ROB	4,164	4,164	16%	662	0.00	16	\$100	100%	35%	35%	2	29%	20%	83.4%	79.8%	79.8%	35.9
720	Heating	Heat Pump - 15.5 IEER COP 3.7 (135,000-239,000 Btu/hr)	Biz-Prescriptive	Health	ROB	4,164	4,164	21%	871	0.00	16	\$139	100%	25%	25%	2	29%	20%	83.4%	78.3%	78.3%	40.0
721	Heating	Geothermal HP - SEER 20.3 (5-20 Tons)	Biz-Prescriptive	Health	ROB	3,628	3,628	31%	1,111	0.00	25	\$2,576	50%	14%	14%	2	29%	20%	44.0%	36.0%	36.0%	3.8
722	Heating	Geothermal HP - SEER 21.5 (5-20 Tons)	Biz-Prescriptive	Health	ROB	3,628	3,628	34%	1,251	0.00	25	\$2,576	50%	14%	14%	2	29%	20%	44.0%	36.0%	36.0%	4.1
723	Heating	Geothermal HP - SEER 23.1 (5-20 Tons)	Biz-Prescriptive	Health	ROB	3,914	3,914	43%	1,702	0.00	25	\$2,576	50%	14%	14%	2	29%	20%	44.0%	36.0%	36.0%	4.9
724	Heating	Geothermal HP - SEER 29.3 (5-20 Tons)	Biz-Prescriptive	Health	ROB	3,914	3,914	56%	2,178	0.00	25	\$2,576	75%	14%	14%	2	29%	20%	62.8%	36.0%	36.0%	5.7
725	Heating	Variable Refrigerant Flow Heat Pump	Biz-Custom	Health	ROB	3,108	3,108	17%	517	0.00	16	\$224	100%	16%	16%	2	29%	2%	83.4%	62.2%	62.2%	12.5
726	Heating	Heat Pump - 12 IEER 3.4 COP (>239,000 Btu/hr)	Biz-Prescriptive	Health	ROB	4,393	4,393	10%	453	0.00	16	\$100	100%	35%	35%	3	29%	20%	83.4%	78.7%	78.7%	27.8
727	Heating	Heat Pump - 13 IEER 3.6 COP (>239,000 Btu/hr)	Biz-Prescriptive	Health	ROB	4,393	4,393	16%	720	0.00	16	\$175	100%	20%	20%	3	29%	20%	83.4%	75.1%	75.1%	33.5
728	Heating	Geothermal HP - SEER 20.3 (20+ Tons)	Biz-Prescriptive	Health	ROB	4,164	4,164	40%	1,647	0.00	25	\$2,576	75%	14%	14%	3	29%	20%	65.8%	39.3%	39.3%	7.1
729	Heating	Geothermal HP - SEER 21.5 (20+ Tons)	Biz-Prescriptive	Health	ROB	4,164	4,164	43%	1,787	0.00	25	\$2,576	100%	14%	14%	3	29%	20%	83.4%	40.2%	40.2%	7.4
730	Heating	Geothermal HP - SEER 23.1 (20+ Tons)	Biz-Prescriptive	Health	ROB	4,164	4,164	47%	1,952	0.00	25	\$2,576	100%	14%	14%	3	29%	20%	83.4%	41.2%	41.2%	7.7
731	Heating	Geothermal HP - SEER 29.3 (20+ Tons)	Biz-Prescriptive	Health	ROB	4,164	4,164	58%	2,429	0.00	25	\$2,576	100%	14%	14%	3	29%	20%	83.4%	43.2%	43.2%	8.6
732	Heating	Mini Split Ductless Heat Pump Cold Climate (Tiers & Sizes TBD)	Biz-Prescriptive	Health	ROB	3,285	3,285	21%	694	0.00	16	\$224	100%	16%	16%	4	43%	20%	83.4%	64.7%	64.7%	14.6
733	Heating	PTHP - <7,000 Btuh - lodging	Biz-Custom	Health	ROB	3,583	3,583	5%	186	0.00	8	\$84	100%	48%	48%	5	0%	10%	83.4%	68.7%	68.7%	2.5
734	Heating	PTHP - >15,000 Btuh - lodging	Biz-Prescriptive	Health	ROB	4,445	4,445	20%	886	0.00	8	\$84	100%	48%	48%	6	0%	10%	83.4%	79.7%	79.7%	12.2
735	Heating	PTHP - 7,000 to 15,000 Btuh - lodging	Biz-Prescriptive	Health	ROB	3,962	3,962	12%	460	0.00	8	\$84	100%	48%	48%	7	0%	10%	83.4%	76.1%	76.1%	6.2
736	HotWater	Heat Pump Water Heater	Biz-Prescriptive	Health	ROB	6,995	6,995	67%	4,684	0.00	15	\$1,115	100%	49%	49%	1	100%	33%	75.5%	68.4%	68.4%	5.2
737	HotWater	Hot Water Pipe Insulation	Biz-Custom	Health	Retro	6,995	6,995	2%	140	0.00	20	\$60	100%	19%	19%	2	100%	80%	86.0%	84.0%	84.0%	8.4
738	HotWater	Faucet Aerator	Biz-Prescriptive	Health	Retro	2,017	2,017	33%	657	0.00	10	\$14	100%	57%	57%	3	20%	90%	93.0%	92.0%	92.0%	34.0
739	HotWater	Low Flow Pre-Rinse Sprayers	Biz-Custom	Health	ROB	18,059	18,059	54%	9,789	0.00	5	\$75	100%	100%	100%	4	20%	80%	86.0%	84.0%	84.0%	22.2
740	HotWater	ENERGY STAR Commercial Washing Machines	Biz-Prescriptive	Health	ROB	1,552	1,552	43%	671	0.00	7	\$250	50%	18%	18%	5	25%	32%	60.4%	45.6%	45.6%	3.7
741	InteriorLighting	LED T8 Tube Replacement	Biz-Prescriptive Light	Health	Retro	225	225	45%	101	0.00	9	\$3	100%	100%	100%	1	70%	38%	85.0%	85.0%	85.0%	13.4
742	InteriorLighting	LED troffer retrofit kit, 2'X2' and 2'X4'	Biz-Prescriptive Light	Health	Retro	509	509	50%	255	0.00	9	\$70	100%	43%	43%	1	70%	38%	85.0%	69.5%	69.5%	3.4
743	InteriorLighting	LED troffer, 2'X2' and 2'X4'	Biz-Prescriptive Light	Health	Retro	509	509	50%	255	0.00	9	\$70	100%	79%	79%	1	70%	38%	85.0%	79.5%	79.5%	1.8
744	InteriorLighting	Bi-Level Lighting Fixture - Stairwells, Hallways	Biz-Custom Light	Health	Retro	509	509	74%	378	0.00	10	\$274	29%	29%	29%	2	8%	38%	56.4%	50.2%	50.2%	1.6
745	InteriorLighting	LED high bay fixture	Biz-Prescriptive Light	Health	Retro	4,737	4,737	68%	3,223	0.00	9	\$330	100%	45%	45%	3	0%	19%	85.0%	79.8%	79.8%	8.6
746	InteriorLighting	LED Mogul-base HID Lamp Replacing High Bay HID	Biz-Prescriptive Light	Health	Retro	4,737	4,737	66%	3,143	0.00	9	\$330	100%	45%	45%	3	0%	19%	85.0%	79.6%	79.6%	8.4
747	InteriorLighting	LED low bay fixture	Biz-Prescriptive Light	Health	Retro	1,009	1,009	61%	613	0.00	9	\$75	100%	100%	100%	4	0%	19%	85.0%	85.0%	85.0%	3.3
748	InteriorLighting	LED Mogul-base HID Lamp Replacing Low Bay HID	Biz-Prescriptive Light	Health	Retro	1,009	1,009	59%	592	0.00	9	\$75	100%	100%	100%	4	0%	19%	85.0%	85.0%	85.0%	3.2
749	InteriorLighting	LED Screw-In Lamps (Directional)	Biz-Prescriptive Light	Health	ROB	385	385	86%	331	0.00	3	\$1	100%	100%	100%	5	3%	13%	85.0%	85.0%	85.0%	57.0
750	InteriorLighting	LED downlight fixture	Biz-Prescriptive Light	Health	Retro	349	349	68%	236	0.00	9	\$27	100%	37%	37%	6	18%	13%	85.0%	78.3%	78.3%	9.4
751	InteriorLighting	LED Screw-In Lamps (Omnidirectional & Decorative)	Biz-Prescriptive Light	Health	ROB	291	291	81%	236	0.00	3	\$1	100%	100%	100%	6	18%	13%	85.0%	85.0%	85.0%	40.6
752	InteriorLighting	DeLamp Fluorescent Fixture Average Lamp Wattage 28W	Biz-Prescriptive Light	Health	Retro	187	187	100%	187	0.00	11	\$4	100%	25%	25%	7	70%	0%	85.0%	83.5%	83.5%	86.4
753	InteriorLighting	Occupancy Sensors	Biz-Prescriptive Light	Health	Retro	855	855	30%	257	0.00	10	\$65	100%	20%	20%	8	95%	10%	85.0%	60.3%	60.3%	6.6
754	InteriorLighting	Daylighting Controls	Biz-Prescriptive Light	Health	Retro	1,095	1,095	30%	329	0.00	10	\$58	100%	34%	34%	8	95%	10%	85.0%	74.7%	74.7%	8.2
755	InteriorLighting	Dual Occupancy & Daylighting Controls	Biz-Custom Light	Health	Retro	489	489	44%	215	0.00	10	\$75	100%	26%	26%	8	95%	10%	85.0%	57.3%	57.3%	4.7
756	InteriorLighting	Central Lighting Monitoring & Controls (non-networked)	Biz-Custom Light	Health	Retro</																	

Appendix C: C&I Measure Assumptions

Measure #	End-Use	Measure Name	Program	Building Type	Replacement Type	Base (Existing) Annual Electric	Base (Standard) Annual Electric	% Elec Savings	Per Unit Elec Savings	Per Unit Summer kW	EE EUL	Measure Cost	MAP Incentive (%)	RAP Incentive (%)	PP Incentive (%)	End Use Measure Group	Base Saturation	EE Saturation	MAP Adoption Rate	RAP Adoption Rate	PP Adoption Rate	UCT Score
758	InteriorLighting	Luminaire Level Lighting Controls w/ HVAC Control	Biz-Custom Light	Health	Retro	489	489	65%	318	0.00	15	\$90	100%	21%	21%	8	79%	10%	85.0%	62.2%	62.2%	9.8
759	InteriorLighting	LED Exit Sign - 4 Watt Fixture (2 lamp)	Biz-Prescriptive Light	Health	Retro	70	70	43%	30	0.00	5	\$33	31%	31%	31%	9	1%	75%	82.5%	80.0%	80.0%	0.7
760	InteriorLighting	Lighting - Custom	Biz-Custom Light	Health	Retro	4	4	25%	1	0.00	15	\$0	100%	50%	50%	10	100%	0%	85.0%	78.4%	78.4%	8.2
761	ExteriorLighting	LED wallpack (existing W<250)	Biz-Prescriptive Light	Health	Retro	856	856	66%	567	0.00	12	\$248	50%	46%	46%	1	12%	44%	60.8%	55.2%	55.2%	1.6
762	ExteriorLighting	LED parking lot fixture (existing W<250)	Biz-Prescriptive Light	Health	Retro	1,589	1,589	60%	959	0.00	12	\$756	25%	20%	20%	2	11%	44%	60.8%	55.2%	55.2%	2.1
763	ExteriorLighting	LED parking lot fixture (existing W<250)	Biz-Prescriptive Light	Health	Retro	856	856	66%	567	0.00	12	\$248	50%	30%	30%	3	11%	44%	60.8%	55.2%	55.2%	2.5
764	ExteriorLighting	LED outdoor pole decorative fixture (existing W<250)	Biz-Prescriptive Light	Health	Retro	1,589	1,589	60%	959	0.00	12	\$756	25%	20%	20%	4	11%	44%	60.8%	55.2%	55.2%	2.1
765	ExteriorLighting	LED parking garage fixture (existing W<250)	Biz-Prescriptive Light	Health	Retro	3,235	3,235	60%	1,953	0.00	6	\$756	25%	13%	13%	5	11%	44%	60.8%	55.2%	55.2%	3.7
766	ExteriorLighting	LED parking garage fixture (existing W<250)	Biz-Prescriptive Light	Health	Retro	1,742	1,742	66%	1,154	0.00	6	\$248	75%	32%	32%	6	11%	44%	78.8%	67.1%	67.1%	2.8
767	ExteriorLighting	LED Mogul-base HID Lamp Replacing Exterior HID (existing W<250)	Biz-Prescriptive Light	Health	Retro	1,589	1,589	60%	959	0.00	12	\$756	25%	20%	20%	7	11%	44%	60.8%	55.2%	55.2%	2.1
768	ExteriorLighting	LED Mogul-base HID Lamp Replacing Exterior HID (existing W<250)	Biz-Prescriptive Light	Health	Retro	856	856	66%	567	0.00	12	\$248	50%	30%	30%	8	11%	44%	60.8%	55.2%	55.2%	2.5
769	ExteriorLighting	Bi-Level Lighting Fixture – Garages	Biz-Custom Light	Health	Retro	509	509	69%	351	0.00	10	\$274	29%	29%	29%	9	11%	44%	60.8%	55.2%	55.2%	1.3
770	ExteriorLighting	LED fuel pump canopy fixture (existing W<250)	Biz-Prescriptive Light	Health	Retro	0	0	0%	0	0.00	12	\$0	0%	0%	0%	10	0%	44%	85.0%	85.0%	85.0%	0.0
771	ExteriorLighting	LED fuel pump canopy fixture (existing W<250)	Biz-Prescriptive Light	Health	Retro	0	0	0%	0	0.00	12	\$0	0%	0%	0%	11	0%	44%	85.0%	85.0%	85.0%	0.0
772	Miscellaneous	Vending Machine Controller - Non-Refrigerated	Biz-Prescriptive	Health	Retro	385	385	61%	237	0.00	5	\$233	17%	17%	17%	1	5%	30%	51.0%	44.0%	44.0%	1.0
773	Miscellaneous	Miscellaneous Custom	Biz-Custom	Health	Retro	7	7	2%	0	0.00	10	\$0	100%	50%	50%	2	0%	10%	85.0%	64.4%	64.4%	3.3
774	Miscellaneous	Kitchen Exhaust Hood Demand Ventilation Control System	Biz-Custom	Health	ROB	9,932	9,932	50%	4,966	0.00	20	\$1,184	100%	34%	34%	3	28%	10%	85.0%	69.8%	69.8%	8.7
775	Miscellaneous	High Efficiency Hand Dryers	Biz-Custom	Health	Retro	1,909	1,909	83%	1,585	0.00	10	\$483	100%	26%	26%	4	5%	10%	85.0%	64.4%	64.4%	6.2
776	Miscellaneous	Ozone Commercial Laundry	Biz-Custom	Health	Retro	2,984	2,984	25%	746	0.00	10	\$20,310	0%	0%	0%	5	2%	2%	31.4%	17.2%	17.2%	3.7
777	Miscellaneous	ENERGY STAR Uninterrupted Power Supply	Biz-Custom	Health	ROB	3,096	3,096	3%	85	0.00	15	\$59	75%	12%	12%	6	20%	70%	79.0%	76.0%	76.0%	8.1
778	Motors	Cogged V-Belt	Biz-Custom	Health	Retro	17,237	17,237	3%	534	0.00	15	\$384	75%	11%	11%	1	50%	10%	66.8%	40.3%	40.3%	8.5
779	Motors	Pump and Fan Variable Frequency Drive Controls (Pumps)	Biz-Custom	Health	Retro	1,902	1,902	38%	731	0.00	15	\$200	100%	30%	30%	2	100%	10%	83.4%	66.1%	66.1%	8.5
780	Motors	Power Drive Systems	Biz-Custom	Health	Retro	4	4	23%	1	0.00	15	\$0	100%	31%	31%	2	100%	10%	83.4%	66.2%	66.2%	8.0
781	Motors	Switch Reluctance Motors	Biz-Custom	Health	Retro	33,406	33,406	31%	10,222	0.00	15	\$869	100%	100%	100%	2	100%	1%	83.4%	83.4%	83.4%	5.7
782	Motors	Escalators Motor Efficiency Controllers	Biz-Custom	Health	Retro	7,500	7,500	20%	1,500	0.00	10	\$5,000	2%	2%	2%	3	0%	10%	37.0%	28.0%	28.0%	7.2
783	Office_NonPC	Energy Star Printer/Copier/Fax	Biz-Custom	Health	ROB	551	551	40%	223	0.00	6	\$0	0%	0%	0%	1	5%	90%	93.0%	92.0%	92.0%	0.0
784	Office_NonPC	Smart Power Strip – Commercial Use	Biz-Custom	Health	Retro	1,086	1,086	10%	109	0.00	7	\$50	25%	17%	17%	2	35%	15%	40.5%	36.1%	36.1%	2.9
785	Office_NonPC	Plug Load Occupancy Sensor	Biz-Custom	Health	Retro	1,126	1,126	15%	169	0.00	8	\$70	50%	19%	19%	2	35%	15%	57.7%	38.8%	38.8%	3.2
786	Office_PC	Electrically Commutated Plug Fans in data centers	Biz-Custom	Health	Retro	86,783	86,783	18%	15,778	0.00	15	\$480	100%	50%	50%	1	65%	20%	85.0%	83.6%	83.6%	37.1
787	Office_PC	Energy Star Server	Biz-Custom	Health	ROB	1,621	1,621	23%	368	0.00	8	\$118	100%	25%	25%	1	65%	25%	85.0%	59.8%	59.8%	4.5
788	Office_PC	Server Virtualization	Biz-Custom	Health	Retro	2	2	45%	1	0.00	8	\$0	100%	50%	50%	1	65%	25%	85.0%	75.5%	75.5%	3.2
789	Office_PC	High Efficiency CRAC unit	Biz-Custom	Health	ROB	541	541	30%	162	0.00	15	\$63	100%	21%	21%	2	65%	20%	85.0%	51.4%	51.4%	7.4
790	Office_PC	Computer Room Air Conditioner Economizer	Biz-Custom	Health	Retro	418	418	86%	358	0.00	15	\$82	100%	35%	35%	2	65%	20%	85.0%	66.6%	66.6%	4.9
791	Office_PC	Data Center Hot/Cold Aisle Configuration	Biz-Custom	Health	Retro	4	4	25%	1	0.00	15	\$0	100%	50%	50%	3	3%	10%	85.0%	77.4%	77.4%	7.1
792	Office_PC	Energy Star Laptop	Biz-Custom	Health	ROB	126	126	33%	41	0.00	4	\$0	0%	0%	0%	4	11%	85%	89.5%	88.0%	88.0%	0.0
793	Office_PC	Energy Star Monitor	Biz-Custom	Health	ROB	72	72	21%	15	0.00	4	\$0	0%	0%	0%	5	25%	85%	89.5%	88.0%	88.0%	0.0
794	Refrigeration	Strip Curtains	Biz-Prescriptive	Health	Retro	0	0	0%	0	0.00	4	\$0	0%	0%	0%	1	5%	30%	79.2%	79.2%	79.2%	0.0
795	Refrigeration	Bare Suction Line	Biz-Custom	Health	Retro	23	23	93%	21	0.00	15	\$4	100%	42%	42%	2	0%	50%	79.2%	72.7%	72.7%	7.0
796	Refrigeration	Floating Head Pressure Controls	Biz-Custom	Health	Retro	1,112	1,112	25%	278	0.00	15	\$431	25%	5%	5%	3	4%	25%	47.5%	39.9%	39.9%	4.9
797	Refrigeration	Saturated Suction Controls	Biz-Custom	Health	Retro	831	831	50%	416	0.00	15	\$559	75%	6%	6%	4	2%	10%	66.8%	28.2%	28.2%	12.8
798	Refrigeration	Compressor Retrofit	Biz-Custom	Health	Retro	813	813	20%	163	0.00	15	\$477	25%	3%	3%	5	12%	25%	47.5%	39.9%	39.9%	12.9
799	Refrigeration	Electronically Commutated (EC) Walk-In Evaporator Fan Motor	Biz-Prescriptive	Health	Retro	2,440	2,440	65%	1,586	0.00	15	\$305	100%	13%	13%	6	3%	80%	86.0%	84.0%	84.0%	22.2
800	Refrigeration	Evaporator Fan Motor Controls	Biz-Prescriptive	Health	Retro	1,912	1,912	25%	478	0.00	13	\$162	100%	62%	62%	7	3%	25%	79.2%	72.0%	72.0%	2.5
801	Refrigeration	Variable Speed Condenser Fan	Biz-Custom	Health	Retro	2,960	2,960	50%	1,480	0.00	15	\$1,170	25%	10%	10%	8	5%	25%	47.5%	40.0%	40.0%	4.9
802	Refrigeration	Refrigeration Economizer	Biz-Custom	Health	Retro	7	7	2%	0	0.00	10	\$0	100%	50%	50%	9	17%	10%	79.2%	69.3%	69.3%	3.3
803	Refrigeration	Anti-Sweat Heater Controls MT	Biz-Prescriptive	Health	Retro	579	579	59%	338	0.00	10	\$100	100%	100%	100%	10	18%	25%	79.2%	79.2%	79.2%	1.2
804	Refrigeration	Auto Door Closer, Cooler	Biz-Prescriptive	Health	Retro	471,500	471,500	0%	943	0.00	8	\$157	100%	70%	70%	11	13%	50%	79.2%	76.0%	76.0%	3.3
805	Refrigeration	Display Case Door Retrofit, Medium Temp	Biz-Custom	Health	Retro	1,584	1,584	36%	578	0.00	12	\$686	25%	7%	7%	11	5%	25%	47.5%	40.0%	40.0%	6.7
806	Refrigeration	Electronically Commutated (EC) Reach-In Evaporator Fan Motor	Biz-Prescriptive	Health	Retro	2,440	2,440	65%	1,586	0.00	15	\$305	100%	13%	13%	12	3%	80%	86.0%	84.0%	84.0%	22.2
807	Refrigeration	Q-Sync Motor for Walk-In and Reach-In Evaporator Fan Motor	Biz-Custom	Health	Retro	1,911	1,911	26%	504	0.00	10	\$96	100%	42%	42%	12	3%	2%	79.2%	72.7%	72.7%	5.3
808	Refrigeration	Energy Star Reach-In Refrigerator, Glass Doors	Biz-Prescriptive	Health	ROB	2,140	2,140	29%	629	0.00	12	\$1,239	6%	6%	6%	13	17%	54%	67.8%	63.2%	63.2%	4.2
809	Refrigeration	Energy Star Reach-In Refrigerator, Solid Doors	Biz-Prescriptive	Health	ROB	1,410	1,410	20%	281	0.00	12	\$1,211	6%	6%	6%	14	17%	54%	67.8%	63.2%	63.2%	1.8
810	Refrigeration	Anti-Sweat Heater Controls LT	Biz-Prescriptive	Health	Retro	2,016	2,016	68%	1,361	0.00	10	\$100	100%	100%	100%	15	6%	25%	79.2%	79.2%	79.2%	4.8
811	Refrigeration	Auto Door Closer, Freezer	Biz-Prescriptive	Health	Retro	419,455	419,455	1%	2,307	0.00	8	\$157	100%	70%	70%	16	6%	50%	79.2%	77.8%	77.8%	7.8
812	Refrigeration	Display Case Door Retrofit, Low Temp	Biz-Custom	Health	Retro	2,922	2,922	50%	1,453	0.00	12	\$686	100%	17%	17%	16	6%	25%	79.2%	51.0%	51.0%	6.7
813	Refrigeration	Energy Star Reach-In Freezer, Glass Doors	Biz-Prescriptive	Health	ROB	6,374	6,374	20%	1,275	0.00	12	\$1,651	28%	28%	28%	17	6%	54%	67.8%	63.2%	63.2%	1.3
814	Refrigeration	Energy Star Reach-In Freezer, Solid Doors	Biz-Prescriptive	Health	ROB	4,522	4,522	7%	305	0.00	12	\$1,521	13%	13%	13%	18	6%	54%	67.8%	63.2%	63.2%	0.7
815	Refrigeration	Refrigeration - Custom	Biz-Custom	Health	ROB	7	7	2%	0	0.00	10	\$0	100%	50%	50%	19	90%	25%	79.2%	69.3%	69.3%	3.3
816	Refrigeration	Retro-commissioning_Refrigerator Optimization	Biz-Custom RCx	Health	Retro	3	3	30%	1	0.00	5	\$0	100%	80%	80%	20	90%	25%	79.2%	76.5%	76.5%	1.5
817	Refrigeration	Energy Star Ice Machine	Biz-Prescriptive	Health	ROB	6,993	6,993	10%	721	0.00	15	\$1,426	25%	18%	18%	21	5%	44%	60.8%	55.1%	55.1%	1.5
818	Refrigeration	Vending Machine Controller - Refrigerated	Biz-Prescriptive	Health	Retro	1,586	1,586	34%	537	0.00	5	\$245	25%	16%	16%	22	3%	30%	51.0%	45.6%	45.6%	2.3

Appendix C: C&I Measure Assumptions

Measure #	End-Use	Measure Name	Program	Building Type	Replacement Type	Base (Existing) Annual Electric	Base (Standard) Annual Electric	% Elec Savings	Per Unit Elec Savings	Per Unit Summer kW	EE EUL	Measure Cost	MAP Incentive (%)	RAP Incentive (%)	PP Incentive (%)	End Use Measure Group	Base Saturation	EE Saturation	MAP Adoption Rate	RAP Adoption Rate	PP Adoption Rate	UCT Score
819	Refrigeration	LED Refrigerated Display Case Lighting Average 6W/LF	Biz-Prescriptive	Health	Retro	273	273	89%	243	0.00	9	\$11	100%	45%	45%	23	11%	66%	79.2%	77.7%	77.7%	24.2
820	Refrigeration	LED Refrigerated Display Case Lighting Controls	Biz-Prescriptive	Health	Retro	522	522	27%	141	0.00	10	\$14	100%	30%	30%	24	11%	13%	79.2%	75.2%	75.2%	19.0
821	Ventilation	Demand Controlled Ventilation	Biz-Custom	Health	Retro	2,639	2,639	20%	528	0.00	15	\$227	100%	19%	19%	1	100%	36%	83.4%	53.7%	53.7%	8.7
822	Ventilation	Pump and Fan Variable Frequency Drive Controls (Fans)	Biz-Prescriptive	Health	Retro	1,902	1,902	38%	731	0.00	15	\$200	100%	30%	30%	2	100%	36%	83.4%	66.3%	66.3%	8.6
823	WholeBldg_HVAC	HVAC - Energy Management System	Biz-Custom RCx	Health	Retro	7	7	15%	1	0.00	15	\$0	100%	50%	50%	1	100%	20%	83.4%	72.8%	72.8%	7.6
824	WholeBldg_HVAC	Guest room energy management system	Biz-Prescriptive	Health	Retro	0	0	0%	0	0.00	15	\$260	0%	77%	77%	2	100%	20%	83.4%	83.4%	83.4%	0.0
825	WholeBldg_HVAC	Retro-commissioning_Bld Optimization	Biz-Custom RCx	Health	Retro	7	7	15%	1	0.00	15	\$0	100%	50%	50%	3	100%	0%	83.4%	72.8%	72.8%	7.6
826	WholeBuilding	WholeBldg - Com RET	Biz-Custom	Health	Retro	7	7	15%	1	0.00	12	\$0	100%	50%	50%	1	100%	0%	83.4%	72.8%	72.8%	6.5
827	WholeBuilding	WholeBldg - Custom (Other)	Biz-Custom	Health	Retro	5	5	20%	1	0.00	12	\$0	100%	50%	50%	2	100%	0%	83.4%	72.8%	72.8%	6.5
828	WholeBuilding	Power Distribution Equipment Upgrades (Transformers)	Biz-Custom	Health	Retro	1,150	1,150	1%	6	0.00	30	\$8	75%	4%	4%	3	100%	20%	58.8%	36.0%	36.0%	21.4
829	WholeBldg_NC	WholeBldg - Com NC	Biz-Custom	Health	NC	4	4	25%	1	0.00	12	\$0	100%	50%	50%	1	100%	60%	83.4%	71.9%	71.9%	5.8
830	Behavioral	COM Competitions	Biz-Custom	Health	Retro	0	0	0%	0	0.00	2	\$0	0%	48%	48%	1	100%	0%	90.0%	90.0%	90.0%	0.0
831	Behavioral	Business Energy Reports	Biz-Custom	Health	Retro	0	0	0%	0	0.00	2	\$0	0%	100%	100%	1	100%	0%	90.0%	90.0%	90.0%	0.0
832	Behavioral	Building Benchmarking	Biz-Custom	Health	Retro	114	114	1%	1	0.00	2	\$0	77%	77%	77%	1	100%	0%	90.0%	90.0%	90.0%	0.5
833	Behavioral	Strategic Energy Management	Biz-Custom SEM	Health	Retro	33	33	3%	1	0.00	5	\$0	50%	7%	7%	1	100%	0%	90.0%	90.0%	90.0%	8.7
834	Behavioral	BEIMS	Biz-Custom	Health	Retro	20	20	5%	1	0.00	2	\$0	39%	39%	39%	1	100%	2%	90.0%	90.0%	90.0%	0.5
835	Behavioral	Building Operator Certification	Biz-Custom	Health	Retro	20	20	3%	0	0.00	3	\$0	46%	46%	46%	1	100%	2%	90.0%	90.0%	90.0%	0.9
836	CompressedAir	Efficient Air Compressors (VSD)	Biz-Prescriptive	Lodging	ROB	1,583	1,583	21%	329	0.00	13	\$127	100%	47%	47%	1	100%	33%	83.4%	69.0%	69.0%	5.2
837	CompressedAir	Efficient Air Nozzles	Biz-Prescriptive	Lodging	Retro	1,480	1,480	50%	740	0.00	15	\$50	100%	40%	40%	2	35%	33%	83.4%	78.4%	78.4%	22.7
838	CompressedAir	AODD Pump Controls	Biz-Custom	Lodging	Retro	103,919	103,919	35%	36,372	0.00	10	\$1,150	100%	50%	50%	3	10%	33%	83.4%	81.4%	81.4%	28.9
839	CompressedAir	Compressed Air - Custom	Biz-Custom	Lodging	Retro	5	5	20%	1	0.00	10	\$0	100%	38%	38%	4	50%	33%	83.4%	69.6%	69.6%	5.7
840	CompressedAir	Retro-commissioning_Compressed Air Optimization	Biz-Custom RCx	Lodging	Retro	3	3	30%	1	0.00	5	\$0	100%	80%	80%	5	50%	33%	83.4%	78.1%	78.1%	1.5
841	Cooking	Commercial Combination Oven (Electric)	Biz-Prescriptive	Lodging	ROB	38,561	38,561	48%	18,432	0.00	12	\$16,884	50%	6%	6%	1	18%	53%	67.1%	62.4%	62.4%	10.6
842	Cooking	Commercial Electric Convection Oven	Biz-Prescriptive	Lodging	ROB	12,193	12,193	15%	1,879	0.00	12	\$1,706	50%	23%	23%	1	18%	53%	67.1%	62.4%	62.4%	2.9
843	Cooking	Commercial Electric Griddle	Biz-Prescriptive	Lodging	ROB	17,056	17,056	15%	2,596	0.00	12	\$3,604	25%	22%	22%	2	14%	17%	41.9%	33.6%	33.6%	1.4
844	Cooking	Commercial Electric Steam Cooker	Biz-Prescriptive	Lodging	ROB	19,549	19,549	67%	13,162	0.00	12	\$3,300	100%	27%	27%	3	6%	45%	79.2%	71.0%	71.0%	9.1
845	Cooking	Dishwasher Low Temp Door (Energy Star)	Biz-Prescriptive	Lodging	ROB	39,306	39,306	44%	17,369	0.00	15	\$662	100%	76%	76%	4	26%	61%	79.2%	78.5%	78.5%	16.6
846	Cooking	Dishwasher High Temp Door (Energy Star)	Biz-Prescriptive	Lodging	ROB	26,901	26,901	32%	8,586	0.00	15	\$995	100%	50%	50%	4	26%	61%	79.2%	75.0%	75.0%	8.2
847	Cooking	Energy efficient electric fryer	Biz-Prescriptive	Lodging	ROB	18,955	18,955	17%	3,274	0.00	12	\$1,500	75%	5%	5%	5	27%	24%	72.2%	45.6%	45.6%	17.2
848	Cooking	Insulated Holding Cabinets (Full Size)	Biz-Custom	Lodging	ROB	13,697	13,697	68%	9,314	0.00	12	\$1,200	100%	62%	62%	6	3%	16%	79.2%	75.7%	75.7%	5.3
849	Cooking	Insulated Holding Cabinets (Half-Size)	Biz-Custom	Lodging	ROB	4,383	4,383	60%	2,630	0.00	12	\$1,500	50%	14%	14%	6	3%	16%	58.5%	42.3%	42.3%	5.3
850	Cooling	Air Conditioner - 13 IEER (5-20 Tons)	Biz-Prescriptive	Lodging	ROB	1,401	1,401	6%	86	0.00	15	\$63	100%	79%	79%	1	23%	20%	83.4%	70.9%	70.9%	2.3
851	Cooling	Air Conditioner - 14 IEER (5-20 Tons)	Biz-Prescriptive	Lodging	ROB	1,401	1,401	13%	180	0.00	15	\$127	100%	39%	39%	1	23%	20%	83.4%	54.3%	54.3%	4.8
852	Cooling	Air Conditioner - 17 IEER (5-20 Tons)	Biz-Prescriptive	Lodging	ROB	1,401	1,401	28%	396	0.00	15	\$127	100%	39%	39%	1	23%	20%	83.4%	68.6%	68.6%	10.6
853	Cooling	Air Conditioner - 21 IEER (5-20 Tons)	Biz-Prescriptive	Lodging	ROB	1,401	1,401	42%	587	0.00	15	\$127	100%	39%	39%	1	23%	20%	83.4%	72.0%	72.0%	15.7
854	Cooling	Air Conditioner - 12.1 IEER (20+ Tons)	Biz-Prescriptive	Lodging	ROB	1,500	1,500	6%	87	0.00	15	\$50	100%	100%	100%	2	23%	20%	83.4%	83.4%	83.4%	2.3
855	Cooling	Air Conditioner - 13 IEER (20+ Tons)	Biz-Prescriptive	Lodging	ROB	1,500	1,500	12%	185	0.00	15	\$50	100%	100%	100%	2	23%	20%	83.4%	83.4%	83.4%	4.9
856	Cooling	Air Conditioner - 14.3 IEER (20+ Tons)	Biz-Prescriptive	Lodging	ROB	1,500	1,500	20%	304	0.00	15	\$50	100%	100%	100%	2	23%	20%	83.4%	83.4%	83.4%	8.1
857	Cooling	Air Conditioner - 21 IEER (20+ Tons)	Biz-Prescriptive	Lodging	ROB	1,500	1,500	46%	686	0.00	15	\$50	100%	100%	100%	2	23%	20%	83.4%	83.4%	83.4%	18.3
858	Cooling	Comprehensive Rooftop Unit Quality Maintenance (AC Tune-up)	Biz-Custom	Lodging	Retro	1,425	1,425	7%	100	0.00	3	\$5	100%	50%	50%	3	45%	50%	83.4%	80.8%	80.8%	13.0
859	Cooling	Air Side Economizer	Biz-Custom	Lodging	Retro	1,401	1,401	20%	280	0.00	10	\$84	75%	27%	27%	4	45%	20%	72.0%	57.4%	57.4%	3.6
860	Cooling	Advanced Rooftop Controls	Biz-Prescriptive	Lodging	Retro	1,425	1,425	0%	0	0.00	10	\$98	0%	26%	26%	5	45%	20%	83.4%	83.4%	83.4%	0.0
861	Cooling	HVAC Occupancy Controls	Biz-Custom	Lodging	ROB	9,967	9,967	20%	1,993	0.00	15	\$537	100%	30%	30%	6	45%	20%	83.4%	65.1%	65.1%	9.2
862	Cooling	Air Conditioner - 16 SEER (<5 Tons)	Biz-Prescriptive	Lodging	ROB	1,221	1,221	13%	153	0.00	15	\$50	100%	100%	100%	7	0%	20%	83.4%	83.4%	83.4%	4.1
863	Cooling	Air Conditioner - 17 SEER (<5 Tons)	Biz-Prescriptive	Lodging	ROB	1,221	1,221	18%	215	0.00	15	\$206	100%	24%	24%	7	0%	20%	83.4%	42.5%	42.5%	5.8
864	Cooling	Air Conditioner - 18 SEER (<5 Tons)	Biz-Prescriptive	Lodging	ROB	1,221	1,221	22%	271	0.00	15	\$206	100%	24%	24%	7	0%	20%	83.4%	46.4%	46.4%	7.2
865	Cooling	Air Conditioner - 21 SEER (<5 Tons)	Biz-Prescriptive	Lodging	ROB	1,221	1,221	33%	407	0.00	15	\$253	100%	20%	20%	7	0%	20%	83.4%	49.4%	49.4%	10.9
866	Cooling	Smart Thermostat	Biz-Prescriptive	Lodging	ROB	1,221	1,221	14%	173	0.00	11	\$175	50%	26%	26%	8	0%	12%	44.3%	36.0%	36.0%	2.5
867	Cooling	PTAC - <7,000 Btuh - Lodging	Biz-Prescriptive	Lodging	ROB	1,437	1,437	8%	122	0.00	8	\$84	100%	42%	42%	9	15%	20%	83.4%	54.7%	54.7%	2.7
868	Cooling	PTAC - 7,000 to 15,000 Btuh - Lodging	Biz-Prescriptive	Lodging	ROB	1,576	1,576	7%	114	0.00	8	\$84	100%	42%	42%	10	15%	20%	83.4%	52.9%	52.9%	2.5
869	Cooling	PTAC - >15,000 Btuh - Lodging	Biz-Prescriptive	Lodging	ROB	1,800	1,800	10%	171	0.00	8	\$84	100%	42%	42%	11	15%	20%	83.4%	62.9%	62.9%	3.7
870	Cooling	Air Cooled Chiller	Biz-Prescriptive	Lodging	ROB	1,248	1,248	6%	70	0.00	23	\$126	100%	40%	40%	12	39%	15%	83.4%	36.9%	36.9%	9.1
871	Cooling	Chiller Tune-up	Biz-Custom	Lodging	Retro	1,425	1,425	7%	100	0.00	3	\$5	100%	50%	50%	13	39%	50%	83.4%	80.8%	80.8%	13.0
872	Cooling	HVAC/Chiller Custom	Biz-Custom	Lodging	Retro	5	5	20%	1	0.00	20	\$1	100%	6%	6%	14	100%	20%	83.4%	36.0%	36.0%	28.2
873	Cooling	Window Film	Biz-Custom	Lodging	Retro	6,000	6,000	4%	264	0.00	10	\$154	100%	14%	14%	15	100%	20%	83.4%	48.1%	48.1%	11.8
874	Cooling	Triple Pane Windows	Biz-Custom	Lodging	ROB	6,000	6,000	6%	360	0.00	25	\$700	75%	4%	4%	15	100%	20%	49.3%	36.0%	36.0%	21.8
875	Cooling	Energy Recovery Ventilator	Biz-Custom	Lodging	Retro	1,500	1,500	0%	0	0.00	15	\$1,500	0%	0%	0%	16	100%	2%	83.4%	83.4%	83.4%	0.0
876	Heating	Heat Pump - 16 SEER (<5 Tons)	Biz-Prescriptive	Lodging	ROB	3,162	3,162	4%	116	0.00	16	\$87	100%	57%	57%	1	0%	20%	83.4%	66.2%	66.2%	2.0
877	Heating	Heat Pump - 17 SEER (<5 Tons)	Biz-Prescriptive	Lodging	ROB	3,162	3,162	8%	263	0.00	16	\$442	25%	11%	11%	1	0%	20%	44.0%	36.0%	36.0%	4.1
878	Heating	Heat Pump - 18 SEER (<5 Tons)	Biz-Prescriptive	Lodging	ROB	3,162	3,162	12%	378	0.00	16	\$507	50%	10%	10%	1	0%	20%	46.5%	36.0%	36.0%	5.8
879	Heating	Heat Pump - 21 SEER (<5 Tons)	Biz-Prescriptive	Lodging	ROB	3,162	3,162	18%	568	0.00	16	\$507	75%	10%	10%	1	0%	20%	69.2%	44.2%	44.2%	9.1
880	Heating	Geothermal HP - SEER 20.3 (<5 Tons)	Biz-Prescriptive	Lodging	ROB	3,162	3,162	22%	702	0.00	25	\$2,576	14%	14%	14%	1	0%	20%	44.0%	36.0%	36.0%	1.8
881	Heating	Geothermal HP - SEER 21.5 (<5 Tons)	Biz-Prescriptive	Lodging	ROB	3,162	3,162	27%	840	0.00	25	\$2,576	25%	14%	14%	1	0%	20%	44.0%	36.0%	36.0%	2.1
882	Heating	Geothermal HP - SEER 23.1 (<5 Tons)	Biz-Prescriptive	Lodging																		

Appendix C: C&I Measure Assumptions

Measure #	End-Use	Measure Name	Program	Building Type	Replacement Type	Base (Existing) Annual Electric	Base (Standard) Annual Electric	% Elec Savings	Per Unit Elec Savings	Per Unit Summer kW	EE EUL	Measure Cost	MAP Incentive (%)	RAP Incentive (%)	PP Incentive (%)	End Use Measure Group	Base Saturation	EE Saturation	MAP Adoption Rate	RAP Adoption Rate	PP Adoption Rate	UCT Score
885	Heating	Heat Pump - 15.0 IEER COP 3.8 (65,000-134,000 Btu/hr)	Biz-Prescriptive	Lodging	ROB	3,795	3,795	16%	597	0.00	16	\$136	100%	37%	37%	2	30%	20%	83.4%	79.1%	79.1%	23.8
886	Heating	Heat Pump - 14.5 IEER COP 3.5 (135,000-239,000 Btu/hr)	Biz-Prescriptive	Lodging	ROB	3,944	3,944	13%	530	0.00	16	\$100	100%	35%	35%	2	30%	20%	83.4%	80.1%	80.1%	34.2
887	Heating	Heat Pump - 15.5 IEER COP 3.7 (135,000-239,000 Btu/hr)	Biz-Prescriptive	Lodging	ROB	3,944	3,944	18%	727	0.00	16	\$139	100%	25%	25%	2	30%	20%	83.4%	78.7%	78.7%	38.1
888	Heating	Geothermal HP - SEER 20.3 (5-20 Tons)	Biz-Prescriptive	Lodging	ROB	3,465	3,465	29%	1,005	0.00	25	\$2,576	25%	14%	14%	2	30%	20%	44.0%	36.0%	36.0%	3.6
889	Heating	Geothermal HP - SEER 21.5 (5-20 Tons)	Biz-Prescriptive	Lodging	ROB	3,465	3,465	33%	1,142	0.00	25	\$2,576	50%	14%	14%	2	30%	20%	44.0%	36.0%	36.0%	3.9
890	Heating	Geothermal HP - SEER 23.1 (5-20 Tons)	Biz-Prescriptive	Lodging	ROB	3,645	3,645	41%	1,483	0.00	25	\$2,576	50%	14%	14%	2	30%	20%	44.0%	36.0%	36.0%	4.5
891	Heating	Geothermal HP - SEER 29.3 (5-20 Tons)	Biz-Prescriptive	Lodging	ROB	3,645	3,645	54%	1,952	0.00	25	\$2,576	50%	14%	14%	2	30%	20%	46.0%	36.0%	36.0%	5.3
892	Heating	Variable Refrigerant Flow Heat Pump	Biz-Custom	Lodging	ROB	2,920	2,920	11%	326	0.00	16	\$224	100%	16%	16%	2	30%	2%	83.4%	60.3%	60.3%	10.2
893	Heating	Heat Pump - 12 IEER 3.4 COP (>239,000 Btu/hr)	Biz-Prescriptive	Lodging	ROB	4,089	4,089	9%	363	0.00	16	\$100	100%	35%	35%	3	30%	20%	83.4%	79.2%	79.2%	26.6
894	Heating	Heat Pump - 13 IEER 3.6 COP (>239,000 Btu/hr)	Biz-Prescriptive	Lodging	ROB	4,089	4,089	15%	600	0.00	16	\$175	100%	20%	20%	3	30%	20%	83.4%	75.9%	75.9%	31.9
895	Heating	Geothermal HP - SEER 20.3 (20+ Tons)	Biz-Prescriptive	Lodging	ROB	3,944	3,944	38%	1,484	0.00	25	\$2,576	75%	14%	14%	3	30%	20%	66.9%	41.0%	41.0%	6.8
896	Heating	Geothermal HP - SEER 21.5 (20+ Tons)	Biz-Prescriptive	Lodging	ROB	3,944	3,944	41%	1,621	0.00	25	\$2,576	75%	14%	14%	3	30%	20%	67.4%	41.8%	41.8%	7.1
897	Heating	Geothermal HP - SEER 23.1 (20+ Tons)	Biz-Prescriptive	Lodging	ROB	3,944	3,944	45%	1,782	0.00	25	\$2,576	100%	14%	14%	3	30%	20%	83.4%	42.7%	42.7%	7.4
898	Heating	Geothermal HP - SEER 29.3 (20+ Tons)	Biz-Prescriptive	Lodging	ROB	3,944	3,944	57%	2,251	0.00	25	\$2,576	100%	14%	14%	3	30%	20%	83.4%	44.4%	44.4%	8.2
899	Heating	Mini Split Ductless Heat Pump Cold Climate (Tiers & sizes TBD)	Biz-Prescriptive	Lodging	ROB	3,162	3,162	18%	568	0.00	16	\$224	100%	16%	16%	4	25%	20%	83.4%	64.4%	64.4%	13.0
900	Heating	PTHP - <7,000 Btuh - lodging	Biz-Custom	Lodging	ROB	3,500	3,500	3%	117	0.00	8	\$84	75%	48%	48%	5	5%	10%	74.0%	68.0%	68.0%	2.0
901	Heating	PTHP - >15,000 Btuh - lodging	Biz-Prescriptive	Lodging	ROB	4,164	4,164	13%	558	0.00	8	\$84	100%	48%	48%	6	5%	10%	83.4%	79.4%	79.4%	10.0
902	Heating	PTHP - 7,000 to 15,000 Btuh - lodging	Biz-Prescriptive	Lodging	ROB	3,817	3,817	8%	290	0.00	8	\$84	100%	48%	48%	7	5%	10%	83.4%	75.6%	75.6%	5.1
903	HotWater	Heat Pump Water Heater	Biz-Prescriptive	Lodging	ROB	6,347	6,347	67%	4,250	0.00	15	\$1,115	100%	49%	49%	1	100%	33%	75.5%	67.5%	67.5%	4.5
904	HotWater	Hot Water Pipe Insulation	Biz-Custom	Lodging	Retro	6,347	6,347	2%	127	0.00	20	\$60	100%	17%	17%	2	100%	80%	86.0%	84.0%	84.0%	8.2
905	HotWater	Faucet Aerator	Biz-Prescriptive	Lodging	Retro	117	117	32%	38	0.00	10	\$8	100%	100%	100%	3	20%	90%	93.0%	92.0%	92.0%	4.4
906	HotWater	Low Flow Pre-Rinse Sprayers	Biz-Custom	Lodging	ROB	18,059	18,059	54%	9,789	0.00	5	\$75	100%	100%	100%	4	20%	80%	86.0%	84.0%	84.0%	21.0
907	HotWater	ENERGY STAR Commercial Washing Machines	Biz-Prescriptive	Lodging	ROB	1,552	1,552	43%	671	0.00	7	\$250	50%	18%	18%	5	25%	32%	60.4%	45.6%	45.6%	3.5
908	InteriorLighting	LED T8 Tube Replacement	Biz-Prescriptive Light	Lodging	Retro	229	229	45%	103	0.00	8	\$3	100%	100%	100%	1	42%	38%	85.0%	85.0%	85.0%	13.5
909	InteriorLighting	LED troffer retrofit kit, 2'X2' and 2'X4'	Biz-Prescriptive Light	Lodging	Retro	519	519	50%	260	0.00	8	\$70	100%	43%	43%	1	42%	38%	85.0%	70.9%	70.9%	3.4
910	InteriorLighting	LED troffer, 2'X2' and 2'X4'	Biz-Prescriptive Light	Lodging	Retro	519	519	50%	260	0.00	8	\$70	100%	79%	79%	1	42%	38%	85.0%	80.0%	80.0%	1.9
911	InteriorLighting	Bi-Level Lighting Fixture – Stairwells, Hallways	Biz-Custom Light	Lodging	Retro	519	519	74%	386	0.00	10	\$274	29%	29%	29%	2	5%	38%	56.4%	50.2%	50.2%	1.6
912	InteriorLighting	LED high bay fixture	Biz-Prescriptive Light	Lodging	Retro	4,832	4,832	68%	3,288	0.00	8	\$330	100%	45%	45%	3	0%	19%	85.0%	80.2%	80.2%	8.7
913	InteriorLighting	LED Mogul-base HID Lamp Replacing High Bay HID	Biz-Prescriptive Light	Lodging	Retro	4,832	4,832	66%	3,206	0.00	8	\$330	100%	45%	45%	3	0%	19%	85.0%	80.1%	80.1%	8.5
914	InteriorLighting	LED low bay fixture	Biz-Prescriptive Light	Lodging	Retro	1,029	1,029	61%	626	0.00	8	\$75	100%	100%	100%	4	0%	19%	85.0%	85.0%	85.0%	3.3
915	InteriorLighting	LED Mogul-base HID Lamp Replacing Low Bay HID	Biz-Prescriptive Light	Lodging	Retro	1,029	1,029	59%	604	0.00	8	\$75	100%	100%	100%	4	0%	19%	85.0%	85.0%	85.0%	3.2
916	InteriorLighting	LED Screw-In Lamps (Directional)	Biz-Prescriptive Light	Lodging	ROB	68	68	86%	58	0.00	3	\$1	100%	100%	100%	5	8%	13%	85.0%	85.0%	85.0%	34.6
917	InteriorLighting	LED downlight fixture	Biz-Prescriptive Light	Lodging	Retro	356	356	68%	241	0.00	8	\$27	100%	37%	37%	6	45%	13%	85.0%	78.8%	78.8%	9.5
918	InteriorLighting	LED Screw-In Lamps (Omnidirectional & Decorative)	Biz-Prescriptive Light	Lodging	ROB	51	51	81%	42	0.00	3	\$1	100%	100%	100%	6	45%	13%	85.0%	85.0%	85.0%	24.7
919	InteriorLighting	DeLamp Fluorescent Fixture Average Lamp Wattage 28W	Biz-Prescriptive Light	Lodging	Retro	191	191	100%	191	0.00	11	\$4	100%	25%	25%	7	42%	0%	85.0%	83.7%	83.7%	95.8
920	InteriorLighting	Occupancy Sensors	Biz-Prescriptive Light	Lodging	Retro	872	872	30%	262	0.00	10	\$65	100%	20%	20%	8	95%	10%	85.0%	61.0%	61.0%	6.5
921	InteriorLighting	Daylighting Controls	Biz-Prescriptive Light	Lodging	Retro	1,117	1,117	30%	335	0.00	10	\$58	100%	34%	34%	8	95%	10%	85.0%	74.9%	74.9%	8.2
922	InteriorLighting	Dual Occupancy & Daylighting Controls	Biz-Custom Light	Lodging	Retro	498	498	44%	219	0.00	10	\$75	100%	26%	26%	8	95%	10%	85.0%	60.6%	60.6%	5.2
923	InteriorLighting	Central Lighting Monitoring & Controls (non-networked)	Biz-Custom Light	Lodging	Retro	41,703	41,703	20%	8,341	0.00	12	\$3,700	75%	18%	18%	8	95%	10%	71.5%	37.1%	37.1%	4.2
924	InteriorLighting	Network Lighting Controls - Wireless (WiFi)	Biz-Prescriptive Light	Lodging	Retro	4	4	49%	2	0.00	15	\$1	100%	42%	42%	8	95%	10%	85.0%	69.2%	69.2%	5.0
925	InteriorLighting	Luminaire Level Lighting Controls w/ HVAC Control	Biz-Custom Light	Lodging	Retro	498	498	65%	324	0.00	15	\$90	100%	21%	21%	8	47%	10%	85.0%	64.4%	64.4%	10.9
926	InteriorLighting	LED Exit Sign - 4 Watt Fixture (2 lamp)	Biz-Prescriptive Light	Lodging	Retro	67	67	43%	29	0.00	5	\$33	31%	31%	31%	9	1%	75%	82.5%	80.0%	80.0%	0.7
927	InteriorLighting	Lighting - Custom	Biz-Custom Light	Lodging	Retro	4	4	25%	1	0.00	15	\$0	100%	50%	50%	10	100%	0%	85.0%	78.9%	78.9%	8.9
928	ExteriorLighting	LED wallpack (existing W<250)	Biz-Prescriptive Light	Lodging	Retro	856	856	66%	567	0.00	12	\$248	75%	46%	46%	1	12%	44%	71.7%	55.2%	55.2%	1.6
929	ExteriorLighting	LED parking lot fixture (existing W≥250)	Biz-Prescriptive Light	Lodging	Retro	1,589	1,589	60%	959	0.00	12	\$756	25%	20%	20%	2	11%	44%	60.8%	55.2%	55.2%	2.1
930	ExteriorLighting	LED parking lot fixture (existing W<250)	Biz-Prescriptive Light	Lodging	Retro	856	856	66%	567	0.00	12	\$248	75%	30%	30%	3	11%	44%	71.7%	55.2%	55.2%	2.5
931	ExteriorLighting	LED outdoor pole decorative fixture (existing W≥250)	Biz-Prescriptive Light	Lodging	Retro	1,589	1,589	60%	959	0.00	12	\$756	25%	20%	20%	4	11%	44%	60.8%	55.2%	55.2%	2.1
932	ExteriorLighting	LED parking garage fixture (existing W≥250)	Biz-Prescriptive Light	Lodging	Retro	3,235	3,235	60%	1,953	0.00	6	\$756	50%	13%	13%	5	11%	44%	60.8%	55.2%	55.2%	3.9
933	ExteriorLighting	LED parking garage fixture (existing W<250)	Biz-Prescriptive Light	Lodging	Retro	1,742	1,742	66%	1,154	0.00	6	\$248	75%	32%	32%	6	11%	44%	78.8%	67.1%	67.1%	2.8
934	ExteriorLighting	LED Mogul-base HID Lamp Replacing Exterior HID (existing W≥250)	Biz-Prescriptive Light	Lodging	Retro	1,589	1,589	60%	959	0.00	12	\$756	25%	20%	20%	7	11%	44%	60.8%	55.2%	55.2%	2.1
935	ExteriorLighting	LED Mogul-base HID Lamp Replacing Exterior HID (existing W<250)	Biz-Prescriptive Light	Lodging	Retro	856	856	66%	567	0.00	12	\$248	75%	30%	30%	8	11%	44%	71.7%	55.2%	55.2%	2.5
936	ExteriorLighting	Bi-Level Lighting Fixture – Garages	Biz-Prescriptive Light	Lodging	Retro	519	519	69%	358	0.00	10	\$274	29%	29%	29%	9	11%	44%	60.8%	55.2%	55.2%	1.3
937	ExteriorLighting	LED fuel pump canopy fixture (existing W<250)	Biz-Prescriptive Light	Lodging	Retro	0	0	0%	0	0.00	12	\$0	0%	0%	0%	10	0%	44%	85.0%	85.0%	85.0%	0.0
938	ExteriorLighting	LED fuel pump canopy fixture (existing W≥250)	Biz-Prescriptive Light	Lodging	Retro	0	0	0%	0	0.00	12	\$0	0%	0%	0%	11	0%	44%	85.0%	85.0%	85.0%	0.0
939	Miscellaneous	Vending Machine Controller - Non-Refrigerated	Biz-Prescriptive	Lodging	Retro	385	385	61%	237	0.00	5	\$233	17%	17%	17%	1	5%	30%	51.0%	44.0%	44.0%	1.0
940	Miscellaneous	Miscellaneous Custom	Biz-Custom	Lodging	Retro	7	7	2%	0	0.00	10	\$0	100%	50%	50%	2	41%	10%	85.0%	65.5%	65.5%	3.3
941	Miscellaneous	Kitchen Exhaust Hood Demand Ventilation Control System	Biz-Custom	Lodging	ROB	9,932	9,932	50%	4,966	0.00	20	\$1,185	100%	34%	34%	3	25%	10%	85.0%	69.8%	69.8%	8.8
942	Miscellaneous	High Efficiency Hand Dryers	Biz-Custom	Lodging	Retro	262	262	83%	217	0.00	10	\$483	4%	4%	4%	4	5%	10%	37.0%	23.9%	23.9%	5.9
943	Miscellaneous	Ozone Commercial Laundry	Biz-Custom	Lodging	Retro	2,984	2,984	25%	746	0.00	10	\$20,310	0%	0%	0%	5	2%	2%	31.4%	17.2%	17.2%	3.6
944	Miscellaneous	ENERGY STAR Uninterrupted Power Supply	Biz-Custom	Lodging	ROB	3,096	3,096	3%	85	0.00	15	\$59	75%	12%	12%	6	20%	70%	79.0%	76.0%	76.0%	8.0

Appendix C: C&I Measure Assumptions

Measure #	End-Use	Measure Name	Program	Building Type	Replacement Type	Base (Existing) Annual Electric	Base (Standard) Annual Electric	% Elec Savings	Per Unit Elec Savings	Per Unit Summer kW	EE EUL	Measure Cost	MAP Incentive (%)	RAP Incentive (%)	PP Incentive (%)	End Use Measure Group	Base Saturation	EE Saturation	MAP Adoption Rate	RAP Adoption Rate	PP Adoption Rate	UCT Score
945	Motors	Cogged V-Belt	Biz-Custom	Lodging	Retro	29,207	29,207	3%	905	0.00	15	\$384	100%	19%	19%	1	50%	10%	83.4%	50.1%	50.1%	6.9
946	Motors	Pump and Fan Variable Frequency Drive Controls (Pumps)	Biz-Custom	Lodging	Retro	1,902	1,902	38%	731	0.00	15	\$200	100%	30%	30%	2	100%	10%	83.4%	66.2%	66.2%	8.5
947	Motors	Power Drive Systems	Biz-Custom	Lodging	Retro	4	4	23%	1	0.00	15	\$0	100%	31%	31%	2	100%	10%	83.4%	64.6%	64.6%	6.5
948	Motors	Switch Reluctance Motors	Biz-Custom	Lodging	Retro	56,602	56,602	31%	17,320	0.00	15	\$1,472	100%	100%	100%	2	100%	1%	83.4%	83.4%	83.4%	5.7
949	Motors	Escalators Motor Efficiency Controllers	Biz-Custom	Lodging	Retro	7,500	7,500	20%	1,500	0.00	10	\$5,000	2%	2%	2%	3	0%	10%	37.0%	28.0%	28.0%	7.1
950	Office_NonPC	Energy Star Printer/Copier/Fax	Biz-Custom	Lodging	ROB	551	551	40%	223	0.00	6	\$0	0%			1	5%	90%	93.0%	92.0%	92.0%	0.0
951	Office_NonPC	Smart Power Strip – Commercial Use	Biz-Custom	Lodging	Retro	1,086	1,086	10%	109	0.00	7	\$50	25%	17%	17%	2	35%	15%	40.5%	36.1%	36.1%	2.8
952	Office_NonPC	Plug Load Occupancy Sensor	Biz-Custom	Lodging	Retro	1,126	1,126	15%	169	0.00	8	\$70	50%	19%	19%	2	35%	15%	57.7%	38.8%	38.8%	3.1
953	Office_PC	Electrically Commutated Plug Fans in data centers	Biz-Custom	Lodging	Retro	86,783	86,783	18%	15,778	0.00	15	\$480	100%	50%	50%	1	65%	20%	85.0%	83.6%	83.6%	36.5
954	Office_PC	Energy Star Server	Biz-Custom	Lodging	ROB	1,621	1,621	23%	368	0.00	8	\$118	100%	25%	25%	1	65%	25%	85.0%	59.8%	59.8%	4.4
955	Office_PC	Server Virtualization	Biz-Custom	Lodging	Retro	2	2	45%	1	0.00	8	\$0	100%	50%	50%	1	65%	25%	85.0%	75.5%	75.5%	3.1
956	Office_PC	High Efficiency CRAC unit	Biz-Custom	Lodging	ROB	541	541	30%	162	0.00	15	\$63	100%	21%	21%	2	65%	20%	85.0%	51.4%	51.4%	7.3
957	Office_PC	Computer Room Air Conditioner Economizer	Biz-Custom	Lodging	Retro	418	418	86%	358	0.00	15	\$82	100%	35%	35%	2	65%	20%	85.0%	66.6%	66.6%	4.8
958	Office_PC	Data Center Hot/Cold Aisle Configuration	Biz-Custom	Lodging	Retro	4	4	25%	1	0.00	15	\$0	100%	50%	50%	3	3%	10%	85.0%	77.4%	77.4%	6.9
959	Office_PC	Energy Star Laptop	Biz-Custom	Lodging	ROB	126	126	33%	41	0.00	4	\$0	0%			4	11%	85%	89.5%	88.0%	88.0%	0.0
960	Office_PC	Energy Star Monitor	Biz-Custom	Lodging	ROB	72	72	21%	15	0.00	4	\$0	0%			5	25%	85%	89.5%	88.0%	88.0%	0.0
961	Refrigeration	Strip Curtains	Biz-Prescriptive	Lodging	Retro	0	0	0%	0	0.00	4	\$0	0%	0%		1	11%	30%	79.2%	79.2%	79.2%	0.0
962	Refrigeration	Bar Section Line	Biz-Custom	Lodging	Retro	23	23	93%	21	0.00	15	\$4	100%	42%	42%	2	0%	50%	79.2%	72.6%	72.6%	6.9
963	Refrigeration	Floating Head Pressure Controls	Biz-Custom	Lodging	Retro	1,112	1,112	25%	278	0.00	15	\$431	5%	5%	5%	3	7%	25%	47.5%	39.9%	39.9%	4.8
964	Refrigeration	Saturated Suction Controls	Biz-Custom	Lodging	Retro	831	831	50%	416	0.00	15	\$559	75%	6%	6%	4	2%	10%	66.6%	28.1%	28.1%	12.8
965	Refrigeration	Compressor Retrofit	Biz-Custom	Lodging	Retro	813	813	20%	163	0.00	15	\$477	25%	3%	3%	5	24%	25%	47.5%	39.9%	39.9%	12.8
966	Refrigeration	Electronically Commutated (EC) Walk-In Evaporator Fan Motor	Biz-Prescriptive	Lodging	Retro	2,440	2,440	65%	1,586	0.00	15	\$305	100%	13%	13%	6	7%	80%	86.0%	84.0%	84.0%	22.0
967	Refrigeration	Evaporator Fan Motor Controls	Biz-Prescriptive	Lodging	Retro	1,912	1,912	25%	478	0.00	13	\$162	100%	62%	62%	7	7%	25%	79.2%	71.9%	71.9%	2.5
968	Refrigeration	Variable Speed Condenser Fan	Biz-Custom	Lodging	Retro	2,960	2,960	50%	1,480	0.00	15	\$1,170	25%	10%	10%	8	9%	25%	47.5%	40.0%	40.0%	4.8
969	Refrigeration	Refrigeration Economizer	Biz-Custom	Lodging	Retro	7	7	2%	0	0.00	10	\$0	100%	50%	50%	9	34%	10%	79.2%	69.2%	69.2%	3.3
970	Refrigeration	Anti-Sweat Heater Controls MT	Biz-Prescriptive	Lodging	Retro	579	579	59%	338	0.00	10	\$100	100%	100%	100%	10	11%	25%	79.2%	79.2%	79.2%	1.2
971	Refrigeration	Auto Door Closer, Cooler	Biz-Prescriptive	Lodging	Retro	471,500	471,500	0%	943	0.00	8	\$157	100%	70%	70%	11	8%	50%	79.2%	75.9%	75.9%	3.2
972	Refrigeration	Display Case Door Retrofit, Medium Temp	Biz-Custom	Lodging	Retro	1,584	1,584	36%	578	0.00	12	\$686	25%	7%	7%	11	3%	25%	47.5%	40.0%	40.0%	6.6
973	Refrigeration	Electronically Commutated (EC) Reach-In Evaporator Fan Motor	Biz-Prescriptive	Lodging	Retro	2,440	2,440	65%	1,586	0.00	15	\$305	100%	13%	13%	12	2%	80%	86.0%	84.0%	84.0%	22.0
974	Refrigeration	Q-Sync Motor for Walk-In and Reach-In Evaporator Fan Motor	Biz-Custom	Lodging	Retro	1,911	1,911	26%	504	0.00	10	\$96	100%	42%	42%	12	2%	2%	79.2%	72.7%	72.7%	5.2
975	Refrigeration	Energy Star Reach-In Refrigerator, Glass Doors	Biz-Prescriptive	Lodging	ROB	2,140	2,140	29%	629	0.00	12	\$1,239	6%	6%	6%	13	11%	54%	67.8%	63.2%	63.2%	4.2
976	Refrigeration	Energy Star Reach-In Refrigerator, Solid Doors	Biz-Prescriptive	Lodging	ROB	1,410	1,410	20%	281	0.00	12	\$1,211	6%	6%	6%	14	11%	54%	67.8%	63.2%	63.2%	1.7
977	Refrigeration	Anti-Sweat Heater Controls LT	Biz-Prescriptive	Lodging	Retro	2,016	2,016	68%	1,361	0.00	10	\$100	100%	100%	100%	15	4%	25%	79.2%	79.2%	79.2%	4.7
978	Refrigeration	Auto Door Closer, Freezer	Biz-Prescriptive	Lodging	Retro	419,455	419,455	1%	2,307	0.00	8	\$157	100%	70%	70%	16	4%	50%	79.2%	77.8%	77.8%	7.7
979	Refrigeration	Display Case Door Retrofit, Low Temp	Biz-Custom	Lodging	Retro	2,922	2,922	50%	1,453	0.00	12	\$686	100%	17%	17%	16	4%	25%	79.2%	50.9%	50.9%	6.6
980	Refrigeration	Energy Star Reach-In Freezer, Glass Doors	Biz-Prescriptive	Lodging	ROB	6,374	6,374	20%	1,275	0.00	12	\$1,651	28%	28%	28%	17	4%	54%	67.8%	63.2%	63.2%	1.3
981	Refrigeration	Energy Star Reach-In Freezer, Solid Doors	Biz-Prescriptive	Lodging	ROB	4,522	4,522	7%	305	0.00	12	\$1,521	13%	13%	13%	18	4%	54%	67.8%	63.2%	63.2%	0.7
982	Refrigeration	Refrigeration - Custom	Biz-Custom	Lodging	ROB	7	7	2%	0	0.00	10	\$0	100%	50%	50%	19	90%	25%	79.2%	69.2%	69.2%	3.3
983	Refrigeration	Retro-commissioning_Refrigerator Optimization	Biz-Custom RCx	Lodging	Retro	3	3	30%	1	0.00	5	\$0	100%	80%	80%	20	90%	25%	79.2%	76.5%	76.5%	1.5
984	Refrigeration	Energy Star Ice Machine	Biz-Prescriptive	Lodging	ROB	6,993	6,993	10%	721	0.00	15	\$1,426	25%	18%	18%	21	6%	44%	60.8%	55.1%	55.1%	1.5
985	Refrigeration	Vending Machine Controller - Refrigerated	Biz-Prescriptive	Lodging	Retro	1,586	1,586	34%	537	0.00	5	\$245	25%	16%	16%	22	4%	30%	51.0%	45.6%	45.6%	2.2
986	Refrigeration	LED Refrigerated Display Case Lighting Average GW/LF	Biz-Prescriptive	Lodging	Retro	273	273	89%	243	0.00	9	\$11	100%	45%	45%	23	7%	66%	79.2%	77.7%	77.7%	24.0
987	Refrigeration	LED Refrigerated Display Case Lighting Controls	Biz-Prescriptive	Lodging	Retro	522	522	27%	141	0.00	10	\$14	100%	30%	30%	24	7%	13%	79.2%	75.2%	75.2%	18.9
988	Ventilation	Demand Controlled Ventilation	Biz-Custom	Lodging	Retro	2,639	2,639	20%	528	0.00	15	\$227	100%	19%	19%	1	100%	23%	83.4%	53.9%	53.9%	8.6
989	Ventilation	Pump and Fan Variable Frequency Drive Controls (Fans)	Biz-Prescriptive	Lodging	Retro	1,902	1,902	38%	731	0.00	15	\$200	100%	30%	30%	2	100%	23%	83.4%	66.4%	66.4%	8.5
990	WholeBldg_HVAC	HVAC - Energy Management System	Biz-Custom RCx	Lodging	Retro	7	7	15%	1	0.00	15	\$0	100%	50%	50%	1	15%	20%	83.4%	73.0%	73.0%	7.5
991	WholeBldg_HVAC	Guest room energy management system	Biz-Prescriptive	Lodging	Retro	7,167	7,167	19%	1,382	0.00	15	\$260	100%	77%	77%	2	85%	20%	83.4%	76.2%	76.2%	2.6
992	WholeBldg_HVAC	Retro-commissioning_Bld Optimization	Biz-Custom RCx	Lodging	Retro	7	7	15%	1	0.00	15	\$0	100%	50%	50%	3	100%	0%	83.4%	73.0%	73.0%	7.5
993	WholeBuilding	WholeBldg - Com RET	Biz-Custom	Lodging	Retro	7	7	15%	1	0.00	12	\$0	100%	50%	50%	1	100%	0%	83.4%	73.0%	73.0%	6.4
994	WholeBuilding	WholeBldg - Custom (Other)	Biz-Custom	Lodging	Retro	5	5	20%	1	0.00	12	\$0	100%	50%	50%	2	100%	0%	83.4%	73.0%	73.0%	6.4
995	WholeBuilding	Power Distribution Equipment Upgrades (Transformers)	Biz-Custom	Lodging	Retro	1,150	1,150	1%	6	0.00	30	\$8	75%	4%	4%	3	100%	20%	59.3%	36.0%	36.0%	21.1
996	WholeBldg_NC	WholeBldg - Com NC	Biz-Custom	Lodging	NC	4	4	25%	1	0.00	12	\$0	100%	50%	50%	1	100%	60%	83.4%	72.1%	72.1%	5.7
997	Behavioral	COM Competitions	Biz-Custom	Lodging	Retro	53	53	2%	1	0.00	2	\$0	100%	48%	48%	1	100%	0%	90.0%	90.0%	90.0%	3.7
998	Behavioral	Business Energy Reports	Biz-Custom	Lodging	Retro	313	313	0%	1	0.00	2	\$0	100%	100%	100%	1	100%	0%	90.0%	90.0%	90.0%	0.4
999	Behavioral	Building Benchmarking	Biz-Custom	Lodging	Retro	263	263	0%	1	0.00	2	\$0	77%	77%	77%	1	100%	0%	90.0%	90.0%	90.0%	0.4
1000	Behavioral	Strategic Energy Management	Biz-Custom SEM	Lodging	Retro	0	0	0%	0	0.00	5	\$0	0%			7%	1	100%	0%	90.0%	90.0%	0.0
1001	Behavioral	BEIMS	Biz-Custom	Lodging	Retro	20	20	5%	1	0.00	2	\$0	39%	39%	39%	1	100%	2%	50.0%	50.0%	50.0%	0.4
1002	Behavioral	Building Operator Certification	Biz-Custom	Lodging	Retro	12	12	3%	0	0.00	3	\$0	29%	29%	29%	1	100%	2%	50.0%	50.0%	50.0%	0.9
1003	CompressedAir	Efficient Air Compressors (VSD)	Biz-Prescriptive	Retail	ROB	1,583	1,583	21%	329	0.00	13	\$127	100%	47%	47%	1	100%	33%	83.4%	69.0%	69.0%	5.2
1004	CompressedAir	Efficient Air Nozzles	Biz-Prescriptive	Retail	Retro	1,480	1,480	50%	740	0.00	15	\$50	100%	40%	40%	2	35%	33%	83.4%	78.4%	78.4%	22.7
1005	CompressedAir	AODD Pump Controls	Biz-Custom	Retail	Retro	103,919	103,919	35%	36,372	0.00	10	\$1,150	100%	50%	50%	3	10%	33%	83.4%	81.4%	81.4%	28.9
1006	CompressedAir	Compressed Air - Custom	Biz-Custom	Retail	Retro	5	5	20%	1	0.00	10	\$0	100%	38%	38%	4	50%	33%	83.4%	69.6%	69.6%	5.7
1007	CompressedAir	Retro-commissioning_Compressed Air Optimization	Biz-Custom RCx	Retail	Retro	3	3	30%	1	0.00	5	\$0	100%	80%	80%	5	50%	33%	83.4%	78.1%	78.1%	1.5

Appendix C: C&I Measure Assumptions

Measure #	End-Use	Measure Name	Program	Building Type	Replacement Type	Base (Existing) Annual Electric	Base (Standard) Annual Electric	% Elec Savings	Per Unit Elec Savings	Per Unit Summer kW	EE EUL	Measure Cost	MAP Incentive (%)	RAP Incentive (%)	PP Incentive (%)	End Use Measure Group	Base Saturation	EE Saturation	MAP Adoption Rate	RAP Adoption Rate	PP Adoption Rate	UCT Score
1008	Cooking	Commercial Combination Oven (Electric)	Biz-Prescriptive	Retail	ROB	38,561	38,561	48%	18,432	0.00	12	\$16,884	50%	6%	6%	1	18%	53%	67.1%	62.4%	62.4%	10.3
1009	Cooking	Commercial Electric Convection Oven	Biz-Prescriptive	Retail	ROB	12,193	12,193	15%	1,879	0.00	12	\$1,706	50%	23%	23%	1	18%	53%	67.1%	62.4%	62.4%	2.8
1010	Cooking	Commercial Electric Griddle	Biz-Prescriptive	Retail	ROB	17,056	17,056	15%	2,596	0.00	12	\$3,604	25%	22%	22%	2	14%	17%	41.9%	33.6%	33.6%	1.4
1011	Cooking	Commercial Electric Steam Cooker	Biz-Prescriptive	Retail	ROB	19,549	19,549	67%	13,162	0.00	12	\$3,300	100%	27%	27%	3	6%	45%	79.2%	71.0%	71.0%	8.8
1012	Cooking	Dishwasher Low Temp Door (Energy Star)	Biz-Prescriptive	Retail	ROB	39,306	39,306	44%	17,369	0.00	15	\$662	100%	76%	76%	4	26%	61%	79.2%	78.5%	78.5%	16.0
1013	Cooking	Dishwasher High Temp Door (Energy Star)	Biz-Prescriptive	Retail	ROB	26,901	26,901	32%	8,586	0.00	15	\$995	100%	50%	50%	4	26%	61%	79.2%	75.0%	75.0%	7.9
1014	Cooking	Energy efficient electric fryer	Biz-Prescriptive	Retail	ROB	18,955	18,955	17%	3,274	0.00	12	\$1,500	75%	5%	5%	5	27%	24%	72.2%	45.6%	45.6%	16.5
1015	Cooking	Insulated Holding Cabinets (Full Size)	Biz-Custom	Retail	ROB	13,697	13,697	68%	9,314	0.00	12	\$1,200	100%	62%	62%	6	3%	16%	79.2%	75.7%	75.7%	5.1
1016	Cooking	Insulated Holding Cabinets (Half-Size)	Biz-Custom	Retail	ROB	4,383	4,383	60%	2,630	0.00	12	\$1,500	50%	14%	14%	6	3%	16%	58.5%	42.3%	42.3%	5.1
1017	Cooling	Air Conditioner - 13 IEER (5-20 Tons)	Biz-Prescriptive	Retail	ROB	831	831	6%	51	0.00	15	\$63	100%	79%	79%	1	14%	20%	83.4%	67.7%	67.7%	2.0
1018	Cooling	Air Conditioner - 14 IEER (5-20 Tons)	Biz-Prescriptive	Retail	ROB	831	831	13%	107	0.00	15	\$127	100%	39%	39%	1	14%	20%	83.4%	45.8%	45.8%	4.3
1019	Cooling	Air Conditioner - 17 IEER (5-20 Tons)	Biz-Prescriptive	Retail	ROB	831	831	28%	235	0.00	15	\$127	100%	39%	39%	1	14%	20%	83.4%	64.4%	64.4%	9.4
1020	Cooling	Air Conditioner - 21 IEER (5-20 Tons)	Biz-Prescriptive	Retail	ROB	831	831	42%	348	0.00	15	\$127	100%	39%	39%	1	14%	20%	83.4%	69.2%	69.2%	14.0
1021	Cooling	Air Conditioner - 12.1 IEER (20+ Tons)	Biz-Prescriptive	Retail	ROB	889	889	6%	51	0.00	15	\$50	100%	100%	100%	2	14%	20%	83.4%	83.4%	83.4%	2.1
1022	Cooling	Air Conditioner - 13 IEER (20+ Tons)	Biz-Prescriptive	Retail	ROB	889	889	12%	109	0.00	15	\$50	100%	100%	100%	2	14%	20%	83.4%	83.4%	83.4%	4.4
1023	Cooling	Air Conditioner - 14.3 IEER (20+ Tons)	Biz-Prescriptive	Retail	ROB	889	889	20%	180	0.00	15	\$50	100%	100%	100%	2	14%	20%	83.4%	83.4%	83.4%	7.2
1024	Cooling	Air Conditioner - 21 IEER (20+ Tons)	Biz-Prescriptive	Retail	ROB	889	889	46%	407	0.00	15	\$50	100%	100%	100%	2	14%	20%	83.4%	83.4%	83.4%	16.3
1025	Cooling	Comprehensive Rooftop Unit Quality Maintenance (AC Tune-up)	Biz-Custom	Retail	Retro	845	845	7%	59	0.00	3	\$5	100%	50%	50%	3	29%	50%	83.4%	79.8%	79.8%	11.5
1026	Cooling	Air Side Economizer	Biz-Custom	Retail	Retro	831	831	20%	166	0.00	10	\$84	50%	16%	16%	4	29%	20%	53.5%	42.1%	42.1%	3.8
1027	Cooling	Advanced Rooftop Controls	Biz-Prescriptive	Retail	Retro	845	845	13%	106	0.00	10	\$98	26%	26%	26%	5	29%	20%	44.0%	36.0%	36.0%	1.3
1028	Cooling	HVAC Occupancy Controls	Biz-Custom	Retail	ROB	2,900	2,900	20%	580	0.00	15	\$537	75%	9%	9%	6	29%	20%	63.0%	36.0%	36.0%	11.3
1029	Cooling	Air Conditioner - 16 SEER (<5 Tons)	Biz-Prescriptive	Retail	ROB	724	724	13%	91	0.00	15	\$50	100%	100%	100%	7	24%	20%	83.4%	83.4%	83.4%	3.6
1030	Cooling	Air Conditioner - 17 SEER (<5 Tons)	Biz-Prescriptive	Retail	ROB	724	724	18%	128	0.00	15	\$206	100%	24%	24%	7	24%	20%	83.4%	36.0%	36.0%	5.1
1031	Cooling	Air Conditioner - 18 SEER (<5 Tons)	Biz-Prescriptive	Retail	ROB	724	724	22%	161	0.00	15	\$206	100%	24%	24%	7	24%	20%	83.4%	40.4%	40.4%	6.5
1032	Cooling	Air Conditioner - 21 SEER (<5 Tons)	Biz-Prescriptive	Retail	ROB	724	724	33%	241	0.00	15	\$253	100%	20%	20%	7	24%	20%	83.4%	43.2%	43.2%	9.7
1033	Cooling	Smart Thermostat	Biz-Prescriptive	Retail	ROB	724	724	14%	103	0.00	11	\$175	50%	26%	26%	8	24%	12%	38.4%	29.6%	29.6%	2.1
1034	Cooling	PTAC - <7,000 Btu/h - lodging	Biz-Prescriptive	Retail	ROB	852	852	8%	72	0.00	8	\$84	75%	42%	42%	9	14%	20%	65.3%	45.8%	45.8%	2.3
1035	Cooling	PTAC - 7,000 to 15,000 Btu/h - lodging	Biz-Prescriptive	Retail	ROB	935	935	7%	68	0.00	8	\$84	75%	42%	42%	10	14%	20%	64.4%	44.8%	44.8%	2.2
1036	Cooling	PTAC - >15,000 Btu/h - lodging	Biz-Prescriptive	Retail	ROB	1,067	1,067	10%	102	0.00	8	\$84	100%	42%	42%	11	14%	20%	83.4%	54.5%	54.5%	3.3
1037	Cooling	Air Cooled Chiller	Biz-Prescriptive	Retail	ROB	740	740	6%	42	0.00	23	\$126	100%	40%	40%	12	33%	15%	83.4%	32.0%	32.0%	2.8
1038	Cooling	Chiller Tune-up	Biz-Custom	Retail	Retro	845	845	7%	59	0.00	3	\$5	100%	50%	50%	13	33%	50%	83.4%	79.8%	79.8%	11.5
1039	Cooling	HVAC/Chiller Custom	Biz-Custom	Retail	Retro	5	5	20%	1	0.00	20	\$1	100%	6%	6%	14	100%	20%	83.4%	36.0%	36.0%	28.4
1040	Cooling	Window Film	Biz-Custom	Retail	Retro	6,000	6,000	4%	264	0.00	10	\$154	100%	14%	14%	15	100%	20%	83.4%	47.2%	47.2%	12.0
1041	Cooling	Triple Pane Windows	Biz-Custom	Retail	ROB	6,000	6,000	6%	360	0.00	25	\$700	75%	4%	4%	15	100%	20%	47.7%	36.0%	36.0%	22.0
1042	Cooling	Energy Recovery Ventilator	Biz-Custom	Retail	Retro	889	889	17%	156	0.00	15	\$1,500	1%	1%	1%	16	100%	2%	31.4%	22.6%	22.6%	6.7
1043	Heating	Heat Pump - 16 SEER (<5 Tons)	Biz-Prescriptive	Retail	ROB	2,296	2,296	3%	78	0.00	16	\$87	75%	57%	57%	1	35%	20%	66.3%	56.0%	56.0%	1.7
1044	Heating	Heat Pump - 17 SEER (<5 Tons)	Biz-Prescriptive	Retail	ROB	2,296	2,296	8%	183	0.00	16	\$442	25%	11%	11%	1	35%	20%	44.0%	36.0%	36.0%	3.5
1045	Heating	Heat Pump - 18 SEER (<5 Tons)	Biz-Prescriptive	Retail	ROB	2,296	2,296	11%	263	0.00	16	\$507	25%	10%	10%	1	35%	20%	44.0%	36.0%	36.0%	4.9
1046	Heating	Heat Pump - 21 SEER (<5 Tons)	Biz-Prescriptive	Retail	ROB	2,296	2,296	17%	388	0.00	16	\$507	50%	10%	10%	1	35%	20%	45.6%	36.0%	36.0%	7.6
1047	Heating	Geothermal HP - SEER 20.3 (<5 Tons)	Biz-Prescriptive	Retail	ROB	2,296	2,296	22%	501	0.00	25	\$2,576	14%	14%	14%	1	35%	20%	44.0%	36.0%	36.0%	1.5
1048	Heating	Geothermal HP - SEER 21.5 (<5 Tons)	Biz-Prescriptive	Retail	ROB	2,296	2,296	26%	601	0.00	25	\$2,576	14%	14%	14%	1	35%	20%	44.0%	36.0%	36.0%	1.8
1049	Heating	Geothermal HP - SEER 23.1 (<5 Tons)	Biz-Prescriptive	Retail	ROB	2,296	2,296	31%	718	0.00	25	\$2,576	25%	14%	14%	1	35%	20%	44.0%	36.0%	36.0%	2.0
1050	Heating	Geothermal HP - SEER 29.3 (<5 Tons)	Biz-Prescriptive	Retail	ROB	2,296	2,296	46%	1,061	0.00	25	\$2,576	25%	14%	14%	1	35%	20%	44.0%	36.0%	36.0%	2.7
1051	Heating	Heat Pump - 14.0 IEER COP 3.6 (65,000-134,000 Btu/hr)	Biz-Prescriptive	Retail	ROB	2,744	2,744	10%	279	0.00	16	\$100	100%	50%	50%	2	21%	20%	83.4%	78.3%	78.3%	20.0
1052	Heating	Heat Pump - 15.0 IEER COP 3.8 (65,000-134,000 Btu/hr)	Biz-Prescriptive	Retail	ROB	2,744	2,744	15%	419	0.00	16	\$136	100%	37%	37%	2	21%	20%	83.4%	75.7%	75.7%	22.4
1053	Heating	Heat Pump - 14.5 IEER COP 3.5 (135,000-239,000 Btu/hr)	Biz-Prescriptive	Retail	ROB	2,847	2,847	13%	358	0.00	16	\$100	100%	35%	35%	2	21%	20%	83.4%	77.5%	77.5%	32.2
1054	Heating	Heat Pump - 15.5 IEER COP 3.7 (135,000-239,000 Btu/hr)	Biz-Prescriptive	Retail	ROB	2,847	2,847	18%	500	0.00	16	\$139	100%	25%	25%	2	21%	20%	83.4%	75.1%	75.1%	35.4
1055	Heating	Geothermal HP - SEER 20.3 (5-20 Tons)	Biz-Prescriptive	Retail	ROB	2,509	2,509	28%	713	0.00	25	\$2,576	25%	14%	14%	2	21%	20%	44.0%	36.0%	36.0%	3.2
1056	Heating	Geothermal HP - SEER 21.5 (5-20 Tons)	Biz-Prescriptive	Retail	ROB	2,509	2,509	32%	814	0.00	25	\$2,576	25%	14%	14%	2	21%	20%	44.0%	36.0%	36.0%	3.4
1057	Heating	Geothermal HP - SEER 23.1 (5-20 Tons)	Biz-Prescriptive	Retail	ROB	2,616	2,616	40%	1,038	0.00	25	\$2,576	50%	14%	14%	2	21%	20%	44.0%	36.0%	36.0%	3.8
1058	Heating	Geothermal HP - SEER 29.3 (5-20 Tons)	Biz-Prescriptive	Retail	ROB	2,616	2,616	53%	1,381	0.00	25	\$2,576	50%	14%	14%	2	21%	20%	44.0%	36.0%	36.0%	4.5
1059	Heating	Variable Refrigerant Flow Heat Pump	Biz-Custom	Retail	ROB	2,102	2,102	9%	193	0.00	16	\$224	100%	16%	16%	2	21%	2%	83.4%	45.3%	45.3%	8.6
1060	Heating	Heat Pump - 12 IEER 3.4 COP (>239,000 Btu/hr)	Biz-Prescriptive	Retail	ROB	2,933	2,933	8%	245	0.00	16	\$100	100%	35%	35%	3	21%	20%	83.4%	75.8%	75.8%	25.2
1061	Heating	Heat Pump - 13 IEER 3.6 COP (>239,000 Btu/hr)	Biz-Prescriptive	Retail	ROB	2,933	2,933	14%	413	0.00	16	\$175	100%	20%	20%	3	21%	20%	83.4%	71.5%	71.5%	29.7
1062	Heating	Geothermal HP - SEER 20.3 (20+ Tons)	Biz-Prescriptive	Retail	ROB	2,847	2,847	37%	1,052	0.00	25	\$2,576	75%	14%	14%	3	21%	20%	57.1%	36.0%	36.0%	6.1
1063	Heating	Geothermal HP - SEER 21.5 (20+ Tons)	Biz-Prescriptive	Retail	ROB	2,847	2,847	40%	1,152	0.00	25	\$2,576	75%	14%	14%	3	21%	20%	58.3%	36.0%	36.0%	6.4
1064	Heating	Geothermal HP - SEER 23.1 (20+ Tons)	Biz-Prescriptive	Retail	ROB	2,847	2,847	45%	1,270	0.00	25	\$2,576	75%	14%	14%	3	21%	20%	59.6%	36.0%	36.0%	6.7
1065	Heating	Geothermal HP - SEER 29.3 (20+ Tons)	Biz-Prescriptive	Retail	ROB	2,847	2,847	57%	1,613	0.00	25	\$2,576	75%	14%	14%	3	21%	20%	62.2%	36.0%	36.0%	7.3
1066	Heating	Mini Split Ductless Heat Pump Cold Climate (Tiers & sizes TBD)	Biz-Prescriptive	Retail	ROB	2,296	2,296	17%	388	0.00	16	\$224	100%	16%	16%	4	14%	20%	83.4%	52.6%	52.6%	10.8
1067	Heating	PTHP - <7,000 Btu/h - lodging	Biz-Custom	Retail	ROB	2,554	2,554	3%	69	0.00	8	\$84	75%	48%	48%	5	3%	10%	69.5%	58.0%	58.0%	1.7
1068	Heating	PTHP - >15,000 Btu/h - lodging	Biz-Prescriptive	Retail	ROB	2,994	2,994	11%	331	0.00	8	\$84	100%	48%	48%	6	3%	10%	83.4%	76.2%	76.2%	8.6
10																						

Appendix C: C&I Measure Assumptions

Measure #	End-Use	Measure Name	Program	Building Type	Replacement Type	Base (Existing) Annual Electric	Base (Standard) Annual Electric	% Elec Savings	Per Unit Elec Savings	Per Unit Summer kW	EE EUL	Measure Cost	MAP Incentive (%)	RAP Incentive (%)	PP Incentive (%)	End Use Measure Group	Base Saturation	EE Saturation	MAP Adoption Rate	RAP Adoption Rate	PP Adoption Rate	UCT Score
1074	HotWater	ENERGY STAR Commercial Washing Machines	Biz-Prescriptive	Retail	ROB	1,552	1,552	43%	671	0.00	7	\$250	50%	18%	18%	5	25%	32%	60.3%	45.6%	45.6%	3.5
1075	InteriorLighting	LED T8 Tube Replacement	Biz-Prescriptive Light	Retail	Retro	153	153	45%	68	0.00	12	\$3	100%	100%	100%	1	68%	38%	85.0%	85.0%	85.0%	13.9
1076	InteriorLighting	LED troffer retrofit kit, 2'X2' and 2'X4'	Biz-Prescriptive Light	Retail	Retro	346	346	50%	173	0.00	12	\$70	100%	43%	43%	1	68%	38%	85.0%	65.3%	65.3%	3.5
1077	InteriorLighting	LED troffer, 2'X2' and 2'X4'	Biz-Prescriptive Light	Retail	Retro	346	346	50%	173	0.00	12	\$70	100%	79%	79%	1	68%	38%	85.0%	78.1%	78.1%	1.9
1078	InteriorLighting	Bi-Level Lighting Fixture – Stairwells, Hallways	Biz-Custom Light	Retail	Retro	346	346	74%	257	0.00	10	\$274	29%	29%	29%	2	8%	38%	56.4%	50.2%	50.2%	1.1
1079	InteriorLighting	LED high bay fixture	Biz-Prescriptive Light	Retail	Retro	3,225	3,225	68%	2,194	0.00	12	\$330	100%	45%	45%	3	1%	19%	85.0%	78.4%	78.4%	8.9
1080	InteriorLighting	LED Mogul-base HID Lamp Replacing High Bay HID	Biz-Prescriptive Light	Retail	Retro	3,225	3,225	66%	2,140	0.00	12	\$330	100%	45%	45%	3	1%	19%	85.0%	78.3%	78.3%	8.7
1081	InteriorLighting	LED low bay fixture	Biz-Prescriptive Light	Retail	Retro	687	687	61%	417	0.00	12	\$75	100%	100%	100%	4	1%	19%	85.0%	85.0%	85.0%	3.4
1082	InteriorLighting	LED Mogul-base HID Lamp Replacing Low Bay HID	Biz-Prescriptive Light	Retail	Retro	687	687	59%	403	0.00	12	\$75	100%	100%	100%	4	1%	19%	85.0%	85.0%	85.0%	3.3
1083	InteriorLighting	LED Screw-In Lamps (Directional)	Biz-Prescriptive Light	Retail	ROB	257	257	86%	221	0.00	5	\$1	100%	100%	100%	5	3%	13%	85.0%	85.0%	85.0%	77.5
1084	InteriorLighting	LED downlight fixture	Biz-Prescriptive Light	Retail	Retro	238	238	68%	161	0.00	12	\$27	100%	37%	37%	6	19%	13%	85.0%	76.3%	76.3%	9.7
1085	InteriorLighting	LED Screw-In Lamps (Omnidirectional & Decorative)	Biz-Prescriptive Light	Retail	ROB	194	194	81%	157	0.00	5	\$1	100%	100%	100%	6	19%	13%	85.0%	85.0%	85.0%	55.2
1086	InteriorLighting	DeLamp Fluorescent Fixture Average Lamp Wattage 28W	Biz-Prescriptive Light	Retail	Retro	128	128	100%	128	0.00	11	\$4	100%	25%	25%	7	68%	0%	85.0%	83.1%	83.1%	72.0
1087	InteriorLighting	Occupancy Sensors	Biz-Prescriptive Light	Retail	Retro	582	582	30%	175	0.00	10	\$65	75%	20%	20%	8	95%	10%	74.6%	44.8%	44.8%	4.4
1088	InteriorLighting	Daylighting Controls	Biz-Prescriptive Light	Retail	Retro	746	746	30%	224	0.00	10	\$58	100%	34%	34%	8	95%	10%	85.0%	71.0%	71.0%	6.2
1089	InteriorLighting	Dual Occupancy & Daylighting Controls	Biz-Custom Light	Retail	Retro	333	333	44%	146	0.00	10	\$75	100%	26%	26%	8	95%	10%	85.0%	47.3%	47.3%	3.9
1090	InteriorLighting	Central Lighting Monitoring & Controls (non-networked)	Biz-Custom Light	Retail	Retro	41,703	41,703	20%	8,341	0.00	12	\$3,700	50%	18%	18%	8	95%	10%	55.0%	37.1%	37.1%	4.1
1091	InteriorLighting	Network Lighting Controls - Wireless (WiFi)	Biz-Prescriptive Light	Retail	Retro	3	3	49%	1	0.00	15	\$1	100%	42%	42%	8	95%	10%	85.0%	63.0%	63.0%	3.8
1092	InteriorLighting	Luminaire Level Lighting Controls w/ HVAC Control	Biz-Custom Light	Retail	Retro	333	333	65%	216	0.00	15	\$90	100%	21%	21%	8	77%	10%	85.0%	53.5%	53.5%	8.2
1093	InteriorLighting	LED Exit Sign - 4 Watt Fixture (2 lamp)	Biz-Prescriptive Light	Retail	Retro	67	67	43%	29	0.00	5	\$33	31%	31%	31%	9	1%	75%	82.5%	80.0%	80.0%	0.7
1094	InteriorLighting	Lighting - Custom	Biz-Custom Light	Retail	Retro	4	4	25%	1	0.00	15	\$0	100%	50%	50%	10	100%	0%	85.0%	79.4%	79.4%	10.1
1095	ExteriorLighting	LED wallpack (existing W<250)	Biz-Prescriptive Light	Retail	Retro	856	856	66%	567	0.00	12	\$248	50%	46%	46%	1	12%	44%	60.8%	55.2%	55.2%	1.6
1096	ExteriorLighting	LED parking lot fixture (existing W<250)	Biz-Prescriptive Light	Retail	Retro	1,589	1,589	60%	959	0.00	12	\$756	25%	20%	20%	2	11%	44%	60.8%	55.2%	55.2%	2.0
1097	ExteriorLighting	LED parking lot fixture (existing W<250)	Biz-Prescriptive Light	Retail	Retro	856	856	66%	567	0.00	12	\$248	50%	30%	30%	3	11%	44%	60.8%	55.2%	55.2%	2.4
1098	ExteriorLighting	LED outdoor pole decorative fixture (existing W<250)	Biz-Prescriptive Light	Retail	Retro	1,589	1,589	60%	959	0.00	12	\$756	25%	20%	20%	4	11%	44%	60.8%	55.2%	55.2%	2.0
1099	ExteriorLighting	LED parking garage fixture (existing W<250)	Biz-Prescriptive Light	Retail	Retro	3,235	3,235	60%	1,953	0.00	6	\$756	25%	13%	13%	5	11%	44%	60.8%	55.2%	55.2%	3.6
1100	ExteriorLighting	LED parking garage fixture (existing W<250)	Biz-Prescriptive Light	Retail	Retro	1,742	1,742	66%	1,154	0.00	6	\$248	75%	32%	32%	6	11%	44%	78.8%	67.1%	67.1%	2.7
1101	ExteriorLighting	LED Mogul-base HID Lamp Replacing Exterior HID (existing W<250)	Biz-Prescriptive Light	Retail	Retro	1,589	1,589	60%	959	0.00	12	\$756	25%	20%	20%	7	11%	44%	60.8%	55.2%	55.2%	2.0
1102	ExteriorLighting	LED Mogul-base HID Lamp Replacing Exterior HID (existing W<250)	Biz-Prescriptive Light	Retail	Retro	856	856	66%	567	0.00	12	\$248	50%	30%	30%	8	11%	44%	60.8%	55.2%	55.2%	2.4
1103	ExteriorLighting	Bi-Level Lighting Fixture – Garages	Biz-Prescriptive Light	Retail	Retro	346	346	69%	239	0.00	10	\$274	29%	29%	29%	9	11%	44%	60.8%	55.2%	55.2%	0.8
1104	ExteriorLighting	LED fuel pump canopy fixture (existing W<250)	Biz-Prescriptive Light	Retail	Retro	0	0	0%	0	0.00	12	\$0	0%	0%	0%	10	0%	44%	85.0%	85.0%	85.0%	0.0
1105	ExteriorLighting	LED fuel pump canopy fixture (existing W<250)	Biz-Prescriptive Light	Retail	Retro	0	0	0%	0	0.00	12	\$0	0%	0%	0%	11	0%	44%	85.0%	85.0%	85.0%	0.0
1106	Miscellaneous	Vending Machine Controller - Non-Refrigerated	Biz-Prescriptive	Retail	Retro	385	385	61%	237	0.00	5	\$233	17%	17%	17%	1	5%	30%	51.0%	44.0%	44.0%	1.0
1107	Miscellaneous	Miscellaneous Custom	Biz-Custom	Retail	Retro	7	7	2%	0	0.00	10	\$0	100%	50%	50%	2	41%	10%	85.0%	64.1%	64.1%	3.3
1108	Miscellaneous	Kitchen Exhaust Hood Demand Ventilation Control System	Biz-Custom	Retail	ROB	9,932	9,932	50%	4,966	0.00	20	\$1,186	100%	33%	33%	3	0%	10%	85.0%	69.2%	69.2%	8.8
1109	Miscellaneous	High Efficiency Hand Dryers	Biz-Custom	Retail	Retro	1,909	1,909	83%	1,585	0.00	10	\$483	100%	26%	26%	4	5%	10%	85.0%	66.4%	66.4%	6.9
1110	Miscellaneous	Ozone Commercial Laundry	Biz-Custom	Retail	Retro	2,984	2,984	25%	746	0.00	10	\$20,310	0%	0%	0%	5	0%	2%	31.4%	17.2%	17.2%	3.6
1111	Miscellaneous	ENERGY STAR Uninterrupted Power Supply	Biz-Custom	Retail	ROB	3,096	3,096	3%	85	0.00	15	\$59	75%	12%	12%	6	20%	70%	79.0%	76.0%	76.0%	7.9
1112	Motors	Cogged V-Belt	Biz-Custom	Retail	Retro	14,670	14,670	3%	455	0.00	15	\$384	75%	9%	9%	1	50%	10%	65.5%	37.6%	37.6%	9.1
1113	Motors	Pump and Fan Variable Frequency Drive Controls (Pumps)	Biz-Custom	Retail	Retro	1,902	1,902	38%	731	0.00	15	\$200	100%	30%	30%	2	100%	10%	83.4%	67.2%	67.2%	8.5
1114	Motors	Power Drive Systems	Biz-Custom	Retail	Retro	4	4	23%	1	0.00	15	\$0	100%	31%	31%	2	100%	10%	83.4%	66.9%	66.9%	8.6
1115	Motors	Switch Reluctance Motors	Biz-Custom	Retail	Retro	28,430	28,430	31%	8,700	0.00	15	\$739	100%	100%	100%	2	100%	1%	83.4%	83.4%	83.4%	5.7
1116	Motors	Escalators Motor Efficiency Controllers	Biz-Custom	Retail	Retro	7,500	7,500	20%	1,500	0.00	10	\$5,000	2%	2%	2%	3	0%	10%	37.0%	28.0%	28.0%	7.0
1117	Office_NonPC	Energy Star Printer/Copier/Fax	Biz-Custom	Retail	ROB	551	551	40%	223	0.00	6	\$0	0%	0%	0%	1	30%	90%	93.0%	92.0%	92.0%	0.0
1118	Office_NonPC	Smart Power Strip – Commercial Use	Biz-Custom	Retail	Retro	1,086	1,086	10%	109	0.00	7	\$50	25%	17%	17%	2	35%	15%	40.5%	36.1%	36.1%	2.8
1119	Office_NonPC	Plug Load Occupancy Sensor	Biz-Custom	Retail	Retro	1,126	1,126	15%	169	0.00	8	\$70	50%	19%	19%	2	35%	15%	57.7%	38.8%	38.8%	3.1
1120	Office_PC	Electrically Commutated Plug Fans in data centers	Biz-Custom	Retail	Retro	86,783	86,783	18%	15,778	0.00	15	\$480	100%	50%	50%	1	65%	20%	85.0%	83.6%	83.6%	36.3
1121	Office_PC	Energy Star Server	Biz-Custom	Retail	ROB	1,621	1,621	23%	368	0.00	8	\$118	100%	25%	25%	1	65%	25%	85.0%	59.8%	59.8%	4.3
1122	Office_PC	Server Virtualization	Biz-Custom	Retail	Retro	2	2	45%	1	0.00	8	\$0	100%	50%	50%	1	65%	25%	85.0%	75.5%	75.5%	3.1
1123	Office_PC	High Efficiency CRAC unit	Biz-Custom	Retail	Retro	541	541	30%	162	0.00	15	\$63	100%	21%	21%	2	65%	20%	85.0%	51.4%	51.4%	7.2
1124	Office_PC	Computer Room Air Conditioner Economizer	Biz-Custom	Retail	Retro	418	418	86%	358	0.00	15	\$82	100%	35%	35%	2	65%	20%	85.0%	66.6%	66.6%	4.8
1125	Office_PC	Data Center Hot/Cold Aisle Configuration	Biz-Custom	Retail	Retro	4	4	25%	1	0.00	15	\$0	100%	50%	50%	3	3%	10%	85.0%	77.4%	77.4%	6.9
1126	Office_PC	Energy Star Laptop	Biz-Custom	Retail	ROB	126	126	33%	41	0.00	4	\$0	0%	0%	0%	4	11%	85%	89.5%	88.0%	88.0%	0.0
1127	Office_PC	Energy Star Monitor	Biz-Custom	Retail	Retro	72	72	21%	15	0.00	4	\$0	0%	0%	0%	5	25%	85%	89.5%	88.0%	88.0%	0.0
1128	Refrigeration	Strip Curtains	Biz-Prescriptive	Retail	Retro	0	0	0%	0	0.00	4	\$0	0%	0%	0%	1	6%	30%	79.2%	79.2%	79.2%	0.0
1129	Refrigeration	Bare Suction Line	Biz-Custom	Retail	Retro	23	23	93%	21	0.00	15	\$4	100%	42%	42%	2	0%	50%	79.2%	72.6%	72.6%	6.9
1130	Refrigeration	Floating Head Pressure Controls	Biz-Custom	Retail	Retro	1,112	1,112	25%	278	0.00	15	\$431	5%	5%	5%	3	4%	25%	47.5%	39.9%	39.9%	4.8
1131	Refrigeration	Saturated Suction Controls	Biz-Custom	Retail	Retro	831	831	50%	416	0.00	15	\$559	75%	6%	6%	4	2%	10%	66.6%	28.1%	28.1%	12.8
1132	Refrigeration	Compressor Retrofit	Biz-Custom	Retail	Retro	813	813	20%	163	0.00	15	\$477	25%	3%	3%	5	13%	25%	47.5%	39.9%	39.9%	12.9
1133	Refrigeration	Electronically Commutated (EC) Walk-In Evaporator Fan Motor	Biz-Prescriptive	Retail	Retro	2,440	2,440	65%	1,586	0.00	15	\$305	100%	13%	13%	6	4%	80%	86.0%	84.0%	84.0%	22.0
1134	Refrigeration	Evaporator Fan Motor Controls	Biz-Prescriptive	Retail	Retro	1,912	1,912	25%	478	0.00	13	\$162	100%	62%	62%	7	4%	25%	79.2%	71.9%	71.9%	2.5

Appendix C: C&I Measure Assumptions

Measure #	End-Use	Measure Name	Program	Building Type	Replacement Type	Base (Existing) Annual Electric	Base (Standard) Annual Electric	% Elec Savings	Per Unit Elec Savings	Per Unit Summer kW	EE EUL	Measure Cost	MAP Incentive (%)	RAP Incentive (%)	PP Incentive (%)	End Use Measure Group	Base Saturation	EE Saturation	MAP Adoption Rate	RAP Adoption Rate	PP Adoption Rate	UCT Score
1135	Refrigeration	Variable Speed Condenser Fan	Biz-Custom	Retail	Retro	2,960	2,960	50%	1,480	0.00	15	\$1,170	25%	10%	10%	8	5%	25%	47.5%	40.0%	40.0%	4.8
1136	Refrigeration	Refrigeration Economizer	Biz-Custom	Retail	Retro	7	7	2%	0	0.00	10	\$0	100%	50%	50%	9	18%	10%	79.2%	69.2%	69.2%	3.3
1137	Refrigeration	Anti-Sweat Heater Controls MT	Biz-Prescriptive	Retail	Retro	579	579	59%	338	0.00	10	\$100	100%	100%	100%	10	18%	75%	82.5%	80.0%	80.0%	1.2
1138	Refrigeration	Auto Door Closer, Cooler	Biz-Prescriptive	Retail	Retro	471,500	471,500	0%	943	0.00	8	\$157	100%	70%	70%	11	13%	50%	79.2%	75.9%	75.9%	3.2
1139	Refrigeration	Display Case Door Retrofit, Medium Temp Electronically Commutated (EC) Reach-In Evaporator Fan Motor	Biz-Custom	Retail	Retro	1,584	1,584	36%	578	0.00	12	\$686	25%	7%	7%	11	5%	25%	47.5%	40.0%	40.0%	6.6
1140	Refrigeration	Q-Sync Motor for Walk-In and Reach-In Evaporator Fan Motor	Biz-Custom	Retail	Retro	2,440	2,440	65%	1,586	0.00	15	\$305	100%	13%	13%	12	3%	80%	86.0%	84.0%	84.0%	22.0
1141	Refrigeration	Energy Star Reach-In Refrigerator, Glass Doors	Biz-Prescriptive	Retail	ROB	2,140	2,140	29%	629	0.00	12	\$1,239	6%	6%	6%	13	17%	54%	67.8%	63.2%	63.2%	4.2
1142	Refrigeration	Energy Star Reach-In Refrigerator, Solid Doors	Biz-Prescriptive	Retail	ROB	1,410	1,410	20%	281	0.00	12	\$1,211	6%	6%	6%	14	17%	54%	67.8%	63.2%	63.2%	1.7
1143	Refrigeration	Anti-Sweat Heater Controls LT	Biz-Prescriptive	Retail	Retro	2,016	2,016	68%	1,361	0.00	10	\$100	100%	100%	100%	15	6%	75%	82.5%	80.0%	80.0%	4.7
1144	Refrigeration	Auto Door Closer, Freezer	Biz-Prescriptive	Retail	Retro	419,455	419,455	1%	2,307	0.00	8	\$157	100%	70%	70%	16	6%	50%	79.2%	77.8%	77.8%	7.7
1145	Refrigeration	Display Case Door Retrofit, Low Temp	Biz-Custom	Retail	Retro	2,922	2,922	50%	1,453	0.00	12	\$686	100%	17%	17%	16	6%	25%	79.2%	50.9%	50.9%	6.6
1146	Refrigeration	Energy Star Reach-In Freezer, Glass Doors	Biz-Prescriptive	Retail	ROB	6,374	6,374	20%	1,275	0.00	12	\$1,651	28%	28%	28%	17	6%	54%	67.8%	63.2%	63.2%	1.3
1147	Refrigeration	Energy Star Reach-In Freezer, Solid Doors	Biz-Prescriptive	Retail	ROB	4,522	4,522	7%	305	0.00	12	\$1,521	13%	13%	13%	18	6%	54%	67.8%	63.2%	63.2%	0.7
1148	Refrigeration	Refrigeration - Custom	Biz-Custom	Retail	ROB	7	7	2%	0	0.00	10	\$0	100%	50%	50%	19	90%	25%	79.2%	69.2%	69.2%	3.3
1149	Refrigeration	Retro-commissioning_Refrigerator Optimization	Biz-Custom RCx	Retail	Retro	3	3	30%	1	0.00	5	\$0	100%	80%	80%	20	90%	25%	79.2%	76.5%	76.5%	1.5
1150	Refrigeration	Energy Star Ice Machine	Biz-Prescriptive	Retail	ROB	6,993	6,993	10%	721	0.00	15	\$1,426	25%	18%	18%	21	2%	44%	60.8%	55.1%	55.1%	1.5
1151	Refrigeration	Vending Machine Controller - Refrigerated	Biz-Prescriptive	Retail	Retro	1,586	1,586	34%	537	0.00	5	\$245	25%	16%	16%	22	4%	30%	51.0%	45.6%	45.6%	2.2
1152	Refrigeration	LED Refrigerated Display Case Lighting Average 6W/LF	Biz-Prescriptive	Retail	Retro	273	273	89%	243	0.00	9	\$11	100%	45%	45%	23	11%	66%	79.2%	77.7%	77.7%	24.0
1153	Refrigeration	LED Refrigerated Display Case Lighting Controls	Biz-Prescriptive	Retail	Retro	522	522	27%	141	0.00	10	\$14	100%	30%	30%	24	11%	13%	79.2%	75.2%	75.2%	18.9
1154	Ventilation	Demand Controlled Ventilation	Biz-Custom	Retail	Retro	2,798	2,798	20%	560	0.00	15	\$227	100%	20%	20%	1	100%	18%	83.4%	58.5%	58.5%	9.9
1155	Ventilation	Pump and Fan Variable Frequency Drive Controls (Fans)	Biz-Prescriptive	Retail	Retro	1,902	1,902	38%	731	0.00	15	\$200	100%	30%	30%	2	100%	18%	83.4%	66.4%	66.4%	8.6
1156	WholeBldg_HVAC	HVAC - Energy Management System	Biz-Custom RCx	Retail	Retro	7	7	15%	1	0.00	15	\$0	100%	50%	50%	1	100%	20%	83.4%	72.8%	72.8%	7.5
1157	WholeBldg_HVAC	Guest room energy management system	Biz-Custom	Retail	Retro	0	0	0%	0	0.00	15	\$260	0%	77%	77%	2	100%	20%	83.4%	83.4%	83.4%	0.0
1158	WholeBldg_HVAC	Retro-commissioning_Bld Optimization	Biz-Custom RCx	Retail	Retro	7	7	15%	1	0.00	15	\$0	100%	50%	50%	3	100%	0%	83.4%	72.8%	72.8%	7.5
1159	WholeBuilding	WholeBldg - Com RET	Biz-Custom	Retail	Retro	7	7	15%	1	0.00	12	\$0	100%	50%	50%	1	100%	0%	83.4%	72.8%	72.8%	6.4
1160	WholeBuilding	WholeBldg - Custom (Other)	Biz-Custom	Retail	Retro	5	5	20%	1	0.00	12	\$0	100%	50%	50%	2	100%	0%	83.4%	72.8%	72.8%	6.4
1161	WholeBuilding	Power Distribution Equipment Upgrades (Transformers)	Biz-Custom	Retail	Retro	1,150	1,150	1%	6	0.00	30	\$8	75%	4%	4%	3	100%	20%	58.6%	36.0%	36.0%	21.0
1162	WholeBldg_NC	WholeBldg - Com NC	Biz-Custom	Retail	NC	4	4	25%	1	0.00	12	\$0	100%	50%	50%	1	100%	60%	83.4%	71.9%	71.9%	5.7
1163	Behavioral	COM Competitions	Biz-Custom	Retail	Retro	53	53	2%	1	0.00	2	\$0	100%	48%	48%	1	100%	0%	50.0%	50.0%	50.0%	3.7
1164	Behavioral	Business Energy Reports	Biz-Custom	Retail	Retro	313	313	0%	1	0.00	2	\$0	100%	100%	100%	1	100%	0%	50.0%	50.0%	50.0%	0.4
1165	Behavioral	Building Benchmarking	Biz-Custom	Retail	Retro	97	97	1%	1	0.00	2	\$0	77%	77%	77%	1	100%	0%	50.0%	50.0%	50.0%	0.4
1166	Behavioral	Strategic Energy Management	Biz-Custom SEM	Retail	Retro	0	0	0%	0	0.00	5	\$0	0%	7%	7%	1	100%	0%	50.0%	50.0%	50.0%	0.0
1167	Behavioral	BEIMS	Biz-Custom	Retail	Retro	20	20	5%	1	0.00	2	\$0	39%	39%	39%	1	100%	2%	50.0%	50.0%	50.0%	0.4
1168	Behavioral	Building Operator Certification	Biz-Custom	Retail	Retro	14	14	3%	0	0.00	3	\$0	33%	33%	33%	1	100%	2%	50.0%	50.0%	50.0%	0.9
1169	CompressedAir	Efficient Air Compressors (VSD)	Biz-Prescriptive	Office	Retro	1,583	1,583	21%	329	0.00	13	\$127	100%	47%	47%	1	100%	33%	83.4%	69.0%	69.0%	5.2
1170	CompressedAir	Efficient Air Nozzles	Biz-Prescriptive	Office	Retro	1,480	1,480	50%	740	0.00	15	\$50	100%	40%	40%	2	35%	33%	83.4%	78.4%	78.4%	22.7
1171	CompressedAir	AODD Pump Controls	Biz-Custom	Office	Retro	103,919	103,919	35%	36,372	0.00	10	\$1,150	100%	50%	50%	3	10%	33%	83.4%	81.4%	81.4%	28.9
1172	CompressedAir	Compressed Air - Custom	Biz-Custom	Office	Retro	5	5	20%	1	0.00	10	\$0	100%	38%	38%	4	50%	33%	83.4%	69.6%	69.6%	5.7
1173	CompressedAir	Retro-commissioning_Compressed Air Optimization	Biz-Custom RCx	Office	Retro	3	3	30%	1	0.00	5	\$0	100%	80%	80%	5	50%	33%	83.4%	78.1%	78.1%	1.5
1174	Cooking	Commercial Combination Oven (Electric)	Biz-Prescriptive	Office	ROB	38,561	38,561	48%	18,432	0.00	12	\$16,884	50%	6%	6%	1	18%	53%	67.1%	62.4%	62.4%	10.5
1175	Cooking	Commercial Electric Convection Oven	Biz-Prescriptive	Office	ROB	12,193	12,193	15%	1,879	0.00	12	\$1,706	50%	23%	23%	1	18%	53%	67.1%	62.4%	62.4%	2.9
1176	Cooking	Commercial Electric Griddle	Biz-Prescriptive	Office	ROB	17,056	17,056	15%	2,596	0.00	12	\$3,604	25%	22%	22%	2	14%	17%	41.9%	33.6%	33.6%	1.4
1177	Cooking	Commercial Electric Steam Cooker	Biz-Prescriptive	Office	ROB	19,549	19,549	67%	13,162	0.00	12	\$3,300	100%	27%	27%	3	6%	45%	79.2%	70.6%	70.6%	9.0
1178	Cooking	Dishwasher Low Temp Door (Energy Star)	Biz-Prescriptive	Office	ROB	39,306	39,306	44%	17,369	0.00	15	\$662	100%	76%	76%	4	26%	61%	79.2%	78.5%	78.5%	16.5
1179	Cooking	Dishwasher High Temp Door (Energy Star)	Biz-Prescriptive	Office	ROB	26,901	26,901	32%	8,586	0.00	15	\$995	100%	50%	50%	4	26%	61%	79.2%	74.9%	74.9%	8.2
1180	Cooking	Energy efficient electric fryer	Biz-Prescriptive	Office	ROB	18,955	18,955	17%	3,274	0.00	12	\$1,500	75%	5%	5%	5	27%	24%	72.1%	45.1%	45.1%	17.1
1181	Cooking	Insulated Holding Cabinets (Full Size)	Biz-Custom	Office	ROB	13,697	13,697	68%	9,314	0.00	12	\$1,200	100%	62%	62%	6	3%	16%	79.2%	75.6%	75.6%	5.3
1182	Cooking	Insulated Holding Cabinets (Half-Size)	Biz-Custom	Office	ROB	4,383	4,383	60%	2,630	0.00	12	\$1,500	50%	14%	14%	6	3%	16%	57.8%	41.7%	41.7%	5.3
1183	Cooling	Air Conditioner - 12 IEER (5-20 Tons)	Biz-Prescriptive	Office	ROB	1,406	1,406	6%	87	0.00	15	\$63	100%	79%	79%	1	26%	20%	83.4%	71.5%	71.5%	2.3
1184	Cooling	Air Conditioner - 14 IEER (5-20 Tons)	Biz-Prescriptive	Office	ROB	1,406	1,406	13%	181	0.00	15	\$127	100%	39%	39%	1	26%	20%	83.4%	56.5%	56.5%	4.8
1185	Cooling	Air Conditioner - 17 IEER (5-20 Tons)	Biz-Prescriptive	Office	ROB	1,406	1,406	28%	397	0.00	15	\$127	100%	39%	39%	1	26%	20%	83.4%	69.3%	69.3%	10.6
1186	Cooling	Air Conditioner - 21 IEER (5-20 Tons)	Biz-Prescriptive	Office	ROB	1,406	1,406	42%	589	0.00	15	\$127	100%	39%	39%	1	26%	20%	83.4%	72.5%	72.5%	15.8
1187	Cooling	Air Conditioner - 12.1 IEER (20+ Tons)	Biz-Prescriptive	Office	ROB	1,505	1,505	6%	87	0.00	15	\$50	100%	100%	100%	2	26%	20%	83.4%	83.4%	83.4%	2.3
1188	Cooling	Air Conditioner - 13 IEER (20+ Tons)	Biz-Prescriptive	Office	ROB	1,505	1,505	12%	185	0.00	15	\$50	100%	100%	100%	2	26%	20%	83.4%	83.4%	83.4%	5.0
1189	Cooling	Air Conditioner - 14.3 IEER (20+ Tons)	Biz-Prescriptive	Office	ROB	1,505	1,505	20%	305	0.00	15	\$50	100%	100%	100%	2	26%	20%	83.4%	83.4%	83.4%	8.4
1190	Cooling	Air Conditioner - 17 IEER (20+ Tons)	Biz-Prescriptive	Office	ROB	1,505	1,505	46%	688	0.00	15	\$50	100%	100%	100%	2	26%	20%	83.4%	83.4%	83.4%	18.4
1191	Cooling	Comprehensive Rooftop Unit Quality Maintenance (AC Tune-up)	Biz-Custom	Office	Retro	1,430	1,430	7%	100	0.00	3	\$5	100%	50%	50%	3	51%	50%	83.4%	81.0%	81.0%	13.1
1192	Cooling	Air Side Economizer	Biz-Custom	Office	Retro	1,406	1,406	20%	281	0.00	10	\$84	75%	27%	27%	4	51%	20%	72.1%	57.6%	57.6%	3.7
1193	Cooling	Advanced Rooftop Controls	Biz-Prescriptive	Office	Retro	1,430	1,430	2%	23	0.00	10	\$98	26%	26%	26%	5	51%	20%	44.0%	36.0%	36.0%	0.3
1194	Cooling	HVAC Occupancy Controls	Biz-Custom	Office	ROB	2,900	2,900	20%	580	0.00	15	\$537	75%	9%	9%	6	51%	20%	64.3%	36.0%	36.0%	11.2
1195	Cooling	Air Conditioner - 16 SEER (<5 Tons)	Biz-Prescriptive	Office	ROB	1,225	1,225	13%	153	0.00	15	\$50	100%	100%	100%	7	8%	20%	83.4%	83.4%	83.4%	4.1
1196	Cooling	Air Conditioner - 17 SEER (<5 Tons)	Biz-Prescriptive	Office	ROB	1,225	1,225	18%	216	0.00	15	\$206	100%	24%	24%	7	8%	20%	83.4%	43.9%	43.9%	5.8
1197	Cooling	Air Conditioner - 18 SEER (<5 Tons)	Biz-Prescriptive	Office	ROB	1,225	1,225	22%	272	0.00	15	\$206	100%	24%	24%	7	8%	20%	83.4%	47.5%	47.5%	7.3

Appendix C: C&I Measure Assumptions

Measure #	End-Use	Measure Name	Program	Building Type	Replacement Type	Base (Existing) Annual Electric	Base (Standard) Annual Electric	% Elec Savings	Per Unit Elec Savings	Per Unit Summer kW	EE EUL	Measure Cost	MAP Incentive (%)	RAP Incentive (%)	PP Incentive (%)	End Use Measure Group	Base Saturation	EE Saturation	MAP Adoption Rate	RAP Adoption Rate	PP Adoption Rate	UCT Score
1199	Cooling	Air Conditioner - 21 SEER(<5 Tons)	Biz-Prescriptive	Office	ROB	1,225	1,225	33%	408	0.00	15	\$253	100%	20%	20%	7	8%	20%	83.4%	51.9%	51.9%	10.9
1200	Cooling	Smart Thermostat	Biz-Prescriptive	Office	ROB	1,225	1,225	14%	174	0.00	11	\$175	50%	26%	26%	8	8%	12%	45.1%	37.2%	37.2%	2.5
1201	Cooling	PTAC - <7,000 Btuh - lodging	Biz-Prescriptive	Office	ROB	1,442	1,442	8%	122	0.00	8	\$84	100%	42%	42%	9	7%	20%	83.4%	56.7%	56.7%	2.7
1202	Cooling	PTAC - 7,000 to 15,000 Btuh - lodging	Biz-Prescriptive	Office	ROB	1,581	1,581	7%	115	0.00	8	\$84	100%	42%	42%	10	7%	20%	83.4%	55.0%	55.0%	2.5
1203	Cooling	PTAC - >15,000 Btuh - lodging	Biz-Prescriptive	Office	ROB	1,806	1,806	10%	172	0.00	8	\$84	100%	42%	42%	11	7%	20%	83.4%	64.0%	64.0%	3.8
1204	Cooling	Air Cooled Chiller	Biz-Prescriptive	Office	ROB	1,252	1,252	6%	70	0.00	23	\$126	100%	40%	40%	12	35%	15%	83.4%	38.9%	38.9%	3.1
1205	Cooling	Chiller Tune-up	Biz-Custom	Office	Retro	1,430	1,430	7%	100	0.00	3	\$5	100%	50%	50%	13	35%	50%	83.4%	81.0%	81.0%	13.1
1206	Cooling	HVAC/Chiller Custom	Biz-Custom	Office	Retro	5	5	20%	1	0.00	20	\$1	100%	6%	6%	14	100%	20%	83.4%	36.0%	36.0%	28.3
1207	Cooling	Window Film	Biz-Custom	Office	Retro	6,000	6,000	4%	264	0.00	10	\$154	100%	14%	14%	15	100%	20%	83.4%	50.6%	50.6%	11.8
1208	Cooling	Triple Pane Windows	Biz-Custom	Office	ROB	6,000	6,000	6%	360	0.00	25	\$700	75%	4%	4%	15	100%	20%	51.7%	36.0%	36.0%	21.8
1209	Cooling	Energy Recovery Ventilator	Biz-Custom	Office	ROB	1,505	1,505	63%	952	0.00	15	\$1,500	100%	5%	5%	16	100%	2%	83.4%	38.1%	38.1%	30.8
1210	Heating	Heat Pump - 16 SEER (<5 Tons)	Biz-Prescriptive	Office	ROB	2,921	2,921	4%	111	0.00	16	\$87	100%	57%	57%	1	8%	20%	83.4%	59.7%	59.7%	2.0
1211	Heating	Heat Pump - 17 SEER (<5 Tons)	Biz-Prescriptive	Office	ROB	2,921	2,921	8%	248	0.00	16	\$442	25%	11%	11%	1	8%	20%	44.0%	36.0%	36.0%	4.0
1212	Heating	Heat Pump - 18 SEER(<5 Tons)	Biz-Prescriptive	Office	ROB	2,921	2,921	12%	356	0.00	16	\$507	50%	10%	10%	1	8%	20%	44.0%	36.0%	36.0%	5.7
1213	Heating	Heat Pump - 21 SEER(<5 Tons)	Biz-Prescriptive	Office	ROB	2,921	2,921	18%	540	0.00	16	\$507	75%	10%	10%	1	8%	20%	65.0%	37.0%	37.0%	8.9
1214	Heating	Geothermal HP - SEER 20.3 (<5 Tons)	Biz-Prescriptive	Office	ROB	2,921	2,921	22%	654	0.00	25	\$2,576	14%	14%	14%	1	8%	20%	44.0%	36.0%	36.0%	1.8
1215	Heating	Geothermal HP - SEER 21.5 (<5 Tons)	Biz-Prescriptive	Office	ROB	2,921	2,921	27%	781	0.00	25	\$2,576	25%	14%	14%	1	8%	20%	44.0%	36.0%	36.0%	2.1
1216	Heating	Geothermal HP - SEER 23.1 (<5 Tons)	Biz-Prescriptive	Office	ROB	2,921	2,921	32%	929	0.00	25	\$2,576	25%	14%	14%	1	8%	20%	44.0%	36.0%	36.0%	2.4
1217	Heating	Geothermal HP - SEER 29.3 (<5 Tons)	Biz-Prescriptive	Office	ROB	2,921	2,921	47%	1,360	0.00	25	\$2,576	25%	14%	14%	1	8%	20%	44.0%	36.0%	36.0%	3.1
1218	Heating	Heat Pump - 14.0 IEER COP 3.6 (65,000-134,000 Btu/hr)	Biz-Prescriptive	Office	ROB	3,512	3,512	11%	378	0.00	16	\$100	100%	50%	50%	2	27%	20%	83.4%	78.2%	78.2%	20.9
1219	Heating	Heat Pump - 15.0 IEER COP 3.8 (65,000-134,000 Btu/hr)	Biz-Prescriptive	Office	ROB	3,512	3,512	16%	560	0.00	16	\$136	100%	37%	37%	2	27%	20%	83.4%	75.7%	75.7%	23.6
1220	Heating	Heat Pump - 14.5 IEER COP 3.5 (135,000-239,000 Btu/hr)	Biz-Prescriptive	Office	ROB	3,653	3,653	14%	506	0.00	16	\$100	100%	35%	35%	2	27%	20%	83.4%	77.5%	77.5%	34.0
1221	Heating	Heat Pump - 15.5 IEER COP 3.7 (135,000-239,000 Btu/hr)	Biz-Prescriptive	Office	ROB	3,653	3,653	19%	688	0.00	16	\$139	100%	25%	25%	2	27%	20%	83.4%	75.2%	75.2%	37.8
1222	Heating	Geothermal HP - SEER 20.3 (5-20 Tons)	Biz-Prescriptive	Office	ROB	3,204	3,204	29%	938	0.00	25	\$2,576	25%	14%	14%	2	27%	20%	44.0%	36.0%	36.0%	3.5
1223	Heating	Geothermal HP - SEER 21.5 (5-20 Tons)	Biz-Prescriptive	Office	ROB	3,204	3,204	33%	1,064	0.00	25	\$2,576	50%	14%	14%	2	27%	20%	44.0%	36.0%	36.0%	3.8
1224	Heating	Geothermal HP - SEER 23.1 (5-20 Tons)	Biz-Prescriptive	Office	ROB	3,385	3,385	41%	1,393	0.00	25	\$2,576	50%	14%	14%	2	27%	20%	44.0%	36.0%	36.0%	4.4
1225	Heating	Geothermal HP - SEER 29.3 (5-20 Tons)	Biz-Prescriptive	Office	ROB	3,385	3,385	54%	1,825	0.00	25	\$2,576	50%	14%	14%	2	27%	20%	44.0%	36.0%	36.0%	5.2
1226	Heating	Variable Refrigerant Flow Heat Pump	Biz-Custom	Office	ROB	2,708	2,708	12%	327	0.00	16	\$224	100%	16%	16%	2	27%	2%	83.4%	48.0%	48.0%	10.3
1227	Heating	Heat Pump - 12 IEER 3.4 COP (>239,000 Btu/hr)	Biz-Prescriptive	Office	ROB	3,797	3,797	9%	346	0.00	16	\$100	100%	35%	35%	3	27%	20%	83.4%	75.8%	75.8%	26.5
1228	Heating	Heat Pump - 13 IEER 3.6 COP (>239,000 Btu/hr)	Biz-Prescriptive	Office	ROB	3,797	3,797	15%	569	0.00	16	\$175	100%	20%	20%	3	27%	20%	83.4%	71.6%	71.6%	31.7
1229	Heating	Geothermal HP - SEER 20.3 (20+ Tons)	Biz-Prescriptive	Office	ROB	3,653	3,653	38%	1,386	0.00	25	\$2,576	75%	14%	14%	3	27%	20%	58.7%	36.0%	36.0%	6.7
1230	Heating	Geothermal HP - SEER 21.5 (20+ Tons)	Biz-Prescriptive	Office	ROB	3,653	3,653	41%	1,512	0.00	25	\$2,576	75%	14%	14%	3	27%	20%	59.7%	36.0%	36.0%	7.0
1231	Heating	Geothermal HP - SEER 23.1 (20+ Tons)	Biz-Prescriptive	Office	ROB	3,653	3,653	45%	1,661	0.00	25	\$2,576	75%	14%	14%	3	27%	20%	61.0%	36.0%	36.0%	7.3
1232	Heating	Geothermal HP - SEER 29.3 (20+ Tons)	Biz-Prescriptive	Office	ROB	3,653	3,653	57%	2,092	0.00	25	\$2,576	100%	14%	14%	3	27%	20%	83.4%	36.0%	36.0%	8.1
1233	Heating	Mini Split Ductless Heat Pump Cold Climate (Tiers & sizes TBD)	Biz-Prescriptive	Office	ROB	2,921	2,921	18%	540	0.00	16	\$224	100%	16%	16%	4	28%	20%	83.4%	57.0%	57.0%	12.7
1234	Heating	PTHP - <7,000 Btuh - lodging	Biz-Custom	Office	ROB	3,225	3,225	4%	117	0.00	8	\$84	75%	48%	48%	5	3%	10%	70.9%	61.8%	61.8%	2.1
1235	Heating	PTHP - >15,000 Btuh - lodging	Biz-Prescriptive	Office	ROB	3,863	3,863	14%	560	0.00	8	\$84	100%	48%	48%	6	3%	10%	83.4%	77.2%	77.2%	10.1
1236	Heating	PTHP - 7,000 to 15,000 Btuh - lodging	Biz-Prescriptive	Office	ROB	3,525	3,525	8%	291	0.00	8	\$84	100%	48%	48%	7	3%	10%	83.4%	72.2%	72.2%	5.2
1237	HotWater	Heat Pump Water Heater	Biz-Prescriptive	Office	ROB	4,536	4,536	67%	3,038	0.00	15	\$1,115	100%	49%	49%	1	100%	16%	75.5%	63.4%	63.4%	3.4
1238	HotWater	Hot Water Pipe Insulation	Biz-Custom	Office	Retro	4,536	4,536	2%	91	0.00	20	\$60	100%	12%	12%	2	100%	80%	86.0%	84.0%	84.0%	8.6
1239	HotWater	Faucet Aerator	Biz-Custom	Office	Retro	545	545	32%	176	0.00	10	\$8	100%	100%	100%	3	20%	90%	93.0%	92.0%	92.0%	14.1
1240	HotWater	Low Flow Pre-Rinse Sprayers	Biz-Custom	Office	ROB	18,059	18,059	54%	9,789	0.00	5	\$75	100%	100%	100%	4	20%	80%	86.0%	84.0%	84.0%	23.3
1241	HotWater	ENERGY STAR Commercial Washing Machines	Biz-Prescriptive	Office	ROB	1,552	1,552	43%	671	0.00	7	\$250	50%	18%	18%	5	25%	32%	60.3%	45.6%	45.6%	3.8
1242	InteriorLighting	LED T8 Tube Replacement	Biz-Prescriptive Light	Office	Retro	115	115	45%	51	0.00	15	\$3	100%	100%	100%	1	72%	38%	85.0%	85.0%	85.0%	13.2
1243	InteriorLighting	LED troffer retrofit kit, 2'X2' and 2'X4'	Biz-Prescriptive Light	Office	Retro	260	260	50%	130	0.00	15	\$70	100%	43%	43%	1	72%	38%	85.0%	55.8%	55.8%	3.3
1244	InteriorLighting	LED troffer, 2'X2' and 2'X4'	Biz-Prescriptive Light	Office	Retro	260	260	50%	130	0.00	15	\$70	100%	79%	79%	1	72%	38%	85.0%	75.3%	75.3%	1.8
1245	InteriorLighting	Bi-Level Lighting Fixture - Stairwells, Hallways	Biz-Custom Light	Office	Retro	260	260	74%	193	0.00	10	\$274	29%	29%	29%	2	8%	38%	56.4%	49.8%	49.8%	0.9
1246	InteriorLighting	LED high bay fixture	Biz-Prescriptive Light	Office	Retro	2,423	2,423	68%	1,649	0.00	15	\$330	100%	45%	45%	3	1%	19%	85.0%	75.8%	75.8%	8.5
1247	InteriorLighting	LED Mogul-base HID Lamp Replacing High Bay HID	Biz-Prescriptive Light	Office	Retro	2,423	2,423	66%	1,608	0.00	15	\$330	100%	45%	45%	3	1%	19%	85.0%	75.6%	75.6%	8.3
1248	InteriorLighting	LED low bay fixture	Biz-Prescriptive Light	Office	Retro	516	516	61%	314	0.00	15	\$75	100%	100%	100%	4	1%	19%	85.0%	85.0%	85.0%	3.2
1249	InteriorLighting	LED Mogul-base HID Lamp Replacing Low Bay HID	Biz-Prescriptive Light	Office	Retro	516	516	59%	303	0.00	15	\$75	100%	100%	100%	4	1%	19%	85.0%	85.0%	85.0%	3.1
1250	InteriorLighting	LED Screw-In Lamps (Directional)	Biz-Prescriptive Light	Office	ROB	283	283	86%	243	0.00	7	\$1	100%	100%	100%	5	2%	13%	85.0%	85.0%	85.0%	103.3
1251	InteriorLighting	LED downlight fixture	Biz-Prescriptive Light	Office	Retro	179	179	68%	121	0.00	15	\$27	100%	37%	37%	6	17%	13%	85.0%	72.9%	72.9%	9.3
1252	InteriorLighting	LED Screw-In Lamps (Omnidirectional & Decorative)	Biz-Prescriptive Light	Office	ROB	214	214	81%	173	0.00	7	\$1	100%	100%	100%	6	17%	13%	85.0%	85.0%	85.0%	73.6
1253	InteriorLighting	DeLamp Fluorescent Fixture Average Lamp Wattage 28W	Biz-Prescriptive Light	Office	Retro	96	96	100%	96	0.00	11	\$4	100%	25%	25%	7	72%	0%	85.0%	82.4%	82.4%	58.7
1254	InteriorLighting	Occupancy Sensors	Biz-Prescriptive Light	Office	Retro	438	438	30%	131	0.00	10	\$65	75%	20%	20%	8	95%	10%	71.3%	37.3%	37.3%	3.8
1255	InteriorLighting	Daylighting Controls	Biz-Prescriptive Light	Office	Retro	560	560	30%	168	0.00	10	\$58	100%	34%	34%	8	95%	10%	85.0%	68.0%	68.0%	6.2
1256	InteriorLighting	Dual Occupancy & Daylighting Controls	Biz-Custom Light	Office	Retro	250	250	44%	110	0.00	10	\$75	75%	26%	26%	8	95%	10%	70.2%	37.3%	37.3%	3.2
1257	InteriorLighting	Central Lighting Monitoring & Controls (non-networked)	Biz-Custom Light	Office	Retro	41,703	41,703	20%	8,341	0.00	12	\$3,700	75%	18%	18%	8	95%	10%	71.5%	37.1%	37.1%	4.3
1258	InteriorLighting	Network Lighting Controls - Wireless (WiFi)	Biz-Prescriptive Light	Office	Retro	5	5	49%	2	0.00	15	\$1	100%	42%	42%	8	95%	10%	85.0%	70.0%	70.0%	5.3
1259	InteriorLighting	Luminaire Level Lighting Controls w/ HVAC Control	Biz-Custom Light	Office	Retro	589	589	65%	383	0.00	15	\$90	100%	21%	21%	8	81%	10%	85.0%	65.3%	65.3%	11.4
1260	InteriorLighting	LED Exit Sign - 4 Watt Fixture (2 lamp)	Biz-Prescriptive Light																			

Appendix C: C&I Measure Assumptions

Measure #	End-Use	Measure Name	Program	Building Type	Replacement Type	Base (Existing) Annual Electric	Base (Standard) Annual Electric	% Elec Savings	Per Unit Elec Savings	Per Unit Summer kW	EE EUL	Measure Cost	MAP Incentive (%)	RAP Incentive (%)	PP Incentive (%)	End Use Measure Group	Base Saturation	EE Saturation	MAP Adoption Rate	RAP Adoption Rate	PP Adoption Rate	UCT Score
1261	InteriorLighting	Lighting - Custom	Biz-Custom Light	Office	Retro	4	4	25%	1	0.00	15	\$0	100%	50%	50%	10	100%	0%	85.0%	78.1%	78.1%	7.9
1262	ExteriorLighting	LED wallpack (existing W<250)	Biz-Prescriptive Light	Office	LED	856	856	66%	567	0.00	12	\$248	75%	46%	46%	1	12%	44%	71.7%	55.2%	55.2%	1.6
1263	ExteriorLighting	LED parking lot fixture (existing W<250)	Biz-Prescriptive Light	Office	Retro	1,589	1,589	60%	959	0.00	12	\$756	25%	20%	20%	2	11%	44%	60.8%	55.2%	55.2%	2.1
1264	ExteriorLighting	LED parking lot fixture (existing W<250)	Biz-Prescriptive Light	Office	Retro	856	856	66%	567	0.00	12	\$248	75%	30%	30%	3	11%	44%	71.7%	55.2%	55.2%	2.5
1265	ExteriorLighting	LED outdoor pole decorative fixture (existing W<250)	Biz-Prescriptive Light	Office	Retro	1,589	1,589	60%	959	0.00	12	\$756	25%	20%	20%	4	11%	44%	60.8%	55.2%	55.2%	2.1
1266	ExteriorLighting	LED parking garage fixture (existing W<250)	Biz-Prescriptive Light	Office	Retro	3,235	3,235	60%	1,953	0.00	6	\$756	50%	13%	13%	5	11%	44%	60.8%	55.2%	55.2%	3.8
1267	ExteriorLighting	LED parking garage fixture (existing W<250)	Biz-Prescriptive Light	Office	Retro	1,742	1,742	66%	1,154	0.00	6	\$248	75%	32%	32%	6	11%	44%	78.8%	67.1%	67.1%	2.8
1268	ExteriorLighting	LED Mogul-base HID Lamp Replacing Exterior HID (existing W<250)	Biz-Prescriptive Light	Office	Retro	1,589	1,589	60%	959	0.00	12	\$756	25%	20%	20%	7	11%	44%	60.8%	55.2%	55.2%	2.1
1269	ExteriorLighting	LED Mogul-base HID Lamp Replacing Exterior HID (existing W<250)	Biz-Prescriptive Light	Office	Retro	856	856	66%	567	0.00	12	\$248	75%	30%	30%	8	11%	44%	71.7%	55.2%	55.2%	2.5
1270	ExteriorLighting	Bi-Level Lighting Fixture -- Garages	Biz-Prescriptive Light	Office	Retro	260	260	69%	179	0.00	10	\$274	29%	29%	29%	9	11%	44%	60.8%	53.6%	53.6%	0.7
1271	ExteriorLighting	LED fuel pump canopy fixture (existing W<250)	Biz-Prescriptive Light	Office	Retro	0	0	0%	0	0.00	12	\$0	0%	0%	0%	10	0%	44%	85.0%	85.0%	85.0%	0.0
1272	ExteriorLighting	LED fuel pump canopy fixture (existing W<250)	Biz-Prescriptive Light	Office	Retro	0	0	0%	0	0.00	12	\$0	0%	0%	0%	11	0%	44%	85.0%	85.0%	85.0%	0.0
1273	Miscellaneous	Vending Machine Controller - Non-Refrigerated	Biz-Prescriptive	Office	Retro	385	385	61%	237	0.00	5	\$233	17%	17%	17%	1	5%	30%	51.0%	44.0%	44.0%	1.0
1274	Miscellaneous	Miscellaneous Custom	Biz-Custom	Office	Retro	7	7	2%	0	0.00	10	\$0	100%	50%	50%	2	32%	10%	85.0%	63.4%	63.4%	3.3
1275	Miscellaneous	Kitchen Exhaust Hood Demand Ventilation Control System	Biz-Custom	Office	ROB	9,932	9,932	50%	4,966	0.00	20	\$1,187	100%	33%	33%	3	31%	10%	85.0%	69.2%	69.2%	8.8
1276	Miscellaneous	High Efficiency Hand Dryers	Biz-Custom	Office	Retro	262	262	83%	217	0.00	10	\$483	25%	4%	4%	4	5%	10%	37.0%	23.9%	23.9%	8.4
1277	Miscellaneous	Ozone Commercial Laundry	Biz-Custom	Office	Retro	2,984	2,984	25%	746	0.00	10	\$20,310	0%	0%	0%	5	3%	2%	31.4%	17.2%	17.2%	3.7
1278	Miscellaneous	ENERGY STAR Uninterrupted Power Supply	Biz-Custom	Office	ROB	3,096	3,096	3%	85	0.00	15	\$59	75%	12%	12%	6	20%	70%	79.0%	76.0%	76.0%	8.2
1279	Motors	Cogged V-Belt	Biz-Custom	Office	Retro	9,092	9,092	3%	282	0.00	15	\$384	50%	6%	6%	1	50%	10%	42.5%	30.6%	30.6%	11.6
1280	Motors	Pump and Fan Variable Frequency Drive Controls (Pumps)	Biz-Custom	Office	Retro	1,902	1,902	38%	731	0.00	15	\$200	100%	30%	30%	2	100%	10%	83.4%	65.4%	65.4%	8.6
1281	Motors	Power Drive Systems	Biz-Custom	Office	Retro	4	4	23%	1	0.00	15	\$0	100%	31%	31%	2	100%	10%	83.4%	68.2%	68.2%	11.0
1282	Motors	Switch Reluctance Motors	Biz-Custom	Office	Retro	17,620	17,620	31%	5,392	0.00	15	\$528	100%	87%	87%	2	100%	1%	83.4%	81.5%	81.5%	5.7
1283	Motors	Escalators Motor Efficiency Controllers	Biz-Custom	Office	Retro	7,500	7,500	20%	1,500	0.00	10	\$5,000	2%	2%	2%	3	0%	10%	37.0%	28.0%	28.0%	7.2
1284	Office_NonPC	Energy Star Printer/Copier/Fax	Biz-Custom	Office	ROB	551	551	40%	223	0.00	6	\$0	0%	0%	0%	1	30%	90%	93.0%	92.0%	92.0%	0.0
1285	Office_NonPC	Smart Power Strip -- Commercial Use	Biz-Custom	Office	Retro	1,086	1,086	10%	109	0.00	7	\$50	25%	17%	17%	2	35%	15%	40.5%	36.1%	36.1%	2.8
1286	Office_NonPC	Plug Load Occupancy Sensor	Biz-Custom	Office	Retro	1,126	1,126	15%	169	0.00	8	\$70	50%	19%	19%	2	35%	15%	57.7%	38.8%	38.8%	3.1
1287	Office_PC	Electrically Commutated Plug Fans in data centers	Biz-Custom	Office	Retro	86,783	86,783	18%	15,778	0.00	15	\$480	100%	50%	50%	1	65%	20%	85.0%	83.5%	83.5%	36.7
1288	Office_PC	Energy Star Server	Biz-Custom	Office	ROB	1,621	1,621	23%	368	0.00	8	\$118	100%	25%	25%	1	65%	25%	85.0%	58.1%	58.1%	4.4
1289	Office_PC	Server Virtualization	Biz-Custom	Office	Retro	2	2	45%	1	0.00	8	\$0	100%	50%	50%	1	65%	25%	85.0%	75.5%	75.5%	3.1
1290	Office_PC	High Efficiency CRAC unit	Biz-Custom	Office	ROB	541	541	30%	162	0.00	15	\$63	100%	21%	21%	2	65%	20%	85.0%	49.1%	49.1%	7.3
1291	Office_PC	Computer Room Air Conditioner Economizer	Biz-Custom	Office	Retro	418	418	86%	358	0.00	15	\$82	100%	35%	35%	2	65%	20%	85.0%	66.6%	66.6%	4.9
1292	Office_PC	Data Center Hot/Cold Aisle Configuration	Biz-Custom	Office	Retro	4	4	25%	1	0.00	15	\$0	100%	50%	50%	3	3%	10%	85.0%	77.0%	77.0%	7.0
1293	Office_PC	Energy Star Laptop	Biz-Custom	Office	ROB	126	126	33%	41	0.00	4	\$0	0%	0%	0%	4	11%	85%	89.5%	88.0%	88.0%	0.0
1294	Office_PC	Energy Star Monitor	Biz-Custom	Office	Retro	72	72	21%	15	0.00	4	\$0	0%	0%	0%	5	25%	85%	89.5%	88.0%	88.0%	0.0
1295	Refrigeration	Strip Curtains	Biz-Prescriptive	Office	Retro	0	0	0%	0	0.00	4	\$0	0%	0%	0%	1	10%	30%	79.2%	79.2%	79.2%	0.0
1296	Refrigeration	Bare Suction Line	Biz-Custom	Office	Retro	23	23	93%	21	0.00	15	\$4	100%	42%	42%	2	0%	50%	79.2%	72.6%	72.6%	6.9
1297	Refrigeration	Floating Head Pressure Controls	Biz-Custom	Office	Retro	1,112	1,112	25%	278	0.00	15	\$431	5%	5%	5%	3	7%	25%	47.5%	39.9%	39.9%	4.8
1298	Refrigeration	Saturated Suction Controls	Biz-Custom	Office	Retro	831	831	50%	416	0.00	15	\$559	75%	6%	6%	4	2%	10%	66.6%	28.1%	28.1%	12.8
1299	Refrigeration	Compressor Retrofit	Biz-Custom	Office	Retro	813	813	20%	163	0.00	15	\$477	25%	3%	3%	5	22%	25%	47.5%	39.9%	39.9%	12.9
1300	Refrigeration	Electronically Commutated (EC) Walk-In Evaporator Fan Motor	Biz-Prescriptive	Office	Retro	2,440	2,440	65%	1,586	0.00	15	\$305	100%	13%	13%	6	6%	80%	86.0%	84.0%	84.0%	22.0
1301	Refrigeration	Evaporator Fan Motor Controls	Biz-Prescriptive	Office	Retro	1,912	1,912	25%	478	0.00	13	\$162	100%	62%	62%	7	6%	25%	79.2%	71.9%	71.9%	2.5
1302	Refrigeration	Variable Speed Condenser Fan	Biz-Custom	Office	Retro	2,960	2,960	50%	1,480	0.00	15	\$1,170	25%	10%	10%	8	8%	25%	47.5%	40.0%	40.0%	4.8
1303	Refrigeration	Refrigeration Economizer	Biz-Custom	Office	Retro	7	7	2%	0	0.00	10	\$0	100%	50%	50%	9	31%	10%	79.2%	69.2%	69.2%	3.3
1304	Refrigeration	Anti-Sweat Heater Controls MT	Biz-Prescriptive	Office	Retro	579	579	59%	338	0.00	10	\$100	100%	100%	100%	10	20%	25%	79.2%	79.2%	79.2%	1.2
1305	Refrigeration	Auto Door Closer, Cooler	Biz-Prescriptive	Office	Retro	471,500	471,500	0%	943	0.00	8	\$157	100%	70%	70%	11	15%	50%	79.2%	75.9%	75.9%	3.2
1306	Refrigeration	Display Case Door Retrofit, Medium Temp	Biz-Custom	Office	Retro	1,584	1,584	36%	578	0.00	12	\$686	25%	7%	7%	11	6%	25%	47.5%	40.0%	40.0%	6.6
1307	Refrigeration	Electronically Commutated (EC) Reach-In Evaporator Fan Motor	Biz-Prescriptive	Office	Retro	2,440	2,440	65%	1,586	0.00	15	\$305	100%	13%	13%	12	3%	80%	86.0%	84.0%	84.0%	22.0
1308	Refrigeration	Qi-Sync Motor for Walk-In and Reach-In Evaporator Fan Motor	Biz-Custom	Office	Retro	1,911	1,911	26%	504	0.00	10	\$96	100%	42%	42%	12	3%	2%	79.2%	72.7%	72.7%	5.2
1309	Refrigeration	Energy Star Reach-In Refrigerator, Glass Doors	Biz-Prescriptive	Office	ROB	2,140	2,140	29%	629	0.00	12	\$1,239	6%	6%	6%	13	19%	54%	67.8%	63.2%	63.2%	4.2
1310	Refrigeration	Energy Star Reach-In Refrigerator, Solid Doors	Biz-Prescriptive	Office	ROB	1,410	1,410	20%	281	0.00	12	\$1,211	6%	6%	6%	14	19%	54%	67.8%	63.2%	63.2%	1.7
1311	Refrigeration	Anti-Sweat Heater Controls LT	Biz-Prescriptive	Office	Retro	2,016	2,016	68%	1,361	0.00	10	\$100	100%	100%	100%	15	7%	25%	79.2%	79.2%	79.2%	4.7
1312	Refrigeration	Auto Door Closer, Freezer	Biz-Prescriptive	Office	Retro	419,455	419,455	1%	2,307	0.00	8	\$157	100%	70%	70%	16	7%	50%	79.2%	77.8%	77.8%	7.7
1313	Refrigeration	Display Case Door Retrofit, Low Temp	Biz-Custom	Office	Retro	2,922	2,922	50%	1,453	0.00	12	\$686	100%	17%	17%	16	7%	25%	79.2%	50.9%	50.9%	6.6
1314	Refrigeration	Energy Star Reach-In Freezer, Glass Doors	Biz-Prescriptive	Office	ROB	6,374	6,374	20%	1,275	0.00	12	\$1,651	28%	28%	28%	17	7%	54%	67.8%	63.2%	63.2%	1.3
1315	Refrigeration	Energy Star Reach-In Freezer, Solid Doors	Biz-Prescriptive	Office	ROB	4,522	4,522	7%	305	0.00	12	\$1,521	13%	13%	13%	18	7%	54%	67.8%	63.2%	63.2%	0.7
1316	Refrigeration	Refrigeration - Custom	Biz-Custom	Office	ROB	7	7	2%	0	0.00	10	\$0	100%	50%	50%	19	90%	25%	79.2%	69.2%	69.2%	3.3
1317	Refrigeration	Retro-commissioning_Refrigerator Optimization	Biz-Custom RCx	Office	Retro	3	3	30%	1	0.00	5	\$0	100%	80%	80%	20	90%	25%	79.2%	76.5%	76.5%	1.5
1318	Refrigeration	Energy Star Ice Machine	Biz-Prescriptive	Office	ROB	6,993	6,993	10%	721	0.00	15	\$1,426	25%	18%	18%	21	9%	44%	60.8%	55.1%	55.1%	1.5
1319	Refrigeration	Vending Machine Controller - Refrigerated	Biz-Prescriptive	Office	Retro	1,586	1,586	34%	537	0.00	5	\$245	25%	16%	16%	22	9%	30%	51.0%	45.6%	45.6%	2.2
1320	Refrigeration	LED Refrigerated Display Case Lighting Average 6W/LF	Biz-Prescriptive	Office	Retro	273	273	89%	243	0.00	9	\$11	100%	45%	45%	23	12%	66%	79.2%	77.7%	77.7%	24.0
1321	Refrigeration	LED Refrigerated Display Case Lighting Controls	Biz-Prescriptive	Office	Retro	522	522	27%	141	0.00	10	\$14	100%	30%	30%	24	12%	13%	79.2%	75.2%	75.2%	18.9
1322	Ventilation	Demand Controlled Ventilation	Biz-Custom	Office	Retro	2,644	2,644	20%	529	0.00	15	\$227	100%	19%	19%	1	100%	48%	83.4%	58.6%	58.6%	5.7

Appendix C: C&I Measure Assumptions

Measure #	End-Use	Measure Name	Program	Building Type	Replacement Type	Base (Existing) Annual Electric	Base (Standard) Annual Electric	% Elec Savings	Per Unit Elec Savings	Per Unit Summer kW	EE EUL	Measure Cost	MAP Incentive (%)	RAP Incentive (%)	PP Incentive (%)	End Use Measure Group	Base Saturation	EE Saturation	MAP Adoption Rate	RAP Adoption Rate	PP Adoption Rate	UCT Score
1323	Ventilation	Pump and Fan Variable Frequency Drive Controls (Fans)	Biz-Prescriptive	Office	Retro	1,902	1,902	38%	731	0.00	15	\$200	100%	30%	30%	2	100%	48%	83.4%	65.9%	65.9%	8.5
1324	WholeBldg_HVAC	HVAC - Energy Management System	Biz-Custom RCx	Office	Retro	7	7	15%	1	0.00	15	\$0	100%	50%	50%	1	100%	20%	83.4%	72.8%	72.8%	7.6
1325	WholeBldg_HVAC	Guest room energy management system	Biz-Custom	Office	Retro	0	0	0%	0	0.00	15	\$260	0%	77%	77%	2	100%	20%	83.4%	83.4%	83.4%	0.0
1326	WholeBldg_HVAC	Retro-commissioning_Bld Optimization	Biz-Custom RCx	Office	Retro	7	7	15%	1	0.00	15	\$0	100%	50%	50%	3	100%	0%	83.4%	72.8%	72.8%	7.6
1327	WholeBuilding	WholeBldg - Com RET	Biz-Custom	Office	Retro	7	7	15%	1	0.00	12	\$0	100%	50%	50%	1	100%	0%	83.4%	72.8%	72.8%	6.5
1328	WholeBuilding	WholeBldg - Custom (Other)	Biz-Custom	Office	Retro	5	5	20%	1	0.00	12	\$0	100%	50%	50%	2	100%	0%	83.4%	72.8%	72.8%	6.5
1329	WholeBuilding	Power Distribution Equipment Upgrades (Transformers)	Biz-Custom	Office	Retro	1,150	1,150	1%	6	0.00	30	\$8	75%	4%	4%	3	100%	20%	58.3%	36.0%	36.0%	21.3
1330	WholeBldg_NC	WholeBldg - Com NC	Biz-Custom	Office	NC	4	4	25%	1	0.00	12	\$0	100%	50%	50%	1	100%	60%	83.4%	71.8%	71.8%	5.8
1331	Behavioral	COM Competitions	Biz-Custom	Office	Retro	53	53	2%	1	0.00	2	\$0	100%	48%	48%	1	100%	0%	50.0%	50.0%	50.0%	3.8
1332	Behavioral	Business Energy Reports	Biz-Custom	Office	Retro	0	0	0%	0	0.00	2	\$0	0%	100%	100%	1	100%	0%	50.0%	50.0%	50.0%	0.0
1333	Behavioral	Building Benchmarking	Biz-Custom	Office	Retro	114	114	1%	1	0.00	2	\$0	77%	77%	77%	1	100%	0%	50.0%	50.0%	50.0%	0.5
1334	Behavioral	Strategic Energy Management	Biz-Custom SEM	Office	Retro	33	33	3%	1	0.00	5	\$0	50%	7%	7%	1	100%	0%	50.0%	50.0%	50.0%	8.6
1335	Behavioral	BEIMS	Biz-Custom	Office	Retro	29	29	4%	1	0.00	2	\$0	39%	39%	39%	1	100%	2%	50.0%	50.0%	50.0%	0.5
1336	Behavioral	Building Operator Certification	Biz-Custom	Office	Retro	16	16	3%	0	0.00	3	\$0	37%	37%	37%	1	100%	2%	50.0%	50.0%	50.0%	0.9
1337	CompressedAir	Efficient Air Compressors (VSD)	Biz-Prescriptive	Warehouse	ROB	1,583	1,583	21%	329	0.00	13	\$127	100%	47%	47%	1	100%	33%	83.4%	69.0%	69.0%	5.2
1338	CompressedAir	Efficient Air Nozzles	Biz-Prescriptive	Warehouse	Retro	1,480	1,480	50%	740	0.00	15	\$50	100%	40%	40%	2	35%	33%	83.4%	78.4%	78.4%	22.7
1339	CompressedAir	AODD Pump Controls	Biz-Custom	Warehouse	Retro	103,919	103,919	35%	36,372	0.00	10	\$1,150	100%	50%	50%	3	10%	33%	83.4%	81.4%	81.4%	28.9
1340	CompressedAir	Compressed Air - Custom	Biz-Custom	Warehouse	Retro	5	5	20%	1	0.00	10	\$0	100%	38%	38%	4	50%	33%	83.4%	69.6%	69.6%	5.7
1341	CompressedAir	Retro-commissioning_Compressed Air Optimization	Biz-Custom RCx	Warehouse	Retro	3	3	30%	1	0.00	5	\$0	100%	80%	80%	5	50%	33%	83.4%	78.1%	78.1%	1.5
1342	Cooking	Commercial Combination Oven (Electric)	Biz-Prescriptive	Warehouse	ROB	38,561	38,561	48%	18,432	0.00	12	\$16,884	50%	6%	6%	1	18%	53%	67.1%	62.4%	62.4%	10.5
1343	Cooking	Commercial Electric Convection Oven	Biz-Prescriptive	Warehouse	ROB	12,193	12,193	15%	1,879	0.00	12	\$1,706	50%	23%	23%	1	18%	53%	67.1%	62.4%	62.4%	2.9
1344	Cooking	Commercial Electric Griddle	Biz-Prescriptive	Warehouse	ROB	17,056	17,056	15%	2,596	0.00	12	\$3,604	25%	22%	22%	2	14%	17%	41.9%	33.6%	33.6%	1.4
1345	Cooking	Commercial Electric Steam Cooker	Biz-Prescriptive	Warehouse	ROB	19,549	19,549	67%	13,162	0.00	12	\$3,300	100%	27%	27%	3	6%	45%	79.2%	70.6%	70.6%	9.0
1346	Cooking	Dishwasher Low Temp Door (Energy Star)	Biz-Prescriptive	Warehouse	ROB	39,306	39,306	44%	17,369	0.00	15	\$662	100%	76%	76%	4	26%	61%	79.2%	78.5%	78.5%	16.5
1347	Cooking	Dishwasher High Temp Door (Energy Star)	Biz-Prescriptive	Warehouse	ROB	26,901	26,901	32%	8,586	0.00	15	\$995	100%	50%	50%	4	26%	61%	79.2%	74.9%	74.9%	8.2
1348	Cooking	Energy efficient electric fryer	Biz-Prescriptive	Warehouse	ROB	18,955	18,955	17%	3,274	0.00	12	\$1,500	75%	5%	5%	5	27%	24%	72.1%	45.1%	45.1%	17.1
1349	Cooking	Insulated Holding Cabinets (Full Size)	Biz-Custom	Warehouse	ROB	13,697	13,697	68%	9,314	0.00	12	\$1,200	100%	62%	62%	6	3%	16%	79.2%	75.6%	75.6%	5.3
1350	Cooking	Insulated Holding Cabinets (Half-Size)	Biz-Custom	Warehouse	ROB	4,383	4,383	60%	2,630	0.00	12	\$1,500	50%	14%	14%	6	3%	16%	57.8%	41.7%	41.7%	5.3
1351	Cooling	Air Conditioner - 13 IEER (5-20 Tons)	Biz-Prescriptive	Warehouse	ROB	357	357	6%	22	0.00	15	\$63	100%	79%	79%	1	25%	20%	83.4%	64.4%	64.4%	1.8
1352	Cooling	Air Conditioner - 14 IEER (5-20 Tons)	Biz-Prescriptive	Warehouse	ROB	357	357	13%	46	0.00	15	\$127	100%	39%	39%	1	25%	20%	83.4%	41.3%	41.3%	3.8
1353	Cooling	Air Conditioner - 17 IEER (5-20 Tons)	Biz-Prescriptive	Warehouse	ROB	357	357	28%	101	0.00	15	\$127	100%	39%	39%	1	25%	20%	83.4%	59.6%	59.6%	8.3
1354	Cooling	Air Conditioner - 21 IEER (5-20 Tons)	Biz-Prescriptive	Warehouse	ROB	357	357	42%	150	0.00	15	\$127	100%	39%	39%	1	25%	20%	83.4%	66.3%	66.3%	12.3
1355	Cooling	Air Conditioner - 12.1 IEER (20+ Tons)	Biz-Prescriptive	Warehouse	ROB	382	382	6%	22	0.00	15	\$50	100%	100%	100%	2	25%	20%	83.4%	83.4%	83.4%	1.8
1356	Cooling	Air Conditioner - 13 IEER (20+ Tons)	Biz-Prescriptive	Warehouse	ROB	382	382	12%	47	0.00	15	\$50	100%	100%	100%	2	25%	20%	83.4%	83.4%	83.4%	3.9
1357	Cooling	Air Conditioner - 14.3 IEER (20+ Tons)	Biz-Prescriptive	Warehouse	ROB	382	382	20%	77	0.00	15	\$50	100%	100%	100%	2	25%	20%	83.4%	83.4%	83.4%	6.4
1358	Cooling	Air Conditioner - 21 IEER (20+ Tons)	Biz-Prescriptive	Warehouse	ROB	382	382	46%	175	0.00	15	\$50	100%	100%	100%	2	25%	20%	83.4%	83.4%	83.4%	14.3
1359	Cooling	Comprehensive Rooftop Unit Quality Maintenance (AC Tune-up)	Biz-Custom	Warehouse	Retro	363	363	7%	25	0.00	3	\$5	100%	38%	38%	3	50%	50%	83.4%	77.7%	77.7%	13.1
1360	Cooling	Air Side Economizer	Biz-Custom	Warehouse	Retro	357	357	20%	71	0.00	10	\$84	7%	7%	7%	4	50%	20%	44.0%	36.0%	36.0%	3.4
1361	Cooling	Advanced Rooftop Controls	Biz-Prescriptive	Warehouse	Retro	363	363	2%	6	0.00	10	\$98	26%	26%	26%	5	50%	20%	44.0%	36.0%	36.0%	0.1
1362	Cooling	HVAC Occupancy Controls	Biz-Custom	Warehouse	ROB	426	426	20%	85	0.00	15	\$537	1%	1%	1%	6	50%	20%	44.0%	36.0%	36.0%	4.6
1363	Cooling	Air Conditioner - 16 SEER (<5 Tons)	Biz-Prescriptive	Warehouse	ROB	311	311	13%	39	0.00	15	\$50	100%	100%	100%	7	50%	20%	83.4%	83.4%	83.4%	3.2
1364	Cooling	Air Conditioner - 17 SEER (<5 Tons)	Biz-Prescriptive	Warehouse	ROB	311	311	18%	55	0.00	15	\$206	100%	24%	24%	7	50%	20%	83.4%	36.0%	36.0%	4.5
1365	Cooling	Air Conditioner - 18 SEER (<5 Tons)	Biz-Prescriptive	Warehouse	ROB	311	311	22%	69	0.00	15	\$206	100%	24%	24%	7	50%	20%	83.4%	36.0%	36.0%	5.7
1366	Cooling	Air Conditioner - 21 SEER (<5 Tons)	Biz-Prescriptive	Warehouse	ROB	311	311	33%	104	0.00	15	\$253	100%	20%	20%	7	50%	20%	83.4%	38.0%	38.0%	8.5
1367	Cooling	Smart Thermostat	Biz-Prescriptive	Warehouse	ROB	311	311	14%	44	0.00	11	\$175	26%	26%	26%	8	50%	12%	38.4%	29.6%	29.6%	1.6
1368	Cooling	PTAC - <7,000 Btuh - lodging	Biz-Prescriptive	Warehouse	ROB	366	366	8%	31	0.00	8	\$84	75%	42%	42%	9	0%	20%	60.5%	40.9%	40.9%	2.0
1369	Cooling	PTAC - 7,000 to 15,000 Btuh - lodging	Biz-Prescriptive	Warehouse	ROB	401	401	7%	29	0.00	8	\$84	75%	42%	42%	10	0%	20%	59.0%	39.6%	39.6%	1.9
1370	Cooling	PTAC - >15,000 Btuh - lodging	Biz-Prescriptive	Warehouse	ROB	459	459	10%	44	0.00	8	\$84	100%	42%	42%	11	0%	20%	83.4%	46.8%	46.8%	2.8
1371	Cooling	Air Cooled Chiller	Biz-Prescriptive	Warehouse	ROB	318	318	6%	18	0.00	23	\$126	100%	40%	40%	12	0%	15%	83.4%	32.0%	32.0%	2.6
1372	Cooling	Chiller Tune-up	Biz-Custom	Warehouse	Retro	363	363	7%	25	0.00	3	\$5	100%	38%	38%	13	0%	50%	83.4%	77.7%	77.7%	13.1
1373	Cooling	HVAC/Chiller Custom	Biz-Custom	Warehouse	Retro	5	5	20%	1	0.00	20	\$1	100%	6%	6%	14	100%	20%	83.4%	36.0%	36.0%	28.0
1374	Cooling	Window Film	Biz-Custom	Warehouse	Retro	6,000	6,000	4%	264	0.00	10	\$154	100%	14%	14%	15	100%	20%	83.4%	47.7%	47.7%	11.6
1375	Cooling	Triple Pane Windows	Biz-Custom	Warehouse	ROB	6,000	6,000	6%	360	0.00	25	\$700	75%	4%	4%	15	100%	20%	48.7%	36.0%	36.0%	21.5
1376	Cooling	Energy Recovery Ventilator	Biz-Custom	Warehouse	Retro	382	382	0%	0	0.00	15	\$1,500	0%	0%	0%	16	100%	2%	83.4%	83.4%	83.4%	0.0
1377	Heating	Heat Pump - 16 SEER (<5 Tons)	Biz-Prescriptive	Warehouse	ROB	1,899	1,899	3%	54	0.00	16	\$87	75%	57%	57%	1	25%	20%	64.0%	50.9%	50.9%	1.5
1378	Heating	Heat Pump - 17 SEER (<5 Tons)	Biz-Prescriptive	Warehouse	ROB	1,899	1,899	7%	137	0.00	16	\$442	25%	11%	11%	1	25%	20%	44.0%	36.0%	36.0%	3.1
1379	Heating	Heat Pump - 18 SEER (<5 Tons)	Biz-Prescriptive	Warehouse	ROB	1,899	1,899	10%	198	0.00	16	\$507	25%	10%	10%	1	25%	20%	44.0%	36.0%	36.0%	4.4
1380	Heating	Heat Pump - 21 SEER (<5 Tons)	Biz-Prescriptive	Warehouse	ROB	1,899	1,899	15%	276	0.00	16	\$507	50%	10%	10%	1	25%	20%	44.0%	36.0%	36.0%	6.7
1381	Heating	Geothermal HP - SEER 20.3 (<5 Tons)	Biz-Prescriptive	Warehouse	ROB	1,899	1,899	21%	398	0.00	25	\$2,576	14%	14%	14%	1	25%	20%	44.0%	36.0%	36.0%	1.4
1382	Heating	Geothermal HP - SEER 21.5 (<5 Tons)	Biz-Prescriptive	Warehouse	ROB	1,899	1,899	25%	482	0.00	25	\$2,576	14%	14%	14%	1	25%	20%	44.0%	36.0%	36.0%	1.6
1383	Heating	Geothermal HP - SEER 23.1 (<5 Tons)	Biz-Prescriptive	Warehouse	ROB	1,899	1,899	31%	580	0.00	25	\$2,576	25%	14%	14%	1	25%	20%	44.0%	36.0%	36.0%	1.8
1384	Heating	Geothermal HP - SEER 29.3 (<5 Tons)	Biz-Prescriptive	Warehouse	ROB	1,899	1,899	46%	868	0.00	25	\$2,576	25%	14%	14%	1	25%	20%	44.0%	36.0%	36.0%	2.4
1385	Heating	Heat Pump - 14.0 IEER COP 3.6 (65,000-134,000 Btu/hr)	Biz-Prescriptive	Warehouse	ROB	2,249	2,249	9%	209	0.00	16	\$100	100%	50%	50%	2	13%	20%	83.4%	78.0%	78.0%	19.5
1386	Heating	Heat Pump - 15.0 IEER COP 3.8 (65,000-134,000 Btu/hr)	Biz-Prescriptive	Warehouse	ROB	2,249	2,249															

Appendix C: C&I Measure Assumptions

Measure #	End-Use	Measure Name	Program	Building Type	Replacement Type	Base (Existing) Annual Electric	Base (Standard) Annual Electric	% Elec Savings	Per Unit Elec Savings	Per Unit Summer kW	EE EUL	Measure Cost	MAP Incentive (%)	RAP Incentive (%)	PP Incentive (%)	End Use Measure Group	Base Saturation	EE Saturation	MAP Adoption Rate	RAP Adoption Rate	PP Adoption Rate	UCT Score
1388	Heating	Heat Pump - 15.5 IEER COP 3.7 (135,000-239,000 Btu/hr)	Biz-Prescriptive	Warehouse	ROB	2,327	2,327	16%	364	0.00	16	\$139	100%	25%	25%	2	13%	20%	83.4%	74.5%	74.5%	33.9
1389	Heating	Geothermal HP - SEER 20.3 (5-20 Tons)	Biz-Prescriptive	Warehouse	ROB	2,063	2,063	27%	561	0.00	25	\$2,576	25%	14%	14%	2	13%	20%	44.0%	36.0%	36.0%	2.9
1390	Heating	Geothermal HP - SEER 21.5 (5-20 Tons)	Biz-Prescriptive	Warehouse	ROB	2,063	2,063	31%	645	0.00	25	\$2,576	25%	14%	14%	2	13%	20%	44.0%	36.0%	36.0%	3.2
1391	Heating	Geothermal HP - SEER 23.1 (5-20 Tons)	Biz-Prescriptive	Warehouse	ROB	2,109	2,109	37%	789	0.00	25	\$2,576	25%	14%	14%	2	13%	20%	44.0%	36.0%	36.0%	3.5
1392	Heating	Geothermal HP - SEER 29.3 (5-20 Tons)	Biz-Prescriptive	Warehouse	ROB	2,109	2,109	51%	1,078	0.00	25	\$2,576	50%	14%	14%	2	13%	20%	44.0%	36.0%	36.0%	4.0
1393	Heating	Variable Refrigerant Flow Heat Pump	Biz-Custom	Warehouse	ROB	1,706	1,706	5%	83	0.00	16	\$224	100%	16%	16%	2	13%	2%	83.4%	41.1%	41.1%	7.4
1394	Heating	Heat Pump - 12 IEER 3.4 COP (>239,000 Btu/hr)	Biz-Prescriptive	Warehouse	ROB	2,364	2,364	7%	170	0.00	16	\$100	100%	35%	35%	3	13%	20%	83.4%	75.4%	75.4%	24.4
1395	Heating	Heat Pump - 13 IEER 3.6 COP (>239,000 Btu/hr)	Biz-Prescriptive	Warehouse	ROB	2,364	2,364	13%	300	0.00	16	\$175	100%	20%	20%	3	13%	20%	83.4%	70.9%	70.9%	28.4
1396	Heating	Geothermal HP - SEER 20.3 (20+ Tons)	Biz-Prescriptive	Warehouse	ROB	2,327	2,327	35%	825	0.00	25	\$2,576	75%	14%	14%	3	13%	20%	54.8%	36.0%	36.0%	5.8
1397	Heating	Geothermal HP - SEER 21.5 (20+ Tons)	Biz-Prescriptive	Warehouse	ROB	2,327	2,327	39%	909	0.00	25	\$2,576	75%	14%	14%	3	13%	20%	56.1%	36.0%	36.0%	6.1
1398	Heating	Geothermal HP - SEER 23.1 (20+ Tons)	Biz-Prescriptive	Warehouse	ROB	2,327	2,327	43%	1,007	0.00	25	\$2,576	75%	14%	14%	3	13%	20%	57.4%	36.0%	36.0%	6.3
1399	Heating	Geothermal HP - SEER 29.3 (20+ Tons)	Biz-Prescriptive	Warehouse	ROB	2,327	2,327	56%	1,295	0.00	25	\$2,576	75%	14%	14%	3	13%	20%	60.1%	36.0%	36.0%	6.8
1400	Heating	Mini Split Ductless Heat Pump Cold Climate (Tiers & sizes TBD)	Biz-Prescriptive	Warehouse	ROB	1,899	1,899	15%	276	0.00	16	\$224	100%	16%	16%	4	50%	20%	83.4%	47.4%	47.4%	9.6
1401	Heating	PTHP - <7,000 Btuh - lodging	Biz-Custom	Warehouse	ROB	2,136	2,136	1%	30	0.00	8	\$84	50%	48%	48%	5	0%	10%	53.2%	51.8%	51.8%	1.5
1402	Heating	PTHP - >15,000 Btuh - lodging	Biz-Prescriptive	Warehouse	ROB	2,425	2,425	6%	142	0.00	8	\$84	100%	48%	48%	6	0%	10%	83.4%	74.5%	74.5%	7.5
1403	Heating	PTHP - 7,000 to 15,000 Btuh - lodging	Biz-Prescriptive	Warehouse	ROB	2,294	2,294	3%	74	0.00	8	\$84	100%	48%	48%	7	0%	10%	83.4%	69.2%	69.2%	3.8
1404	HotWater	Heat Pump Water Heater	Biz-Prescriptive	Warehouse	ROB	3,027	3,027	67%	2,027	0.00	15	\$1,115	100%	49%	49%	1	100%	0%	75.5%	57.2%	57.2%	2.2
1405	HotWater	Hot Water Pipe Insulation	Biz-Custom	Warehouse	Retro	3,027	3,027	2%	61	0.00	20	\$60	50%	8%	8%	2	100%	80%	86.0%	84.0%	84.0%	8.4
1406	HotWater	Faucet Aerator	Biz-Prescriptive	Warehouse	ROB	195	195	32%	63	0.00	10	\$8	100%	100%	100%	3	20%	90%	93.0%	92.0%	92.0%	5.1
1407	HotWater	Low Flow Pre-Rinse Sprayers	Biz-Custom	Warehouse	ROB	18,059	18,059	54%	9,789	0.00	5	\$75	100%	100%	100%	4	20%	80%	86.0%	84.0%	84.0%	22.3
1408	HotWater	ENERGY STAR Commercial Washing Machines	Biz-Prescriptive	Warehouse	ROB	1,552	1,552	43%	671	0.00	7	\$250	50%	18%	18%	5	25%	32%	60.5%	45.7%	45.7%	3.7
1409	InteriorLighting	LED T8 Tube Replacement	Biz-Prescriptive Light	Warehouse	Retro	110	110	45%	49	0.00	15	\$3	100%	100%	100%	1	69%	38%	85.0%	85.0%	85.0%	13.9
1410	InteriorLighting	LED troffer retrofit kit, 2'X2' and 2'X4'	Biz-Prescriptive Light	Warehouse	Retro	248	248	50%	124	0.00	15	\$70	100%	43%	43%	1	69%	38%	85.0%	59.6%	59.6%	3.5
1411	InteriorLighting	LED troffer, 2'X2' and 2'X4'	Biz-Prescriptive Light	Warehouse	Retro	248	248	50%	124	0.00	15	\$70	100%	79%	79%	1	69%	38%	85.0%	76.3%	76.3%	1.9
1412	InteriorLighting	Bi-Level Lighting Fixture – Stairwells, Hallways	Biz-Custom Light	Warehouse	Retro	248	248	74%	184	0.00	10	\$274	29%	29%	29%	2	8%	38%	56.4%	49.5%	49.5%	0.8
1413	InteriorLighting	LED high bay fixture	Biz-Prescriptive Light	Warehouse	Retro	2,310	2,310	68%	1,571	0.00	15	\$330	100%	45%	45%	3	2%	19%	85.0%	76.8%	76.8%	8.9
1414	InteriorLighting	LED Mogul-base HID Lamp Replacing High Bay HID	Biz-Prescriptive Light	Warehouse	Retro	2,310	2,310	66%	1,532	0.00	15	\$330	100%	45%	45%	3	2%	19%	85.0%	76.5%	76.5%	8.7
1415	InteriorLighting	LED low bay fixture	Biz-Prescriptive Light	Warehouse	Retro	492	492	61%	299	0.00	15	\$75	100%	100%	100%	4	2%	19%	85.0%	85.0%	85.0%	3.4
1416	InteriorLighting	LED Mogul-base HID Lamp Replacing Low Bay HID	Biz-Prescriptive Light	Warehouse	Retro	492	492	59%	289	0.00	15	\$75	100%	100%	100%	4	2%	19%	85.0%	85.0%	85.0%	3.3
1417	InteriorLighting	LED Screw-In Lamps (Directional)	Biz-Prescriptive Light	Warehouse	ROB	352	352	86%	302	0.00	6	\$1	100%	100%	100%	5	2%	13%	85.0%	85.0%	85.0%	107.7
1418	InteriorLighting	LED downlight fixture	Biz-Prescriptive Light	Warehouse	Retro	170	170	68%	115	0.00	15	\$27	100%	37%	37%	6	16%	13%	85.0%	74.2%	74.2%	9.8
1419	InteriorLighting	LED Screw-In Lamps (Omidirectional & Decorative)	Biz-Prescriptive Light	Warehouse	ROB	266	266	81%	215	0.00	6	\$1	100%	100%	100%	6	16%	13%	85.0%	85.0%	85.0%	76.8
1420	InteriorLighting	DeLamp Fluorescent Fixture Average Lamp Wattage 28W	Biz-Prescriptive Light	Warehouse	Retro	91	91	100%	91	0.00	11	\$4	100%	25%	25%	7	69%	0%	85.0%	82.7%	82.7%	61.5
1421	InteriorLighting	Occupancy Sensors	Biz-Prescriptive Light	Warehouse	Retro	417	417	30%	125	0.00	10	\$65	50%	20%	20%	8	95%	10%	52.5%	36.3%	36.3%	3.3
1422	InteriorLighting	Daylighting Controls	Biz-Prescriptive Light	Warehouse	Retro	534	534	30%	160	0.00	10	\$58	100%	34%	34%	8	95%	10%	85.0%	67.4%	67.4%	5.3
1423	InteriorLighting	Dual Occupancy & Daylighting Controls	Biz-Custom Light	Warehouse	Retro	238	238	44%	105	0.00	10	\$75	75%	26%	26%	8	95%	10%	71.6%	39.3%	39.3%	3.4
1424	InteriorLighting	Central Lighting Monitoring & Controls (non-networked)	Biz-Custom Light	Warehouse	Retro	41,703	41,703	20%	8,341	0.00	12	\$3,700	50%	18%	18%	8	95%	10%	55.0%	37.1%	37.1%	4.1
1425	InteriorLighting	Network Lighting Controls - Wireless (WiFi)	Biz-Prescriptive Light	Warehouse	Retro	3	3	49%	1	0.00	15	\$1	100%	42%	42%	8	95%	10%	85.0%	63.4%	63.4%	3.8
1426	InteriorLighting	Luminaire Level Lighting Controls w/ HVAC Control	Biz-Custom Light	Warehouse	Retro	338	338	65%	220	0.00	15	\$90	100%	21%	21%	8	82%	10%	85.0%	54.3%	54.3%	8.3
1427	InteriorLighting	LED Exit Sign - 4 Watt Fixture (2 lamp)	Biz-Prescriptive Light	Warehouse	Retro	63	63	43%	27	0.00	5	\$33	31%	31%	31%	9	1%	75%	82.5%	80.0%	80.0%	0.7
1428	InteriorLighting	Lighting - Custom	Biz-Custom Light	Warehouse	Retro	4	4	25%	1	0.00	15	\$0	100%	50%	50%	10	100%	0%	85.0%	79.4%	79.4%	10.1
1429	ExteriorLighting	LED wallpack (existing W<250)	Biz-Prescriptive Light	Warehouse	Retro	856	856	66%	567	0.00	12	\$248	75%	46%	46%	1	12%	44%	71.7%	55.2%	55.2%	1.7
1430	ExteriorLighting	LED parking lot fixture (existing W≥250)	Biz-Prescriptive Light	Warehouse	Retro	1,589	1,589	60%	959	0.00	12	\$756	25%	20%	20%	2	11%	44%	60.8%	55.2%	55.2%	2.2
1431	ExteriorLighting	LED parking lot fixture (existing W<250)	Biz-Prescriptive Light	Warehouse	Retro	856	856	66%	567	0.00	12	\$248	75%	30%	30%	3	11%	44%	71.7%	55.2%	55.2%	2.6
1432	ExteriorLighting	LED outdoor pole decorative fixture (existing W≥250)	Biz-Prescriptive Light	Warehouse	Retro	1,589	1,589	60%	959	0.00	12	\$756	25%	20%	20%	4	11%	44%	60.8%	55.2%	55.2%	2.2
1433	ExteriorLighting	LED parking garage fixture (existing W≥250)	Biz-Prescriptive Light	Warehouse	Retro	3,235	3,235	60%	1,953	0.00	6	\$756	50%	13%	13%	5	11%	44%	60.8%	55.2%	55.2%	4.0

AES INDIANA



2022 Demand Side Management Market Potential Study

November 18,
2022

FINAL REPORT

prepared by
GDS ASSOCIATES INC

AES INDIANA



2022
Market Potential Study
Distributed Energy
Resources and
Electrification

September 2,
2022

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VOLUME I 2022 MPS – DER and Electrification Report

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Chapter 1 Introduction

1 Introduction

1.1 BACKGROUND & STUDY SCOPE

This distributed energy resource (“DER”) and electrification Market Potential Study was conducted to as part of a broader effort that included an energy efficiency and demand response potential study in support of Integrated Resource Plan (IRP) and DSM planning for AES Indiana. The study included an analysis of various DER options including solar photovoltaics and combined heat and power, a study of transportation electrification, including both commercial sector and residential sector vehicles, and a building electrification analysis of the residential, commercial, and industrial sectors.

1.2 STUDY LIMITATIONS

This DER and Electrification Market Potential Study was developed using the best currently available data to inform the estimates of future potential. The long-term projections of these technologies remain highly uncertain as the cost-effectiveness of DER could change in future years and become a more attractive option, while electrification projections continue to evolve based on various factors such as policy decisions, manufacturer goals and consumer preferences.

1.3 ORGANIZATION OF REPORT

The remainder of this report is organized in seven sections as follows:

Section 2 Distributed Energy Resources provides the approach to analyzing DER potential and the technical, economic and market potential for solar photovoltaics and combined heat and power.

Section 3 Transportation Electrification provides the results of the analysis for commercial and residential transportation electrification.

Section 4 Building Electrification provides approach and results of the building electrification analysis for the residential, commercial, and industrial sectors.

2 Distributed Energy Resources

The GDS Team considered distributed energy resources (DER) as sources of behind-the-meter customer-sited generation. The DER potential study followed the same method as the energy efficiency potential study in that the DER analysis reviewed the opportunity for technical, economic, and achievable potential. We used the same forecast data as used in the energy efficiency study to assess DER potential. The analysis limited resources for this potential study to technologies that are behind-the-meter and owned by the customer and did not consider market potential for supply-side resources. Specifically, this market potential assessment for DER focused on solar photovoltaic (PV) and combined heat and power (CHP) systems for the period 2023 to 2042.

2.1 APPROACH

The following section discusses the methods used to conduct the DER potential analysis. We detail approaches used to assess technical, economic, and achievable potential for solar PV and CHP.

2.1.1 Distributed Energy Resources Potential

2.1.1.1 Solar Photovoltaic Systems

Photovoltaic systems utilize solar panels, a packaged collection of photovoltaic cells, to convert sunlight into electricity. A system is constructed with multiple solar panels, a DC/AC inverter(s), a racking system to hold the panels, and electrical system interconnections. These systems are often roof-mounted and face south-west, south, and/or, south-east.

The study analyzed the potential associated with roof-mounted systems installed on residential and non-residential sector buildings. For the non-residential sector, the analysis also estimated potential for ground mounted (or covered parking) systems for a few specific business types. The analysis included battery storage as an additional configuration with each solar PV system type; however, due to the uncertainty associated with battery dispatch schedules, potential battery generation is excluded from this analysis. As noted above, this study did not explore the market potential associated utility-scale solar PV installations.

The approach to estimating technical potential required calculating the total square footage of suitable rooftop area within the AES-IN's territory and calculating solar PV system generation based on building and regional characteristics. Technical potential is computed using the following equation.

$$PV \text{ Technical Potential} = \Sigma(\text{Suitable Rooftop Square Footage} \times PV \text{ System Generation per Sq. Ft.})$$

The two key parameters in prior equation were estimated based on multiple data sources relevant to the AES-IN territory. Methods for defining these parameters are discussed below.

The GDS Team estimated total rooftop square footage using the forecast disaggregation analysis to characterize the residential and non-residential building stocks. The building stocks were characterized based on relevant parameters such as number of facilities, average number of floors, average premise consumption, and premise EUI. The GDS Team used these parameters to estimate the total rooftop square footage.

To estimate the fraction of the total roof area that is suitable for rooftop solar PV, the GDS Team relied on research completed by the National Renewable Energy Laboratory (NREL). NREL has developed estimates of the portion of total rooftops across the country that are suitable for solar PV based on analysis of LIDAR data. NREL criteria for suitable roof area include:

- **Contiguous rooftop area size:** Rooftops with fewer than 10 square meters of contiguous roof area excluded.

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- **Rooftop orientation (tilt and azimuth):** Northeast through northwest orientation and roof pitches greater than 60 degrees excluded.
- **Shading:** Roof areas that had a minimum solar exposure of less than 80% relative to an unshaded roof were excluded.

Based on NREL’s data, the GDS Team was able to apply unique suitability factors to estimate the total square footage of suitable rooftop for residential and non-residential buildings across AES-IN’s territory.

The second key parameter – PV system generation – was estimated by developing standardized solar PV system configurations. These included system sizes for residential premises ranging from 3 to 20 kW (DC) and 10 to 2,000 kW (DC) for non-residential premises. Additionally, the GDS Team selected battery system sizes for each solar PV system size to dispatch energy for 2-4 hours.

The Team relied on NREL’s PVWatts¹ (Version 6.1.4) and System Advisor Model (SAM)² tools to estimate system generation for both residential and non-residential sited systems. These tools model PV power density based on site specific data from NREL’s LIDAR-based NSRDB to estimate total solar irradiance in conjunction with PV system specifications. The PV system simulations were generated based on Indianapolis, IN characteristics. The GDS Team based assumptions for PV system azimuth on rooftop orientation data sourced from Google’s Project Sunroof, also based on Indianapolis, IN. The analysis assumptions are summarized in Table 2-1.

TABLE 2-1: KEY ASSUMPTIONS IN SOLAR PV ANALYSIS

Parameter	Assumptions
Residential System Sizes (Nominal DC Capacity)	3 kW, 5 kW, 7.5 kW, 10 kW, 15 kW, 20 kW
Non-Residential System Sizes (Nominal DC Capacity)	10 kW, 15 kW, 20 kW, 25 kW, 50 kW, 100 kW, 250 kW, 500 kW, 1,000 kW, 2,000 kW
System losses	14.1%
Tilt	By region
Azimuth:	By region
DC to AC size ratio	1.2
Inverter efficiency	96% (micro-inverter)
Battery Round-Trip Efficiency	85%

Based on the simulations and resulting capacity factors for residential and non-residential buildings for the Indianapolis, we applied the state-specific capacity factor to the system size to estimate annual electricity generation. These system generation values were used to calculate total energy generation per square foot of rooftop and extrapolated based on the total suitable rooftop square footage to estimate overall all technical potential. As a final step, the GDS Team removed from the technical potential for any generation occurring from existing systems. Data on existing systems was provided directly by AES-IN.

2.1.1.2 Combined Heat and Power

CHP systems generate electric power and useful thermal energy in a single integrated system. Heat that is normally wasted in conventional power generation is recovered as useful thermal energy. Due to the

1 PVWatts estimates solar PV energy production and costs. Developed by the National Renewable Energy Laboratory. (NREL) <http://pvwatts.nrel.gov/>

2 SAM estimates hourly solar PV energy production and costs with more detailed inputs and outputs than PVwatts. Developed by the National Renewable Energy Laboratory. (NREL) [http:// https://sam.nrel.gov/](http://https://sam.nrel.gov/)

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integration of both power and thermal generation, CHP systems are more efficient than separate sources for electric power generation and thermal energy production.

In most CHP applications, a heat engine creates shaft power that drives an electrical generator (fuel cells can produce electrical power directly from electrochemical reactions). The waste heat from the engine is then recovered to provide steam or hot water to meet on-site needs. By combining the thermal and electrical energy generation in one process, the total efficiency of a CHP application far exceeds that of a separate plant and boiler system. Overall, the efficiency of CHP technologies can reach 80% or more, while simple-cycle electricity generation reaches only 30% and combined cycle generation typically achieves 50%. When considering both thermal and electric energy generation, CHP requires 40% less energy input to achieve the same energy output as a separate plant and boiler system. Figure 2-1 illustrates this point.

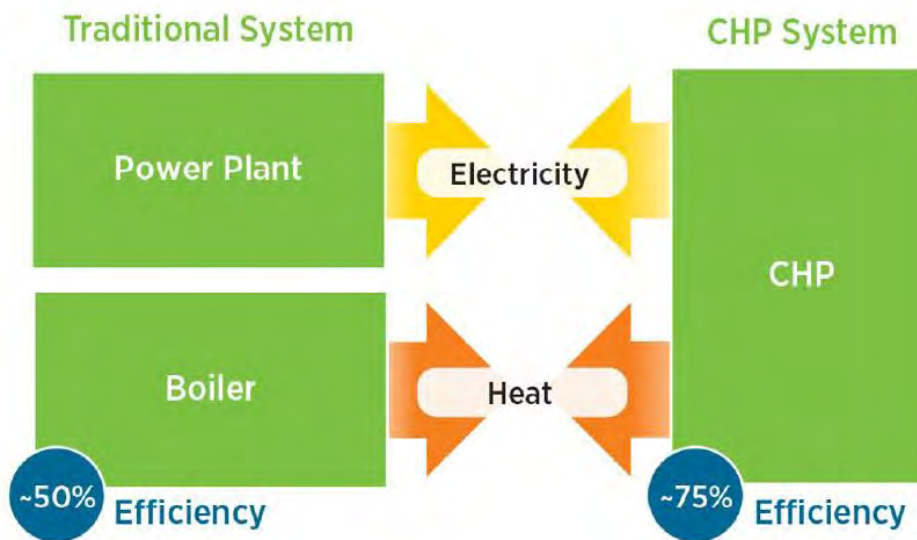


Figure courtesy of US DOE Energy Efficiency & Renewable Energy

FIGURE 2-1: CHP ENERGY FLOW DIAGRAM

Common technologies used in CHP applications and explored in this study include:

- Steam turbines
- Gas turbines
- Micro turbines
- Fuel Cells
- Reciprocating engines

Applications with steady demand for electricity and thermal energy are potentially good economic targets for CHP deployment. Industrial applications, particularly in industries with continuous processing and high steam requirements, are very economic and represent a large share of existing CHP capacity today. Commercial applications such as hospitals, nursing homes, laundries, and hotels with large hot water needs are well suited for CHP. Institutional applications such as colleges and schools, prisons, and residential and recreational facilities are also excellent prospects for CHP.

Selecting a specific CHP technology depends on several factors, which include but are not limited to power requirements, the duty cycle, space constraints, thermal energy needs, emission regulations, fuel availability, utility prices, and interconnection issues. Table 2-2 summarizes the CHP technologies evaluated in this study and their assumed operating parameters.

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TABLE 2-2: CHP TECHNOLOGY COMPARISON³

Parameter	Reciprocating Engine	Gas Turbine	Steam Turbine	Micro-Turbine	Fuel Cell
Size (kW)	50-5,000	500-50,000	10-100,000	30-250	200-2,000
Electric Efficiency	28-39%	25-40% (simple) 40-60% (combined)	5-15%	25-28%	36-42%
Overall Efficiency	73-79%	64-72%	~80%	67-72%	62%-67%
Fuels	Natural gas, biogas, propane, liquid fuels	Natural gas, biogas, propane, distillate oil	All	Natural gas, biogas, propane, distillate oil	Hydrogen, natural gas, propane
NO _x Emissions (lb/MWh)	0.15-2.17	0.55-0.68	Function of boiler emissions	0.14-0.17	0.01-0.04
Uses for Heat Recovery	Hot water, low pressure steam, district heating	Direct heat, hot water-, low- or high-pressure steam, district heating	Low- or high-pressure steam, district heating	Direct heat, hot water, low pressure steam	Hot water-, low- or high-pressure steam
Thermal Output (Btu/kWh)	3,000-6,100	3,200-5,000	n/a	4,800-6,300	1,500-3,000
Useable Temp (°F)	200-500	500-1,100	n/a	400-650	140-700

To estimate technical potential for CHP, the GDS Team first developed a screening process based on the DOE’s national technical potential study of CHP resources⁴ to identify probable CHP candidate premises. First, customers with less than 50,000 kWh annual consumption were removed from eligibility as a CHP candidate. Second, we considered customer loads to assess if and what CHP system type and size may be a potential match to a customer. To effectively utilize CHP, a facility must have coincident electric and thermal energy requirements for a large load factor of the year. A continuous process industry with nearly constant steam or hot water demand electric load is an excellent target, such as a chemicals manufacturer or a hospital. Facilities with intermittent electric and thermal loads are progressively less attractive as the number of hours of coincident load diminishes. We therefore screened for eligible customers based on the customer’s annual kWh usage and an approximate sized CHP system based on a thermal factor.

The team calculated and applied a thermal factor to potential candidate customer loads to reflect thermal load considerations in CHP sizing. In most cases, on-site thermal energy demand is smaller than electrical demand. Thus, CHP size is usually dictated by the thermal load to achieve proper efficiencies and adequate returns on investment. The Team used power to heat ratios⁵ for both the CHP technology as well as different market segments to calculate the thermal factor as shown in following equation.

³ Combined Heat and Power Market Assessment. ICF International for the California Energy Commission, April 2010.

⁴ U.S. Department of Energy. Combined Heat and Power (CHP) Technical Potential in the United States, March 2016.

⁵ Power to heat ratios were sourced from a combination of the following sources:

- U.S. Environmental Protection Agency Combined Heat and Power Partnership. Catalog of CHP Technologies, September 2017.
- U.S. Environmental Protection Agency Combined Heat and Power Partnership. Spark Spread Estimator Version 1.2
- U.S. Department of Energy. Combined Heat and Power (CHP) Technical Potential in the United States, March 2016.

$$\text{Thermal Factor} = \frac{P/H \text{ (CHP System)}}{P/H \text{ (Customer Segment)}}$$

A thermal factor of one (1.0) would result in the CHP system capacity being equal to the electric demand of the facility. A thermal factor of less than one would indicate that the application is thermally limited, and the resulting CHP system size would be below the electric demand of the facility. A thermal factor greater than one indicates that a CHP system sized to the thermal load would produce more electricity than can be used on-site, resulting in excess power that could be exported to the grid. Following the method applied in the DOE national technical potential study, the thermal factor was multiplied by each customer’s annual consumption to estimate the appropriate CHP system size. The GDS Team screened and removed any CHP technology that did not fall within +/- 15% generation of the customer’s annual kWh consumption. A summary of the power to heat ratios by segment is listed in Table 2-3, as sourced from the DOE EPA CHP potential study.

TABLE 2-3: POWER TO HEAT RATIO BY SEGMENT

Industrial Segment	Heat to Power Ratio	Commercial Segment	Heat to Power Ratio
Utilities	1.29	Education	0.50
Smelting	0.26	Healthcare	0.75
Food Manufacturing	1.10	Institutions	0.94
Transportation Manufacturing	0.33	Grocery	0.62
Paper Manufacturing	2.37	Lodging	0.62
Plastics Manufacturing	0.31	Office	0.20
Misc. Manufacturing	1.34	Retail	0.84
Agriculture	0.25	Warehouse	0.68
Construction	0.25	Misc.	0.68
Metal Manufacturing	3.83		

After applying the screening method, we reviewed which CHP systems were eligible matches for given customer sites. In cases where multiple CHP technologies were viable for a single customer site, an applicability factor was assigned for each eligible CHP technology. After assigning applicability factors, the GDS Team summed the total CHP generation across the population. The GDS Team removed from the technical potential any generation occurring from existing systems. Data on existing systems was provided directly by AES-IN.

2.1.2 Economic Potential

Economic potential represents the DER generation possible given full adoption of all cost-effective DER measures. For the cost effectiveness analysis on solar PV and CHP, the GDS Team used a Total Resource Cost (TRC) hurdle of 1.0. To assess the TRC, the GDS Team relied on the same avoided energy and capacity costs used in the energy efficiency analysis. These avoided costs serve as the benefits while the costs are represented as the installation and O&M costs of the modeled solar PV and CHP measures.

2.1.2.1 Solar Photovoltaic

To estimate economic potential for solar PV, we gathered pertinent data on system costs along with calculated generation benefits to use in the benefit-cost analysis, which we conducted at the system measure

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level. The GDS Team assessed system component costs based on data included in the National Renewable Energy Laboratory’s (NREL) Q1 2020 Benchmarking report as well as public data files from Tracking the Sun⁶ and compared these national cost parameters to AES-IN-specific values by using various market data provided by Energy Sage.⁷ This analysis produced an estimated installation cost per watt installed, which we applied to each system size to estimate total installed cost. Additionally, the GDS Team included O&M costs that scale with system size.⁸ Finally, we assumed the impact of the federal investment tax credit (ITC) to follow the existing schedule at the time of this report which equates to a 10% tax credit for commercial systems by 2024 and a 0% tax credit for residential systems by 2024.

In addition to modeling solar PV system costs, the GDS Team estimated cost impacts for solar PV systems coupled with battery storage based on analysis from NREL’s Q1 2020 Benchmarking report and Lazard’s Levelized Cost of Storage Analysis.⁹ The GDS Team estimated an average lithium-ion battery installation cost of \$1,093/kWh and \$721/kWh for the residential and non-residential sectors, respectively, inclusive of the ITC. Table 2-4 provides the average solar PV installation cost by sector.

TABLE 2-4: AVERAGE SOLAR PV INSTALLATION COST

Sector	System Cost (\$/ DC W) ¹
Residential	\$3.05
Non-Residential (<100 kW)	\$2.56
Non-Residential (>100 kW)	\$2.20
Non-Residential - Tracking (<100 kW)	\$3.95
Non-Residential - Tracking (>100 kW)	\$3.39

¹Costs reflect impact of federal investment tax credit; battery systems not reflected in cost.

2.1.2.2 Combined Heat and Power

To assess costs for the various CHP technologies analyzed in the potential study, the GDS Team relied on data sourced from the EPA Catalog of CHP Technologies.¹⁰ Costs were calculated for fuel cell, gas turbine, micro turbine, reciprocating engine, and steam turbine CHP configurations at various capacity sizes. These costs reflect the inclusion of the ITC based on the existing schedule at the time of this report which equates to a 10% tax credit for CHP through 2023.

Table 2-5 summarizes detailed CHP cost considerations and assumptions utilized in the cost-effectiveness screening. These costs reflect the inclusion of the ITC based on the existing schedule at the time of this report which equates to a 10% tax credit for CHP through 2023.

⁶ Feldman, D, et. al., U.S. Solar Photovoltaic System and Energy Storage Cost Benchmark: Q1 2020. NREL, January 2021.

⁷ <https://www.energysage.com/solar-panels/in/>; <https://www.energysage.com/solar-panels/mi/> (accessed March 2021).

⁸ Feldman, D, et. al., U.S. Solar Photovoltaic System and Energy Storage Cost Benchmark: Q1 2020. NREL, January 2021.

⁹ Ibid.

¹⁰ U.S. Environmental Protection Agency Combined Heat and Power Partnership. Catalog of CHP Technologies, September 2017.

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TABLE 2-5: DETAILED CHP COST CONSIDERATION SUMMARY

Technology Type	Size (kW)	Installed System Cost (\$/W)	O&M Costs (\$/kWh)	Technology Type	Size (kW)	Installed System Cost (\$/W)	O&M Costs (\$/kWh)
Fuel Cell	125	\$17.33	\$0.35	Reciprocating Engine	125	\$2.85	\$0.07
	250	\$12.42	\$0.31		250	\$2.81	\$0.07
	500	\$6.69	\$0.27		500	\$2.73	\$0.07
	750	\$6.10	\$0.27		750	\$2.64	\$0.07
	1000	\$5.50	\$0.26		1000	\$2.55	\$0.06
	1250	\$4.91	\$0.26		1250	\$2.47	\$0.06
	1500	\$4.32	\$0.26		1500	\$2.38	\$0.06
Gas Turbine	2000	\$3.13	\$0.26		2000	\$2.21	\$0.06
	750	\$3.84	\$0.09		2500	\$2.04	\$0.05
	1000	\$3.77	\$0.09		3000	\$1.86	\$0.05
	1250	\$3.69	\$0.09		3000	\$1.86	\$0.05
	1500	\$3.62	\$0.09		4000	\$1.74	\$0.05
	2000	\$3.48	\$0.09		4500	\$1.71	\$0.05
	2500	\$3.34	\$0.09		5000	\$1.68	\$0.04
	3000	\$3.20	\$0.09	Steam Turbine	500	\$4.95	\$0.18
	3500	\$3.06	\$0.09		750	\$4.95	\$0.18
	4000	\$2.92	\$0.09		1000	\$4.95	\$0.18
	4500	\$2.78	\$0.09		1250	\$4.95	\$0.18
5000	\$2.64	\$0.09	1500		\$4.95	\$0.18	
5500	\$2.50	\$0.09	2000		\$4.95	\$0.18	
6000	\$2.36	\$0.08	2500		\$4.95	\$0.18	
Micro Turbine	50	\$3.50	\$0.05		3000	\$4.95	\$0.18
	100	\$3.30	\$0.05		3500	\$4.95	\$0.18
	150	\$3.10	\$0.05		4000	\$4.95	\$0.18
	200	\$2.90	\$0.05		4500	\$4.95	\$0.18
				5000	\$4.95	\$0.18	
				5500	\$4.95	\$0.18	
				6000	\$4.95	\$0.18	

2.1.3 Market Potential

Market potential is the amount of energy that can realistically be saved given likely future utility program intervention and various market barriers. The anticipated approach to assess achievable potential for the DER potential analysis was to follow the same logic and methods as used in the energy efficiency achievable potential analysis. However, as discussed in Section 2.2 below, market potential was not assessed as neither the solar PV nor CHP technologies passed a TRC screen of 1.0.

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2.2 DER POTENTIAL FINDINGS

This section of the report presents the Technical, Economic, Achievable (MAP and RAP) for CHP and solar PV.

2.2.1 Solar Photovoltaics

Table 2-6 summarizes the solar PV cumulative annual potential estimates for electric demand and Table 2-7 for electric energy within AES-IN’s territory. The residential 2042 technical market potential for solar PV represents 46.6% of the 2042 residential sector sales forecast. Additionally, the non-residential 2042 technical market potential represents 60.7% of the 2042 non-residential sector sales forecast.

TABLE 2-6: SUMMART OF SOLAR PV ELECTRIC DEMAND MARKET POTENTIAL

Year	Technical DC Capacity (MW)	Technical Peak Capacity (MW)	Economic (MW)	MAP (MW)	RAP (MW)
2023	319	104	0	0	0
2027	1,836	575	0	0	0
2032	5,416	1,695	0	0	0
2042	6,344	1,985	0	0	0

TABLE 2-7: SUMMARY OF SOLAR PV ELECTRIC ENERGY MARKET POTENTIAL

Year	Technical (MWh)	Economic (MWh)	MAP (MWh)	RAP (MWh)
2023	415,268	0	0	0
2027	2,297,314	0	0	0
2032	6,767,212	0	0	0
2042	7,926,314	0	0	0

Table 2-8 summarizes the cost effectiveness results for each technology and for the TRC cost-effectiveness perspective.

TABLE 2-8: SUMMARY OF SOLAR PV COST-EFFECTIVENESS

Solar PV Technologies	TRC Test Range
Residential Roof-mounted (3 – 20 kW)	0.40
Residential Roof-mounted with Batteries (3 – 20 kW)	0.19 – 0.35
Non-residential Roof mounted (10 – 50 kW)	0.42
Non-residential Roof mounted with Batteries (10 – 50 kW)	0.31 – 0.35
Non-residential Ground mounted (100 kW – 2MW)	0.48
Non-residential Ground mounted with Batteries (100 kW – 2MW)	0.41 – 0.42
Non-residential Ground mounted Tracking (100 kW – 2MW)	0.44
Non-residential Ground mounted Tracking with Batteries (10 – 50 kW)	0.39 – 0.40

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It is notable that no solar PV technologies pass cost-effectiveness screening under the TRC. This test is the primary cost-effectiveness criteria used to determine whether a utility sponsored program intervention is prudent. Low avoided costs serve as the primary driver behind the cost effectiveness results. At a technology level, the introduction of battery storage reduces cost effectiveness despite potential capacity benefit gains. Similarly, benefits achieved through additional generation using tracking-enabled systems are ultimately outweighed by the higher installation cost associated with the tracking technology.

It is notable while the TRC test for solar PV systems doesn't meet a 1.0 cost-effectiveness threshold, AES-IN customers install solar PV systems at their homes and businesses. Consequently, a baseline, business-as-usual (BAU) forecast was developed for integration into the IRP modeling. The BAU forecasts are based upon the:

- AES-IN customer and rooftop characterization described earlier
- Number of existing systems
- Trend of existing system installation from 2015-2020
- Willingness to participate and market adoption data collected from AES-IN customers
- Bass-diffusion curve and coefficients based upon the NREL dGen model¹¹ and EIA DGPV interconnection and Census data

Three adoption scenarios for BAU solar PV installations are described below for the Residential sector:

- Low; up to 6% market adoption
- Medium; up to 15% market adoption
- High; up to 29% market adoption

The BAU forecasts for system and energy (MWh-DC) are shown in Figure 2-2 and Figure 2-3, respectively.

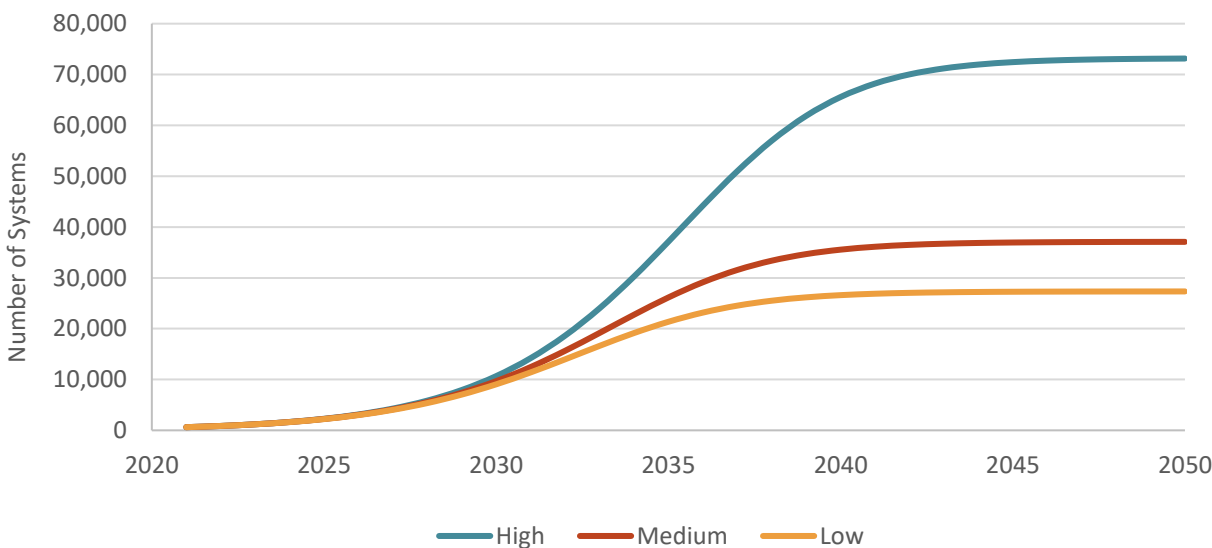


FIGURE 2-2: RESIDENTIAL SOLAR PV SYSTEM FORECAST (BUSINESS-AS-USUAL)

¹¹ <https://www.nrel.gov/analysis/dgen/>

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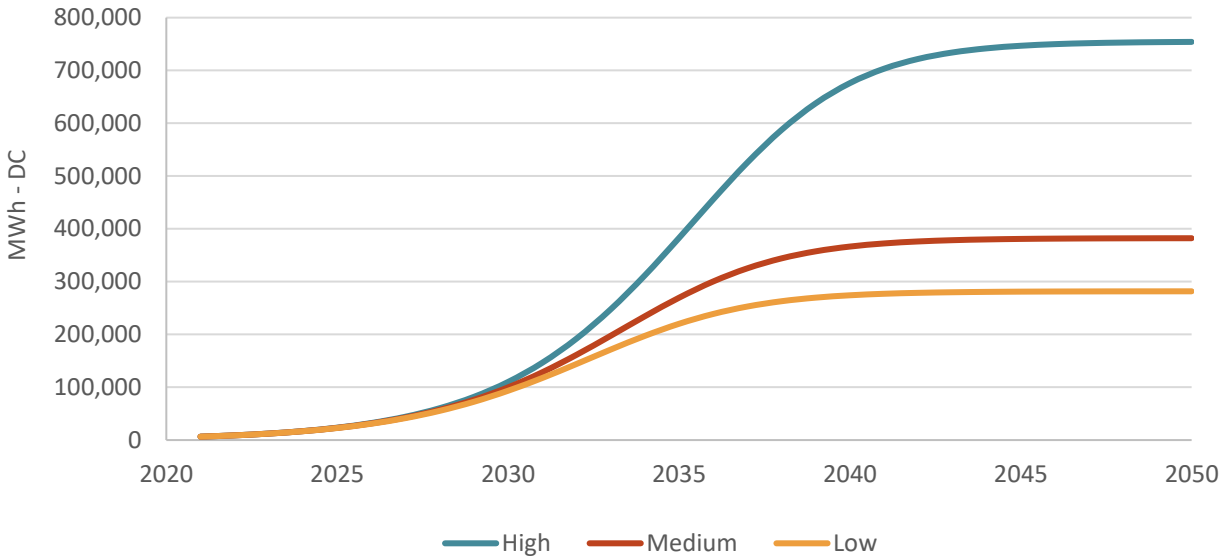


FIGURE 2-3: RESIDENTIAL SOLAR PV SYSTEM ENERGY CONSUMPTION (MWH-DC) (BUSINESS-AS-USUAL)

Three adoption scenarios for BAU solar PV installations are described below for the Non-residential sector:

- Low; up to 7% market adoption
- Medium; up to 19% market adoption
- High; up to 35% market adoption

The BAU forecasts for system and energy (MWh-DC) are shown in Figure 2-4 and Figure 2-5, respectively.

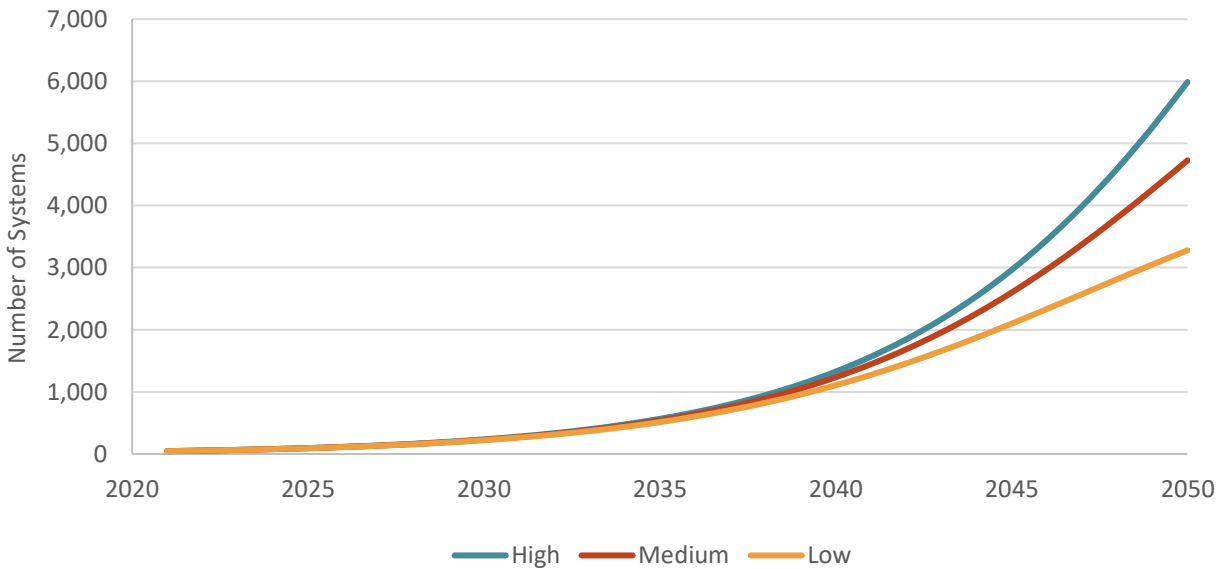


FIGURE 2-4: NON-RESIDENTIAL SOLAR PV SYSTEM FORECAST (BUSINESS-AS-USUAL)

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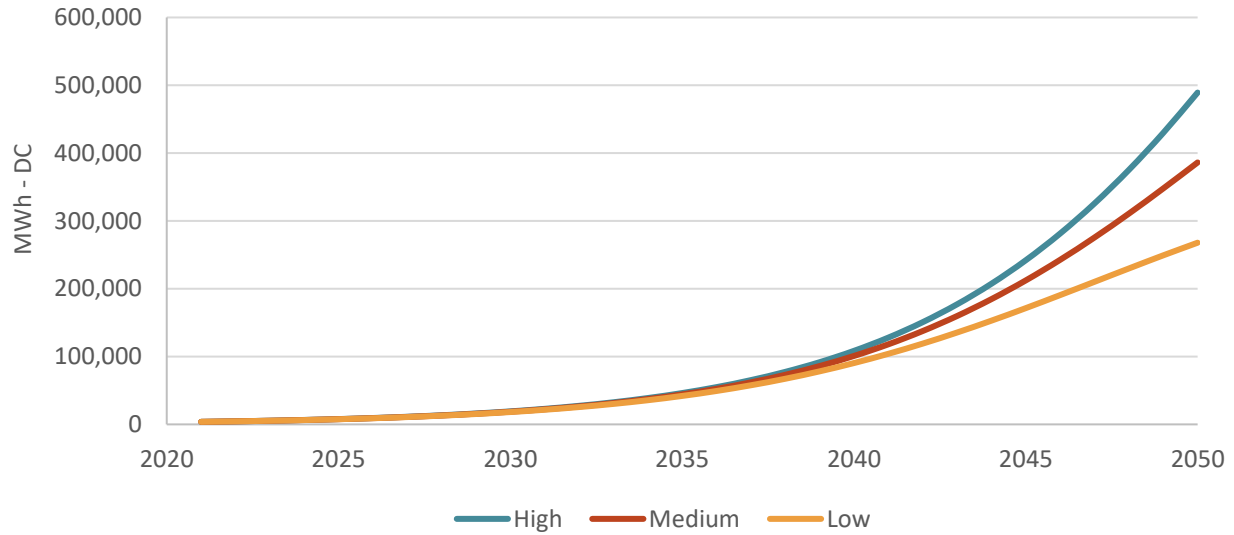


FIGURE 2-5: NON-RESIDENTIAL SOLAR PV SYSTEM ENERGY CONSUMPTION (MWH-DC) (BUSINESS-AS-USUAL)

2.2.2 Combined Heat & Power

Table 2-9 summarizes the CHP cumulative annual potential estimates for electric demand and Table 2-10 for electric energy within AES-IN territory. 2042 technical market potential for CHP represents of the 2042 non-residential sector sales forecast.

TABLE 2-9: SUMMARY OF CHP ELECTRIC DEMAND MARKET POTENTIAL

Year	Technical Peak Capacity (MW)	Economic (MW)	MAP (MW)	RAP (MW)
2023	7	0	0	0
2027	40	0	0	0
2032	125	0	0	0
2042	150	0	0	0

TABLE 2-10: SUMMARY OF CHP ELECTRIC MARKET POTENTIAL

Year	Technical (MWh)	Economic (MWh)	MAP (MWh)	RAP (MWh)
2023	59,521	0	0	0
2027	346,669	0	0	0
2032	1,089,496	0	0	0
2042	1,308,179	0	0	0

Table 2-11 summarizes the cost effectiveness results for each technology and for the TRC cost-effectiveness perspective.

TABLE 2-11: SUMMARY OF CHP COST-EFFECTIVENESS

CHP Technologies	TRC Test Range
Fuel Cell (125 – 2,000 kW)	0.14 – 0.32
Gas Turbine (750 – 6,000 kW)	0.46 – 0.77
Micro-Turbine (50 – 200 kW)	0.26 – 0.30
Reciprocating Engine (125 – 5,000 kW)	0.32 – 0.54
Steam Turbine (500 – 6,000KW)	Less than 0.1

It is notable that no CHP technologies pass cost-effectiveness screening under the TRC. This test is the primary cost-effectiveness criteria used to determine whether a utility sponsored program intervention is prudent. Low avoided costs serve as the primary driver behind the cost effectiveness results. However, it may be the case that certain site location conditions have important performance parameters that allow for a favorable cost-effectiveness assessment for that specific site, even if the average system and facility is not cost-effective as analyzed.

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3 Transportation Electrification

Wide-scale adoption of EVs across the U.S. will necessitate a substantial amount of energy supply to meet the needs of consumers over time. As traditional internal combustion engine (ICE) vehicles are offset by both battery electric vehicles (BEVs) and plug-in hybrid electric vehicles (PHEVs), electric service providers will need to account for the expanding EV market in their resource planning efforts.¹² EVs increase the demand for electricity that regulated electric utilities like AES-IN are required to supply to customers in their service territory. The growing adoption of EVs amongst all customer classes (residential, commercial, and industrial) poses supply and demand challenges that may require increased focus towards the assessment of the transportation sector and how it effects retail electric rates.

As of December 2021, the Federal Highway Administration provides that there are over 275 million vehicles in the U.S., and roughly 6.1 million in Indiana.¹³ The Department of Energy (DOE), in accordance with the National Renewable Energy Laboratory (NREL) estimates that for 2021, just over 1 million electric vehicles were registered in the U.S.¹⁴ The annual number of EV sales has been steadily increasing over time as well. In 2010, there were just over 15,000 EVs sold in the U.S.; in 2015 that number grew to over 120,000; and in 2021, that number was up to over 600,000.¹⁵ As of the beginning of 2022, the Environmental Protection Agency's (EPA) fuel economy report notes over 65 different makes and models of EV passenger cars are available to consumers, with new makes and models reported to hit the market year after year.

Differentiating between residential and commercial vehicles is the first step to determining the impact of new EVs in AES-IN's service territory. Residential vehicles can be typically defined as light- or medium-duty passenger vehicles or trucks used for daily commutes or recreational purposes. Commercial vehicles can be any type of vehicle used for business purposes (e.g., used for the transportation of goods or people; owned by a company or the public sector). This range of potential commercial vehicles can include light-duty passenger cars such as taxis and cop cars, all the way to vans, large trucks, and transit/school buses. Determining the number of each vehicle type takes a bottom-up approach before the energy consumption values can be approximated for AES-IN's service territory.

While EV passenger cars have a wide variety of options, the market for small delivery trucks and vans, large heavy-duty trucks (e.g., semi and tractor trailer trucks), limos, transit buses, school buses, is currently limited to a small number of makes and models, as of 2022. The adoption of these vehicles is still in its infancy. For example, car manufacturers like Tesla, Volvo, Dailmer, and BYD are still in the process of developing an EV semi-truck, with production estimates as early as Q4, 2022.¹⁶ Additionally, regarding school buses, of the roughly 500,000 in the U.S. as of December 2021, less than 1% are electric.¹⁷ Getting initial vehicle counts of these vehicle types is useful but forecasting out the adoption of each, and its associated energy usage has its limitations.

3.1 COMMERCIAL TRANSPORTATION ELECTRIFICATION

Within the market potential study, The GDS Team developed a commercial Electric Vehicle (EV) forecast for the AES-IN service territory over the 20-year resource planning period (2021-2041), to assess the potential energy and demand consumption attributed to increasing EV adoption by the commercial sector. This

¹² For purposes of this report, "EV" will refer to both battery electric vehicles and plug-in hybrid vehicles.

¹³ Federal Highway Administration, Highway Statistics Series "Highway Statistics 2020" (December 2021)

¹⁴ U.S. Dept. of Energy, Alternative Fuels Data Center "10962-Electric Vehicle Registrations by State, 2021"

¹⁵ U.S. Dept. of Energy, "New Plug-in Electric Vehicle Sales in the United States Nearly Doubled from 2020 to 2021"

¹⁶ See U.S. News "Future Electric Semi Trucks" 02/18/22.

¹⁷ See SchoolBusFleet "School Bus Statistics" Dec. 2021

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analysis should be utilized as a supplement to support AES-IN’s energy forecasting efforts. This analysis utilizes existing, publicly available, historical data and trends along with supplemental information supplied by AES-IN. The forecast in this report is solely a business-as-usual forecast; meaning there are no assumptions built in for utility intervention, or State or Federal policy implications throughout the planning period.

This section describes the overall methodology used to develop the commercial EV forecast. The structure of this report will be as follows:

- Characterizing the commercial EV market in AES-IN’s service territory as it relates to commercial vehicle registrations, sales, and historical trends;
- Developing EV measures, segmented by measure group to determine unique energy consumption values;
- Defining EV market penetration scenarios (low, medium, and high case);
- Approach used to forecast vehicle classes and energy consumption through the 20-year resource planning period; and
- Offering concluding findings and remarks surrounding the forecasted scenarios considered, and challenges posed by future adoption of heavy-duty EVs.

3.1.1 Commercial EV Market Characterization

First, to establish a forecasted value of commercial vehicles in AES-IN’s service territory, an AES-IN provided baseline year of 2021 is used. Commercial vehicle types are determined, and primary data is collected for historical U.S. vehicle registrations from sources such as the U.S. Dept. of Transportation’s Federal Highway Administration (FHA), and the DOE. Historical values are compared against national, state, and city population values year-over-year,¹⁸ and number of registered vehicles in a specific State and County can be extrapolated for a single historical year. Commercial vehicle types are then grouped in segments based on characteristics.

3.1.1.1 Vehicle Classification

The Federal government typically classifies vehicles based on the vehicle’s Gross Vehicle Weight Rating (GVWR). Eight cohorts of vehicles are categorized ranging from Class 1 (GVWR < 6,000 lbs) to Class 8 (GVWR > 33,000 lbs). This analysis utilizes these classifications and further categorizes each based on current EV models available in the market today. Table 3-1 provides a listing of the federal commercial vehicle cohorts by GVWR.

TABLE 3-1: FEDERAL COMMERCIAL VEHICLE COHORTS

Gross Vehicle Weight Rating (GVWR) (lbs)	Federal Highway Admin Vehicle Class	Federal Highway Admin GVWR Category
<6,000	Class 1: <6,000 lbs	Light Duty (< 10,000 lbs)
10,000	Class 2: 6,001 - 10,000 lbs	
14,000	Class 3: 10,001 - 14,000 lbs	Medium Duty (10,001-19,500 lbs)
16,000	Class 4: 14,001 - 16,000 lbs	
19,500	Class 5: 16,001 - 19,500 lbs	Light Heavy Duty (19,001 -26,000 lbs)
26,000	Class 6: 19,501 - 26,000 lbs	
33,000	Class 7: 26,001 - 33,000 lbs	Heavy Duty (> 26,000 lbs)
>33,000	Class 8: >33,000 lbs	

¹⁸ U.S. Census Bureau, U.S. population data, 2021

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Classes 1 and 2 are typical passenger vehicle on the road today. Of the 275 million vehicles registered in the U.S. in 2020, 37% would be considered under this class. Semi and Tractor trailer trucks make up most of the Class 7 and 8 vehicles, with the FHA reporting that over 13 million registered in 2020. The amount of fuel needed to power these different Classes of vehicles varies greatly, and furthermore, the Miles Per Gallon (“MPG”) of a Class 1 vehicle could dramatically differ from a Class 8 vehicle.¹⁹ For an EV model of each class, the amount of electricity needed to supply one vehicle to travel equal distances will also greatly vary.

For purposes of this study, based on the data that was available to be collected, along with vehicle characteristics and EV models available, the federal classes discussed were further recategorized into unique segments for all commercial vehicle types. Table 3-2 shows each of the vehicle segments.

TABLE 3-2: COMMERCIAL EV SEGMENTS

Segment	Class/ Additional Description
Government Passenger Cars	Light & Medium Duty, SUVs
Government Trucks	Light, Medium and Heavy Duty
Police Cars	Light & Medium Duty, SUVs
Police Trucks	Light, Medium and Heavy Duty
Private Vehicle – Class 1	Excluding all other segments
Private Vehicle – Class 2	Excluding all other segments
Private Vehicle – Class 3 through 6	Excluding all other segments
Private Vehicle – Class 7 & 8	Excluding all other segments
School Buses	-
Transit Buses	-
Limos	All Types

Each segment was scaled to Marion County based on population changes year-over-year. A total count of vehicles was determined for 2021, to be used as the initial baseline for scenario development and forecasting efforts.

3.1.2 Technology Characterization

Data on current makes and models of commercial EVs available in the U.S. market as of 2021 were collected and analyzed. Unique model characteristics such as Gross Vehicle Weight Rating (GVWR),²⁰ range, Manufacturer Suggested Retail Price (MSRP), Miles Per Gallon Equivalent (MPGe),²¹ etc., were compared to models into unique commercial EV cohorts.

Based on the range and battery, miles per kWh was defined for each model, and then averaged within each vehicle cohort, if multiple products are available. The FHA publishes an annual Vehicle Miles Traveled (VMT) every year based on types of vehicles. Using the miles per kWh values, and VMT values regionalized to central States, annual kWh values are derived for each of the vehicle segments.

Along with the uniqueness of the vehicle segments, each has a useful life, which is the length of time that the individual vehicle will, on average, be replaced. The DOT, EPA and individual car manufacturers provide insight towards the useful life of different vehicle types. The values have been collected and averaged and are used in the forecast of commercial EVs. Table 3-3 provides a summary of the vehicle segments, useful life,

¹⁹ EPA ratings for Class 1 vehicles are on average 24.2 MPG, while Class 8 vehicles can range from 2.5 to 6.5 MPG.

²⁰ Values provided by the DOE, Office of Energy Efficiency & Renewable Energy.

²¹ EPA unit used for alternative fuel vehicles. 1 U.S. gallon of unleaded gasoline equals 33.7 kilowatt-hours of electricity based on an energy standard of 115,000 BTUs (British thermal units) per gallon of gasoline.

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and number of commercial vehicles within AES-IN’s service territory used in this study. The turnover and new purchase for each commercial vehicle provides the opportunity for vehicle to switch to electric from internal combustion.

TABLE 3-3: USEFUL LIFE AND BASELINE YEAR MARKET SIZE FOR EACH VEHICLE SEGMENT

Segment	Estimated Vehicles in 2021	Useful Life (years)
Government Passenger Cars	12	5,416
Government Trucks	8	2,267
Police Cars	5	1,326
Police Trucks	5	284
Private Vehicle – Class 1	12	100,524
Private Vehicle – Class 2	12	10,538
Private Vehicle – Class 3 through 6	15	32,405
Private Vehicle – Class 7 & 8	15	17,170
School Buses	14	288
Transit Buses	14	2,115
Limos	15	107

3.1.3 Forecasting Scenarios and Assumptions

Various industry sources have offered opinions and projections towards the future of the U.S. EV market. For example, the Energy Information Administration (EIA),²² the International Energy Agency (IEA),²³ and NREL²⁴ all publish annual studies on potential EV penetration and adoption, with unique sales forecasts for the U.S. The characterization of the current EV market and the best estimates of future trends are based on leveraging both national and local historical data to the extent possible. Local data was used when available, such as historical values of school and transit buses in Marion County, IN.

Due to the 20-yr length of the study timeframe, and the current state of the EV market, this study uses three linear-trend scenarios of EV shares of total vehicle sales as described below:

- Low – starting at 1.7% in 2020 rising to 9.1% in 2042
- Medium – starting at 1.7% in 2020 rising to 18.2% in 2042
- High – starting at 1.7% in 2020 rising to 36.0% in 2042

A linear regression analysis is utilized for each cohort to develop a projected of new commercial vehicle purchases and replacements for each cohort within the forecasted years in the planning period. The linear regression approach is used because of its simplicity and the uncertainty of the EV market. The forecast does not include any additional market interventions by AES-IN, such as customer incentives of exceptional energy rate structures.

3.1.4 Commercial Transportation Electrification Results

Figure 3-1 and Figure 3-2 show the forecasts for incremental new commercial electric vehicles and incremental energy usage for all three scenarios (low, medium, high).

²² U.S. Energy Information Administration, Annual Energy Outlook 2022 (AEO2022) “Light-duty vehicle sales by technology or fuel type”

²³ International Energy Agency: Global EV Outlook 2021

²⁴ NREL: Electrification Futures Study (“EFS”), May 2021

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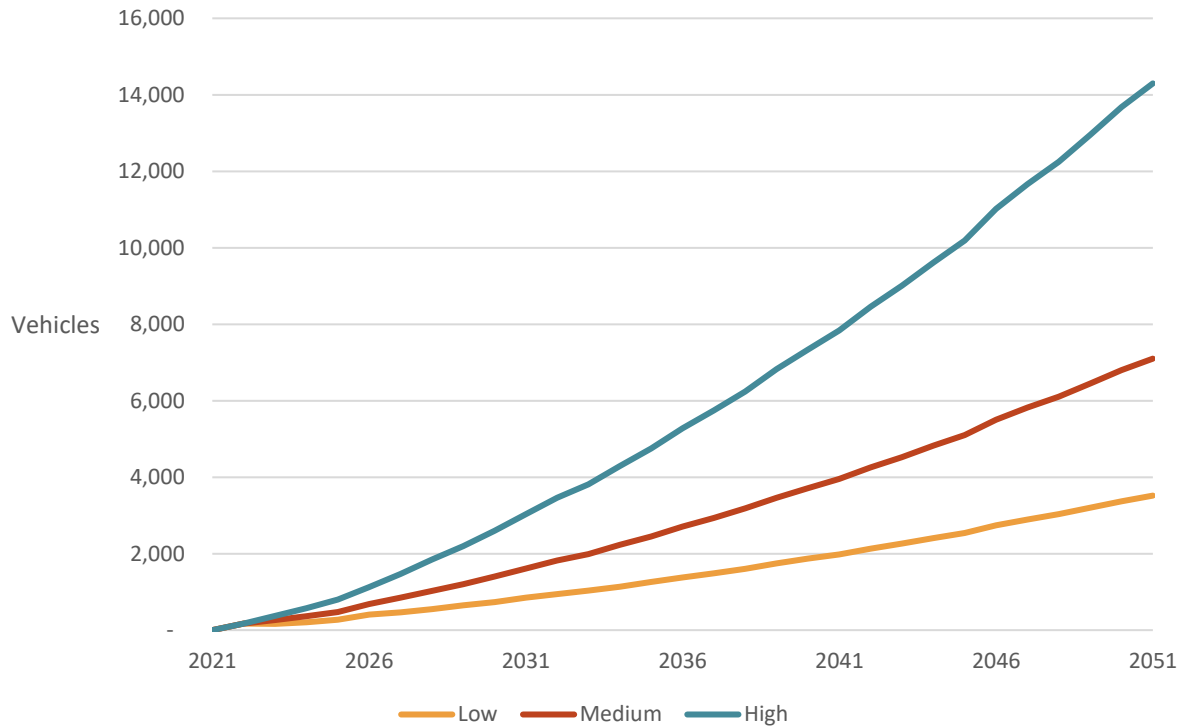


FIGURE 3-1: INCREMENTAL NEW COMMERCIAL ELECTRIC VEHICLES

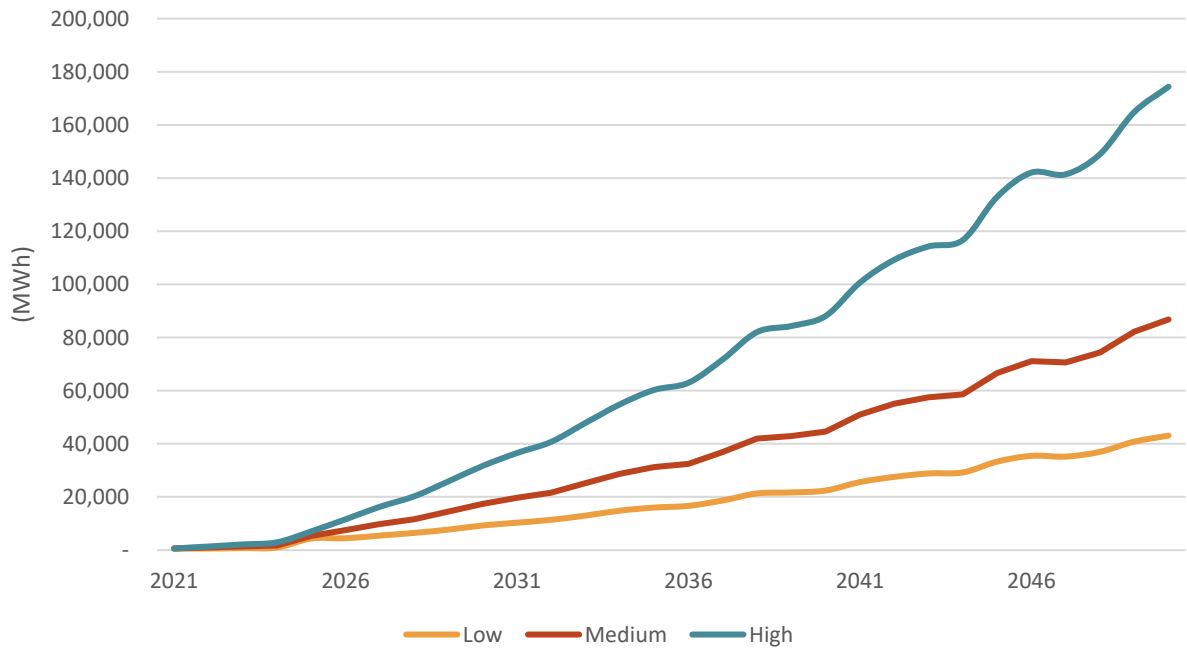


FIGURE 3-2: INCREMENTAL ENERGY USAGE FROM NEW COMMERCIAL ELECTRIFICATION VEHICLES

After the offset adoption of some of the larger vehicles is realized after 2024, the commercial EV’s incremental energy usage takes a significant jump under all three scenarios. By 2030, under the “low scenario” the commercial EV sector will consume 7,700 MWh of energy supply. Under the high scenario, that energy supply increases to over 25,800 MWh. By 2041, incremental energy usage ranges from roughly 22k

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MWh to 88k MWh between the low and high scenarios. Under all scenarios, Class 7 and 8 vehicles account for nearly 50% of all energy needs every year. The adoption of these vehicles has the most potential to influence the energy usage values of the commercial EV market. Table 3-4 shows the EV cumulative energy usage as percentage of total forecasted AES-IN non-residential energy sales through 2041 in the low and high scenarios.

TABLE 3-4: CUMULATIVE ENERGY USAGE – NON-RESIDENTIAL EV

Year	Non-Residential Sales Forecast (GWh)	EV % (Low)	EV % (High)
2022	8,025	0.01%	0.01%
2026	8,087	0.09%	0.18%
2031	8,080	0.51%	1.48%
2036	8,052	1.32%	4.47%
2041	8,080	2.57%	9.30%

It is notable that no commercial EV technologies pass cost-effectiveness screening under a TRC 1.0 threshold. This test is the primary cost-effectiveness criteria used to determine whether a utility sponsored program intervention is prudent. Consequently, no technical, economic, or achievable potential is estimated.

3.1.5 Conclusion

As the EV market continues to develop, new EV models, technology enhancements, and overall public opinion will begin to influence the rate of EV adoption. Studies like this are a challenging exercise because they lack the ability to accurately take these factors into account with such a new and uncertain market. Electric utilities like AES-IN may need to account for the potential load on their distribution lines associated with more of their customers choosing to purchase EVs over conventional ICE vehicles. Assessing potential supply and demand needs is common practice with electric utilities although greater assessment will need to be done towards EV usage year-after-year.

Heavy-duty vehicles like tractor trailer and semi-trucks account for only 10% of all commercial vehicles in AES-IN’s service territory but have the potential to account for roughly 50% of the commercial EV market’s energy needs. Analysis of the adoption of these vehicles will need to be closely monitored by AES-IN as they evaluate their generation supply. Indiana is home to the second largest FedEx hub in the world and is ranked first in the U.S. in pass-through highways, with access to five major interstates. The need to supply these vehicles as more EV models are made and adopted, may result in greater EV energy usage in AES-IN’s service territory relative to most other electric utilities.

Although this study utilizes forecast absent utility intervention, it is expected that federal and state policies can influence the adoption rate of EVs both on the residential and commercial level. AES-IN doesn’t currently have a mandated requirement for energy efficiency, beneficial electrification, or EV adoption, but many States around the country do have these policies. Greater incentives towards adoption in these States, along with the Federal level can influence the levels of EV adoption seen in AES-IN’s service territory. Thus, there remains a high level of uncertainty surrounding future deployment of commercial EVs in the AES-IN territory. This study is the result of publicly available data and trends available at the time of publication and should be used to aide AES-IN’s resource planning efforts today and as more information becomes available.

3.2 RESIDENTIAL TRANSPORTATION ELECTRIFICATION

GDS developed a residential electric vehicle (EV) forecast for AES-IN, which includes low, base, and high scenarios for the number of residential EV’s and the associated total energy consumption by the forecasted EV’s. The forecasting model is based on many inputs and assumptions. This section describes the methodology, data inputs, some of which will be detailed below.

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The first key input in the residential EV model is the number of AES-IN customers that make up potential EV owners. GDS utilized the most recently completed load forecast from AES-IN to input the number of residential customers on the system. The number of residential customers is essentially the number of households served by AES-IN, therefore the number of residential customers can be multiplied by the number of vehicles per household to estimate the total number of vehicles within the AES-IN service territory. The U.S. Census Bureau estimates there are 1.86 vehicles per household in the Indianapolis metropolitan area.

A second key assumption is the number of EV’s currently in the AES-IN service territory. GDS utilized Indiana Bureau of Motor Vehicles (BMV) registration data and the 2021 residential consumer survey conducted for the 2021 MPS to determine the number of residential EV’s served by AES-IN. Based on the data discussed above, GDS estimates that in 2021 3,575 EV’s were served by AES-IN.

The final key assumption used in the EV model is the percentage of EV’s that make up new vehicle sales. GDS started with publicly available data from the Energy Information Administration (EIA) and their published Annual Energy Outlook (AEO) for 2021.²⁵ The 2021 AEO projects that 11.7% of new vehicle sales will be EV’s in the year 2050. GDS conducted broad and thorough EV industry research to understand the AEO projections and form a basis for what new vehicle sales percentage should be in alternate scenarios. The AEO estimate of 11.7% is on the low end of the current industry projections based on GDS research, so the AEO trend was closely followed for the low scenario. GDS then developed a base case and high case scenario based on the industry research. As seen in Figure 3-3 below, the various scenarios all produce a linear growth trend for EV sales as a percentage of new vehicle sales, with the Low scenario closely following the AEO projections and the Base and High scenarios representing more optimistic projections. While the High scenario may appear overly optimistic compared to the Low and Base scenarios, many auto manufacturers have stated goals for EV sales that far outpace the percentages in the High scenario.

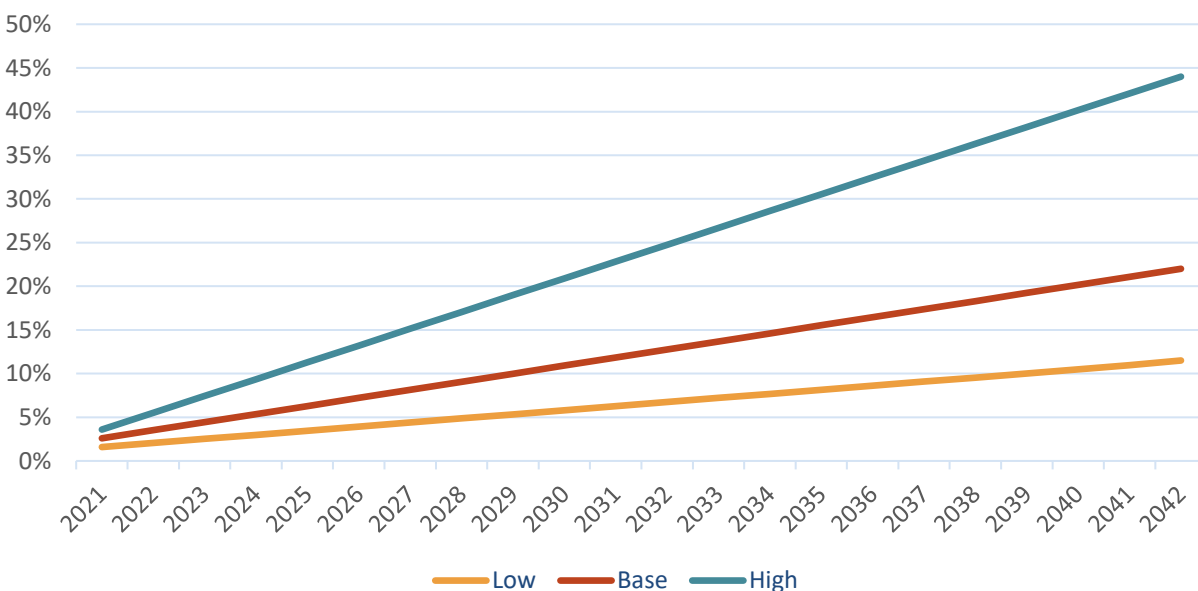


FIGURE 3-3: EV SALES AS A PERCENTAGE OF NEW VEHICLE SALES

Given the initial number of EV’s in Indianapolis and the projected percentage of new vehicle EV sales, the cumulative number of EV’s served by AES-IN can be projected annually. The projection for total number of EV’s accounts for the typical “lifespan” of a vehicle as well. Figure 3-4 below shows the projections for total number of electric vehicles.

²⁵ https://www.eia.gov/outlooks/aeo/tables_ref.php

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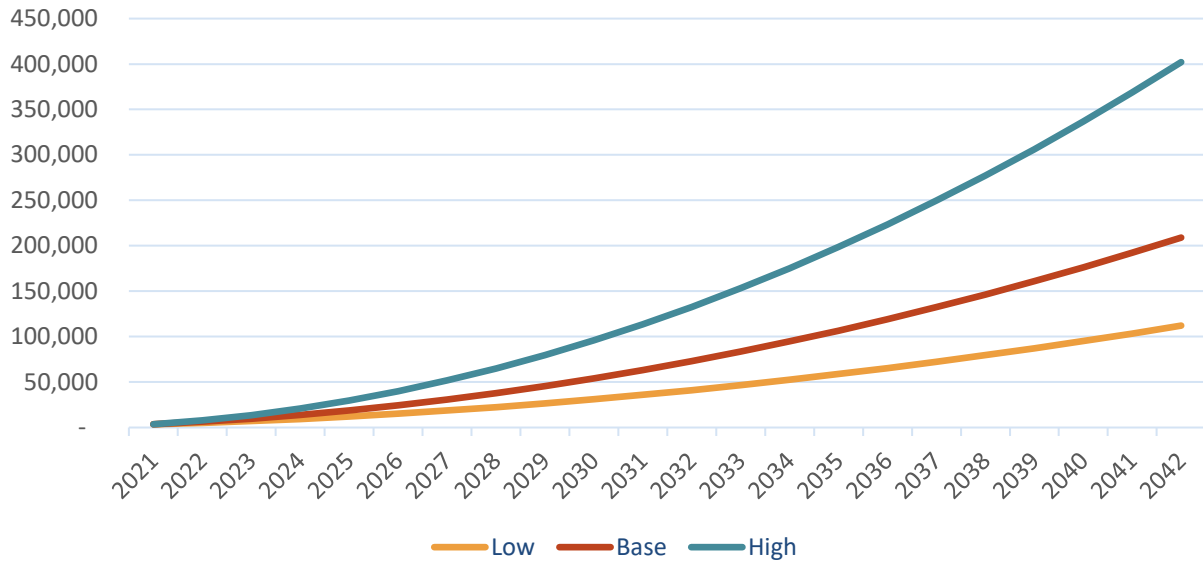


FIGURE 3-4: TOTAL EV'S

The total number of electric vehicles and several other inputs, including average miles driven per year and kWh per mile efficiency, are used to calculate the total energy sales attributable to the projected number of EV's on the AES-IN system. The expected average miles driven varies between scenarios, representing another layer of either optimistic or pessimistic assumptions regarding EV adoption and use. As seen below in Figure 3-5, the differences between the scenarios in expected MWh sales has increased due to the changing miles/year assumption.

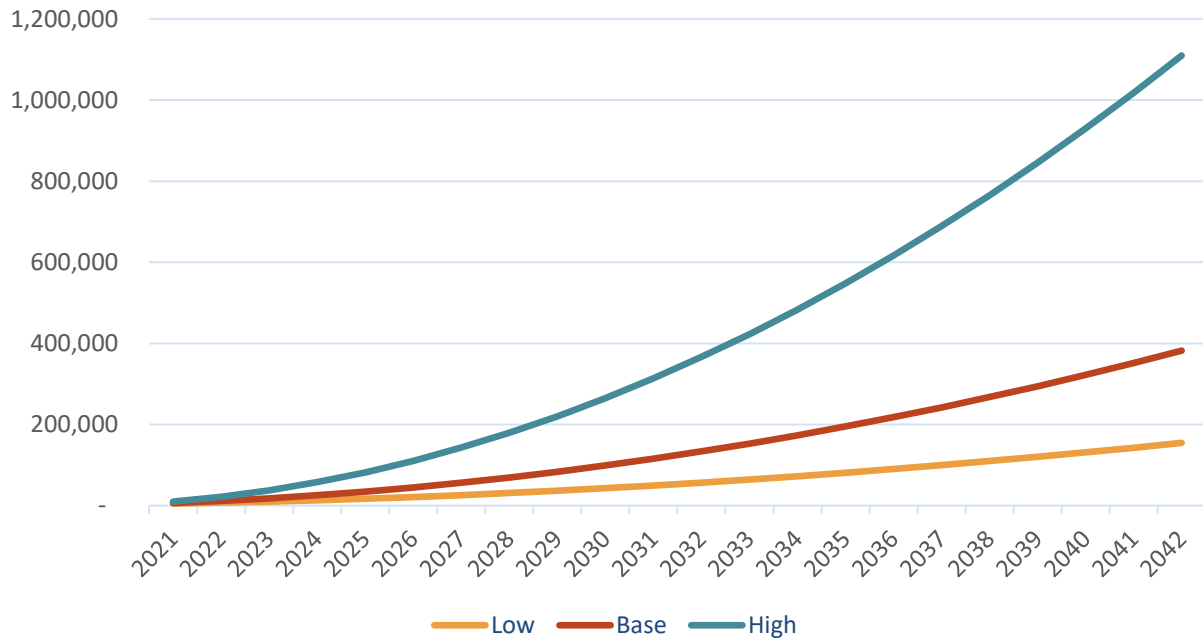


FIGURE 3-5: MWH SALES ATTRIBUTABLE TO EV'S

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4 Building Electrification

This chapter describes a building electrification forecast to understand the cost-effectiveness of building electrification measures and a range of possible electrification adoption impacts on AES’s base forecast of MWh sales. The forecast includes the residential, commercial, and industrial sectors.

4.1 OVERVIEW OF APPROACH

GDS approached the forecast of building electrification load impacts using three methods, varying by each sector. Each are summarized below. In all cases, GDS assumed that building electrification would offset natural gas consumption.

4.1.1 Residential Sector

The residential building electrification forecast was developed using a bottom-up approach. In this approach, the count of single family and multifamily buildings using natural gas for space heating, water heating, cooking, and laundry had electrification measures applied to the natural gas loads. GDS first utilized AES customer data to understand the share of end-uses that utilize natural gas. Table 4-1 summarizes the share of homes currently using natural gas.

TABLE 4-1: RESIDENTIAL USE OF NATURAL GAS BY END USE

Housing Type / End Use	Single Family	Multifamily	Total
Existing Customer Count	341,467	121,225	462,692
Space Heating Share	55.25%	22.89%	46.8%
Water Heating	49.71%	20.97%	42.2%
Gas range or stovetop	29.48%	14.32%	25.5%
Gas oven	24.75%	16.41%	22.6%
Gas clothes dryer	8.31%	5.34%	7.5%

GDS developed baseline technology models using assumptions from the Illinois TRM V10 for space heating and water heating natural gas consumption. GDS developed estimates of cooking equipment performance for gas ranges/stovetops and gas ovens. Gas clothes dryers were dropped from the model due to the limited share currently using natural gas. The resulting natural gas consumption was compared to reported natural gas sales by Citizens Energy Group in American Gas Association 2019 sales data. The bottom-up measure modeling estimated a total of 20,001,293 annual MMBTU of natural gas consumption, 96 percent of the 2019 Citizens Energy Group sales.

GDS applied assumptions regarding possible electrification alternatives to each end-use. These included:

- Dual-fuel and 100 percent offset HVAC heat pumps operating at a range of efficiencies from 16 SEER/8.1 HSPF to 21 SEER/9.0 HSPF, and ground-source heat pumps
- Electric resistance water heaters and heat pump water heaters
- Induction and electric resistance stovetops
- Electric resistance ovens

The technical performance of these measures developed electricity consumption estimates for each technology. GDS also applied assumptions regarding the technical feasibility for AES customers to incorporate a technology in their home.

GDS analyzed the economics of the natural gas and electrification technologies. As a starting point, customer perspectives based on equipment costs and retail rates for electricity and natural gas drove a life-cycle cost

Chapter 4 Building Electrification

analysis and simple payback metric in which the cost of equipment, available AES incentives, and operational costs created a customer-based benefit-cost ratio. The metrics provide insight into the lifecycle cost of purchasing and operating equipment, as well as whether operational energy costs were more or less for the electrification technologies than their natural gas counterparts. Additionally, GDS developed an analysis of utility economics in which the additional revenue from electrification electricity sales was offset by wholesale energy costs and program incentives. While not used directly, this second economic analysis provides insight into utility economic thresholds for program costs or incentives. Under the Utility Cost Test (UCT) used in Indiana to gauge energy efficiency cost-effectiveness, electrification would not pass the test due to increasing energy sales. The UCT was not used in economic modeling.

The general outcome of the economic modeling found that:

- Air-source heat pumps were cost-effective for customers. Ground-source heat pumps were not due to equipment costs.
- Electric water heating was cost-effective for customers (electric resistance or heat pump).
- Electric resistance stovetops were cost-effective for customers, though induction stovetops and electric resistance ovens were not.
- For residential new construction, all end-uses could be cost-effectively electrified for customers, other than electric resistance ovens.

With the resulting cost-effectiveness results for customers, GDS then utilized a Bass diffusion curve to develop estimates of low, medium, and high scenarios for future market adoptions. For existing residential buildings, the adoption curves assumed that half of customers would adopt electrification over time. The medium adoption scenario assumed 25 percent would adopt electrification, and the low adoption scenario assumed 12.5 percent would adopt electrification. For the high scenario, the available annual equipment sales were confirmed to approach 100 percent of sales across HVAC and water heating annual unit sales but did not exceed that amount.

Finally, GDS compared the forecasted electrification electricity sales increase to NREL's 2018 Electrification Futures study reference case. The NREL study analyzed, nationally, residential electrification electricity sales. The NREL study's reference case was used as a "Business As Usual" (BAU) case from which the low, medium, and high adoption scenarios could reflect varying levels of possible program interventions.

4.1.2 Commercial Sector

For the commercial building sector, GDS employed a top-down analysis. In this case, GDS began with the Citizens Energy Group 2019 commercial sector natural sales, as reported to the American Gas Association. GDS then disaggregated those sales into end-use consumption using a variety of data sources, including EIA's CBECs data for the Midwest region, USDOE's Energy Scout data, ACEEE reports, and other existing industry literature that presented estimates of commercial building natural gas consumption end-use shares. Of the possible commercial end-uses, only space heating, water heating, and cooking had data. As such, the analysis focuses on possible electrification from only those end uses. GDS acknowledges that other end uses of commercial natural gas exist, such as commercial laundry drying, gas-based cooling, or combined heat and power equipment. The electrification of those end-uses, due to the apparently low-share of commercial sector natural gas consumption, is expected to have minor impacts on overall electricity consumption. The general impact of electrifying space heating, water heating, and cooking end uses may also be representative of the impacts of electrifying the unaccounted-for end-uses and may be implicitly assumed in the forecast.

Table 4-2 describes the end-use share assumptions for each of the end-uses modeled for electrification.

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TABLE 4-2: COMMERCIAL SECTOR END-USE NATURAL GAS CONSUMPTION

End Use	Share
Space Heating	60 percent
Water Heating	30 percent
Cooking	10 percent

Within each end-use GDS developed a variety of technology models that captured a range of possible baseline and electrified equipment configurations. For all technologies, GDS developed the technology performance assumptions utilizing the Illinois TRM V10 for space heating and water heating. Parameters for high, low, and average use were developed to capture diversity within the commercial sector, though the sector was modeled as a whole and did not include measure permutations for different building types. For commercial cooking, GDS developed estimates of energy and cost impacts from its own research, focusing on commercial-scale professional cooking equipment.

For new construction, GDS utilized the AES commercial forecast to identify how new construction electricity load was expected to grow absent DSM programs. The aggregate growth of load absent DSM program was approximately 5.2 percent across the forecast period. GDS assumed that same growth rate for natural gas consumption, allowing that growth to occur at an equal level year-to-year to inform possible new natural gas consumption that could be electrified. New construction electrification potential was only applied to space heating and hot water loads due to the small share and high uncertainty regarding the presence of new gas cooking. Averages of the existing commercial sector measure performances were applied to these new construction loads.

GDS applied assumptions regarding possible electrification alternatives to each end-use. These included:

- Electric resistance and heat pump water heaters in distributed and central water heating configurations with higher and lower hot water consumption assumptions.
- Replacing residential-size furnaces and boilers with central or ductless heat pumps
- Replacing a boiler or furnace with rooftop or window air conditioning with ductless heat pumps
- Replacing a boiler or furnace with chillers with large VRF heat pumps and ground source heat pumps
- For HVAC systems, heating loads used configurations of average (IL TRM) loads, and then higher and lower HVAC loads to reflect more or less efficient commercial buildings

The purpose of the mix of technologies and consumption level assumptions was to understand the mix of possible energy loads and equipment configurations. GDS developed assumptions on the share of furnaces and boilers and cooling equipment using DOE’s Energy Scout Data for the Indianapolis climate region. This mix provides a range of possible equipment costs and energy impacts to support the economic analysis and thermodynamic relationship of equipment type electrification impacts on utility electricity sales.

GDS analyzed the economics of the natural gas and electrification technologies. As a starting point, customer perspectives based on equipment costs and retail rates for electricity and natural gas drove a life-cycle cost analysis and simple payback metric in which the cost of equipment, available AES incentives, and operational costs created a customer-based benefit-cost ratio. The metrics provide insight into the lifecycle cost of purchasing and operating equipment, as well as whether operational energy costs were more or less for the electrification technologies than their natural gas counterparts. Additionally, GDS developed an analysis of utility economics in which the additional revenue from electrification electricity sales was offset by wholesale energy costs and program incentives. While not used directly, this second economic analysis provides insight into utility economic thresholds for program costs or incentives. Under the Utility Cost Test (UCT) used in Indiana to gauge energy efficiency cost-effectiveness, electrification would not pass the test due to increasing energy sales. The UCT was not used in economic modeling.

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The general outcome of the economic modeling found that:

- Under current and forecasted retail rates, HVAC heat pumps and water heaters were not cost effective to electrify.
- Of cooking equipment, only combination ovens and steam cookers were shown to be cost effective to electrify

As a result of the economic analysis, GDS elected to provide flexibility in the potential adoption of electrification measures for the commercial sector. GDS reduced the threshold of cost-effectiveness to 0.70 and elected to assume that new construction HVAC and water heating electrification would be cost effective. This approach provides several benefits to the forecast:

- Allows for the diversity of the commercial sector to allow that cost-effective conditions may exist that could not be directly modeled with the available data.
- Accounts for commercial sector customers to that may choose to make sub-economic decisions.
- Acknowledges that some commercial sector customers in the economy are choosing to electrify despite sub-economic outcomes or that non-energy impacts may overcome energy economics.
- Allows that economic conditions, including equipment costs and relative costs of energy, may shift to favor electrification over the forecast period.

Nevertheless, GDS still found that electrification measures did not pass cost-effectiveness criteria. For HVAC, ground source heat pumps and larger commercial VRF systems remained non-cost effective when compared to natural gas options. For water heating, electric resistance water heating remained non-cost effective. For cooking, electric griddles and fryers remained not cost-effective. The outcome points to the importance of possible program interventions to encourage electrification.

To model the possible adoption of commercial sector electrification and its impact on AES electricity sales, GDS applied Bass diffusion curves based on NREL research. The scenarios all assumed that 50 percent of the commercial sector could ultimately adopt electrification. Three Bass diffusion curves were selected to model the adoption of electrification to reflect high/medium/low adoptions.

- High adoption utilized the residential sector Bass parameters, reflecting rapid adoption over time.
- Medium adoption utilized NREL's national estimate for commercial sector curves, reflecting a pace of adoption based on a national average, which may be more reflective of AES' service territory than the State as a whole.
- Low adoption utilized NREL's Indiana-specific commercial sector parameters, reflecting a slower pace to durable goods adoption.

The selection of these curves are compared to NREL's Electrification Futures Study reference case, which was used to estimate a "Business As Usual" (BAU) scenario. The High/Medium/Low adoptions envision program support and market acceptance above that of the BAU case.

4.1.3 Industrial Sector

Despite challenging energy economics, the industrial sector, nationally, has exhibited some adoptions of electrification. The industrial sector differs from the residential and commercial sectors due to specialized process equipment that may consume considerable amounts of natural gas, though varies by industrial type. For example, using industrial heat pumps to provide low-grade process heat will have substantially different outcomes than replacing a gas steam boiler with an arc boiler using electricity. The specific timing and type of technology that may be adopted is highly uncertain, particularly for a specific utility service territory. Corporate decisions will be based on energy economics, possible decarbonization goals, and the timing for aging process equipment to be replaced.

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GDS utilized data from NREL’s Electrification Futures Study to estimate the possible impact of electrification growth in AES’ industrial sector. The NREL study provides national-level estimates of industrial electrification, with NREL’s reference case indicating zero industrial electrification. NREL’s low and medium case envision nearly zero industrial adoptions of electrification. Only in NREL’s high case does industrial electrification exhibit meaningful growth.

GDS began with AES’ forecast of industrial sales across the forecast period. GDS notes that industrial electricity sales are approximately 15 percent of AES’ total electricity sales, indicating that the industrial sector makes up a relatively small portion of AES’ customer base, further suggesting caution at making assumptions for electrification for a specific service territory. To estimate the impact of NREL’s high case for industrial electrification, GDS analyzed the NREL assumption regarding overall industrial load growth and removed the share of load growth already accounted for in AES’ forecast. The remaining share was assumed to be driven by electrification. The growth occurs in the last decade of the forecast.

To model adoptions of industrial electrification and the resulting increase in electricity sales above the current forecast, GDS applied a compound annual growth rate that models the entire period’s growth in industrial electrification. Three scenarios were developed to estimate the load impacts:

- A high scenario that utilizes NREL’s high case
- A medium scenario that assumes two-thirds the growth of the high case occurs
- A low scenario that assumes one-third the growth of the high case occurs

These three scenarios can be compared to NREL’s reference case, which serves as a “Business As Usual” (BAU) scenario. With NREL’s reference case indicating that no industrial electrification would occur, the BAU case is inherently reflecting that AES’ industrial sector would not adopt electrification technologies.

4.2 RESULTS

Below we present the results of the building electrification modeling in aggregate, by sector, and for each of the adoption scenarios. For the total across all sectors and for each sector, the results show the estimated impact of electrification and 2042 results compared to the base forecast for 2042.

4.2.1 All Sectors

Table 4-3 shows the impact of additional electrification load compared to the AES base electricity sales forecast for the combined residential, commercial, and industrial sectors for selected forecast years. The 2042 electricity sales under the three electrification scenarios are compared to the base electrification forecast, which does not include any assumed electrification growth.

TABLE 4-3: CUMULATIVE ELECTRIFICATION SALES ABOVE BASE FORECAST, MWH

Scenario	2023	2025	2030	2035	2040	2042	Percent Above Base Forecast
Low	8,910	16,954	52,983	109,200	163,058	187,904	1.3%
Medium	10,709	22,653	74,905	181,388	301,705	347,890	2.4%
High	12,727	29,661	111,370	329,653	598,830	654,627	4.4%

The above results for additional load due to electrification show a range of 1.3 percent to 4.4 percent above the AES base forecast, which does not include electrification. As a comparison, the business-usual-case (BAU) based on NREL’s Electrification Futures study Reference Case, was modeled as showing 0.9 percent growth above the base forecast by 2042. As a national model, the growth in total electric consumption does not necessarily mirror AES’s forecast are not illustrative of year-on-year differences between scenarios that are

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specific to AES. In the BAU forecast, NREL’s modeling assumes no incremental load growth due to electrification occurring for the industrial sector.

4.2.2 Residential Sector

Table 4-4 presents the impact of additional electrification load compared to the AES base electricity sales forecast for the residential sector.

TABLE 4-4: CUMULATIVE RESIDENTIAL BUILDING ELECTRIFICATION SALES ABOVE BASE FORECAST, MWH

Scenario	2023	2025	2030	2035	2040	2042	Percent Above Base Forecast
Low	3,786	7,150	28,233	60,645	73,712	75,624	1.2%
Medium	3,807	7,322	32,907	95,698	140,253	146,732	2.3%
High	3,818	7,410	35,760	131,534	254,286	278,720	4.4%

The above results for additional load due to residential building electrification show a range of 1.2 percent to 4.4 percent above the AES base forecast, which does not include electrification. As a comparison, the business-usual-case (BAU) based on NREL’s Electrification Futures study Reference Case, was modeled as showing 0.85 percent growth above the base forecast by 2042. A contributor to the residential sector results is that both single-family and multifamily buildings already exhibit relatively high shares of electric market penetration for end uses.

4.2.3 Commercial Sector

Table 4-5 presents the impact of additional commercial building electrification load compared to the AES base electricity sales forecast for the commercial sector.

TABLE 4-5: CUMULATIVE COMMERCIAL BUILDING ELECTRIFICATION SALES ABOVE BASE FORECAST, MWH

Scenario	2023	2025	2030	2035	2040	2042	Percent Above Base Forecast
Low	3,535	5,036	12,034	27,890	60,734	80,488	1.3%
Medium	3,674	5,649	16,179	43,735	103,360	136,611	2.1%
High	4,092	7,800	37,075	135,499	257,840	279,569	4.3%

The above results for additional load due to commercial building electrification show a range of 1.25 percent to 4.3 percent above the AES base forecast, which does not include electrification. As a comparison, the business-usual-case (BAU) based on NREL’s Electrification Futures study Reference Case, was modeled as showing 1.2 percent growth above the base forecast by 2042. That both the BAU case (derived from NREL) and the Low scenario result in similar load growth assumptions suggest that commercial sector electrification decision making regarding may be similar between national perspectives and AES’s commercial sector.

4.2.4 Industrial Sector

Table 4-6 presents the impact of additional electrification load compared to the AES base electricity sales forecast for the industrial sector.

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TABLE 4-6: CUMULATIVE INDUSTRIAL BUILDING ELECTRIFICATION SALES ABOVE BASE FORECAST, MWH

Scenario	2023	2025	2030	2035	2040	2042	Percent Above Base Forecast
Low	1,590	4,769	12,717	20,664	28,612	31,791	1.6%
Medium	3,227	9,682	25,819	41,955	58,092	64,546	3.3%
High	4,817	14,451	38,535	62,620	86,704	96,338	4.9%

The above results for additional load due to industrial sector building electrification (including processes) show a range of 1.5% to 4.4% above the AES base forecast, which does not include electrification. NREL’s Reference Case informs a BAU case, which indicates no industrial electrification load growth. Note that the High scenario directly utilizes NREL’s High Case to inform the AES low growth assumption. As such, the High Scenario assumes the same general mix of industry types, processes, and other drivers of NREL’s High Case. The Low and Medium Scenarios are assumed as multiples of the High Case to provide a range of possible impacts, though without reflection on the decision making, thermodynamics, and technologies that may drive electrification decisions by AES’s industrial customers over the next two decades.

AES INDIANA

 **Indiana**

2022

*Market Potential Study
Distributed Energy
Resources and
Electrification*

FINAL REPORT

September 2,
2022

prepared by
GDS ASSOCIATES INC

The logo for AES Indiana features the lowercase letters 'aes' in a stylized, rounded font. The 'a' is blue, the 'e' is purple, and the 's' is green. To the right of 'aes' is the word 'Indiana' in a black, sans-serif font. Below 'Indiana' is the text '2022 IRP' in a bold, black, sans-serif font.

aes Indiana
2022 IRP

Attachment 8-3

(Quanta Technology's System Reliability Assessment of AES Indiana's
2022 IRP Portfolios)

System Reliability Assessment of AES Indiana's 2022 IRP Portfolios

PREPARED FOR

AES Indiana
(AES)

DATE

November 23, 2022

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VERSION HISTORY:

Version	Date	Description
1	10/24/2022	Initial Submission
2	11/23/2022	Revised document to conform with scenario and strategy names

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EXECUTIVE SUMMARY

1.1 Background

Quanta Technology was retained by AES US Services, LLC (AES) to provide an independent assessment, a scoring methodology and metrics for the reliability attributes of 24 resource portfolios that have been studied in its 2022 integrated resource plan (IRP). AES has evolved its IRP process to include measures of resource reliability contributions to ensure meeting its reliability and affordability obligations.

AES Indiana provides retail electric service to approximately 517,000 residential, commercial, and industrial customers in Indianapolis, as well as portions of other Central Indiana communities surrounding Marion County and owns and operates 3,634 MW of generation assets. AES is part of the Midcontinent Independent System Operator (MISO) grid and represents a small fraction of the grid's total makeup.

Electric power systems require several reliability services from installed resources to function properly and to deliver reliable and safe electricity to consumers that meets mandatory industry requirements embodied in several of the North American Electric Reliability (NERC) standards. Some of the reliability services such as reserves can be procured from the RTO while others such as voltage control have traditionally been assumed to be innately provided by the local resources. Integrating high levels of intermittent renewable resources (e.g., solar, wind) and other inverter-based resources (IBR) (e.g., energy storage) into the power grid brings a clear opportunity to realize a clean energy future. However, it also brings significant concerns about the preparedness of the electric grid to operate reliably.

A careful assessment of the essential grid services that can be provided by the various IRP portfolios is required to ensure continued safe and reliable operation of the power system in accordance with industry standards, and where applicable, the provision of additional reliability services and enforcement of interconnection standards to assure the successful implementation of the IRP objectives in a timely and affordable manner.

The 2022 IRP optimized five strategies and one “Encompass Optimization” analysis across four scenarios or future views.¹ See Section 8 of the AES Indiana IRP 2022 IRP Report for more information on the IRP Modeling Framework including strategies and scenarios. This reliability study analyzed all 24 portfolios. A range of solar, storage, wind, energy efficiency, demand response, and gas resources are incorporated across the portfolios.

¹ Scenarios (No Environmental Action, Current Trends, Aggressive Environmental, Decarbonized Economy); Portfolios (No Early Retirement, Petersburg Conversion, One Petersburg Unit Retires, Both Petersburg Units Retire, Clean Energy Strategy, Encompass Optimization)

The report will use the following naming conventions for the five strategies and “Encompass Optimization” analysis in tables and charts where space is limited:

- “No Early Retirement” = No Retire
- “Petersburg Conversion” = Convert
- “One Petersburg Unit Retires” = 1 Retire
- “Both Petersburg units Retire” = 2 Retire
- “Clean Energy Strategy” = Clean
- “Encompass Optimization” analysis = Optimize

The acronym IBR used in this report means “Inverter-Based Resources”.

The 24 portfolios that were analyzed in this study explored a wide range of resource strategies as exhibited in Figure ES-1 and Table E-1 where the inverter-based resources reached 7.3GWs and the renewable penetration 85% by 2042. This study focused all its analysis on the Y2031 as a midyear within the 20-year horizon and also as a year when most of the portfolio temporal changes have taken place.

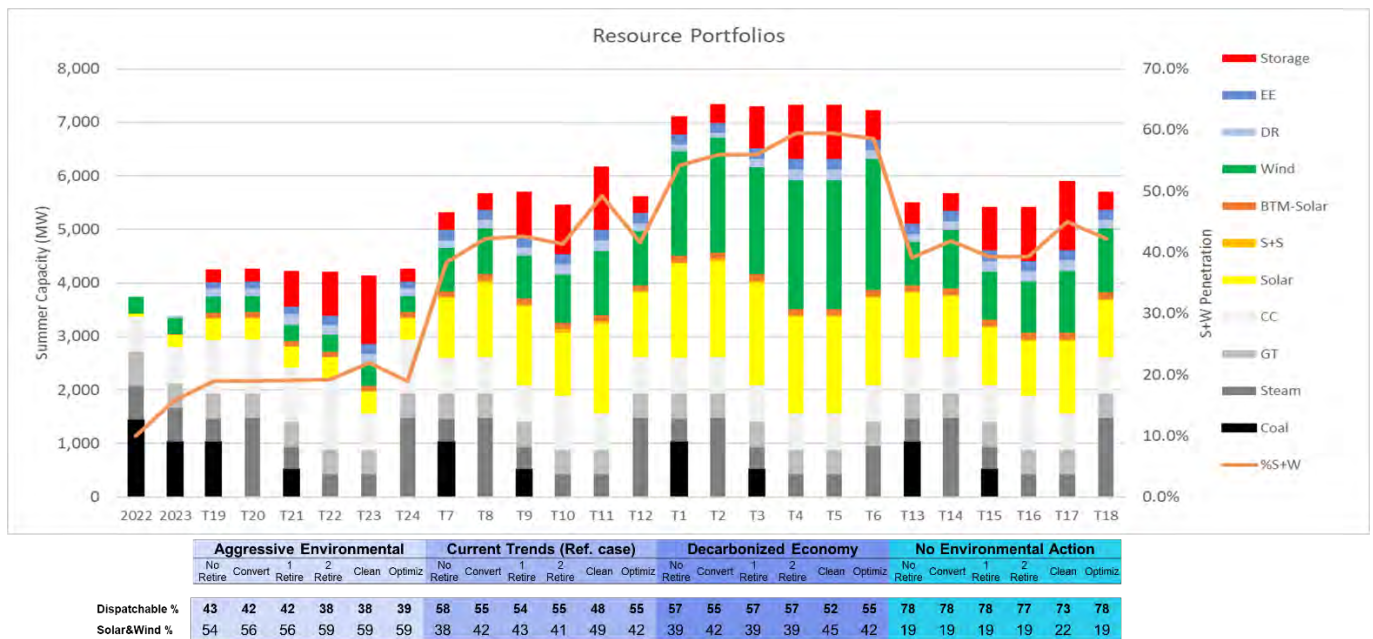


Figure ES-1: Resource Mix in each of the Portfolios

Table E-1

	Inverter Based Resources (IBR) (GW)	Solar + Wind (% of All Resource ICAP)	Renewable Penetration (%)
2022	0.4	10%	8%
2031	1.0 – 5.4	19% - 59%	13 – 81%
2042	1.1 – 7.3	18% - 61%	8 – 85%

Grid reliability and security standards require grid planners and operators to adhere to numerous performance requirements², including the ones abbreviated and summarized in Table ES-2.

Table ES-2. Selected Grid Reliability and Security Requirements

Reliability/Security Category	Requirement / Guidance	Consequence
Steady-State Voltages	Voltages on 138 kV and above facilities to remain within 92-105% of rated levels	Equipment insulation failure or heating and fire hazard
Steady-State Frequency	Maintain system frequency within -/+0.5% of 60 Hz	Affects the voltage level and magnetizing currents of transformers; Affects speed of motors; Affects power-sharing between interconnecting areas
Thermal Limits Pre-contingency	Electric current flows on all bulk power facilities should not exceed 100% of their normal rating limits.	Exceeding grid equipment ratings causes equipment loss of life or catastrophic failure.
Thermal Limits Post-contingency	Electric current flows on all bulk power facilities should not exceed 100% of emergency (SE) rating limits after any P1 ³ , P2-1, and P3 contingency and 100% of SE after any P4-P7 category contingencies.	Exceeding grid equipment ratings causes equipment loss of life or catastrophic failure.
Voltage Stability Limits Post-contingency	Voltages on 138 kV and above facilities should not exceed -10%/+5% of rated levels after any contingency of P1-P7 categories.	Exceeding grid equipment ratings leading to loss of life and failure
Stability Limits Post-contingency	The power system should not lose synchronism following any P1-P7 category contingency and should not drop load. There should be an acceptable transient voltage recovery where the voltage following fault clearing shall	Cascading outages

² NERC standards such as TPL-001-4, and AES's Electric Transmission Planning Criteria

³ Contingency classification per NERC TPL-001-4 standard. P0 is intact system (N-0); P1 is single element failure (circuit, generator, transformer, shunt device); P2 is also single element failure (line section, bus, breaker); P3 is loss of a second element after a period of losing a generator (N-1-1), P4 is multiple element loss (stuck breaker), P5 is also multiple element loss (delayed fault clearing due to relay failure); P6 is a loss of single element (line, transformer, shunt) followed by a loss of another single element (N-1-1), and P7 is loss of multiple elements (common structure).

Reliability/Security Category	Requirement / Guidance	Consequence
	<p>recover to an allowable steady state condition. after 5 seconds.</p> <p>Following the disturbance, the oscillations of the monitored parameters should display positive damping. The damping ratio should reach 3% or better for inter-area oscillations and 4% or better for local mode oscillations.</p>	
Rate of Change of Frequency (RoCoF)	Following the loss of the largest generator, the RoCoF should not exceed 1.0Hz/s.	Reduced synchronizing torques may cause generators to trip; may exceed the speed of operation of protective equipment; may damage generators.
Power Quality - Harmonics	Connecting equipment should not inject harmonics in excess of allowable levels. The harmonic content of grid voltages should not exceed allowable levels.	Heating of equipment, audible noise, mis-operation of electronic devices, and deterioration of insulation in cables
Power Quality – Flicker (Voltage Fluctuations)	The variability of the power output of connecting equipment should not rise to a level that causes irritation to customers.	Visible irritation to customers, lost productivity, and damage to sensitive electronic equipment
Short Circuit Ratio	The connecting equipment power injection level should be limited to a level commensurate with the strength of the grid at the point of common coupling.	<p>Grid voltages become very sensitive, resulting in large voltage deviations in response to renewable power fluctuations, beyond acceptable limits. This results in the malfunction of inverters’ controls. Inverter manufacturers do not guarantee proper operation of equipment under these conditions.</p> <p>It becomes difficult to energize large power transformers.</p>
Protection System Operation	Short circuit currents should be high enough for proper operation of protection systems.	Protection system mis-operation resulting in equipment failure, cascading outages, and human safety concerns

Being part of the MISO grid, AES Indiana relies on the market to provide many of the required reliability services as shown in Figure ES-2 such as the dispatch of its resources, the balancing of its energy requirements, and the control of frequency. However, some reliability services are local in nature and not procured by the markets such as frequency responsive reserves and voltage support. Other services such as blackstart and restoration are planned by AES Indiana and approved by MISO. Most of the time, the regional markets work as planned and provide the required reliability services to all participants.

However, during periods of extreme weather or emergency operation events, such as “Max Gen” events, the available resources in the market are severely restricted and thus the ability of AES Indiana to continue serving its baseload customer needs should be assessed. A careful analysis of each portfolio is prudent to ensure it has the requisite reliability attributes and can be integrated reliably into the T&D grid.

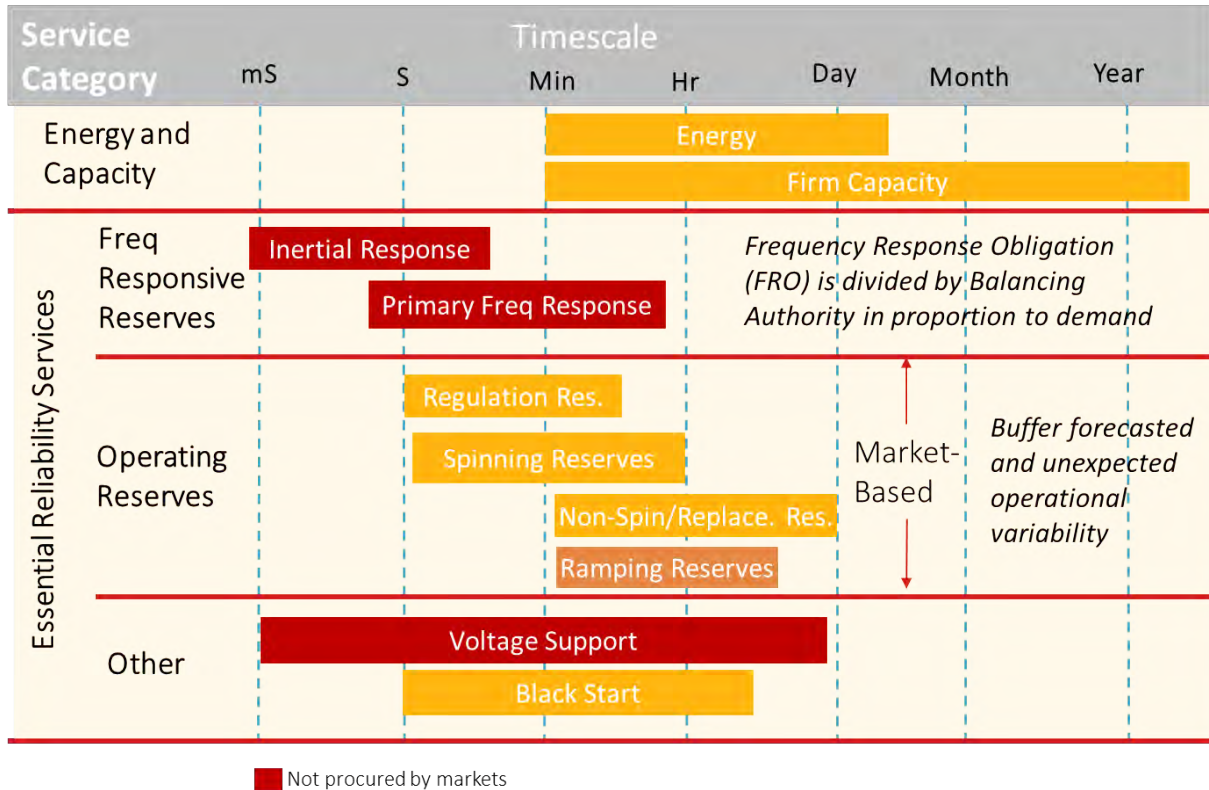


Figure ES-2: Essential Reliability Services

1.2 Study Methodology

The reliability assessment study (Figure ES-3) started by gathering and collating data characterizing the existing and planned resources along with locations, planned retirement schedules, portfolio resource additions, and transmission grid power flow and dynamic models.

The study then reviewed, refined, and augmented the initial set of reliability metrics, along with the measures that will be used to quantify the performance of each portfolio against each metric.

The study then proceeded to conduct a series of system analyses, each quantifying the performance of each of the twenty-four portfolios against each measure, and where appropriate determining the required mitigations to address any performance gaps. The nature of the study is akin to a series of analysis filters. Passing one analysis filter is not a guarantee for the ability to integrate IBRs and to operate reliably.

However, limits imposed or flagged by any analysis filter represent a reliability concern that should be mitigated.

A scoring matrix is organized along with acceptable performance thresholds to provide a quantifiable score for each reliability measure. These scores are aggregated for each metric, and eventually for each portfolio. Mitigations are quantified for each portfolio to address its reliability shortcomings.

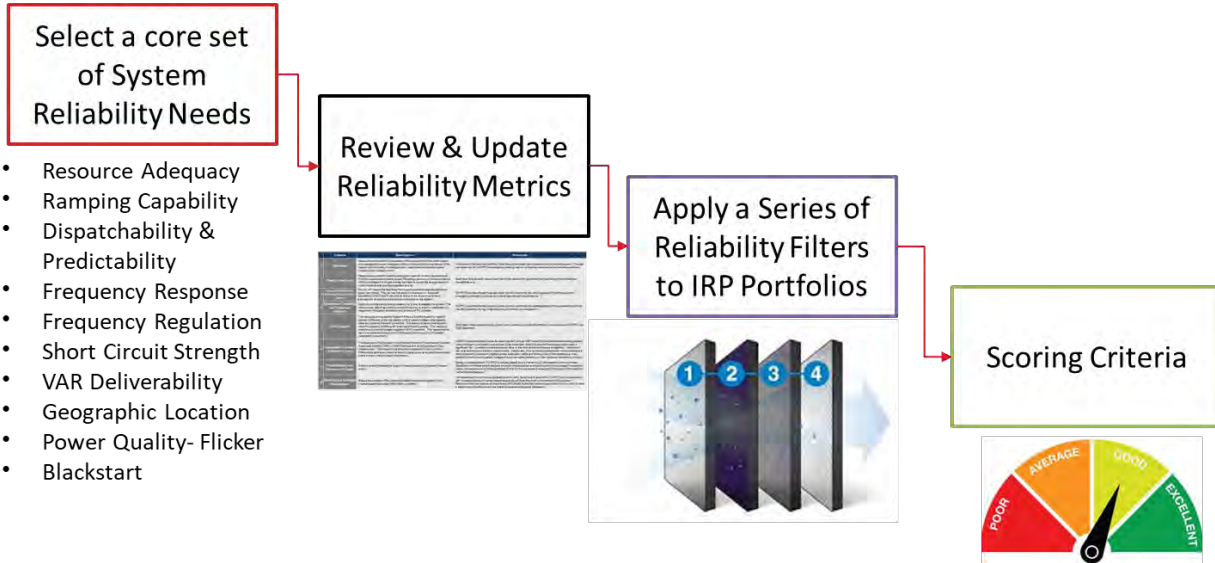


Figure ES-3: Reliability Study Methodology

1.3 Reliability Metrics

Nine metrics have been selected to assess the reliability attributes of each portfolio, as summarized in Table ES-3.

Table ES-3: Reliability Metrics

	Metric	Description	Rationale
1	Energy Adequacy	Resources are able to meet the energy and capacity duration requirements. Portfolio resources are able to supply the energy demand of customers during normal and emergency max gen events, and also to supply the energy needs of critical loads during islanded operation events.	Utility must have long duration resources to serve the needs of its customers during emergency and islanded operation events.
2	Operational Flexibility and Frequency Support	Ability to provide inertial energy reservoir or a sink to stabilize the system. Additionally, resources can adjust their output to provide frequency support or stabilization in response	Regional markets and/or control centers balance supply and demand under different time frames according to prevailing market construct under normal conditions, but preferable that local control

		to frequency deviations with a droop of 5% or better.	centers possess the ability to maintain operation during under-frequency conditions in emergencies.
3	Short Circuit Strength Requirement	Ensure the strength of the system to enable the stable integration of all inverter-based resources (IBRs) within a portfolio.	The retirement of synchronous generators within utility footprint and replacements with increasing levels of inverter-based resources will lower the short circuit strength of the system. Resources that can operate at lower levels of short circuit ratio (SCR) and those that provide higher short circuit current provide a better future proofing without the need for expensive mitigation measures.
4	Power Quality (Flicker)	The “stiffness of the grid” affects the sensitivity of grid voltages to the intermittency of renewable resources. Ensuring the grid can deliver power quality in accordance with IEEE standards is essential.	Retirement of large thermal generation plants lower the strength of the grid and increases its susceptibility to voltage flicker due to intermittency of renewable resources, unless properly assessed and mitigated.
5	Blackstart	Ensure that resources have the ability to be started without support from the wider system or are designed to remain energized without connection to the remainder of the system, with the ability to energize a bus, supply real and reactive power, frequency and voltage control	In the event of a black out condition, utility must have a blackstart plan to restore its local electric system. The plan should demonstrate the ability to energize a cranking path to start large flexible resources with sufficient energy reservoir.
6	Dynamic VAR Support	Customer equipment driven by induction motors (e.g., air conditioning or factories) requires dynamic reactive power after a grid fault to avoid stalling. The ability of portfolio resources to provide this service depends on their closeness to the load centers.	Utility must retain resources electrically close to load centers to provide this attribute in accordance with NERC and IEEE Standards
7	Dispatchability and Automatic Generation Control	Resources should respond to directives from system operators regarding their status, output, and timing. Resources that can be ramped up and down automatically to respond immediately to changes in the system contribute more to reliability than resources which can be ramped only up or only down, and those in turn are better than ones that cannot be ramped.	Ability to control frequency is paramount to stability of the electric system and the quality of power delivered to customers. Control centers (regional or local) provide dispatch signals under normal conditions, and under emergency restoration procedures or other operational considerations.
8	Predictability and Firmness of Supply	Ability to predict/forecast the output of resources and to counteract forecast errors.	The ability to predict resource output from a day-ahead to real-time is advantageous to minimize the need for spinning reserves. In places with an active energy market, energy is scheduled with the market in the day-ahead hourly market and in the real-time 5-minute market. Deviations from these schedules have financial consequences and thus the ability to accurately forecast the output of a resource up to 38 hours ahead of time for the day-

			ahead market and 30 minutes for the real time market is advantageous.
9	Geographic Location Relative to Load (Resilience)	Ensure the ability to have redundant power evacuation or deliverability paths from resources. Preferable to locate resources at substations with easy access to multiple high voltage paths, unrestricted fuel supply infrastructure, and close to major load centers.	Location provides economic value in the form of reduced losses, congestion, curtailment risk, and address local capacity requirements. Additionally, from a reliability perspective, resources that are interconnected to buses with multiple power evacuation paths and those close to load centers are more resilient to transmission system outages and provide better assistance in the blackstart restoration process.

Each reliability metric is assessed using one or multiple measures as shown in Table ES-4.

Table ES-4: Reliability Measures for Each Metric

Metric		Measure
1	Energy Adequacy	Loss of Load Hours (LOLH) - normal system, 50/50 forecast
		Expected Energy not Served (GWh) - normal system 50/50 forecast
		max MW Short (MW) - normal system 50/50 forecast
		max MW Short - loss of 50% of tie-line capacity, 50/50 forecast
		max MW Short (islanded, 50/50 forecast)
2	Operational Flexibility and Frequency Support	max MW Short (normal system, 90/10 forecast)
		Inertia MVA-s
		Inertial Gap FFR MW (% CAP)
3	Short Circuit Strength	Primary Gap PFR MW (% CAP)
		Inverter MWs passing ESCR limits (%) - Connected System
		Inverter MWs passing ESCR limits (%) - Islanded System
		Required Additional Synch Condensers MVA (% peak load) - Connected
4	Flicker	Required Additional Synch Condensers MVA (% peak load) - Islanded
		Compliance with Flicker limits when Connected (GE Flicker Curve or IEC Flicker Meter)
		Compliance with Flicker limits when islanded
5	Blackstart	Required Synchronous Condensers MVA to mitigate Flicker
6	Dynamic VAR Support	Qualitative Assessment of Ability to blackstart the system
7	Dispatchability	Dynamic VAR to load Center Capability (% of Peak Load)
		Dispatchable (%CAP)
		Unavoidable VER Penetration %
		Increased Freq Regulation Requirements (% Peak Load)
		1-min Ramp Capability (MW)
8	Predictability and Firmness	10-min Ramp Capability (MW)
9	Location	Ramping Capability to Mitigate Forecast Errors (+Excess/-Deficit) (%VER MW)
		Average Number of Evacuation Paths

1.4 Scope of Reliability Analysis

Operating a power system with high levels of inverter-based resources (IBR) requires careful analysis of the resource reliability attributes to ensure a safe and reliable system operation during normal, emergency, and islanded system conditions. This study evaluated twenty-four portfolios across nine reliability metrics involving 25 measures. The study focused on the year 2031 for all quantitative analyses because it is in the middle of 20-year horizon and because most of the portfolio temporal changes have taken place by then. Table ES-5 summarizes the reliability assessments that have been conducted in this study.

Table ES-5: Reliability Assessments

	Reliability Study Area	Normal (50/50, Connected)	Max-Gen (90/10, Import Limited)	Islanded (Critical Load)
1	Energy Adequacy	X	X	X
2	Operational Flexibility and Frequency Support	X		X
3	Short Circuit Strength Requirement	X		X
4	Power Quality (Flicker)	X		X
5	Blackstart			X
6	Dynamic VAR Deliverability	X		
7	Dispatchability and Automatic Generation Control	X		
8	Predictability and Firmness of Supply	X		
9	Geographic Location Relative to Load	X		

This study takes the resource portfolios and associated schedules of retirements and additions from the IRP along with the standard models of the existing transmission grid and generation resources and assesses several of the mandatory reliability requirements for the year 2031. Given the dynamic nature of renewable energy developments during the 10-year horizon and the future state of the transmission grid buildout, this study provides an envelope of outcomes (and in many cases, best or optimistic outcomes) under a regime of well-coordinated or guided project development.

Prudent assumptions were made in the study. For example, operating renewable resources economically requires them to generate all the time at their maximum potential power levels as allowed by solar irradiance and wind speeds. This mode of economic operation precludes these resources from providing frequency response in the upward direction, as will be required when a generator or import is suddenly lost. Reducing the power output to enable participation in frequency response in the upward direction is very expensive. However, the speed of control of the IBRs makes them perfectly suited for participating in frequency response in the downward direction (i.e., curtailment), as will be required when a large load or export is suddenly lost.

Screening-level quantitative studies were conducted for several reliability standards, including inertial response, primary frequency response, secondary frequency response, short circuit strength, system ramping requirements, dynamic reactive support, flicker, and energy adequacy. Qualitative assessments were made for blackstart and system restoration capability. Other areas of reliability assessment are outside the scope of this study and include system protection and control interactions. Detailed system studies will be required to ascertain the reliability of the system once a portfolio is selected and the location, size, and technology of all portfolio resources are available.

1.5 Summary of Study Results

This study identified potential reliability gaps for each of the twenty-four IRP portfolios and has also suggested potential mitigations to these gaps. The mitigations take the form of grid-forming inverter technology, additional fast power resources such as battery storage, super capacitors, or combustion turbines, and additional synchronous condensers.

The key findings of this study are summarized in Table ES-6 for each of the performance measures under each of the nine metrics of the Current Trends/Reference Case Scenario. The results of all portfolios are summarized in the Appendix.

Table ES-6: Study Results of the Reliability Performance of Portfolios in the Current Trends Future

		Current Trends/Reference Case					
		No Retire	Convert	1 Retire	2 Retire	Clean	Optimize
Year 2031		T7	T8	T9	T10	T11	T12
Resource Adequacy	Additional Reserve Margin Required - Summer (MW)	-210	-373	-101	47	61	-318
Energy Adequacy	Loss of Load Hours (LOLH) - normal system, 50/50 forecast	0	0	11	39	64	0
	Expected Energy not Served (GWh) - normal system 50/50 forecast	0	0	0	0	0	0
	max MW Short (MW) - normal system 50/50 forecast	0	0	503	748	1029	0
	max MW Short - loss of 50% of tieline capacity, 50/50 forecast	0	0	614	798	1079	0
	max MW Short (islanded, 50/50 forecast)	0	0	663	847	1128	0
	max MW Short (normal system, 90/10 forecast)	621	600	1138	1322	1603	582

Operational Flexibility and Frequency Support	Inertia MVA-s	12,740	13,829	11,115	11,903	9,490	13,829
	Inertial Gap FFR MW	129	99	183	49	128	98
	Primary Gap PFR MW	298	326	0	0	0	325
Short Circuit Strength	Inverter MWs passing ESCR limits (%) - Connected System	100%	100%	100%	100%	100%	100%
	Inverter MWs passing ESCR limits (%) - Islanded System	100%	100%	49%	53%	10%	100%
	Required Additional Synch Condensers MVA (when connected)	0	0	0	0	0	0
	Required Additional Synch Condensers MVA (when Islanded)	0	0	350	300	1500	0
Power Quality (Flicker)	Compliance with Flicker limits when connected (GE Flicker Curve or IEC Flicker Meter)	100%	100%	100%	100%	100%	100%
	Compliance with Flicker limits when Islanded	100%	100%	100%	100%	100%	100%
	Required Synchronous Condensers MVA to mitigate Flicker	0	0	0	0	0	0
Blackstart	Qualitative Assessment of Ability to Blackstart the system	1	1	1	1	1	1
Dynamic VAR Support	Dynamic VARs that can be delivered to select load centers (% of Load) at peak	59%	50%	53%	50%	51%	52%
Dispatchability and Automatic Generation Control	Dispatchable (%CAP)	82%	80%	78%	79%	74%	82%
	Unavoidable VER Penetration %	0%	0%	0%	0%	0%	0%
	Increased Freq Regulation Requirements (MW)	39	48	49	45	66	47
	1-min Ramp Capability (MW)	417	403	919	1,005	1,255	403
	10-min Ramp Capability (MW)	1,159	1,200	1,621	1,756	1,915	1,200
Predictability and Firmness	Ramping Capability to Mitigate Forecast Errors (+Excess/-Deficit) MW	329	231	752	752	870	952
Location	Average Number of Paths for Evacuating Power from Resources	4.5	4.5	4.4	4.4	4.4	4.5

Quantitative assessment of each measure, except blackstart, was calculated using resource technology, size, and location within each portfolio along with resource production profiles and grid data. Blackstart, on the other hand, was deemed acceptable for all portfolios since the existing blackstart restoration plan is not impacted by the resource mix in each portfolio.

Table ES-7 summarizes potential mitigation measures to address the reliability concerns and their estimated costs.

Table ES-7. Summary of Proposed Mitigations of Portfolios in the Current Trends Future

	Current Trends/Reference Case					
	No Retire	Convert	1 Retire	2 Retire	Clean	Optimize
	T7	T8	T9	T10	T11	T12
Equip Stand-alone ESS with GFM inverters (MW)	129	99	183	49	128	98
Additional Synchronous Condensers (MVA)	0	0	350	300	1500	0
Additional Power Mitigations (MW) ⁴	298	326	183	49	128	325
Increased Freq Regulation	39	48	49	45	66	47
Address Inertial Response Gaps	129	99	183	49	128	98
Address Primary Response Gaps	298	326	0	0	0	325
Firm up Intermittent Renewable Forecast	0	0	0	0	0	0
GFM Inverter Premium (\$M)	\$6	\$5	\$9	\$2	\$6	\$5
Additional BESS (\$M)	\$120	\$131	\$74	\$20	\$52	\$131
Additional Synchronous Condensers (\$M)	\$0	\$0	\$158	\$135	\$871	\$0
Estimated Cost of Mitigations (\$M)	\$127	\$136	\$241	\$157	\$929	\$136

Observations and Comments:

1. Reliability concerns were identified for each portfolio, especially under emergency and islanded conditions, and mitigation measures were identified as follows:
 - a. Stand-alone energy storage should have grid-forming inverters (GFM) with additional capabilities including blackstart and fast frequency response (FFR). GFM inverters are not widely used today in the US market, but the technology is available and is recommended for portfolios with high penetration of IBRs.
 - b. The provision of additional fast power resources is required in each portfolio. These have been quantified for energy storage technology. However, super capacitors or combustion turbines can also provide the same function, but the size should be determined for these technologies.
 - c. Specifications of equivalent short circuit ratio (SCR) of inverters not to exceed 3.5.

⁴ Requires fast frequency response within 100ms. Can be in the form of battery storage, super capacitors, or appropriately upsized combustion engines or gas turbines.

- d. Provision of additional synchronous condensers to increase the grid’s short circuit strength ranging from 0 to 1500 MVar.
2. This study covered several areas of reliability assessment. However, it is not exhaustive. Areas that have not been covered include the following:
- e. The study assumed that any required grid upgrades will be implemented as part of MISO interconnection process, and thus excluded the analysis of portfolio deliverability.
 - f. The study assumed the IRP process produced portfolios with sufficient capacity to assure meeting the LOLE target of 0.1 days/year, and thus excluded the analysis of resource adequacy.
 - g. All reliability assessments in this study applied screening level indicative analyses. Detailed system studies are essential and should be conducted to properly assess system reliability of the short-listed Portfolios.

1.6 Scoring Methodology and Performance Thresholds

Table ES 8 summarizes the thresholds that are used in this study to score the reliability assessment of each measure, along with the rationale for setting the threshold values. Measures that exceed the upper threshold are deemed satisfactory (Pass) and given a score of 1, while those measures below the lower threshold are deemed potentially problematic and given a score of 0. Measures in between are cautionary and given a score of ½. The scores of measures within each of the eight metrics are averaged to yield a single score for each metric. Metric scores are then added for each portfolio and compared. The maximum score of each portfolio is nine.

Table ES 8: Scoring Thresholds

Year 2031		1 (Pass)	2 (Caution)	3 (Problem)	Rationale	
1	Energy Adequacy	Loss of Load Hours (LOLH) - normal system, 50/50 forecast	<2.4 hrs	2.4-4.8 hrs	>4.8 hrs	Expected number of hours in a year the portfolio is energy short and relies on imports (2.4hrs = 1day in 10 years)
		Expected Energy not Served (GWh) - normal system 50/50 fcst	<2.4*Peak	2.4-4.8*Peak	>4.8*Peak	The energy consumption which is not supplied due to insufficient capacity resources within portfolio to meet the demand
		max MW Short (MW) - normal system 50/50 forecast	<0%	0-10%	>10%	The maximum hourly power shortage in the portfolio that has to be supplied by imports (% of Tie-line Import Limits)
		max MW Short - loss of 50% of tieline capacity, 50/50 fcst	<0%	0-5%	>5%	The energy consumption which is not supplied due to insufficient resources and imports to meet the demand, when tieline import capacity is halved
		max MW Short (islanded, 50/50 forecast)	<70%	70-85%	>85%	Ability of Resources to serve critical loads, estimated at 15% of total load. Adding other important loads brings the total to 30%
		max MW Short (normal system, 90/10 forecast)	<5%	5-20%	>20%	Ability of portfolio resources to serve unanticipated growth in load consumption during MISO emergency max-gen events
2	Operational Flexibility and	Inertia MVA-s	>4.2 *Peak	2.6-4.2 *Peak	<2.6 *Peak	Synchronous machine has inertia of 2-5xMVA rating. Conventional systems have inertia that exceeds 2-5x (Peak load x 1.3)

	Frequency Support	Inertial Gap FFR MW (% CAP)	0	0-10% of CAP	>10% of CAP	System should have enough inertial response, so gap should be 0. Inertial response of synch machine ≈ 10% of CAP
		Primary Gap PFR MW (% CAP)	0	0 - 2% of CAP	>2% of CAP	System should have enough primary response, so gap should be 0. Primary response of synch machine ≈ 3.3% of CAP/0.1Hz (Droop 5%)
3	Short Circuit Strength	Inverter MWs passing ESCR limits (%) - Connected System	95%	80-95%	80%	Grid following inverters require short circuit strength at the point of connection to operate properly (ESCR threshold of 3.5)
		Inverter MWs passing ESCR limits (%) - Islanded System	0	0-20%	>20%	Grid following inverters require short circuit strength at the point of connection to operate properly (ESCR threshold of 3.5)
		Required Additional Synch Condensers MVA (% peak load)	0	0-500	>500	Portfolio should not require additional synchronous condensers. 500MVARs is a threshold
4	Flicker	Compliance with Flicker limits when connected (GE Flicker Curve or IEC Flicker Meter)	>95%	80-95%	<80%	% of system load buses that is likely to experience flicker (>100% of Border line of irritation or Pst>1)
		Compliance with Flicker limits when islanded	>80%	50-80%	<50%	% of system load buses that is likely to experience flicker (>100% of Border line of irritation or Pst>1)
		Required Synchronous Condensers MVA to mitigate Flicker	0%	0-500	>500	Size of Synchronous condensers required to mitigate flicker (500MVARs is a threshold)
5	Blackstart	Qualitative Assessment of Ability to Blackstart the system	Excellent	Average	Poor	System requires real and reactive power sources with sufficient rating and duration to start other resources. Higher rated resources lower the risk
6	Dynamic VAR Support	Dynamic VAR to load Center Capability (% of Peak Load)	≥85%	55-85%	<55%	Dynamic reactive power (DRP) should exceed 55-85% of the peak load served by the load centers. DRP requirement to prevent induction motor stalling is 2.5x the steady state reactive consumption. Assuming a PF=0.9, and Induction motors account for 50-80% of the load.
7	Dispatchability	Dispatchable (%CAP)	>60%	50-60%	<50%	Dispatchable resource are essential for system operation
		Unavoidable VER Penetration %	<60%	60-70%	>70%	Intermittent Power Penetration above 60% is problematic when islanded
		Increased Freq Regulation Requirements (% Peak Load)	<2% of peak load	2-3% of Peak Load	>3% of peak load	Regulation of Conventional Systems ≈1%
		1-min Ramp Capability (MW)	>15% of CAP	10-15% of CAP	<10% of CAP	10% per minute was the norm for conventional systems. Renewable portfolios require more ramping capability
		10-min Ramp Capability (MW)	>65% of CAP	50-65% of CAP	<50% of CAP	10% per minute was the norm for conventional systems. But with 50% min loading, that will be 50% in 10 min. Renewable portfolios require more ramping capability
8	Predictability and Firmness	Ramping Capability to Mitigate Forecast Errors (+Excess/-Deficit) (%VER MW)	≥ 0	-10% - 0% of CAP	<-10% of CAP	Excess ramping capability to offset higher levels of intermittent resource output variability is desired
9	Location	Average Number of Evacuation Paths	>3	2-3	<2	More power evacuation paths increase system resilience

The study results as summarized in **Table ES-6** are normalized following the threshold definitions and shown in Table ES-9.

Table ES-9: Normalized Study Results

Year 2031		Current Trends/Reference Case						
		No Retire	Convert	1 Retire	2 Retire	Clean	Optimize	
		T7	T8	T9	T10	T11	T12	
1	Energy Adequacy	Loss of Load Hours (LOLH) - normal system, 50/50 forecast	1	1	0	0	0	1
		Expected Energy not Served (GWh) - normal system 50/50 forecast	1	1	1	1	1	1
		max MW Short (MW) - normal system 50/50 forecast	1	1	1	1	1	1
		max MW Short - loss of 50% of tieline capacity, 50/50 forecast	1	1	1	1/2	0	1
		max MW Short (islanded, 50/50 forecast)	1	1	1	1	1	1
		max MW Short (normal system, 90/10 forecast)	1/2	1/2	0	0	0	1/2
2	Operational Flexibility and Frequency Support	Inertia MVA-s	1/2	1/2	1/2	1/2	1/2	1/2
		Inertial Gap FFR MW (% CAP)	1/2	1/2	1/2	1/2	1/2	1/2
		Primary Gap PFR MW (% CAP)	0	0	1	1	1	0
3	Short Circuit Strength	Inverter MWs passing ESCR limits (%) - Connected System	1	1	1	1	1	1
		Inverter MWs passing ESCR limits (%) - Islanded System	1	1	0	1/2	0	1
		Required Additional Synch Condensers MVA (when connected)	1	1	1	1	1	1
		Required Additional Synch Condensers MVA (when islanded)	1	1	1/2	1/2	0	1
4	Power Quality	Compliance with Flicker limits when connected (GE Flicker Curve or IEC Flicker Meter)	1	1	1	1	1	1
		Compliance with Flicker limits when islanded	1	1	1	1	1	1
		Required Synchronous Condensers MVA to mitigate Flicker	1	1	1	1	1	1
5	Blackstart	Qualitative Assessment of Ability to Blackstart the system	1	1	1	1	1	1
6	Dynamic VAR Support	Dynamic VAR to load Center Capability (% of Peak Load)	1	1	1	1	1	1
7	Dispatchability and Automatic Generation Control	Dispatchable (%CAP)	1	1	1	1	1	1
		Unavoidable VER Penetration %	1	1	1	1	1	1
		Increased Freq Regulation Requirements (% Peak Load)	1	1	1	1	1	1
		1-min Ramp Capability (MW)	1/2	1/2	1	1	1	1/2
		10-min Ramp Capability (MW)	0	0	1/2	1/2	1/2	0
8	Predictability and Firmness	Ramping Capability to Mitigate Forecast Errors (+Excess/-Deficit) (%VER MW)	1	1	1	1	1	1
9	Location	Average Number of Evacuation Paths	1	1	1	1	1	1
Cumulative core (out of possible 9)		7.95	7.95	7.86	7.90	7.57	7.95	

VER: Variable Energy Resources (e.g., solar, wind)

CAP: Capacity credit of all resources including existing, planned, and portfolio

1.7 Appendix A – Reliability Analysis Results of All Portfolios

Year 2031			No Environmental Action						Current Trends (reference Case)						Aggressive Environmental						Decarbonized Economy						
			No Retire	Convert	1 Retire	2 Retire	Clean	Optimize	No Retire	Convert	1 Retire	2 Retire	Clean	Optimize	No Retire	Convert	1 Retire	2 Retire	Clean	Optimize	No Retire	Convert	1 Retire	2 Retire	Clean	Optimize	
-	Resource Adequacy	Additional Reserve Margin Required - Summer (MW)	-144	-217	50	123	466	-218	-210	-373	-101	47	61	-318	-450	-515	-293	30	30	-160	-270	-315	-21	60	116	-299	
1	Energy Adequacy	Loss of Load Hours (LOLH) - normal system, 50/50 forecast	0	0	0	20	325	0	0	0	11	39	64	0	0	0	0	32	32	0	0	0	9	0	68	0	
		Expected Energy not Served (GWh) - normal system 50/50 fcst	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
		max MW Short (MW) - normal system 50/50 forecast	0	0	0	515	1152	0	0	0	503	748	1029	0	0	0	0	0	863	863	0	0	0	487	0	1033	0
		max MW Short - loss of 50% of tieline capacity, 50/50 fcst	0	0	271	567	1201	0	0	0	614	798	1079	0	0	0	0	301	913	913	109	0	0	598	0	1082	0
		max MW Short (Islanded, 50/50 forecast)	0	0	394	616	1251	0	0	0	663	847	1128	0	0	0	0	351	1059	1059	328	0	0	647	0	1132	0
		max MW Short (normal system, 90/10 forecast)	362	350	897	1092	1727	350	621	600	1138	1322	1603	582	365	294	967	1436	1436	905	613	542	1121	350	1605	475	
2	Operational Flexibility and Frequency Support	Inertia MVA-s	15,153	16,242	13,528	14,316	9,490	16,242	12,740	13,829	11,115	11,903	9,490	13,829	12,740	13,829	11,115	9,490	9,490	11,659	12,740	13,829	11,115	11,903	9,490	13,829	
		Inertial Gap FFR MW	53	23	107	221	133	23	129	99	183	49	128	98	124	93	178	123	123	164	129	98	183	49	128	98	
		Primary Gap PFR MW	370	378	0	0	0	378	298	326	0	0	0	325	323	322	0	0	0	117	239	310	0	0	0	310	
3	Short Circuit Strength	Inverter MWs passing ESCR limits (%) - Connected System	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	
		Inverter MWs passing ESCR limits (%) - Islanded System	100%	100%	100%	100%	100%	100%	100%	100%	49%	53%	10%	100%	30%	28%	8%	6%	6%	8%	100%	100%	55%	55%	15%	100%	
		Required Additional Synch Condensers MVA (when Connected)	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
		Required Additional Synch Condensers MVA (when Islanded)	0	0	0	0	0	0	0	0	350	300	1500	0	1250	1500	1900	2700	2700	2050	0	0	100	200	1100	0	
4	Power Quality (Flicker)	Compliance with Flicker limits when Connected (GE Flicker Curve or IEC Flicker Meter)	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	
		Compliance with Flicker limits when Islanded	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	78%	78%	100%	100%	100%	100%	100%	100%	100%	
		Required Synchronous Condensers MVA to mitigate Flicker	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	200	200	0	0	0	0	0	0	0	
5	Blackstart	Qualitative Assessment of Ability to Blackstart the system	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
6	Dynamic VAR Support	Dynamic VARs that can be delivered to select load centers (% of Load) at peak	57%	36%	36%	34%	29%	24%	59%	50%	53%	50%	51%	52%	63%	64%	65%	63%	56%	56%	54%	52%	56%	51%	51%	51%	
#	Dispatchability and Automatic Generation Control	Dispatchable (%CAP)	92%	92%	91%	90%	87%	92%	82%	80%	78%	79%	74%	82%	76%	75%	73%	70%	70%	74%	82%	82%	81%	81%	77%	82%	
		Unavoidable VER Penetration %	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	5%	5%	4%	0%	0%	0%	0%	0%	0%	
		Increased Freq Regulation Requirements (MW)	9	9	9	9	11	9	39	48	49	45	66	47	90	97	97	105	105	101	42	48	41	41	56	49	
		1-min Ramp Capability (MW)	334	340	770	915	1,355	340	417	403	919	1,005	1,255	403	417	435	864	1,087	1,087	635	477	423	892	1,097	1,367	423	
		10-min Ramp Capability (MW)	1,167	1,228	1,562	1,757	2,015	1,228	1,159	1,200	1,621	1,756	1,915	1,200	1,159	1,233	1,566	1,748	1,748	1,364	1,219	1,220	1,593	1,848	2,028	1,220	
8.0	Predictability and Firmness	Ramping Capability to Mitigate Forecast Errors (+Excess/-Deficit) MW	242	518	518	958	1,098	1,534	329	231	752	752	870	952	-94	-138	310	467	467	34	239	364	249	788	987	1,147	
9	Location	Average Number of Paths for Evacuating Power from Resources	4.8	4.8	4.6	4.6	4.4	4.8	4.5	4.5	4.4	4.4	4.4	4.5	4.6	4.6	4.6	4.5	4.5	4.6	4.5	4.5	4.4	4.4	4.4	4.5	

1.8 Appendix B – Cost Assumptions for Mitigation Measures

Cost Category	Value	Units
GFM Inverter Premium	50	\$/kVA
BESS - AC Side	272	\$/kW
BESS - DC Side (<1C)	351	\$/kWh
BESS Cost Premium (4C)	50%	
BESS Capacity (hrs) – Frequency Response	0.25	
BESS Capacity (hrs) - Firm up Forecast	1.00	
Synchronous Condenser	450	\$/kVA
Grid Headroom to Integrate Synch. Condensers	520	MVA
Grid Upgrade Cost	200	\$/kVA