

aes Indiana
**2025 Integrated
Resource Plan**
(IRP)

Volume III

October 31, 2025



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

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Attachment 5-1

(Test Year Hourly Loads)

Provided electronically

The logo for AES, with the letters 'a', 'e', and 's' in a stylized, rounded font. The 'a' is blue, the 'e' is purple, and the 's' is green.

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Attachment 5-2

(Energy and Demand ITRON Report)

2025 Long-Term Energy and Demand Forecast Report

AES Indiana

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Contents

CONTENTS.....	I
1 OVERVIEW.....	1
2 FORECAST APPROACH.....	6
2.1 RESIDENTIAL MODELS.....	10
2.2 NONRESIDENTIAL MODELS.....	14
2.3 STREET AND SECURITY LIGHTING MODELS.....	17
2.4 ENERGY AND PEAK FORECAST MODELS.....	17
3 FORECAST ASSUMPTIONS.....	21
3.1 WEATHER DATA.....	21
3.2 ECONOMIC DATA.....	25
3.3 COVID-19 IMPACT.....	27
3.4 PRICES.....	28
3.5 APPLIANCE SATURATION AND EFFICIENCY TRENDS.....	28
3.6 HISTORICAL EE PROGRAM SAVINGS.....	30
4 FORECAST SENSITIVITIES.....	32
5 APPENDIX A: MODEL STATISTICS.....	35
6 APPENDIX B: RESIDENTIAL SAE MODELING FRAMEWORK.....	53
6.2 RESIDENTIAL STATISTICALLY ADJUSTED END-USE MODELING FRAMEWORK.....	53
6.2.1 Constructing <i>XHeat</i>	54
6.2.2 Constructing <i>XCool</i>	56
6.2.3 Constructing <i>XOther</i>	58
7 APPENDIX C: COMMERCIAL SAE MODELING FRAMEWORK.....	60
7.2 COMMERCIAL STATISTICALLY ADJUSTED END-USE MODEL FRAMEWORK.....	60
7.2.1 Constructing <i>XHeat</i>	61
7.2.2 Constructing <i>XCool</i>	63
7.2.3 Constructing <i>XOther</i>	64

1 Overview

The 2025 IRP forecast provides sector and system energy and demand forecasts through 2045. The forecast is derived using a bottom-up approach where customer sector sales forecasts for residential, commercial, and industrial sectors are translated 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.

AES Indiana serves over 520,000 customers in the city of Indianapolis and surrounding area. In 2023, residential sales accounted for 39% of sales, small C&I 14%, and large C&I 47%. Figure 1 shows 2023 class-level sales distribution.

Figure 1: 2023 Class Sales (MWh) Distribution

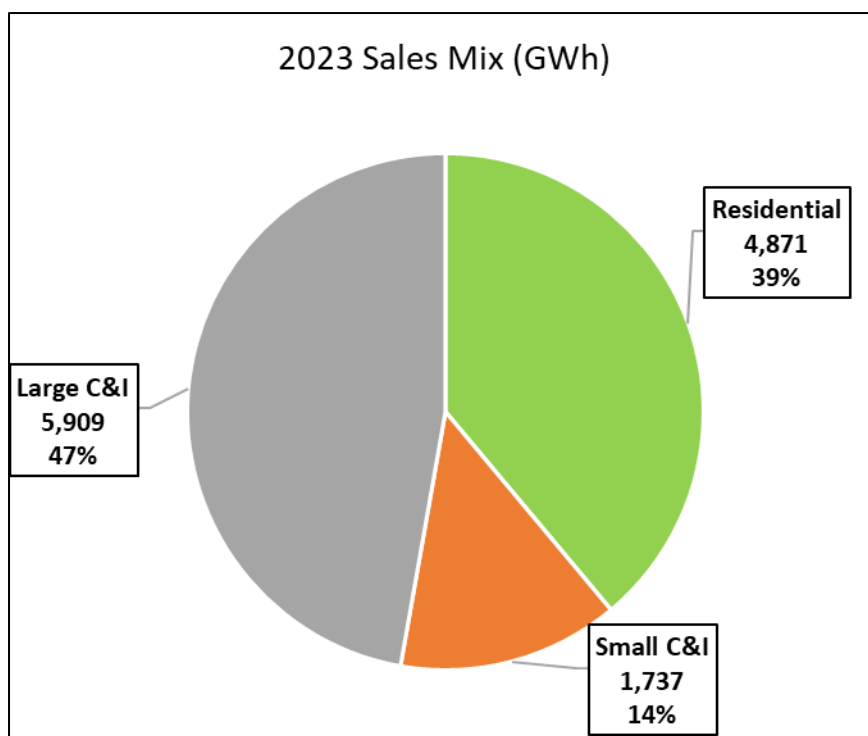
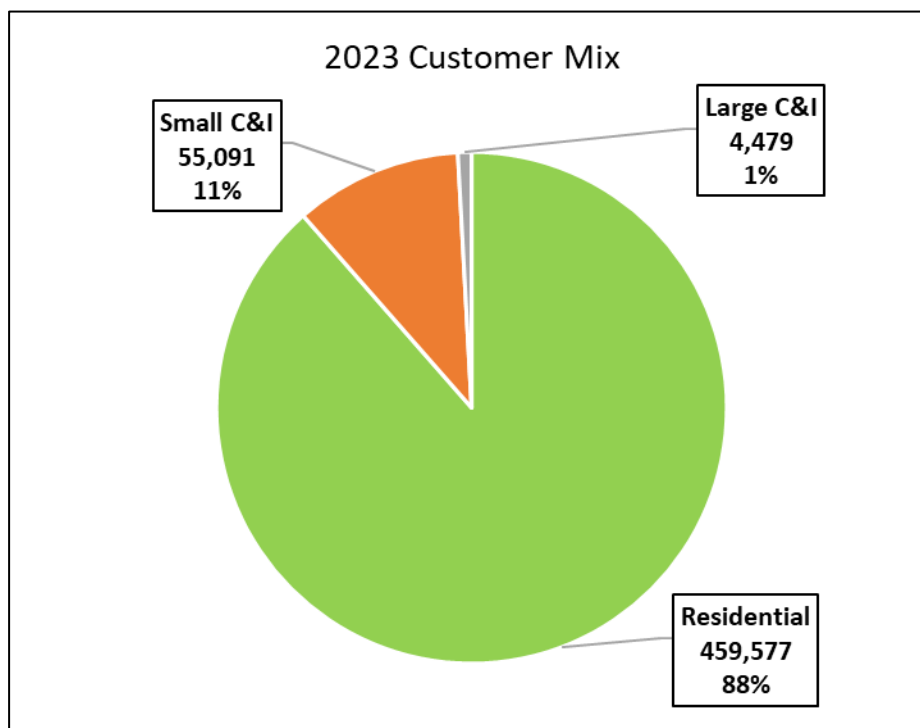


Figure 2 shows class level customer mix.

Figure 2: AES Indiana Customers



Between 2005 and 2011 there was little customer growth. This all changed starting in 2011 with customer growth averaging 0.9% per year. Small C&I customers have been averaging 0.6% annual growth while the number of large C&I customers has declined. AES Indiana is expected to see strong customer growth over the forecast horizon driven by a strong economy.

Despite relatively strong customer growth, the weather normalized system energy and peak demand have 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 2013 to 2023.

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Figure 3: System Energy (MWh)

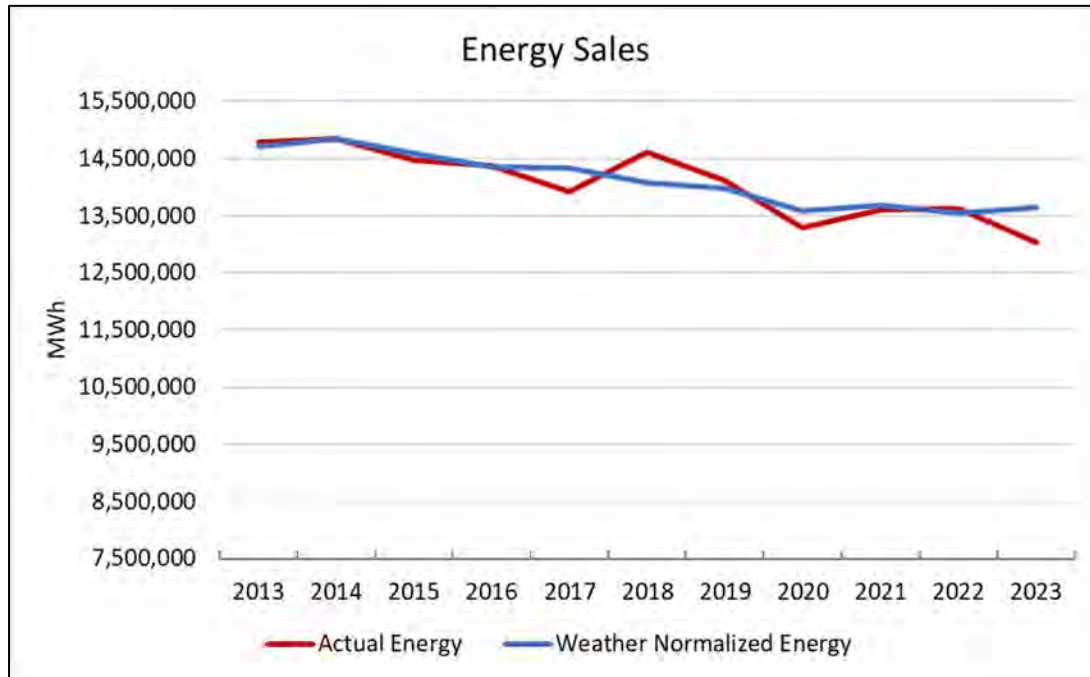
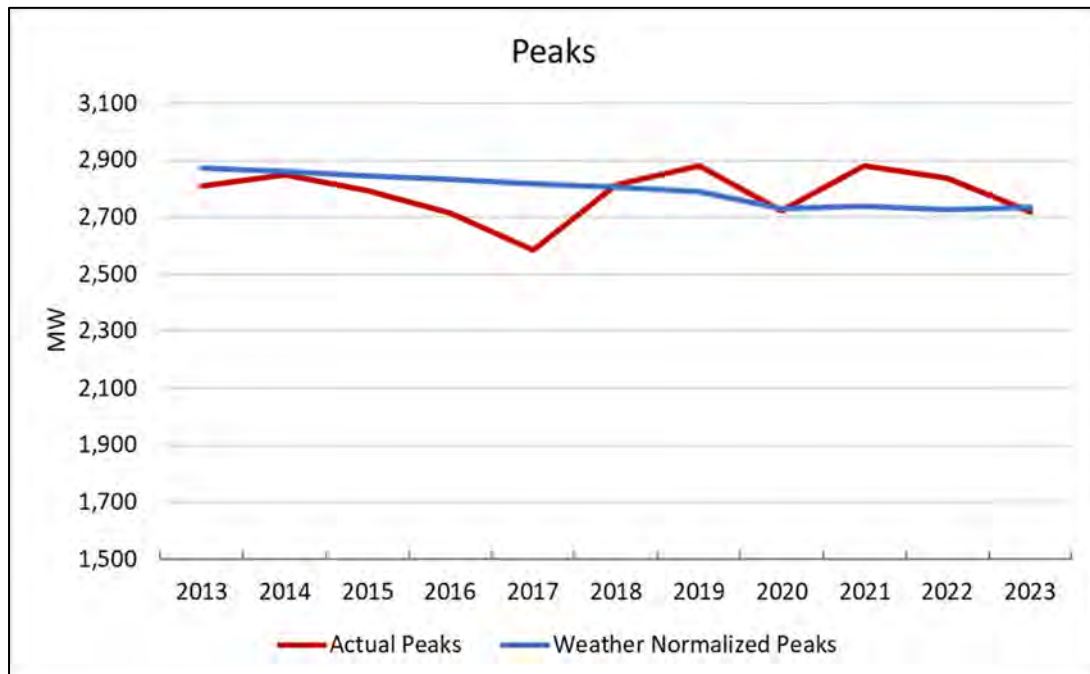


Figure 4: System Demand (MW)



Weather normalized system energy requirements in 2023 were 13,637 GWh compared with system energy requirements of 14,711 GWh in 2013. Energy requirements have, on average,



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declined 1.2% annually over this period. Normalized peak demand has fallen from roughly 2,875 MW in 2013 to 2,735 MW in 2023.

The noticeable decline in 2020 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.

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 customers 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 0.7% and system peak demand 0.8% annual growth. The baseline forecast also excludes behind-the-meter (BTM) solar projections and electric vehicles. Table 1-1 shows the annual energy and demand forecast.



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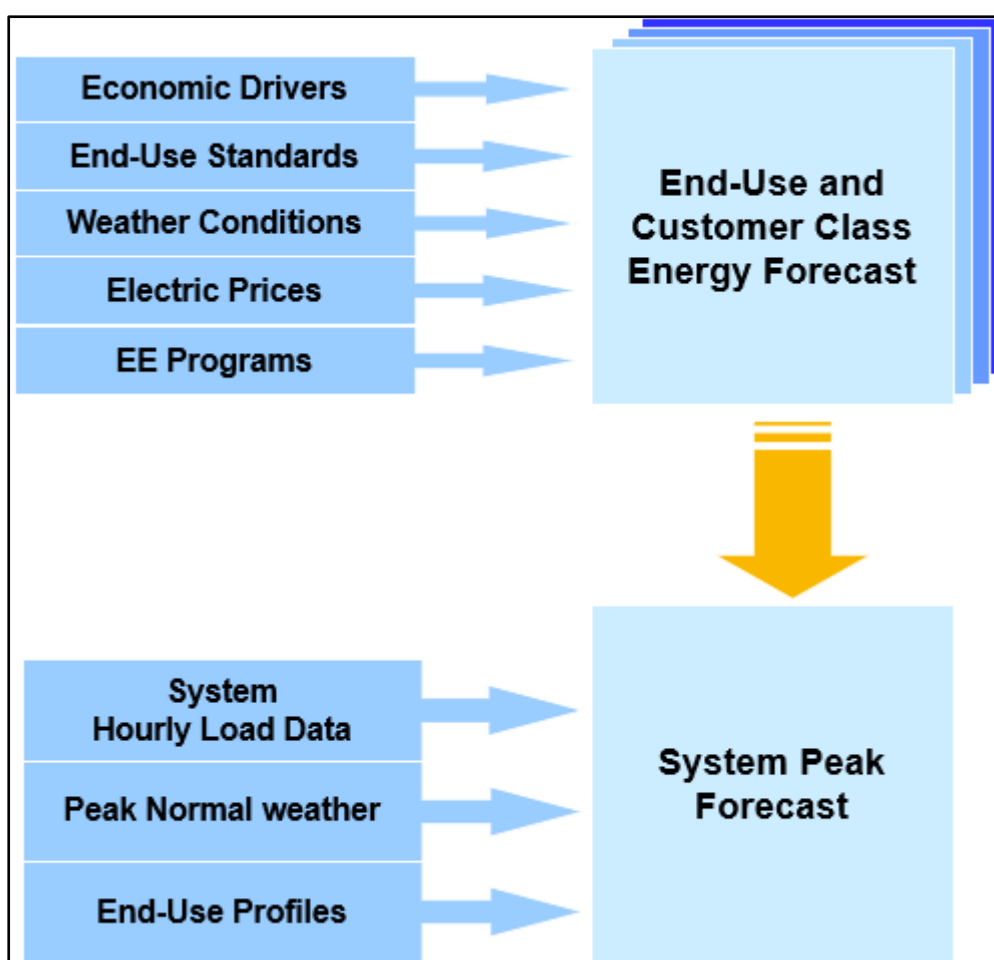
Table 1-1: Energy and Demand Forecast

Year	Energy (MWh)	Change	Peak (MW)	Change
2025	13,764,181		2,779	
2026	13,871,050	0.8%	2,798	0.7%
2027	14,026,866	1.1%	2,814	0.6%
2028	14,114,491	0.6%	2,834	0.7%
2029	14,202,889	0.6%	2,849	0.5%
2030	14,276,811	0.5%	2,866	0.6%
2031	14,354,642	0.5%	2,884	0.6%
2032	14,439,158	0.6%	2,906	0.8%
2033	14,539,343	0.7%	2,926	0.7%
2034	14,635,596	0.7%	2,948	0.8%
2035	14,741,976	0.7%	2,972	0.8%
2036	14,857,523	0.8%	3,000	0.9%
2037	14,969,017	0.8%	3,022	0.7%
2038	15,079,685	0.7%	3,048	0.9%
2039	15,190,025	0.7%	3,074	0.9%
2040	15,303,703	0.7%	3,103	0.9%
2041	15,422,255	0.8%	3,127	0.8%
2042	15,544,982	0.8%	3,153	0.8%
2043	15,672,414	0.8%	3,178	0.8%
2044	15,804,324	0.8%	3,208	0.9%
2045	15,939,721	0.9%	3,232	0.7%
2025-45		0.7%		0.8%

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. The commercial and



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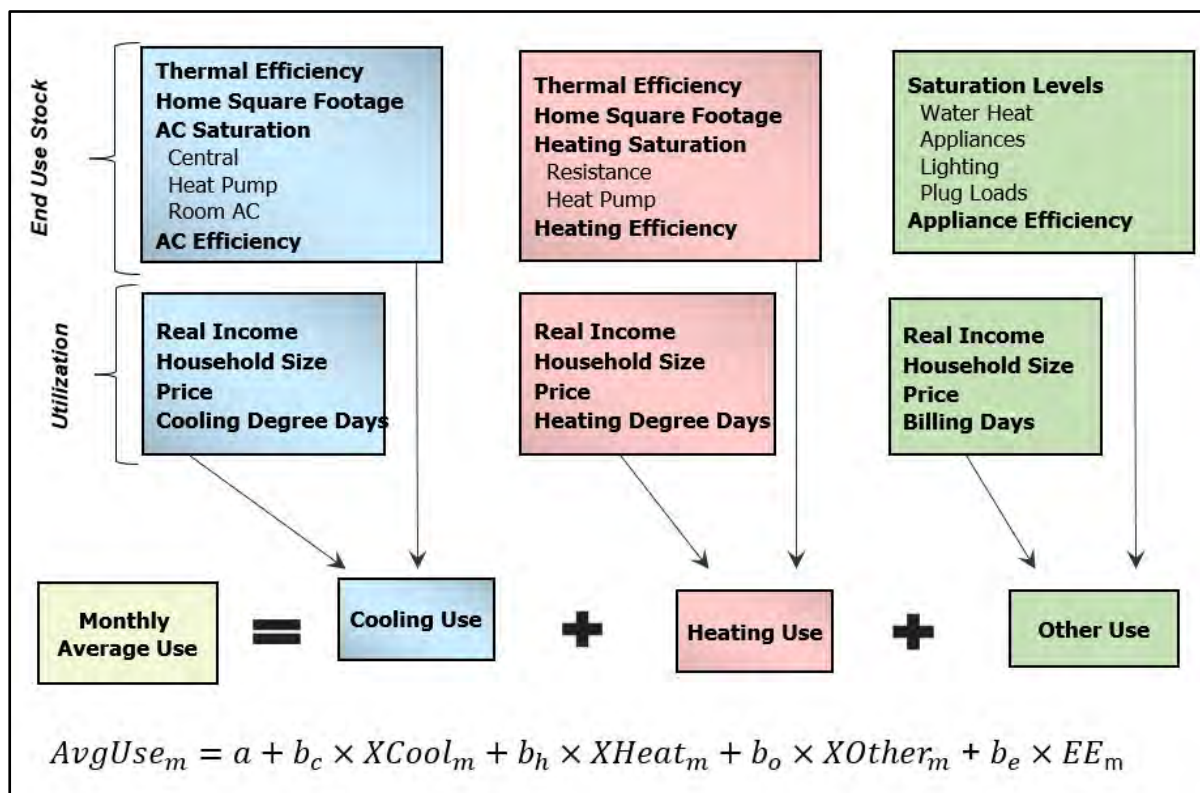
industrial rate schedules are grouped into small C&I (commercial & industrial) and large C&I.

Table 2-1: 2023 Customers and Sales

Sector	Rate Schedule	Definition	Customers	MWh
Residential	RS	General Service	253,698	2,224,987
Residential	RH	Electric Heat	168,267	2,141,862
Residential	RC	Electric Water Heat	37,612	424,605
Small C&I	SS	General Service	51,204	1,233,666
Small C&I	SH	GS All Electric	3,706	457,355
Small C&I	SE	GS Electric Heat	22	12,728
Small C&I	CB	GS Water Heat (Controlled)	84	379
Small C&I	UW	GS Water Heat (Uncontrolled)	78	1,041
Small C&I	APL	GS Security Lighting		28,492
Large C&I	SL	Secondary Service	4,304	3,230,423
Large C&I	PL	Primary Service	122	1,039,697
Large C&I	PH	Process Heating	20	23,639
Large C&I	HL1	High Load Factor 1	26	1,228,882
Large C&I	HL2	High Load Factor 2	5	160,595
Large C&I	HL3	High Load Factor 3	2	240,681
Large C&I	APL	IND Security Light		3,727
Other	ST	Street Lighting		19,212
Total			519,150	12,471,971

Residential, small C&I, and SL class models are estimated using a Statistically Adjusted End-Use (SAE) model specification. This entails estimating monthly average use (residential) or sales models (C&I) 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.

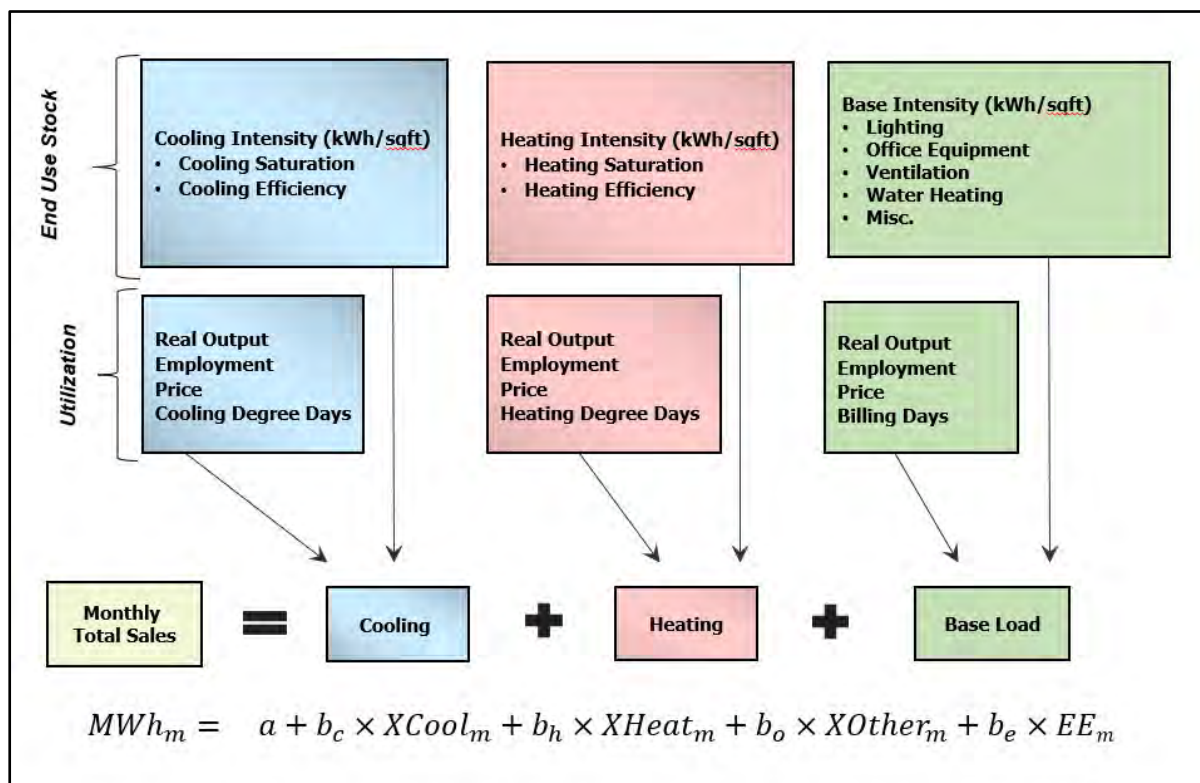
Figure 6: Residential Forecast Model Framework



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 detailed 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.

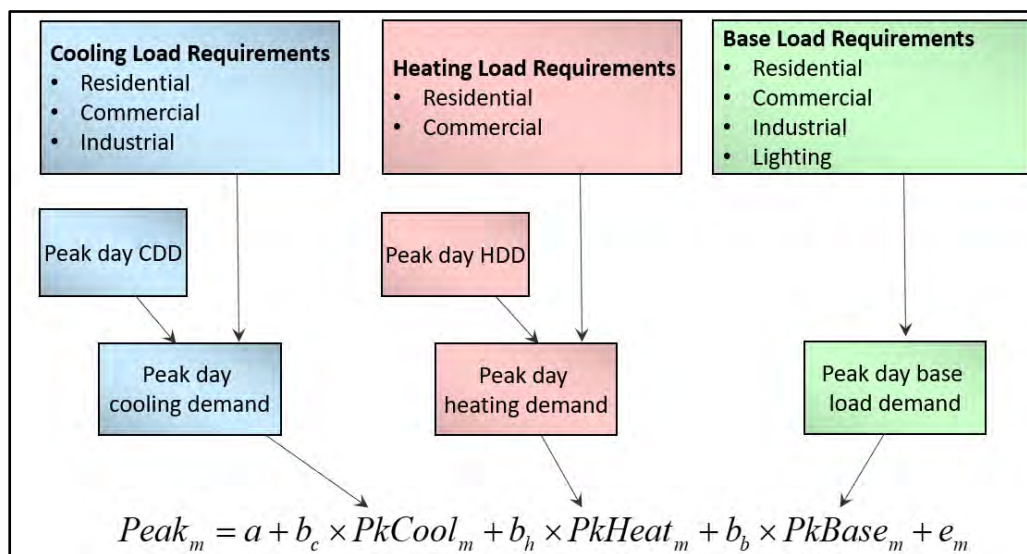
Figure 7: Commercial SAE Model



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



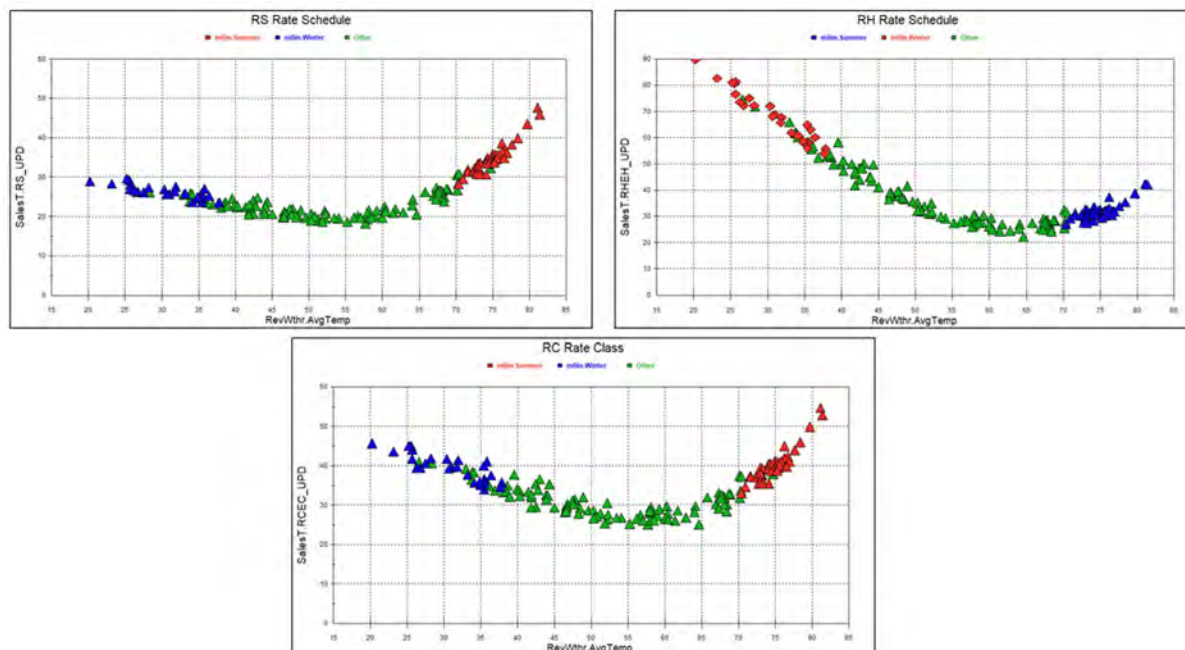
PkCool and PkHeat are derived by combining cooling and heating requirements with peak-day weather conditions. In this structure, the impact of peak-day temperatures on load will increase or decrease over time with changes in cooling and heating load requirements. Base loads at the time of peak are estimated 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



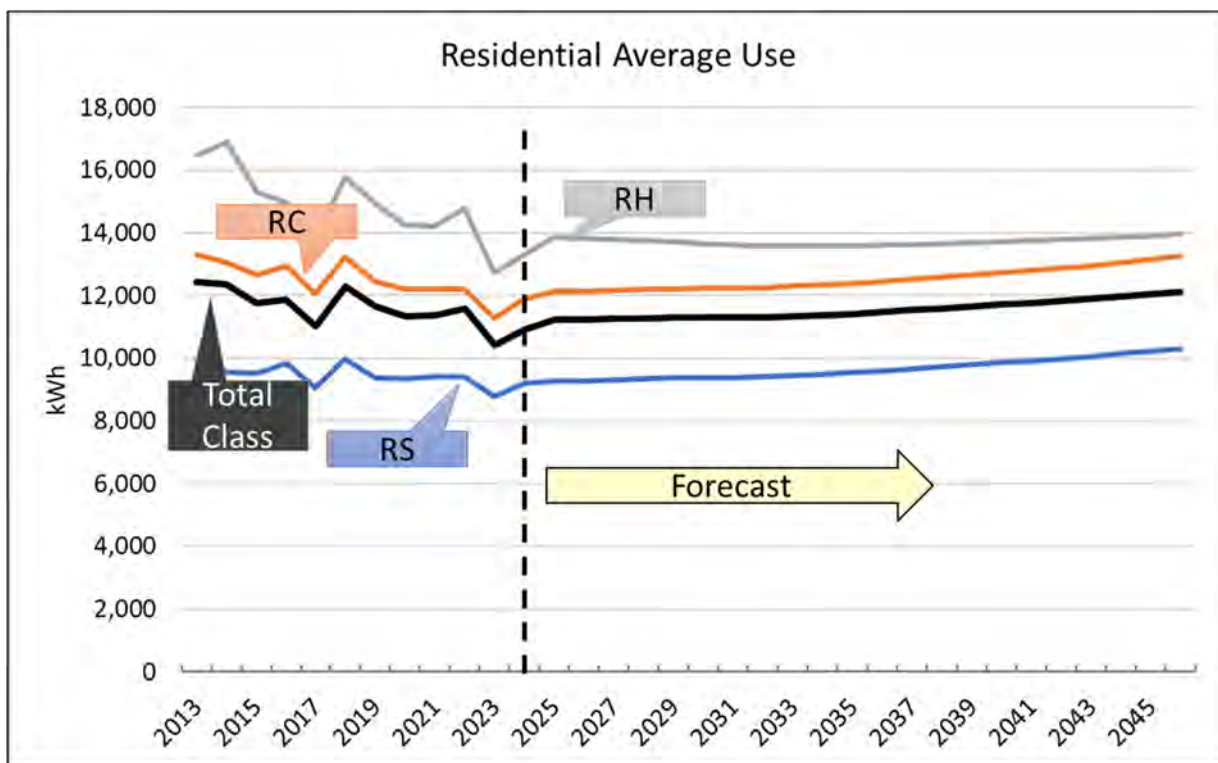
Each slide shows the relationship between average monthly temperature on the X axis and average class monthly use on a per billing-day basis. The curves are distinct with the RH rate schedule having a significantly steeper heating-side slope than either the RS or RC rate schedules. The base use for RC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

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

The model coefficients (B_1 , B_2 , B_3 , B_4) are estimated using a linear regression model. Monthly average use data is derived from historical monthly billed sales and customer data from January 2013 to September 2024. Model statistics are included in Appendix A. Figure 10 shows historical and forecasted average use, excluding future EE.

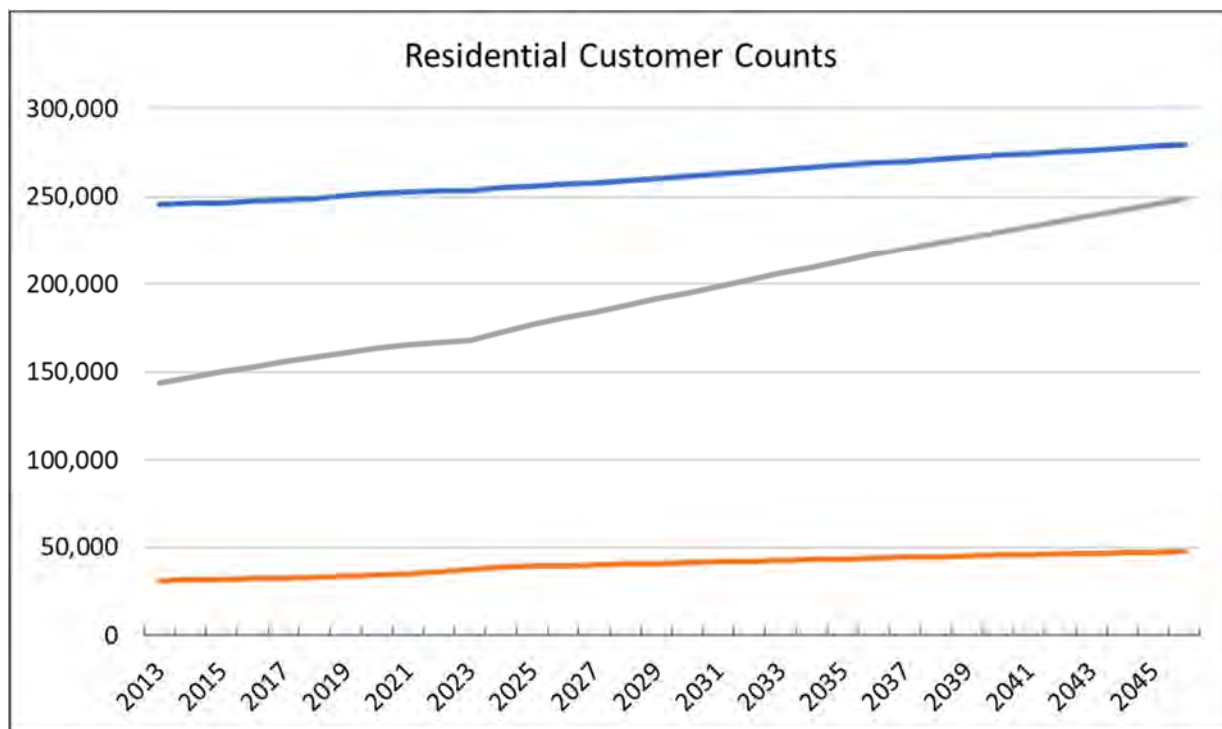
Figure 10: Residential Average Use



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. Residential customers are forecasted using a composite economic variable which is comprised of Marion County and Indianapolis MSA household projections. Although the majority of AES Indiana’s service territory lies within Marion County, residential customers are more highly correlated with Indianapolis households than Marion County households. For this reason, a composite customer variable was constructed which places a 75% weight on Indianapolis households and 25% weight on Marion County households. 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 customers are forecasted to increase 1.6% annually, RC customers 0.9% and RS customers 0.4%. 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, solar and electric vehicle adjustments.

Table 2-2: Residential Forecast

Year	Sales (MWh)	Change	Customers	Change	Average Use (kWh)	Change
2025	5,311,304		472,476		11,241	
2026	5,366,192	1.0%	477,305	1.0%	11,243	0.0%
2027	5,432,370	1.2%	482,278	1.0%	11,264	0.2%
2028	5,499,770	1.2%	487,500	1.1%	11,282	0.2%
2029	5,565,805	1.2%	492,874	1.1%	11,293	0.1%
2030	5,630,158	1.2%	498,345	1.1%	11,298	0.0%
2031	5,696,609	1.2%	503,809	1.1%	11,307	0.1%
2032	5,765,185	1.2%	509,242	1.1%	11,321	0.1%
2033	5,844,860	1.4%	514,590	1.1%	11,358	0.3%
2034	5,919,268	1.3%	519,705	1.0%	11,390	0.3%
2035	6,000,610	1.4%	524,926	1.0%	11,431	0.4%
2036	6,086,967	1.4%	530,134	1.0%	11,482	0.4%
2037	6,174,901	1.4%	535,025	0.9%	11,541	0.5%
2038	6,262,362	1.4%	539,792	0.9%	11,601	0.5%
2039	6,350,503	1.4%	544,534	0.9%	11,662	0.5%
2040	6,435,900	1.3%	549,273	0.9%	11,717	0.5%
2041	6,522,227	1.3%	553,866	0.8%	11,776	0.5%
2042	6,610,395	1.4%	558,409	0.8%	11,838	0.5%
2043	6,700,334	1.4%	562,881	0.8%	11,904	0.6%
2044	6,794,592	1.4%	567,329	0.8%	11,976	0.6%
2045	6,891,753	1.4%	571,810	0.8%	12,053	0.6%
2025-45		1.3%		1.0%		0.3%

2.2 Nonresidential Models

Small commercial and SL 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:

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

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

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down as end-use efficiency continues to improve. 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, primary service, and lighting rate schedules are modeled using the SAE model specification; the commercial model specification explains sales variation well based on model fit statistics. The high load factor and primary service rates are primarily industrial loads and include some of AES Indiana's largest customers.

Commercial sales like residential have been trending down. Since 2013 annual commercial sales have declined on average 0.4% per year. The COVID-19 pandemic had a significant impact on commercial electric sales, with sales declining by over 7% in 2020. Sales recovered in 2021 and 2022 but have not fully returned to pre-COVID levels. 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 0.4% and 1.9% annual growth, and total end-use intensity declines 0.5% per year. The combination of these factors results in 0.3% annual commercial sales growth through 2045 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:

$$\bullet \quad SS \text{ Econ Var}_m = (NonManOutput_m^{0.35}) \times (NonManEmployment_m^{0.65})$$

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

Overall, the constructed model variables explain historical variation well as measured by model Adjusted R-Squared and MAPE. Adjusted R-Squared varies from 0.95 to 0.97 with MAPEs that vary from 3.5% to 1.6%. Model statistics and forecast plots are included in Appendix A.



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Industrial Models. The high load factor and primary services rates are mostly industrial customers. These classes have relatively few customers, ranging between 3 and 30 customers per class. Sales in these classes are often not highly correlated with economic drivers and have large fluctuations in sales from month to month. The industrial models include a CDD variable to account for weather response in the summer months but do not include an HDD variable as their sales do not increase or decrease with changes in winter temperatures. The models are estimated over a shorter time period, beginning in 2018. The models do not include economic drivers; the resulting forecast is flat only reflecting seasonal and monthly usage patterns. 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	Small C&I (MWh)	Change	Large C&I (MWh)	Change
2025	1,850,420		6,020,015	
2026	1,858,783	0.5%	6,059,504	0.7%
2027	1,861,686	0.2%	6,140,103	1.3%
2028	1,865,911	0.2%	6,152,803	0.2%
2029	1,870,946	0.3%	6,166,796	0.2%
2030	1,872,035	0.1%	6,172,540	0.1%
2031	1,873,667	0.1%	6,179,214	0.1%
2032	1,876,522	0.2%	6,188,794	0.2%
2033	1,880,591	0.2%	6,201,081	0.2%
2034	1,885,060	0.2%	6,214,465	0.2%
2035	1,890,455	0.3%	6,229,696	0.2%
2036	1,897,035	0.3%	6,247,511	0.3%
2037	1,901,765	0.2%	6,261,714	0.2%
2038	1,906,375	0.2%	6,275,733	0.2%
2039	1,910,711	0.2%	6,289,031	0.2%
2040	1,916,807	0.3%	6,306,513	0.3%
2041	1,924,141	0.4%	6,326,497	0.3%
2042	1,932,222	0.4%	6,347,892	0.3%
2043	1,941,182	0.5%	6,371,140	0.4%
2044	1,950,137	0.5%	6,394,370	0.4%
2045	1,959,208	0.5%	6,417,920	0.4%
2025-45		0.3%		0.3%

2.3 Street and Security Lighting Models

Street lighting sales declined rapidly beginning in 2018, coinciding with the start of an 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 1.044. Total baseline sales and energy increase 0.7% annually through the forecast period. The baseline forecast does not include the impact of future EE savings, solar load growth, or electric vehicles.

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*) 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 12 to Figure 14 show the calculated peak model variables.

Figure 12: Peak Heating Variable

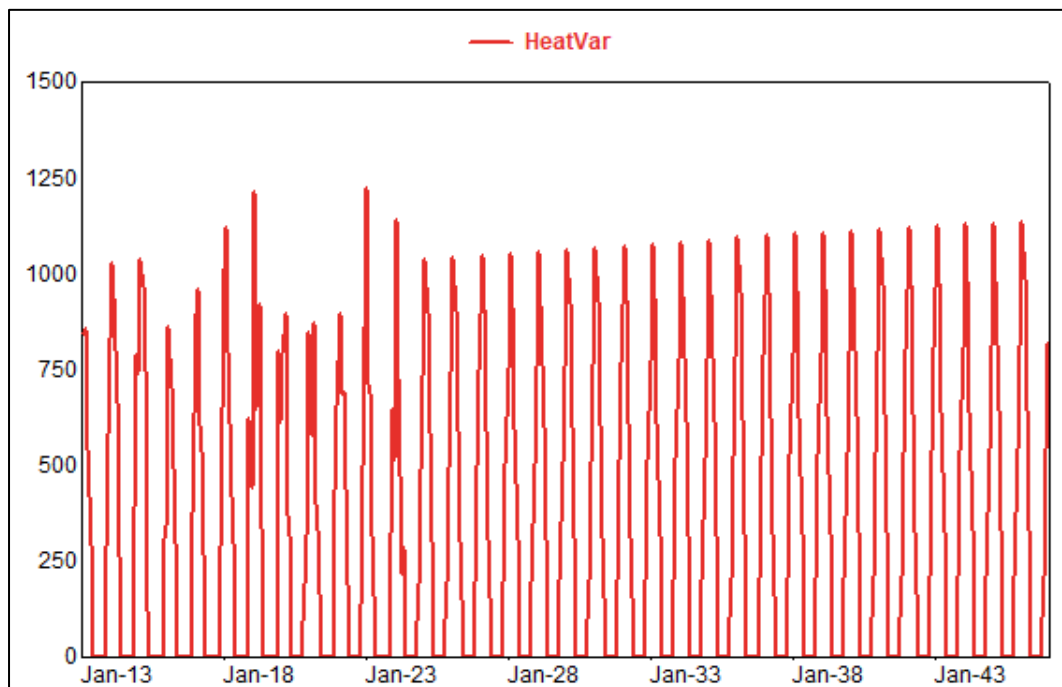


Figure 13: Peak Cooling Variable

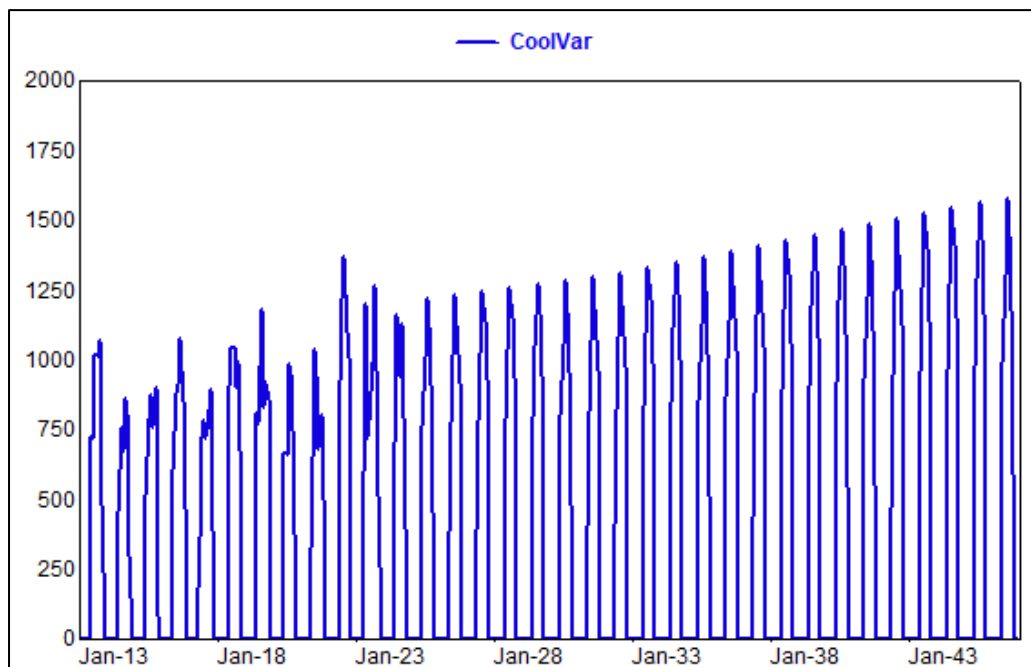
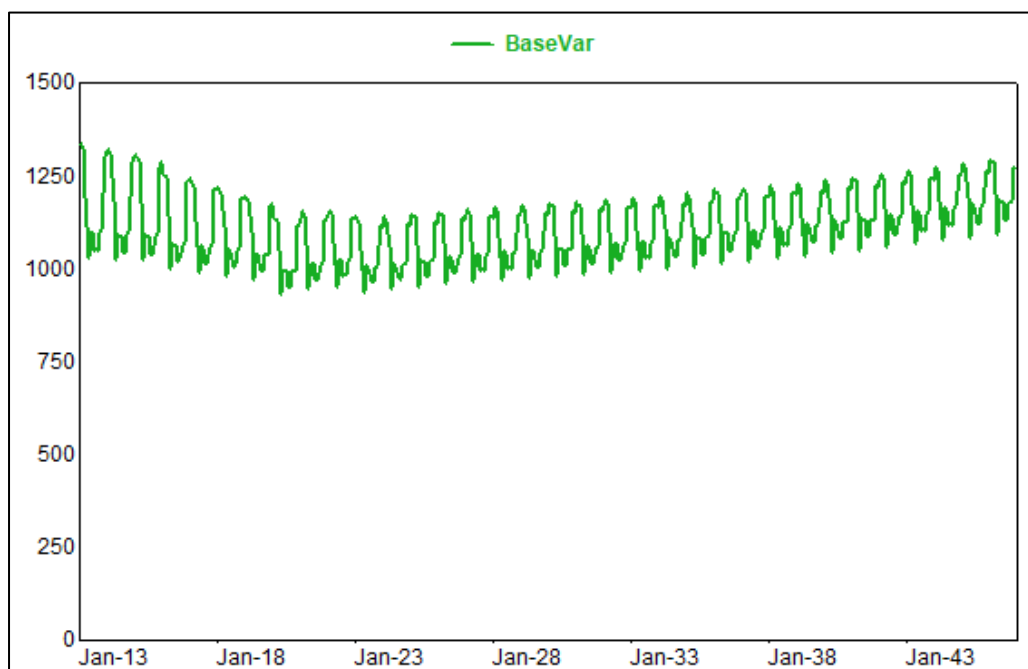


Figure 14: Peak Base Variable

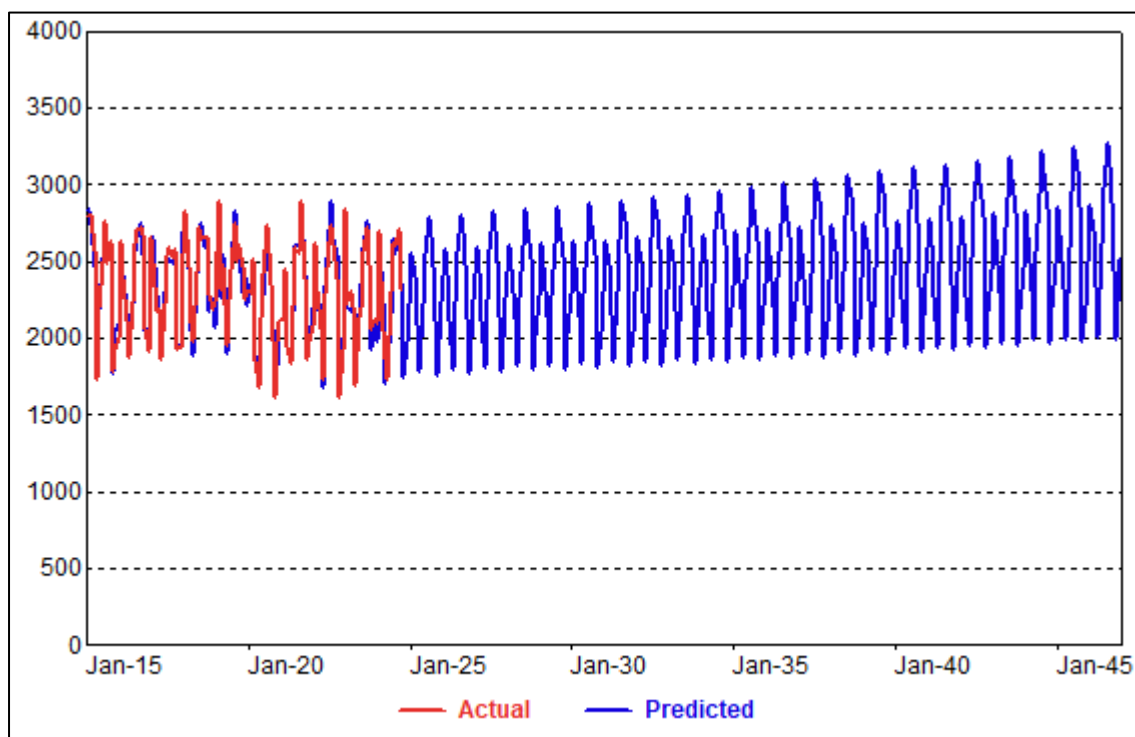


The peak model is estimated over the period January 2015 to September 2024. The model explains monthly peak variation well with an adjusted R² of 0.93 and an in-sample MAPE of 2.8%. The model variables – PkHeat, PKCool, and PkBase are highly statistically significant.

Figure 15 shows actual and predicted model results.

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Figure 15: System Peak Model (MW)



Excluding future EE, solar, and EVs, the baseline peak occurs in the summer and averages 0.8% annual growth; this compares with 0.7% 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 is positive when temperatures are below a specified temperature reference point and are 0 when temperatures are at or above the temperature reference point. CDD is 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.

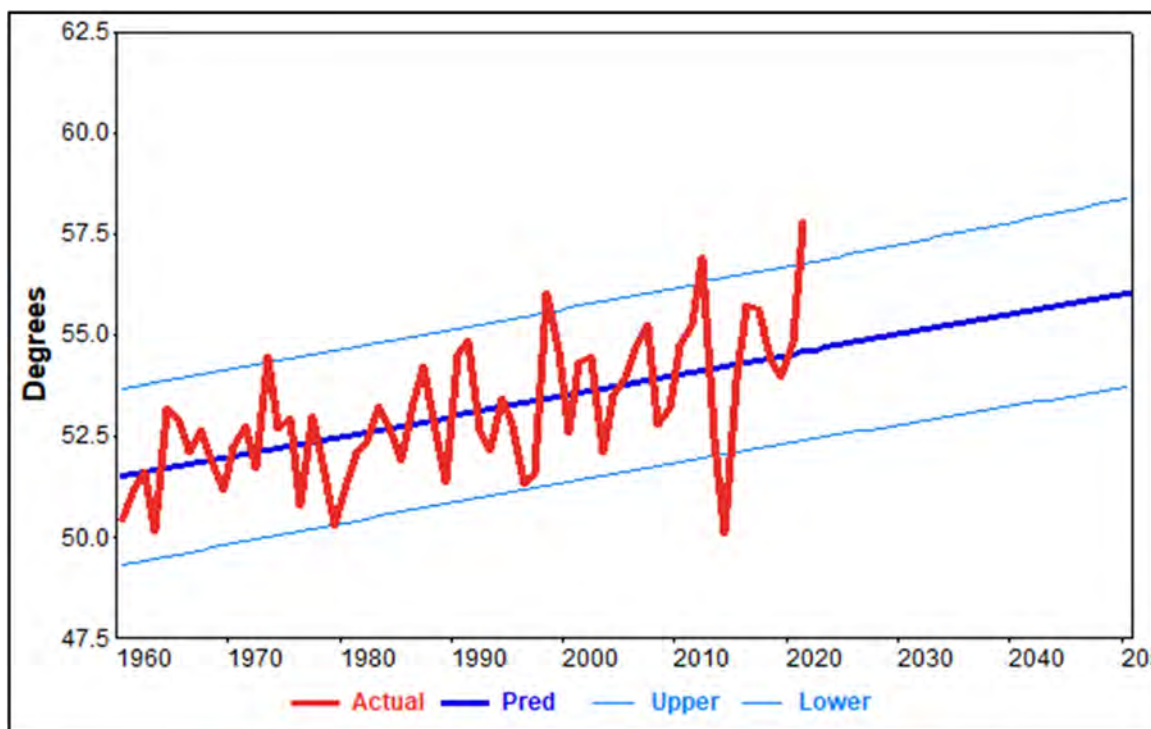
Capturing Increasing Temperatures. Traditionally, utilities base their long-term forecast on what the industry calls *normal* weather. Normal weather is calculated by averaging historical weather usually over a 20-year or 30-year period. Given the large variation in month-to-month and year-over-year 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. Figure 16 shows the long-term Indianapolis temperature trend, and 90% confidence interval.

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Figure 16: 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 2023 the expected annual temperature was 54.8 degrees. The average annual temperature in 2023 is 6 percent higher than in 1960. Average minimum temperatures are increasing at an even faster rate of 1.2 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 17 and Figure 18 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 17: Heating Degree Days (Base 60)

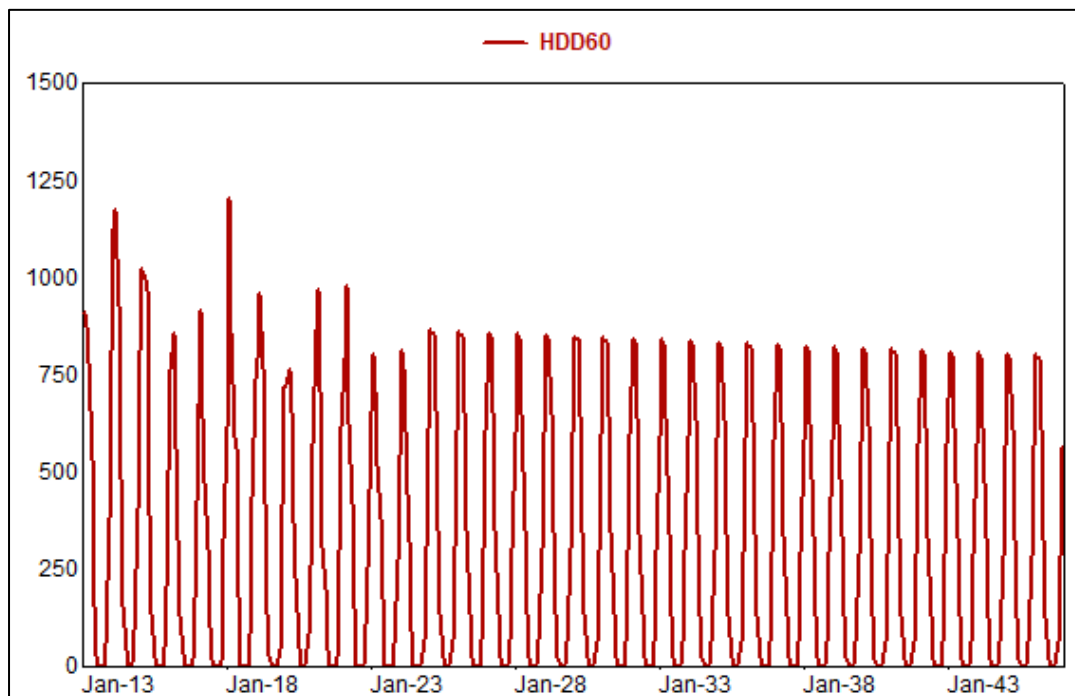
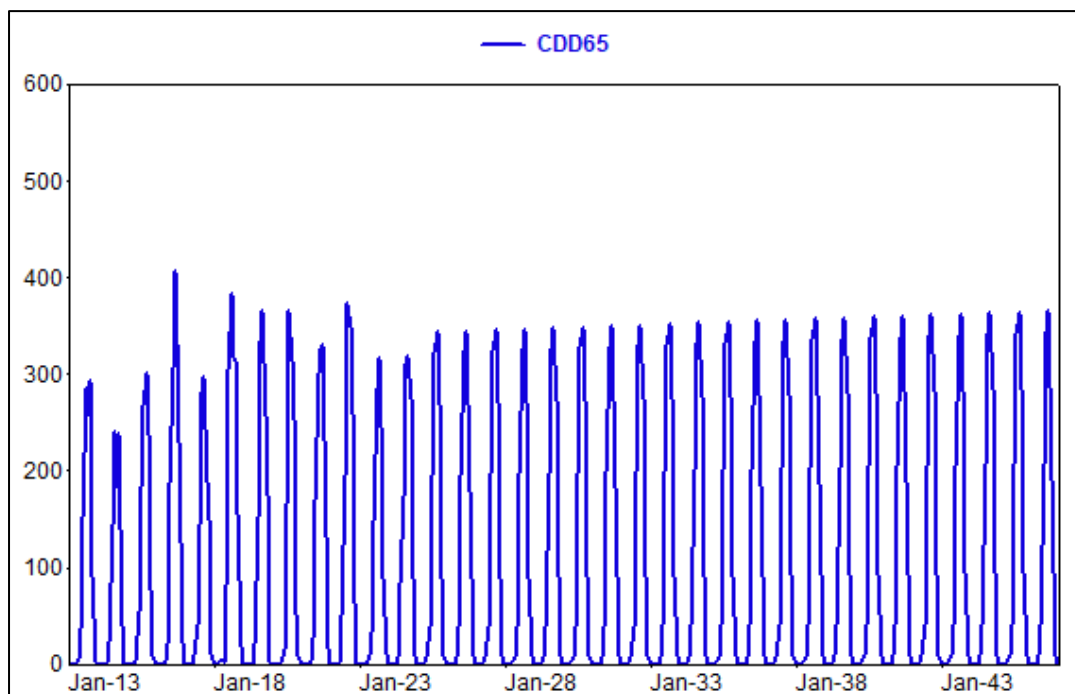


Figure 18: Cooling Degree Days (Base 65)

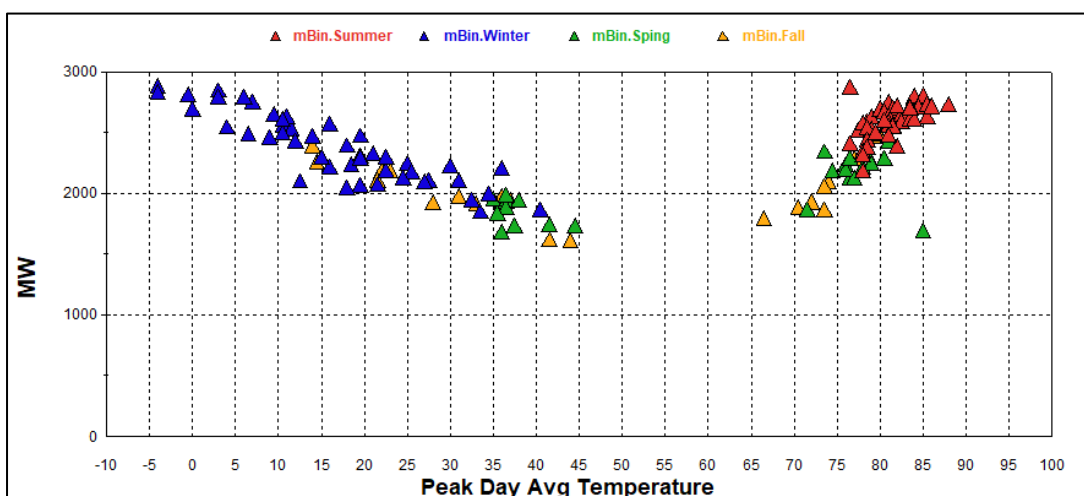


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Peak-Day Weather Variables

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 19.

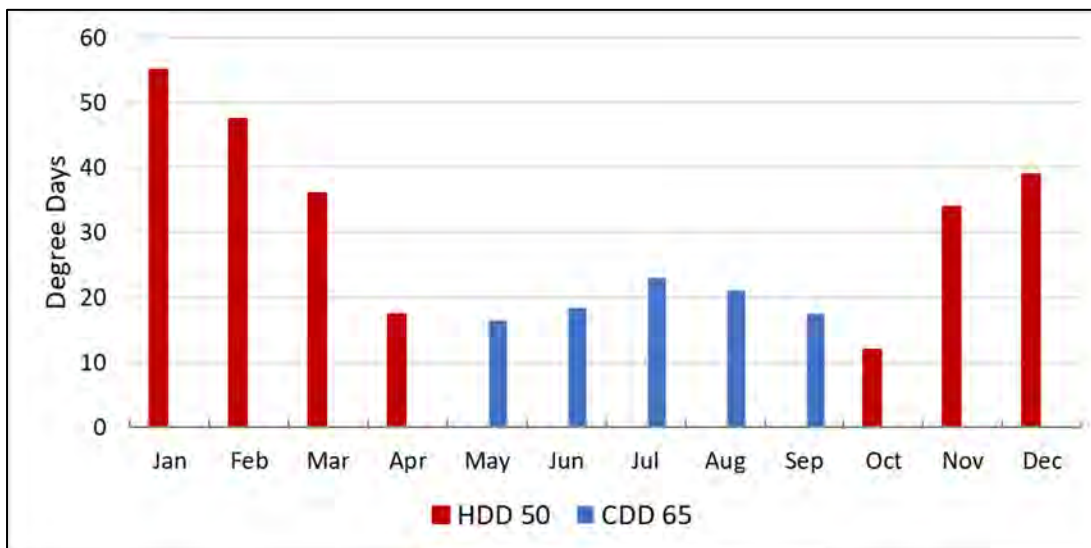
Figure 19: Monthly Peak Demand /Temperature Relationship



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 (2004 to 2023). 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 20 shows normal peak-day HDD (base 50 degrees) and peak-day CDD (base 65 degrees).

Figure 20: 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 (October 2024 forecast) for Marion County, Indianapolis Metropolitan Statistical Area (MSA), and the state. The primary economic drivers in the residential model are Indianapolis MSA and Marion County population projections, real income projections and household size. Commercial sales are driven by Indianapolis MSA and state non-manufacturing employment and non-manufacturing output. Table 3-1 and Table 3-2 shows the economic forecasts applicable to each customer class.



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Table 3-1: Residential Economic Drivers

Year	Customer Driver		Household Size		Household Income	
	(Index Year 2009=1)	Change	(People per House)	Change	(Real \$ 000's)	Change
2025	1.18		2.43		149.7	
2026	1.20	1.3%	2.42	-0.5%	150.9	0.8%
2027	1.21	1.2%	2.41	-0.4%	152.4	1.0%
2028	1.22	1.2%	2.40	-0.4%	154.1	1.1%
2029	1.24	1.1%	2.39	-0.4%	155.9	1.2%
2030	1.25	1.1%	2.38	-0.4%	157.8	1.2%
2031	1.27	1.1%	2.37	-0.4%	159.6	1.1%
2032	1.28	1.1%	2.36	-0.4%	161.7	1.3%
2033	1.29	1.1%	2.35	-0.3%	163.7	1.2%
2034	1.31	1.0%	2.35	-0.3%	165.8	1.3%
2035	1.32	1.0%	2.34	-0.3%	167.8	1.2%
2036	1.33	1.0%	2.33	-0.3%	169.8	1.2%
2037	1.35	0.9%	2.33	-0.3%	171.9	1.2%
2038	1.36	0.9%	2.32	-0.3%	174.1	1.3%
2039	1.37	0.9%	2.31	-0.3%	176.3	1.3%
2040	1.38	0.9%	2.31	-0.3%	178.5	1.2%
2041	1.39	0.8%	2.30	-0.2%	180.8	1.3%
2042	1.40	0.8%	2.30	-0.2%	183.2	1.3%
2043	1.42	0.8%	2.29	-0.2%	185.6	1.3%
2044	1.43	0.8%	2.29	-0.2%	188.1	1.3%
2045	1.44	0.8%	2.28	-0.2%	190.5	1.3%
2025-45		1.0%		-0.3%		1.2%

Table 3-2: Small C&I Economic Drivers

Year	Non-Manufacturing Employment (thou's)	Change	Non-Manufacturing Output (mil Real \$)	Change
2025	1,098		309,442	
2026	1,105	0.6%	315,903	2.1%
2027	1,110	0.5%	322,392	2.1%
2028	1,115	0.4%	329,260	2.1%
2029	1,120	0.4%	336,144	2.1%
2030	1,124	0.4%	342,813	2.0%
2031	1,129	0.4%	349,199	1.9%
2032	1,134	0.4%	355,851	1.9%
2033	1,139	0.4%	362,821	2.0%
2034	1,144	0.4%	370,029	2.0%
2035	1,149	0.4%	377,191	1.9%
2036	1,154	0.4%	384,411	1.9%
2037	1,158	0.3%	391,582	1.9%
2038	1,161	0.3%	398,636	1.8%
2039	1,165	0.3%	405,749	1.8%
2040	1,168	0.3%	412,815	1.7%
2041	1,172	0.3%	419,816	1.7%
2042	1,176	0.3%	426,825	1.7%
2043	1,179	0.3%	433,836	1.6%
2044	1,183	0.3%	440,914	1.6%
2045	1,185	0.2%	447,986	1.6%
2025-45		0.4%		1.9%

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

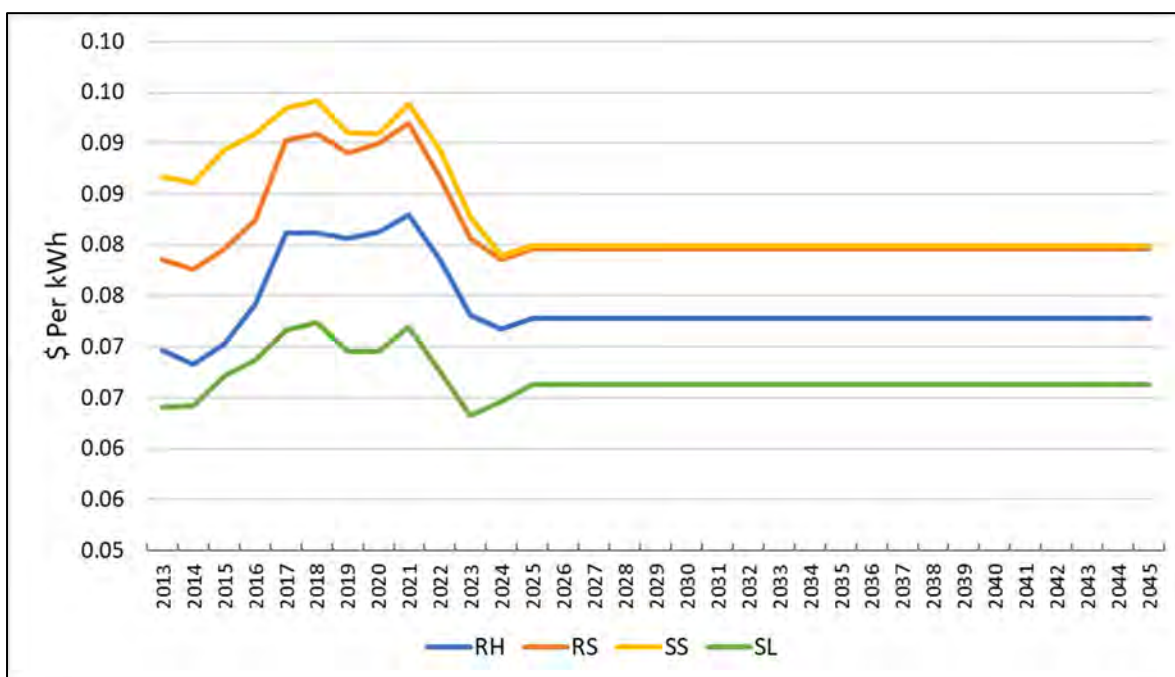
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electric sales. Google ceased publishing data in October 2022. The COVID impact variable is held constant at its October 2022 level throughout the forecast period.

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 21 shows price forecasts for the residential RH and RS schedules, the commercial SS and SL schedules. Electric prices are held constant in real terms throughout the forecast period.

Figure 21: Historical and projected real electricity prices (cents per kWh)



3.5 Appliance Saturation and Efficiency Trends

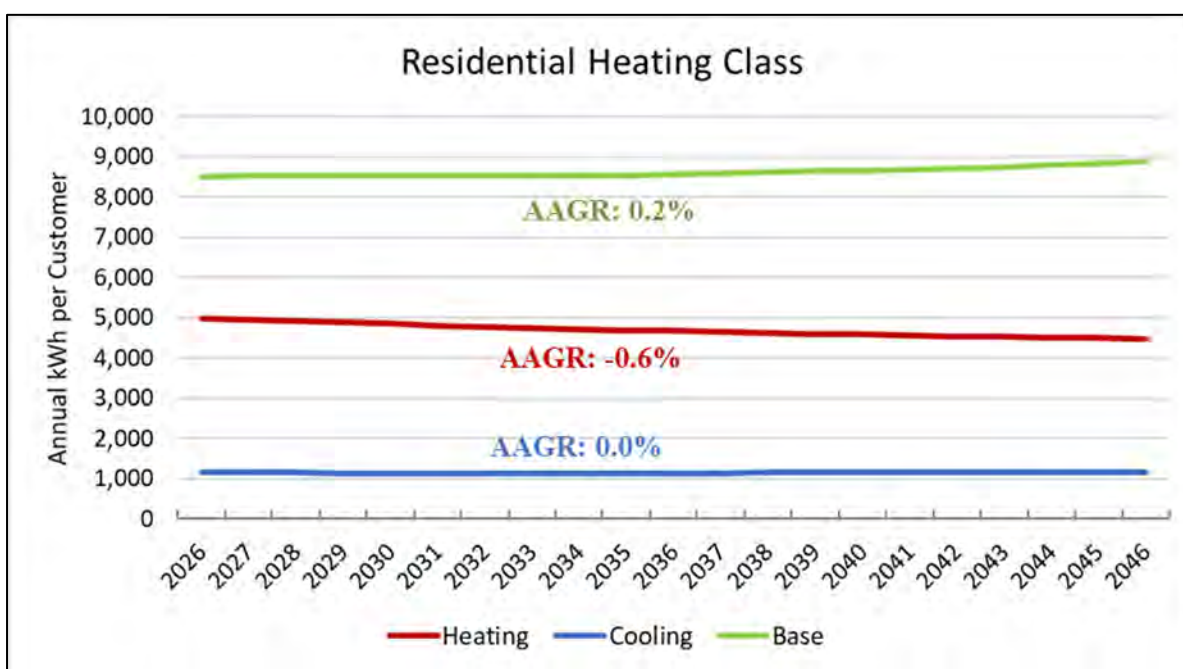
Over the long-term, changes in end-use saturation and stock efficiency impact class sales, system energy, and peak demand. End-use energy intensities, expressed in kWh per household for the residential sector and kWh per square foot for the commercial sectors, are incorporated into the constructed forecast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

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from Energy Information Administration's (EIA) 2023 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 22 shows the resulting aggregated end-use intensity projections.

Figure 22: Residential End-Use Energy Intensities



*AAGR=Average Annual Growth Rate

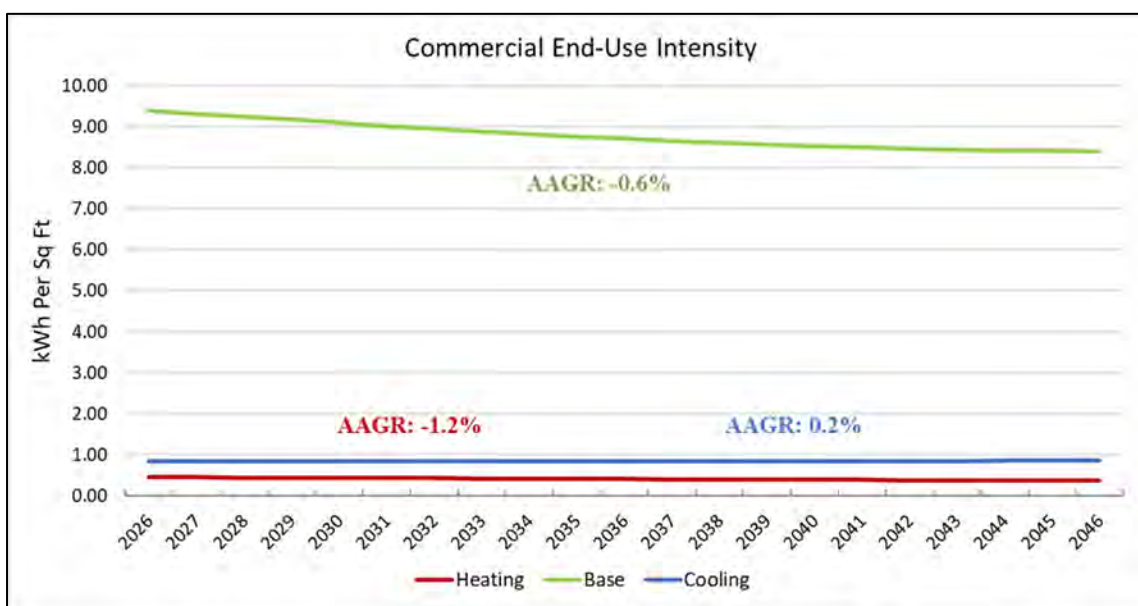
While overall, heating use per household is declining, total AES Indiana heating load is increasing as a result of strong growth in electric heat customers. Cooling largely unchanged through the forecast period as overall air conditioning efficiency improvements and change from less efficient room air conditioning to central air conditioning is offset by the increase in air conditioning saturation. Again, while cooling intensity is flat, 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) is flat in the first 10 years of the forecast before increasing over the last 10 years. Most non-weather sensitive end-uses

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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 23 shows commercial end-use energy intensity forecasts for the aggregated end-use categories.

Figure 23: Commercial End-Use Energy Intensity



Commercial usage is dominated by non-weather sensitive end-uses, which over the forecast period are projected to decline 0.6% annually, driven by improvements in lighting and ventilation efficiency. Cooling intensity increases 0.2% annually through the forecast period. Heating intensity declines 1.2% annually, 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



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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 24 the cumulative MWh savings for the residential and commercial and industrial classes.

Figure 24: EE Savings

Annual Cumulative Saving (MWh)		
Year	Res	C&I
2011	30,123	25,003
2012	66,290	57,329
2013	133,328	119,604
2014	170,356	193,592
2015	201,208	239,919
2016	247,829	347,312
2017	274,827	423,859
2018	315,502	515,427
2019	372,124	606,108
2020	396,524	684,020
2021	416,086	766,668
2022	454,899	843,940
2023	490,129	935,231

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 beginning in October 2024. Scenarios are further adjusted to ensure the growth rates are less than the baseline growth rates in the low case and greater than the baseline growth rates in the high case. This is accomplished by analyzing the standard deviation of the historical growth of the concepts.

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 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.



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Table 4-1: Scenario Forecasts: Energy

Year	Baseline (GWh)	change	Low Scenario (GWh)	change	High Scenario (GWh)	change
2025	13,764		13,405		13,902	
2026	13,871	0.8%	13,407	0.0%	14,096	1.4%
2027	14,027	1.1%	13,498	0.7%	14,316	1.6%
2028	14,114	0.6%	13,521	0.2%	14,466	1.0%
2029	14,203	0.6%	13,547	0.2%	14,617	1.0%
2030	14,277	0.5%	13,563	0.1%	14,754	0.9%
2031	14,355	0.5%	13,584	0.2%	14,896	1.0%
2032	14,439	0.6%	13,613	0.2%	15,046	1.0%
2033	14,539	0.7%	13,656	0.3%	15,213	1.1%
2034	14,636	0.7%	13,695	0.3%	15,376	1.1%
2035	14,742	0.7%	13,744	0.4%	15,552	1.1%
2036	14,858	0.8%	13,801	0.4%	15,738	1.2%
2037	14,969	0.8%	13,854	0.4%	15,921	1.2%
2038	15,080	0.7%	13,906	0.4%	16,104	1.2%
2039	15,190	0.7%	13,958	0.4%	16,289	1.1%
2040	15,304	0.7%	14,012	0.4%	16,478	1.2%
2041	15,422	0.8%	14,070	0.4%	16,674	1.2%
2042	15,545	0.8%	14,132	0.4%	16,876	1.2%
2043	15,672	0.8%	14,197	0.5%	17,083	1.2%
2044	15,804	0.8%	14,266	0.5%	17,296	1.2%
2045	15,940	0.9%	14,338	0.5%	17,513	1.3%
2025-45		0.7%		0.4%		1.1%



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Table 4-2: Scenario Forecasts: Demand

Year	Baseline (MW)	change	Low Scenario (MW)	change	High Scenario (MW)	change
2025	2,779		2,722		2,800	
2026	2,798	0.7%	2,727	0.2%	2,833	1.2%
2027	2,814	0.6%	2,733	0.2%	2,859	0.9%
2028	2,834	0.7%	2,743	0.3%	2,888	1.0%
2029	2,849	0.5%	2,748	0.2%	2,913	0.9%
2030	2,866	0.6%	2,755	0.3%	2,940	0.9%
2031	2,884	0.6%	2,764	0.3%	2,968	1.0%
2032	2,906	0.8%	2,776	0.4%	3,000	1.1%
2033	2,926	0.7%	2,787	0.4%	3,032	1.0%
2034	2,948	0.7%	2,800	0.4%	3,065	1.1%
2035	2,972	0.8%	2,814	0.5%	3,100	1.1%
2036	3,000	1.0%	2,832	0.7%	3,140	1.3%
2037	3,022	0.7%	2,845	0.4%	3,174	1.1%
2038	3,048	0.8%	2,860	0.5%	3,212	1.2%
2039	3,074	0.9%	2,876	0.6%	3,251	1.2%
2040	3,103	0.9%	2,894	0.6%	3,293	1.3%
2041	3,127	0.8%	2,908	0.5%	3,329	1.1%
2042	3,153	0.8%	2,923	0.5%	3,369	1.2%
2043	3,178	0.8%	2,938	0.5%	3,408	1.2%
2044	3,208	0.9%	2,957	0.6%	3,452	1.3%
2045	3,232	0.7%	2,970	0.4%	3,489	1.1%
2025-45		0.8%		0.4%		1.1%

5 Appendix A: Model Statistics

RS Average Use Model

Variable	Coefficient	StdErr	T-Stat	P-Value
RS_Vars.XOther	1.03	0.01	80.24	0.00%
RS_Vars.XCool	1.67	0.02	80.02	0.00%
RS_Vars.XHeat	0.84	0.03	28.98	0.00%
mBin.Jan	20.57	4.61	4.46	0.00%
mBin.Mar	-18.63	5.34	-3.49	0.07%
mBin.Apr	-33.74	6.60	-5.12	0.00%
mBin.May	-28.81	5.43	-5.30	0.00%
mBin.Nov	-19.69	4.59	-4.29	0.00%
mBin.Oct17	-42.53	14.92	-2.85	0.50%
COVID_Shift.Res	16.76	15.22	1.10	27.25%
mBin.Oct23	-58.32	18.33	-3.18	0.18%
mBin.Nov23	64.34	18.69	3.44	0.08%
DSM_10YrML.RS_Constant	-1.60	0.13	-12.31	0.00%
MA(1)	0.59	0.07	8.80	0.00%
Model Statistics				
Iterations	16			
Adjusted Observations	165			
Deg. of Freedom for Error	151			
R-Squared	0.992			
Adjusted R-Squared	0.991			
AIC	5.863			
BIC	6.127			
Model Sum of Squares	5,841,359			
Sum of Squared Errors	48,987			
Mean Squared Error	324.42			
Std. Error of Regression	18.01			
Mean Abs. Dev. (MAD)	13.07			
Mean Abs. % Err. (MAPE)	1.58%			
Durbin-Watson Statistic	2.08			

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RS Customer Model

Variable	Coefficient	StdErr	T-Stat	P-Value
CONST	164,000.94	12,138.93	13.51	0.00%
mEcon.CustomerDriver	77,074.02	11,015.85	7.00	0.00%
mBin.Yr2020Plus	914.61	513.67	1.78	7.69%
AR(1)	0.88	0.04	25.31	0.00%
Model Statistics				
Iterations	20			
Adjusted Observations	164			
Deg. of Freedom for Error	160			
R-Squared	0.976			
Adjusted R-Squared	0.975			
AIC	12.54			
BIC	12.61			
Model Sum of Squares	1,730,239,481			
Sum of Squared Errors	43,407,474			
Mean Squared Error	271296.71			
Std. Error of Regression	520.86			
Mean Abs. Dev. (MAD)	320.36			
Mean Abs. % Err. (MAPE)	0.13%			
Durbin-Watson Statistic	2.30			

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RC Average Use Model

Variable	Coefficient	StdErr	T-Stat	P-Value
RC_Vars.XHeat	1.51	0.03	44.65	0.00%
RC_Vars.XCool	1.56	0.03	48.92	0.00%
RC_Vars.XOther	1.39	0.02	83.23	0.00%
mBin.Jan	18.09	5.34	3.39	0.09%
mBin.Apr	-14.95	6.46	-2.32	2.19%
mBin.May	-22.74	6.95	-3.27	0.13%
mBin.Jul	22.96	7.62	3.01	0.30%
mBin.Aug	30.98	7.27	4.26	0.00%
mBin.Oct	-15.75	7.38	-2.13	3.45%
mBin.Nov	-23.27	6.83	-3.41	0.08%
mBin.Sep20	52.42	18.50	2.83	0.52%
mBin.Oct23	-80.72	18.98	-4.25	0.00%
mBin.Dec23	-56.02	18.70	-3.00	0.32%
DSM_10YrML.RC_Constant	-2.19	0.10	-21.05	0.00%
MA(1)	0.47	0.07	6.33	0.00%
Model Statistics				
Iterations	19			
Adjusted Observations	165			
Deg. of Freedom for Error	150			
R-Squared	0.99			
Adjusted R-Squared	0.989			
AIC	6.088			
BIC	6.37			
Model Sum of Squares	5,906,113			
Sum of Squared Errors	60,583			
Mean Squared Error	403.89			
Std. Error of Regression	20.1			
Mean Abs. Dev. (MAD)	14.84			
Mean Abs. % Err. (MAPE)	1.41%			
Durbin-Watson Statistic	2.06			

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RC Customer Model

Variable	Coefficient	StdErr	T-Stat	P-Value
mEcon.CustomerDriver	29,737.31	43.63	681.53	0.00%
mBin.June20_Plus	1,577.43	125.30	12.59	0.00%
mBin.April24_Plus	1,084.62	226.74	4.78	0.00%
mBin.Jan22_Plus	1,430.01	150.44	9.51	0.00%
Model Statistics				
Iterations	1			
Adjusted Observations	165			
Deg. of Freedom for Error	161			
R-Squared	0.953			
Adjusted R-Squared	0.952			
AIC	12.46			
BIC	12.54			
Model Sum of Squares	814,890,458			
Sum of Squared Errors	40,632,582			
Mean Squared Error	252376.29			
Std. Error of Regression	502.37			
Mean Abs. Dev. (MAD)	394.4			
Mean Abs. % Err. (MAPE)	1.18%			
Durbin-Watson Statistic	0.16			

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RH Average Use Model

Variable	Coefficient	StdErr	T-Stat	P-Value
RH_Vars.XOther	0.91	0.02	61.24	0.00%
RH_Vars.XHeat	1.70	0.01	126.16	0.00%
RH_Vars.XCool	1.17	0.03	46.11	0.00%
mBin.Mar	-23.23	9.54	-2.43	1.61%
mBin.Apr	-34.59	9.16	-3.78	0.02%
mBin.Nov	-83.36	10.10	-8.25	0.00%
mBin.Dec	-92.69	9.54	-9.72	0.00%
mBin.Jun22	82.62	29.65	2.79	0.60%
mBin.Nov22	88.11	30.97	2.85	0.50%
mBin.Nov23	112.84	30.98	3.64	0.04%
DSM_10YrML.RH_Constant	-1.53	0.09	-16.22	0.00%
MA(1)	0.33	0.08	4.00	0.01%
Model Statistics				
Iterations	14			
Adjusted Observations	165			
Deg. of Freedom for Error	153			
R-Squared	0.996			
Adjusted R-Squared	0.996			
AIC	6.949			
BIC	7.175			
Model Sum of Squares	38,688,019			
Sum of Squared Errors	148,675			
Mean Squared Error	971.73			
Std. Error of Regression	31.17			
Mean Abs. Dev. (MAD)	23.92			
Mean Abs. % Err. (MAPE)	2.06%			
Durbin-Watson Statistic	1.94			

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RH Customer Model

Variable	Coefficient	StdErr	T-Stat	P-Value
CONST	-131,237.49	22,891.45	-5.73	0.00%
mEcon.CustomerDriver	260,244.12	20,308.29	12.82	0.00%
AR(1)	0.96	0.02	60.80	0.00%
Model Statistics				
Iterations	38			
Adjusted Observations	164			
Deg. of Freedom for Error	161			
R-Squared	0.999			
Adjusted R-Squared	0.999			
AIC	11.96			
BIC	12.02			
Model Sum of Squares	16,730,114,284			
Sum of Squared Errors	24,801,975			
Mean Squared Error	154049.53			
Std. Error of Regression	392.49			
Mean Abs. Dev. (MAD)	254.69			
Mean Abs. % Err. (MAPE)	0.16%			
Durbin-Watson Statistic	2.14			

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Residential APL Sales

Variable	Coefficient	StdErr	T-Stat	P-Value
mBin.Jan	1,762,982.65	31,381.46	56.18	0.00%
mBin.Feb	1,638,937.81	31,465.33	52.09	0.00%
mBin.Mar	1,600,005.21	32,431.15	49.34	0.00%
mBin.Apr	1,471,269.05	32,515.62	45.25	0.00%
mBin.May	1,424,101.34	32,983.14	43.18	0.00%
mBin.Jun	1,368,265.12	33,068.06	41.38	0.00%
mBin.Jul	1,403,980.55	33,152.99	42.35	0.00%
mBin.Aug	1,460,160.58	33,237.93	43.93	0.00%
mBin.Sep	1,509,040.88	33,322.89	45.29	0.00%
mBin.Oct	1,653,563.82	33,022.78	50.07	0.00%
mBin.Nov	1,702,104.80	32,761.60	51.95	0.00%
mBin.Dec	1,777,563.58	33,191.96	53.55	0.00%
mBin.Nov23	400,827.05	26,329.36	15.22	0.00%
mBin.Mar24	-1,044,195.68	26,217.84	-39.83	0.00%
mBin.Apr24	951,906.65	26,217.84	36.31	0.00%
mBin.WinterYr2022Plus	-44,014.82	13,044.23	-3.37	0.11%
mBin.TrendVar3	-28,376.54	1,051.13	-27.00	0.00%
Model Statistics				
Iterations	1			
Adjusted Observations	105			
Deg. of Freedom for Error	88			
R-Squared	0.989			
Adjusted R-Squared	0.987			
AIC	20.34			
BIC	20.77			
Model Sum of Squares	4,505,755,667,845			
Sum of Squared Errors	52,017,887,576			
Mean Squared Error	591112358.8			
Std. Error of Regression	24312.8			
Mean Abs. Dev. (MAD)	14164.2			
Mean Abs. % Err. (MAPE)	2.09%			
Durbin-Watson Statistic	1.15			

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SS Sales

Variable	Coefficient	StdErr	T-Stat	P-Value
SS_Vars.XOther	0.90	0.01	115.33	0.00%
SS_Vars.XHeat	2.57	0.12	21.64	0.00%
SS_Vars.XCool	0.77	0.02	39.42	0.00%
mBin.Jan	-3,594.88	757.18	-4.75	0.00%
mBin.Nov	-2,837.48	726.20	-3.91	0.01%
mBin.Dec	-5,016.62	853.46	-5.88	0.00%
mBin.Oct23	-9,127.85	2,126.01	-4.29	0.00%
mBin.Jan24	4,295.93	2,164.50	1.99	4.89%
DSM_10YrML.SS_Constant	-0.19	0.04	-5.32	0.00%
MA(1)	0.48	0.07	6.63	0.00%
Model Statistics				
Iterations	22			
Adjusted Observations	165			
Deg. of Freedom for Error	155			
R-Squared	0.957			
Adjusted R-Squared	0.955			
AIC	15.5808			
BIC	15.769			
Model Sum of Squares	19,049,090,437			
Sum of Squared Errors	854,037,126			
Mean Squared Error	5509916.939			
Std. Error of Regression	2347.321			
Mean Abs. Dev. (MAD)	1688.954			
Mean Abs. % Err. (MAPE)	1.61%			
Durbin-Watson Statistic	1.82			

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SH Sales

Variable	Coefficient	StdErr	T-Stat	P-Value
SH_Vars.XOther	0.68	0.02	28.16	0.00%
SH_Vars.XHeat	9.38	0.37	25.74	0.00%
SH_Vars.XCool	0.59	0.11	5.48	0.00%
mBin.Jan	3,616.01	798.26	4.53	0.00%
mBin.Feb	9,009.74	953.21	9.45	0.00%
mBin.Mar	8,256.44	861.25	9.59	0.00%
mBin.Apr	5,363.03	881.54	6.08	0.00%
mBin.May	3,894.78	1,016.54	3.83	0.02%
mBin.Jun	4,149.72	1,566.56	2.65	0.89%
mBin.Jul	5,610.93	2,175.20	2.58	1.09%
mBin.Aug	7,623.93	2,196.06	3.47	0.07%
mBin.Sep	5,786.94	1,880.13	3.08	0.25%
mBin.Oct	3,777.25	984.64	3.84	0.02%
DSM_10YrML.SH_Constant	-2.20	0.28	-7.76	0.00%
AR(1)	0.56	0.07	7.84	0.00%
Model Statistics				
Iterations	9			
Adjusted Observations	164			
Deg. of Freedom for Error	149			
R-Squared	0.972			
Adjusted R-Squared	0.969			
AIC	15.4106			
BIC	15.6941			
Model Sum of Squares	23,098,101,174			
Sum of Squared Errors	673,182,344			
Mean Squared Error	4518002.311			
Std. Error of Regression	2125.559			
Mean Abs. Dev. (MAD)	1557.764			
Mean Abs. % Err. (MAPE)	3.50%			
Durbin-Watson Statistic	2.03			

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Small C&I APL Sales

Variable	Coefficient	StdErr	T-Stat	P-Value
mBin.Jan	3,250.55	33.12	98.14	0.00%
mBin.Feb	2,779.77	33.38	83.28	0.00%
mBin.Mar	2,722.60	34.22	79.56	0.00%
mBin.Apr	2,246.51	34.15	65.79	0.00%
mBin.May	2,085.42	33.38	62.48	0.00%
mBin.Jun	1,874.75	33.38	56.16	0.00%
mBin.Jul	1,994.69	33.38	59.76	0.00%
mBin.Aug	2,198.53	33.38	65.86	0.00%
mBin.Sep	2,372.93	33.38	71.09	0.00%
mBin.Oct	2,891.05	34.15	84.65	0.00%
mBin.Nov	3,064.25	35.10	87.31	0.00%
mBin.Dec	3,321.80	33.98	97.75	0.00%
mBin.Yr2022Plus	-266.39	31.83	-8.37	0.00%
mBin.Nov23	462.50	105.00	4.41	0.00%
mBin.Mar24	-4,582.04	121.85	-37.61	0.00%
mBin.Apr24	3,936.30	117.08	33.62	0.00%
MA(1)	0.45	0.08	5.82	0.00%
Model Statistics				
Iterations	23			
Adjusted Observations	165			
Deg. of Freedom for Error	148			
R-Squared	0.976			
Adjusted R-Squared	0.973			
AIC	9.52			
BIC	9.84			
Model Sum of Squares	73,657,571			
Sum of Squared Errors	1,836,955			
Mean Squared Error	12411.86			
Std. Error of Regression	111.41			
Mean Abs. Dev. (MAD)	71.11			
Mean Abs. % Err. (MAPE)	2.77%			
Durbin-Watson Statistic	1.93			

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SL Sales

Variable	Coefficient	StdErr	T-Stat	P-Value
SLVars.XOther	299,310.97	2,281.61	131.18	0.00%
SLVars.XHeat	54,825.95	25,202.31	2.18	3.12%
SLVars.XCool	104,398.67	4,724.29	22.10	0.00%
mBin.Feb	10,951.41	1,859.99	5.89	0.00%
mBin.Mar	10,656.80	1,842.53	5.78	0.00%
mBin.Aug	9,825.98	1,971.70	4.98	0.00%
mBin.Sep	8,329.25	2,361.22	3.53	0.06%
mBin.Oct	4,261.19	1,833.91	2.32	2.15%
mBin.Jun23	-36,465.68	5,091.03	-7.16	0.00%
mBin.Nov23	-24,499.95	6,254.49	-3.92	0.01%
mBin.Dec23	35,589.18	6,429.59	5.54	0.00%
mBin.Mar24	12,092.02	5,576.37	2.17	3.17%
mBin.Jun24	-82,421.44	6,541.74	-12.60	0.00%
mBin.Jul24	103,816.36	6,666.03	15.57	0.00%
COVID_Shift.LCI	-25,357.05	6,130.97	-4.14	0.01%
mBin.Yr2022Plus	-13,314.00	2,624.93	-5.07	0.00%
mBin.Yr2024Plus	-13,922.35	3,869.04	-3.60	0.04%
DSM_10YrML.SL_Constant	-0.65	0.09	-7.35	0.00%
MA(1)	0.55	0.07	7.65	0.00%
Model Statistics				
Iterations	16			
Adjusted Observations	165			
Deg. of Freedom for Error	146			
R-Squared	0.968			
Adjusted R-Squared	0.964			
AIC	17.4902			
BIC	17.8478			
Model Sum of Squares	155,224,749,974			
Sum of Squared Errors	5,168,411,705			
Mean Squared Error	35400080.17			
Std. Error of Regression	5949.797			
Mean Abs. Dev. (MAD)	4358.553			
Mean Abs. % Err. (MAPE)	1.54%			
Durbin-Watson Statistic	2.04			

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PL Sales

Variable	Coefficient	StdErr	T-Stat	P-Value
CONST	85,407.40	5,013.02	17.04	0.00%
mRevWthr.CDD60	45.24	2.04	22.22	0.00%
mBin.Feb21	-8,326.69	3,562.08	-2.34	2.23%
mBin.Feb20	-12,354.89	3,882.68	-3.18	0.22%
mBin.Nov23	-30,238.11	3,563.18	-8.49	0.00%
mBin.Dec23	11,367.58	3,570.55	3.18	0.22%
mBin.Jun24	-30,121.34	3,742.48	-8.05	0.00%
mBin.Jul24	24,746.80	3,777.32	6.55	0.00%
COVID_Shift.LCI	-9,350.81	3,501.99	-2.67	0.94%
mBin.Yr2020Plus	8,374.76	2,632.45	3.18	0.22%
mBin.Yr2024Plus	-4,612.81	1,470.04	-3.14	0.25%
DSM_10YrML.PL_Constant	-1.16	0.83	-1.40	16.56%
Model Statistics				
Iterations	1			
Adjusted Observations	81			
Deg. of Freedom for Error	69			
R-Squared	0.923			
Adjusted R-Squared	0.911			
AIC	16.4508			
BIC	16.8055			
Model Sum of Squares	10,094,811,733			
Sum of Squared Errors	840,024,762			
Mean Squared Error	12174271.92			
Std. Error of Regression	3489.165			
Mean Abs. Dev. (MAD)	2439.059			
Mean Abs. % Err. (MAPE)	2.79%			
Durbin-Watson Statistic	2.12			

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H1 Sales

Variable	Coefficient	StdErr	T-Stat	P-Value
CONST	107,698.60	2,054.18	52.43	0.00%
mRevWthr.CDD60	23.53	5.06	4.65	0.00%
mBin.Feb	-6,534.05	3,435.85	-1.90	6.13%
mBin.Nov	-5,415.82	3,946.18	-1.37	17.43%
mBin.Nov23	-57,076.92	9,158.59	-6.23	0.00%
mBin.Jan24	24,433.62	8,448.44	2.89	0.51%
mBin.Jun24	-49,932.25	8,405.80	-5.94	0.00%
mBin.Jul24	47,262.23	8,484.13	5.57	0.00%
mBin.Yr2020Plus	-9,629.57	2,380.42	-4.05	0.01%
mBin.Yr2022Plus	6,483.42	2,281.73	2.84	0.59%
Model Statistics				
Iterations	1			
Adjusted Observations	81			
Deg. of Freedom for Error	71			
R-Squared	0.738			
Adjusted R-Squared	0.705			
AIC	18.1483			
BIC	18.4439			
Model Sum of Squares	13,564,308,015			
Sum of Squared Errors	4,818,883,724			
Mean Squared Error	67871601.75			
Std. Error of Regression	8238.422			
Mean Abs. Dev. (MAD)	5606.442			
Mean Abs. % Err. (MAPE)	5.33%			
Durbin-Watson Statistic	2.46			

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H2 Sales

Variable	Coefficient	StdErr	T-Stat	P-Value
CONST	17,780.86	331.70	53.61	0.00%
mCalWthr.CDD60	6.80	0.82	8.29	0.00%
mBin.Nov19	-3,831.08	1,111.23	-3.45	0.10%
mBin.Nov23	-12,552.49	1,112.49	-11.28	0.00%
mBin.Yr2020Plus	-3,626.93	359.03	-10.10	0.00%
MA(1)	0.27	0.12	2.25	2.78%
Model Statistics				
Iterations	13			
Adjusted Observations	73			
Deg. of Freedom for Error	67			
R-Squared	0.868			
Adjusted R-Squared	0.858			
AIC	14.1549			
BIC	14.3431			
Model Sum of Squares	571,766,999			
Sum of Squared Errors	86,959,758			
Mean Squared Error	1297906.84			
Std. Error of Regression	1139.257			
Mean Abs. Dev. (MAD)	898.523			
Mean Abs. % Err. (MAPE)	6.05%			
Durbin-Watson Statistic	1.94			

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H3 Sales

Variable	Coefficient	StdErr	T-Stat	P-Value
CONST	20,022.69	235.10	85.17	0.00%
mCalWthr.CDD60	6.53	0.75	8.66	0.00%
mBin.Yr2022Plus	-1,101.39	342.23	-3.22	0.19%
mBin.Yr2024Plus	-1,124.76	554.96	-2.03	4.62%
Model Statistics				
Iterations	1			
Adjusted Observations	79			
Deg. of Freedom for Error	75			
R-Squared	0.561			
Adjusted R-Squared	0.544			
AIC	14.4642			
BIC	14.5842			
Model Sum of Squares	174,580,625			
Sum of Squared Errors	136,579,345			
Mean Squared Error	1821057.934			
Std. Error of Regression	1349.466			
Mean Abs. Dev. (MAD)	982.029			
Mean Abs. % Err. (MAPE)	4.77%			
Durbin-Watson Statistic	2.32			

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Large C&I APL Sales

Variable	Coefficient	StdErr	T-Stat	P-Value
mBin.Jan	531.86	23.16	22.97	0.00%
mBin.Feb	471.80	21.93	21.51	0.00%
mBin.Mar	450.96	21.45	21.02	0.00%
mBin.Apr	373.58	21.07	17.73	0.00%
mBin.May	345.43	20.62	16.75	0.00%
mBin.Jun	315.53	20.50	15.39	0.00%
mBin.Jul	332.32	20.42	16.28	0.00%
mBin.Aug	357.67	20.37	17.56	0.00%
mBin.Sep	381.38	20.34	18.75	0.00%
mBin.Oct	443.18	20.46	21.66	0.00%
mBin.Nov	487.28	20.75	23.49	0.00%
mBin.Dec	518.02	20.44	25.34	0.00%
mBin.Yr19Plus	-31.38	19.42	-1.62	11.13%
mBin.Yr2022Plus	-47.96	16.84	-2.85	0.60%
mBin.Yr2023Plus	-47.09	17.68	-2.66	0.99%
mBin.Nov23	-74.88	23.02	-3.25	0.19%
mBin.Apr24	217.76	23.30	9.34	0.00%
AR(1)	0.62	0.11	5.75	0.00%
Model Statistics				
Iterations	11			
Adjusted Observations	79			
Deg. of Freedom for Error	61			
R-Squared	0.942			
Adjusted R-Squared	0.926			
AIC	6.63			
BIC	7.17			
Model Sum of Squares	617,087			
Sum of Squared Errors	38,002			
Mean Squared Error	622.98			
Std. Error of Regression	24.96			
Mean Abs. Dev. (MAD)	15.63			
Mean Abs. % Err. (MAPE)	4.61%			
Durbin-Watson Statistic	2.08			



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Street Lighting Sales

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Peaks

Variable	Coefficient	StdErr	T-Stat	P-Value
mCPkEndUses.BaseVar	1.36	0.03	40.40	0.00%
mPkWthr.HeatVar	1.02	0.05	19.61	0.00%
mPkWthr.CoolVar	0.76	0.07	11.71	0.00%
mBin.Mar	104.29	32.95	3.17	0.21%
mBin.Apr	243.68	36.69	6.64	0.00%
mBin.May	299.79	62.22	4.82	0.00%
mBin.Jun	443.58	71.25	6.23	0.00%
mBin.Jul	570.29	75.06	7.60	0.00%
mBin.Aug	532.96	74.41	7.16	0.00%
mBin.Sep	445.92	69.88	6.38	0.00%
mBin.Oct	230.16	49.47	4.65	0.00%
mBin.Dec20	-253.38	92.35	-2.74	0.72%
mBin.Aug21	508.71	94.06	5.41	0.00%
mBin.April23	-681.13	117.97	-5.77	0.00%
mBin.Mar23	402.22	94.15	4.27	0.00%
COVID_Shift.COVID_Shift	-51.70	46.98	-1.10	27.38%
mBin.Yr22Plus	-56.81	18.88	-3.01	0.33%
Model Statistics				
Iterations	1			
Adjusted Observations	117			
Deg. of Freedom for Error	100			
R-Squared	0.937			
Adjusted R-Squared	0.927			
AIC	9.075			
BIC	9.477			
Model Sum of Squares	11,328,566			
Sum of Squared Errors	764,493			
Mean Squared Error	7644.93			
Std. Error of Regression	87.44			
Mean Abs. Dev. (MAD)	62.99			
Mean Abs. % Err. (MAPE)	2.80%			
Durbin-Watson Statistic	2.18			

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 2023 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,

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

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.

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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

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- $XCool_{y,m}$ 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:

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

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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:

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

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.

$$ApplianceIndex_{y,m} = Weight^{Type} \times \frac{\left(\frac{Sat_y^{Type}}{\frac{1}{UEC_y^{Type}}} \right)}{\left(\frac{Sat_{base\ yr}^{Type}}{\frac{1}{UEC_{base\ yr}^{Type}}} \right)} \times MoMult_m^{Type} \times (12)$$

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:

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

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 2023 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,

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

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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:

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

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

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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:

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

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' is stylized with a blue-to-green gradient. The 'a' and 'e' are connected, and the 's' is a single continuous stroke.

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Attachment 5-3a-f

(EIA End Use Data)

Provided electronically

The logo for AES (American Electric Power) features the letters 'aes' in a stylized, rounded font. The 'a' is blue, the 'e' is purple, and the 's' is green. The word 'Indiana' is in a black, sans-serif font to the right of the logo.

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Attachment 5-4

(CMU EV/PV Technical Paper)

Hierarchical Spatio-Temporal Uncertainty Quantification for Distributed Energy Adoption

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Abstract—The rapid deployment of distributed energy resources (DER) has introduced significant spatio-temporal uncertainties in power grid management, necessitating accurate multilevel forecasting methods. However, existing approaches often produce overly conservative uncertainty intervals at individual spatial units and fail to properly capture uncertainties when aggregating predictions across different spatial scales. This paper presents a novel hierarchical spatio-temporal model based on the conformal prediction framework to address these challenges. Our approach generates circuit-level DER growth predictions and efficiently aggregates them to the substation level while maintaining statistical validity through a tailored non-conformity score. Applied to a decade of DER installation data from a local utility network, our method demonstrates superior performance over existing approaches, particularly in reducing prediction interval widths while maintaining coverage.

Index Terms—Distributed energy resource, uncertainty quantification, spatio-temporal hierarchical prediction.

I. INTRODUCTION

In recent years, the global energy landscape has experienced a transformative shift, primarily characterized by an extraordinary increase in renewable energy sources [1]. One of its primary contributors is *distributed energy resources* (DER), a decentralized approach to power generation that includes a variety of technologies such as solar panels, wind turbines, and small-scale hydroelectric systems [2].

While DER deployment has accelerated rapidly, it introduces significant spatio-temporal variability and uncertainties that vary across regions and evolve over time. Understanding these uncertainties is crucial for effective energy management [3], facilitating DER integration into existing power grids [4], identifying grid enhancement opportunities [5], and planning for future energy demands [6]. More importantly, such uncertainty quantification (UQ) must also be accessible at multiple spatial scales to offer a more comprehensive overview of the future and support their downstream strategic decision-making. For example, granular circuit-level predictions enable precise operational decisions, such as real-time load balancing and resource allocation. Meanwhile, aggregated substation-level forecasts provide the broader perspective needed for long-term infrastructure investments, including capacity enhancement and resilience improvements.

However, achieving multilevel uncertainty quantification presents two main challenges: First, jointly predicting multiple

spatial units (*e.g.*, circuits) can result in overly conservative uncertainty intervals, potentially diminishing their practical utility. Excessively wide prediction intervals fail to provide actionable insights for specific operational needs. Second, while aggregating these predictions from circuit to substation level may seem straightforward, doing so without careful adjustment can result in prediction intervals that do not fully capture the true underlying uncertainty at the aggregate level. Simple summation of circuit-level uncertainties often overestimates variability, leading to either inflated risk assessments or misleading confidence in grid performance metrics.

To address these challenges, we propose a hierarchical spatio-temporal model based on conformal prediction [7] to predict the spatio-temporal uncertainty in DER growth. Our approach begins by generating circuit-level growth predictions along with corresponding uncertainty measures, and then aggregates these predictions to the substation level based on the grid topology. A key methodological contribution of our method is a novel non-conformity score tailored to this multilevel spatio-temporal predictive task. Our results show that this method maintains both statistical validity and efficiency across multiple spatial levels, ensuring that prediction intervals remain informative and practically useful.

Finally, we apply our method to a real-world dataset containing rooftop solar panel installation records in a major U.S. city over the last decade, collected in collaboration with the local utility. Our findings demonstrate the method's empirical effectiveness and show remarkable improvements over the state-of-the-art approaches, especially in reducing the width of prediction intervals while maintaining coverage. This highlights the utility of our model in providing stakeholders with actionable insights for future strategic decisions.

II. RELATED WORK

Forecasting demand for DER has gained increased attention in recent years, particularly in predicting power and electricity consumption [8]. Driven by the high-stakes nature of their downstream operations, a wide range of UQ techniques have been explored, such as probabilistic forecasting [9], interval forecasting [10], and deep learning approaches [11]. Due to the unique distributed network topology structure of these renewable energy infrastructures, much work has also explored how these inherent hierarchies can be respected or exploited

in various forecasting applications including electricity grid management [12] and power generation forecasts [13].

Our work extends further on these works by incorporating conformal prediction (CP) [7], a distribution-free UQ approach. We consider the distribution shift [14] induced by time series by adopting the line of sequential CP framework [15]. Additionally, our method gained inspiration from the Probabilistic Conformal Prediction [16], [17], allowing our method to tailor to more complex DER forecasting problems by integrating probabilistic models. Our work is also related to hierarchical time series prediction [18].

III. PROBLEM SETUP

Consider a utility network consisting of n distribution circuits and m distribution substations. Each substation serves as a “hub”, connecting and coordinating multiple circuits within the network. The network topology between circuits and substations is defined by a matrix $\mathbf{C} := (c_{ij}) \in \{0, 1\}^{n \times m}$, where $c_{ij} = 1$ indicates circuit $i \in \mathcal{I}$ is associated with substation $j \in \mathcal{J}$, and $c_{ij} = 0$ otherwise.

For each circuit i at time t , let $Y_{it} \in \mathbb{Z}_+$ represent the number of DER installations (*e.g.*, rooftop solar panels). Additionally, let $Z_{it} \in \mathbb{R}^p$ denote a set of demographic covariates associated with circuit i at time t ; these covariates may include factors like population density, average income, or degree of urbanization in the circuit’s vicinity. To simplify notation, define $Y_t := (Y_{it})_{i=1}^n$ as the vector capturing DER installation counts across all circuits at time t , and $Z_t := (Z_{it})_{i=1}^n$ as the corresponding vector of demographic covariates. Suppose we have a calibration dataset, denoted by $\mathcal{D} = \{(x_t, y_t)\}_{t=1}^T$, where y_t represents the DER installation counts at time t , and $x_t := (\{y_\tau\}_{\tau < t}, z_{t-1})$ represents all observed predictor variables, including both the historical DER installation counts across circuits up to time $t-1$ and the demographic covariates z_t at time $t-1$.

Our objective is to construct prediction intervals for each circuit at future time $T+1$, defined by lower bounds $\hat{L} := (\hat{L}_i)$ and upper bounds $\hat{U} := (\hat{U}_i)$. Let Y_{T+1} represent the DER installation counts across all circuits for the next time step, and $\mathbf{C}^\top Y_{T+1}$ represent aggregated DER installation counts at the substation level. For a specified confidence level $1 - \alpha$, we require these prediction intervals to satisfy:

$$\begin{aligned} \mathbb{P}(\hat{L}_i \leq Y_{i,T+1} \leq \hat{U}_i) &\geq 1 - \alpha, \quad i \in \mathcal{I}, \\ \mathbb{P}([\mathbf{C}^\top \hat{L}]_j \leq [\mathbf{C}^\top Y_{T+1}]_j \leq [\mathbf{C}^\top \hat{U}]_j) &\geq 1 - \alpha, \quad j \in \mathcal{J}, \end{aligned} \quad (1)$$

where $[\cdot]_j$ denotes the j -th element of a vector.

We evaluate our prediction intervals based on two criteria: (i) *Validity*: Ensuring the intervals meet the coverage requirements specified in (1); (ii) *Efficiency*: Minimizing the width of the prediction intervals. While wide intervals could trivially achieve the desired coverage, our goal is to produce narrow, informative prediction sets that remain statistically valid and practically useful for decision-making.

Algorithm 1 HST-Conformal

Require: Dataset $\mathcal{D}$, network topology $\mathbf{C}$, significance level α , sample size K , prediction model λ_t^* .

- 1: Initialize $\mathcal{E}_i = \emptyset$ for all $i = 1, \dots, n$.
- 2: Split $\mathcal{D}$ into training set $\mathcal{D}_{\text{tr}}$ and calibration set $\mathcal{D}_{\text{cal}}$;
- 3: Fit model $\hat{\lambda}_t^*$ on $\mathcal{D}_{\text{tr}}$ by maximizing the likelihood;
- 4: **for** $t \in \{t_0, \dots, T\}$ **do**
- 5: Simulate K outcomes $\hat{y}_t^{(1)}, \dots, \hat{y}_t^{(K)} \sim \hat{\lambda}_t^*$;
- 6: **for** $i \in \{1, \dots, n\}$ **do**
- 7: Compute $\hat{e}_{it}$ using (2);
- 8: $\mathcal{E}_i \leftarrow \mathcal{E}_i \cup \{\hat{e}_{it}\}$;
- 9: **end for**
- 10: **end for**
- 11: Compute α -empirical quantile $\hat{q}_i(\alpha)$ from $\mathcal{E}_i$ for each i ;
- 12: Simulate K outcomes $\hat{y}_{T+1}^{(1)}, \dots, \hat{y}_{T+1}^{(K)} \sim \hat{\lambda}_{T+1}^*$;
- 13: Output prediction intervals according to (3).

IV. PROPOSED METHOD

We propose a novel method called “Hierarchical Spatio-Temporal Conformal Prediction” (HST-Conformal) based on the conformal prediction (CP) framework [7], [14]–[16] to predict the spatio-temporal uncertainty in DER growth. Given a fitted prediction model, the key idea of CP is to construct the uncertainty intervals as a wrapper function around the model’s predictions. The size of the interval is calibrated on a separate calibration dataset through the use of a non-conformity score, which measures the deviance of the model from the designated uncertainty quantification objective. CP is completely distribution-free, meaning that no distributional assumptions need to be imposed as part of the algorithmic procedure, and thus has gained broad popularity in application settings where complex statistical interdependencies may be present between prediction variables.

Specifically, our approach begins by dividing the data into two parts: a training set and a calibration set. The training set is used to create a probabilistic model that simulates future scenarios across all circuits, while the calibration set enables us to evaluate prediction errors and fine-tune prediction intervals for each circuit to ensure valid coverage. One key challenge in this process is the hierarchical constraint of substation-level validity, as described in (1). This constraint has not been considered in prior CP literature, making existing non-conformity scores inadequate for achieving (1). To address this, we design a novel non-conformity score that effectively integrates topology network knowledge, ensuring compatibility with this hierarchical structure. This ensures that the resulting prediction intervals achieve statistical validity without compromising much efficiency compared to prior alternative non-conformity score designs.

A. Data Splitting and Model Training

We first partition the dataset $\mathcal{D}$ based on a specified cut-off time index, $t_0 \in 1, \dots, T$. This separation allows us to use historical data to train a model and use recent data to

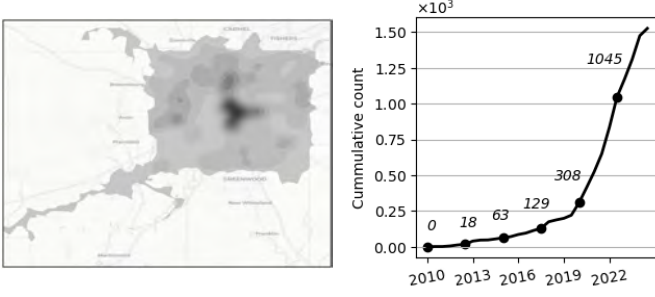


Fig. 1: DER data overview. *Left*: Spatial density plot. *Right*: Cumulative counts by year.

assess and calibrate its predictions. The first part of the dataset, denoted by $\mathcal{D}_{\text{tr}} := \{(x_t, y_t)\}_{t < t_0}$, is used to fit a probabilistic prediction model. The second part of the data, denoted by $\mathcal{D}_{\text{cal}} = \{(x_t, y_t)\}_{t \geq t_0}$, is reserved for calibration in the next phase, where we evaluate how well the model's predictions match observed outcomes, and adjust prediction intervals to achieve valid coverage.

In our analysis, we specify the probabilistic prediction model as a multivariate spatio-temporal Hawkes process [19]–[21]. It is a widely used statistical framework for modeling discrete events across space and time, making it well-suited for capturing DER adoption dynamics. Specifically, it is specified by a vector-valued conditional intensity function $\lambda_t^* := (\lambda_{it}^*)_{i=1}^n$, where each i -th entry represents the likelihood of an installation occurring in circuit i at time t given the history. Here, the star notation emphasizes its dependence on the observed events in the past. We define it as:

$$\lambda_{it}^* := \gamma_t \left(\mu_i + \sum_{t' < t} \sum_{i'} \alpha_{i,i'} \kappa(t, t') \right),$$

where $\kappa(t, t') = \beta e^{-\beta(t-t')}$ is an exponentially decaying kernel function capturing the self-exciting effect of DER growth, and $\alpha_{i,i'}$ quantifies the spatial spillover effect between circuits i and i' . These parameters are designed to capture the customer-level triggering effect of DER adoption, which is a phenomenon in which individuals exhibit an increased likelihood of adopting DER equipment after observing their peers do so. This social contagion effect in shaping adoption behaviors has been well-documented in previous empirical studies [22]. The parameter γ_t reflects the decay rate of the intensity function, accounting for the *saturation effect*, which occurs as the penetration rate of DER approaches a population-based limit. Multivariate spatio-temporal Hawkes processes can be fitted by maximizing the likelihood function over observed data [21].

B. Calibration

For each data pair $(x_t, y_t) \in \mathcal{D}_{\text{cal}}$, the calibration procedure operates as follows:

- 1) Simulate K outcomes from the fitted multivariate spatio-temporal Hawkes process via thinning algorithm [23]:

$$\hat{y}_t^{(1)}, \dots, \hat{y}_t^{(K)} \sim \hat{\lambda}_t^*,$$

where each sample $\hat{y}_t^{(k)} \in \mathbb{Z}_+^n$ is one possible joint prediction across all circuits at time t .

- 2) Let $\mathbf{S} = \mathbf{C}\mathbf{C}^\top \in \{0, 1\}^{n \times n}$ represent shared substation memberships, where each entry $s_{ii'} = 1$ if circuit i and i' are associated with the same substation, and $s_{ii'} = 0$ otherwise. The non-conformity score can be written as

$$\hat{e}_{it} = \min_{1 \leq k \leq K} \left\| \mathbf{S}_i \odot (y_t - \hat{y}_t^{(k)}) \right\|_\infty, \quad (2)$$

where $\odot$ is the elementwise product, and $\mathbf{S}_i$ is the i th row of $\mathbf{S}$, indicating the indices of circuits that share the same substation with circuit i .

Here, the proposed non-conformity score $\hat{e}_{it}$ in (2) represents the smallest Substation Maximum Error (SME) for circuit i across all K samples. For each circuit, the SME is computed using the infinity norm to capture the largest prediction error among circuits sharing the same substation, thus quantifying the worst-case deviation within each substation group.

C. Constructing Prediction Intervals

To construct prediction intervals for each circuit i , we first compute non-conformity scores from the calibration data using (2), creating the set:

$$\mathcal{E}_i := \{\hat{e}_{it}\}, \text{ for all } i \in \mathcal{I} \text{ and } t : (x_t, y_t) \in \mathcal{D}_{\text{cal}}.$$

The prediction intervals for circuit i are then defined as

$$\hat{L}_i := \min_k \hat{y}_{i,T+1}^{(k)} - \hat{q}_i(\alpha), \quad \hat{U}_i := \max_k \hat{y}_{i,T+1}^{(k)} + \hat{q}_i(\alpha), \quad (3)$$

where $\hat{q}_i(\alpha)$ is the α -empirical quantile of $\mathcal{E}_i$, estimated using quantile regression to account for potential temporal distributional shifts [15]. Substation-level prediction intervals are constructed by aggregating the prediction bounds of associated circuits, given by $\mathbf{C}^\top \hat{L}$ and $\mathbf{C}^\top \hat{U}$. We incorporate standardization for both predictive errors in (2) and estimated quantiles in (3) to further enhance prediction efficiency.

V. RESULTS: DER ADOPTION FORECAST

We validate our proposed method using a comprehensive real-world dataset of rooftop solar panel installations from a local utility's network. The dataset spans from 2010 to 2024, consisting of 1,742 installation records distributed across $n = 245$ circuits and $m = 51$ substations. This extensive network coverage not only provides an ideal testbed for validating our

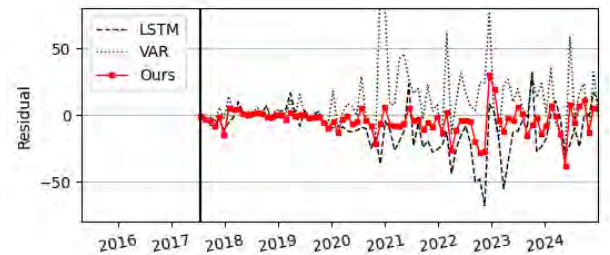


Fig. 2: Comparison of out-of-sample point prediction residuals between HST-Conformal and two point prediction baselines. Our method yields residuals with minimal magnitudes.

TABLE I: Comparison of prediction interval evaluation metrics of all methods in out-of-sample prediction task.

Method	Full			Half		
	Val $\uparrow$	AggVal $\uparrow$	Size $\downarrow$	Val	AggVal $\uparrow$	Size $\downarrow$
LSTM	No (-)	No (-)	-	No (-)	No (-)	-
VAR	No (56%)	No (45%)	0.37	No (68%)	No (79%)	0.37
GPR	No (83%)	Yes (96%)	1.24	No (83%)	Yes (98%)	1.24
QFR	Yes (93%)	Yes (99%)	1.09	Yes (93%)	Yes (100%)	1.09
HST-Conformal	Yes 99%	Yes 100%	1.06	Yes 99%	Yes 95%	0.77

predictive framework but also enables us to generate actionable insights for system operators. Our analysis delivers valuable decision support for both operational planning and strategic infrastructure management.

In our implementation of HST-Conformal, we set $K = 10$, and the parameters of the Hawkes process are randomly initialized, and trained until convergence for 10^3 number of epochs using a learning rate of 10^{-2} learning rate with the Adam gradient descent optimizer.

A. Data Description and Preprocessing

In partnership with the local utility, we analyze detailed records of DER installations at the customer level. Each installation record contains geo-location coordinates, application date, and network topology information, including associated pole, circuit, and substation identifiers. The spatial distribution and temporal evolution of these installations over the past decade are visualized in Figure 1.

For our analysis, we aggregate installation data at six-month intervals for each circuit i , where y_{it} represents the total number of installations within circuit i during time period t . To incorporate socioeconomic factors, we supplement our dataset with five covariates z_{it} for each circuit i at time t , sourced from both the utility and the US Census Bureau. These variables are key socioeconomic indicators, including the average number of power outages, average electrical load, mean electricity price, average education level, and median household income.

B. Numerical Evaluation

We conduct a comprehensive numerical experiment on the dataset, benchmarking against four state-of-the-art load/demand forecasting methods: (i) Linear Vector Autoregression (VAR) [24], (ii) Long Short-Term Memory (LSTM) [25] (iii) Gaussian Process (GPR) [26] and (iv) Quantile Regression (QFR) [27]. We use a significance level of 95% uniformly across all methods, and assess the validity and efficiency of constructed prediction intervals by evaluating the circuit-level validity (Val), substation-level validity (AggVal),

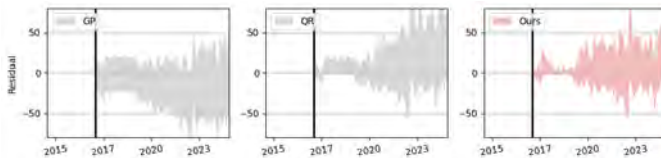


Fig. 3: Comparison of out-of-sample prediction interval residuals between HST-Conformal and two UQ baselines. Our method yields unbiased and tight prediction intervals.

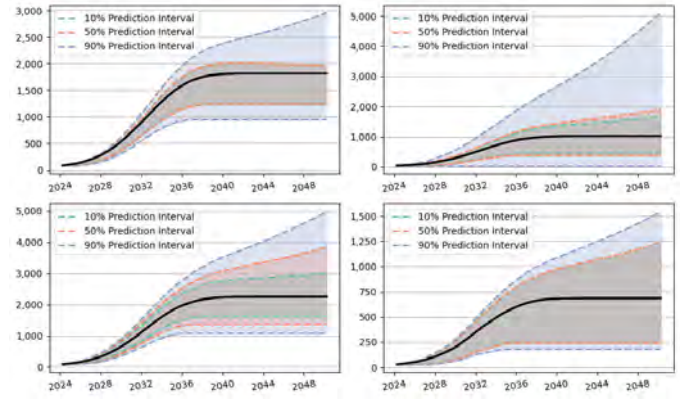


Fig. 4: Prediction intervals of randomly selected four substations from 2024 to 2050.

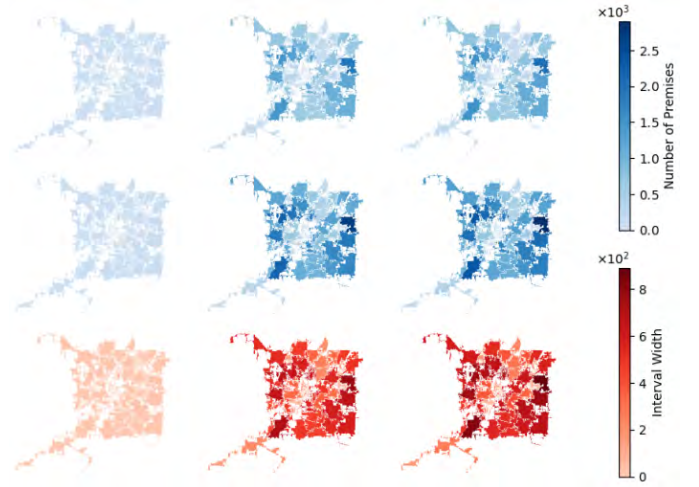


Fig. 5: Prediction results by substation regions. From left to right: 2024, 2037 and 2050. From top to bottom: lower bound, upper bound, and degree of uncertainty.

and average interval size (Size). To ensure the robustness of our results, the evaluation is performed iteratively by computing one-step ahead monthly prediction intervals in the test set under two trials, wherein the second trial we randomly sample half of its nodes.

As shown in Table I, while our method ensures that both the validity and aggregated validity are satisfied, it also achieves the best efficiency compared to the other baseline methods. Figure 2 and Figure 3 attribute our superior performance at both circuit and substation levels to a robust predictive model configuration combined with a well-designed uncertainty quantification approach, underscoring its practical reliability for deployment within the utility service territory.

C. Long-Term Forecast and Analysis

To capture the long-term growth trajectory of DER growth, we present forecasts spanning 2024 to 2050 using the proposed HST-Conformal model. Recognizing the influence of regional economic development on energy infrastructure, we enhance our model with additional socioeconomic predictors, including economic indicators, population demographics, and

load usage patterns. Expert insights from the local utility further refine our model to ensure alignment with localized industry trends and infrastructure needs.

As illustrated in Figure 4, our forecasts reveal a rapid initial growth phase for DER adoption, which gradually slows as saturation is reached, with a plateau projected around 2036. This trend holds consistently across the base, low, and high forecast scenarios, reflecting a natural adoption limit as market penetration reaches peak capacity within the service area. At the substation level, our analysis identifies significant disparity in growth magnitude and uncertainty. Figure 5 offers a spatial perspective on this heterogeneity, highlighting that the degree of uncertainty (prediction interval width) is closely tied to each location's base adoption rate. This pattern suggests that high-adoption substations are also areas of high forecast uncertainty, a critical insight for grid operators and planners.

These findings underscore the importance of strategic investment and planning in high-demand substations, as these regions are especially susceptible to compounded risks of elevated demand and forecast uncertainty. Our work emphasizes the utility of our method in delivering granular, hierarchical interval forecasts that can support informed decision-making, ensuring resilience in planning for grid infrastructure under variable adoption trajectories.

VI. CONCLUSION

This paper addresses the critical need for multilevel uncertainty quantification in forecasting DER growth by developing a hierarchical spatio-temporal model. Our method jointly predicts circuit-level growth and aggregates them to the substation level, tackling challenges associated with overly conservative prediction intervals and excessive variability in aggregated forecasts. By tailoring non-conformity scores to the unique demands of spatio-temporal data, we ensured that our method achieves both statistical validity and practical relevance across spatial scales. Applied to the local utility's DER installation data, our model demonstrated improved prediction interval efficiency without sacrificing coverage, offering a robust tool for energy stakeholders navigating the dynamic landscape of DER integration.

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The logo for 'aes' is stylized with a blue-to-green gradient. The 'a' and 'e' are connected, and the 's' is a thick, curved stroke.

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Attachment 5-5a

(Moody's Q3 2024 - Base)

Provided electronically

The logo for AES, with the letters 'a', 'e', and 's' in a stylized, rounded font. The 'a' is blue, the 'e' is purple, and the 's' is green.

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Attachment 5-5b

(Moody's Q3 2024 - High)

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Attachment 5-5c

(Moody's Q3 2024 - Low)

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Attachment 5-6

(Peak Forecast Drivers and Input Data)

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Attachment 5-7

(AES Indiana 20 -Year Base Load Forecast)

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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 6-1a

(Capital Costs for model)

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Attachment 6-1b

(Capital Costs with source material)

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Attachment 6-2a and b

(Decrement Load Shapes Summary)

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Attachment 6-3

(AES Indiana 2025 MPS)

AES INDIANA



2025 Demand Side Management Market Potential Study

October 24,
2025

FINAL REPORT

VOLUME I 2025 Demand Side Management Market Potential Study Report

1 INTRODUCTION.....	2
1.1 Background & Study Scope.....	2
1.2 Types of Potential Estimated	2
1.3 Approach Summary	3
1.4 Study Limitations	3
1.5 Potential Savings Overview.....	3
1.5.1 Residential Energy Efficiency Potential	4
1.5.2 Commercial and Industrial Energy Efficiency Potential	5
1.5.3 Demand Response Potential.....	6
2 MARKET RESEARCH	7
2.1 Primary Data Collection.....	8
2.1.1 Survey Administration.....	8
2.1.2 Sampling Approach	8
2.1.3 Residential Online Survey	9
2.1.4 Business Sector Online Survey.....	10
2.2 Residential Market Data.....	10
2.3 Business Market Data.....	12
2.4 Adoption Curve Market Data	13
2.4.1 Residential Sector Final Adoption Scores	15
2.4.2 Business Sector Final Adoption Scores	15
3 BASELINE FORECAST	17
3.1 AES Indiana Load Forecasting System.....	17
3.2 Adjustments to the AES-Indiana Load Forecast.....	17
3.2.1 Appliance Market Share Adjustments	17
3.2.2 Adjustment for Large C&I Opt-Out Customers	17
3.2.3 Reclassification of Load.....	18
3.3 Load Forecast Disaggregation.....	18
3.3.1 Residential Sector	19
3.3.2 C&I Sector.....	19
4 ENERGY EFFICIENCY POTENTIAL ANALYSIS.....	22
4.1 Overview Of Approach.....	22
4.2 Market Characterization	22
4.2.1 Forecast Disaggregation	22
4.2.2 Eligible Opt-Out Customers.....	23
4.2.3 Building Stock/Equipment Saturation.....	24
4.2.4 Remaining Factor	24

4.3 Measure Characterization.....	25
4.3.1 Measure Lists.....	25
4.3.2 Emerging Technologies.....	25
4.3.3 Assumptions & Sources.....	25
4.3.4 Treatment of Codes & Standards.....	26
4.3.5 Net to Gross (NTG)	26
4.4 Energy Efficiency Potential	27
4.4.1 Types of Potential	27
4.4.2 Technical Potential	27
4.4.3 Economic Potential	28
4.4.4 Achievable Potential.....	29
4.5 Residential Energy Efficiency Potential.....	32
4.5.1 Scope of Measures & End Uses Analyzed	32
4.5.2 Summary of Residential Electric Potential.....	33
4.5.3 Residential Technical, Economic and Achievable Potential	34
4.5.4 Residential Achievable Potential Benefits & Costs	37
4.6 Commercial and Industrial Energy Efficiency Potential.....	38
4.6.1 Scope of Measures & End Uses Analyzed	38
4.6.2 Summary of C&I Electric Potential	38
4.6.3 C&I Technical, Economic and Achievable Potential.....	40
4.6.4 C&I Achievable Potential Benefits & Costs.....	43
4.7 Program Savings and Budgets.....	44
5 DEMAND RESPONSE POTENTIAL	47
5.1 Demand Response Program Options	47
5.1.1 Demand Response Potential Assessment Approach Overview	49
5.1.2 Avoided Costs.....	50
5.1.3 Demand Response Program Assumptions.....	50
5.2 Total Demand Response Potential	52
5.3 Benefits & Costs	57

Market Potential Study *List of Tables*

TABLE 1-1: RESIDENTIAL INCREMENTAL ANNUAL ENERGY EFFICIENCY POTENTIAL SUMMARY	4
TABLE 1-2: C&I INCREMENTAL ANNUAL ENERGY EFFICIENCY POTENTIAL SUMMARY	5
TABLE 2-1: SURVEY SAMPLING TARGETS AND RESPONSE SUMMARY	9
TABLE 2-2: TARGETED AND COMPLETED RESIDENTIAL SECTOR ONLINE SERVICES	9
TABLE 2-3: RESIDENTIAL HOME INFORMATION.....	10
TABLE 2-4: KEY HOUSEHOLD AND EQUIPMENT CHARACTERISTICS (AVG # PER HH).....	10
TABLE 2-5: SELECT RESIDENTIAL MARKET RESEARCH RESULTS FOR KEY END-USES.....	11

TABLE 2-6: COMMERCIAL BUILDING CHARACTERISTICS	12
TABLE 2-7: COMMERCIAL SECTOR LIGHTING END-USE CHARACTERISITCS.....	12
TABLE 2-8: COMMERCIAL SECTOR EQUIPMENT PENETRATION ACROSS KEY END-USES	13
TABLE 2-9: ADOPTION RATE CATEGORIES ANALYZED	13
TABLE 2-10: RESIDENTIAL FINAL ADOPTION SCORES BY INCENTIVE LEVEL.....	15
TABLE 2-11: DLC DEMAND RESPONSE FINAL ADOPTION SCORES BY INCENTIVE LEVEL	15
TABLE 2-12: TOU DEMAND RESPONSE FINAL ADOPTION SCORES BY INCENTIVE LEVEL	15
TABLE 2-13: NONRESIDENTIAL FINAL ADOPTION SCORES BY INCENTIVE LEVEL AND INVESTMENT TYPE.....	16
TABLE 2-14: NONRESIDENTIAL DEMAND RESPONSE FINAL ADOPTION SCORES	16
TABLE 3-1: FORECAST RECLASSIFICATION AND OPT-OUT REMOVAL (MWH)	18
TABLE 4-1: ELECTRIC END-USE LOADS	23
TABLE 4-2: NUMBER OF MEASURES EVALUATED	25
TABLE 4-3: RESIDENTIAL LONG-TERM MARKET ADOPTION RATES AT DISCRETE INCENTIVE LEVELS.....	30
TABLE 4-4 NONRESIDENTIAL LONG-TERM MARKET ADOPTION RATES AT DISCRETE PAYBACK INTERVALS	31
TABLE 4-5 NON-INCENTIVE COST ASSUMPTIONS – BY PROGRAM AND SECTOR.....	32
TABLE 4-6: RESIDENTIAL ENERGY EFFICIENCY MEASURES – BY END USE	32
TABLE 4-7: RESIDENTIAL CUMULATIVE ANNUAL ENERGY EFFICIENCY POTENTIAL SUMMARY.....	33
TABLE 4-8: RESIDENTIAL INCREMENTAL ANNUAL ENERGY EFFICIENCY POTENTIAL SUMMARY	34
TABLE 4-9: RESIDENTIAL ANNUAL MAP, RAP AND ENHANCED RAP BY END-USE.....	36
TABLE 4-10: RESIDENTIAL ACHIEVABLE POTENTIAL NPV BENEFITS & COSTS.....	38
TABLE 4-11: C&I ENERGY EFFICIENCY MEASURES – BY END USE.....	38
TABLE 4-12: C&I CUMULATIVE ANNUAL ENERGY EFFICIENCY POTENTIAL SUMMARY	39
TABLE 4-13: C&I INCREMENTAL ANNUAL ENERGY EFFICIENCY POTENTIAL SUMMARY	40
TABLE 4-14: C&I ANNUAL MAP, RAP AND ENHANCED RAP BY END-USE	42
TABLE 4-15: C&I ACHIEVABLE POTENTIAL NPV BENEFITS & COSTS.....	44
TABLE 4-16: ANNUAL PROGRAM BUDGETS – RAP AND ENHANCED RAP	46
TABLE 5-1: DEMAND RESPONSE PROGRAM OPTIONS AND ELIGIBLE MARKETS	47
TABLE 5-2: DR HIERARCHY FOR EACH SECTOR.....	49
TABLE 5-3: ANNUAL MAP SAVINGS BY PROGRAM	52
TABLE 5-4: ANNUAL RAP SAVINGS BY PROGRAM.....	53
TABLE 5-5: RAP SEASONAL SAVINGS BY PROGRAM IN 2045	54
TABLE 5-5: SUMMARY OF MAP AND RAP BUDGET REQUIREMENTS.....	57
TABLE 5-7 MAP NPV BENEFITS, COSTS, AND UCT RATIOS FOR EACH DEMAND RESPONSE PROGRAM....	58
TABLE 5-8 RAP NPV BENEFITS, COSTS, AND UCT RATIOS FOR EACH DEMAND RESPONSE PROGRAM	59

Market Potential Study *List of Figures*

FIGURE 1-1: RESIDENTIAL ELECTRIC ENERGY CUMULATIVE ANNUAL POTENTIAL (% OF RESIDENTIAL SALES)	4
FIGURE 1-2: C&I ELECTRIC ENERGY CUMULATIVE ANNUAL POTENTIAL (% OF C&I SALES).....	5
FIGURE 1-3: RESIDENTIAL AND COMMERCIAL DEMAND RESPONSE RAP	6
FIGURE 2-1: SURVEY SCOPE.....	7
FIGURE 3-1 RESIDENTIAL ELECTRIC END-USE BREAKDOWN	19
FIGURE 3-2: COMMERCIAL ELECTRIC SALES BREAKDOWN BY BUILDING TYPE	20
FIGURE 3-3: INDUSTRIAL ELECTRIC SALES BREAKDOWN BY BUILDING TYPE	20
FIGURE 3-4: COMMERCIAL ELECTRIC END-USE BREAKDOWN BY BUILDING TYPE.....	21
FIGURE 3-5: INDUSTRIAL ELECTRIC END-USE BREAKDOWN BY BUILDING TYPE.....	21
FIGURE 4-1: OPT-OUT SALES BY C&I SECTOR.....	23
FIGURE 4-2: TYPES OF ENERGY EFFICIENCY POTENTIAL	27
FIGURE 4-3: RESIDENTIAL ELECTRIC ENERGY CUMULATIVE ANNUAL POTENTIAL (% OF RESIDENTIAL SALES)	33
FIGURE 4-4: RESIDENTIAL TECHNICAL AND ECONOMIC ANNUAL POTENTIAL	35
FIGURE 4-5: RESIDENTIAL ANNUAL ACHIEVABLE POTENTIAL	35
FIGURE 4-6: RESIDENTIAL POTENTIAL BY END-USE AND BUILDING TYPE – RAP 2045.....	36
FIGURE 4-7: RESIDENTIAL ANNUAL BUDGETS – ACHIEVABLE POTENTIAL SCENARIOS.....	38
FIGURE 4-8: C&I ELECTRIC ENERGY CUMULATIVE ANNUAL POTENTIAL (% OF C&I SALES).....	39
FIGURE 4-9: C&I TECHNICAL AND ECONOMIC ANNUAL POTENTIAL	41
FIGURE 4-10: C&I ANNUAL ACHIEVABLE POTENTIAL.....	41
FIGURE 4-11: C&I POTENTIAL BY END-USE AND BUILDING TYPE – RAP 2045	42
FIGURE 4-12: C&I ANNUAL BUDGETS – ACHIEVABLE POTENTIAL SCENARIOS.....	44
FIGURE 4-13: ANNUAL RAP SAVINGS BY PROGRAM (NET).....	45
FIGURE 4-14: ANNUAL ENHANCED RAP SAVINGS BY PROGRAM (NET)	45
FIGURE 5-1: ILLUSTRATION OF S-SHAPED MARKET ADOPTION CURVE	51
FIGURE 5-2: RESIDENTIAL AND COMMERCIAL DEMAND RESPONSE RAP	55
FIGURE 5-3: RESIDENTIAL SECTOR DEMAND RESPONSE RAP – BY PROGRAM.....	56
FIGURE 5-4 NON-RESIDENTIAL SECTOR DEMAND RESPONSE RAP – BY PROGRAM	57
FIGURE 5-5 RESIDENTIAL AND COMMERCIAL DEMAND RESPONSE RAP	58

VOLUME I

2025 AES INDIANA Demand Side Management Market Potential Study

prepared for



OCTOBER 2025

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 three 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 percentage of incremental measure costs) closely calibrated to historical levels but is not constrained by any previously determined spending levels.
 - **Enhanced RAP** estimates achievable potential by adjusting incentive levels in the RAP scenario to increase participation beyond the RAP scenario while also considering implications related to cost-effectiveness. For this scenario, a maximum incentive was calculated to either cover a sector-specific lifetime cost per MWh (\$35 for non-residential and \$50 for residential) or 100% of the measure cost, whichever was less. There was also an incentive floor of 10% of measure cost. Effectively, it is a scenario that has savings and costs greater than the RAP scenario, but less than the MAP scenario.

Chapter 1 Introduction

1.3 APPROACH SUMMARY

The purpose of this market potential study is to provide a foundation for the continuation of utility-administered energy efficiency and demand response programs in the AES Indiana service area, to determine the remaining opportunities for cost-effective energy savings, demand savings, and distributed energy resources for the AES Indiana service area. This study has examined a full array of technologies, programs, and energy efficient building practices that are technically achievable.

The GDS Team used a bottom-up approach to estimate energy efficiency potential in the residential sector. Bottom-up approaches begin with characterizing the eligible equipment stock, estimating savings and screening for cost-effectiveness first at the measure level, then summing savings at the end-use and service area levels. In the commercial and industrial sectors, the GDS team utilized a top-down modeling approach to first estimate measure-level savings and costs as well as cost-effectiveness, and then applied cost-effective measure savings to all applicable shares of electric energy load. A bottom-up approaches was also used in the demand response analysis.

1.4 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
- ❑ 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 (including the use of new primary market research in key market subsegments of interest based on stakeholder feedback) there are often reasonable alternative assumptions which would yield slightly different results. For instance, the analysis assumes that many existing measures, regardless of their current efficiency levels, can be eligible for future installation and savings opportunities. Other studies may select a narrower viewpoint, limiting the amount of potential from equipment that is already considered to be energy efficient. Additionally, the models used in this analysis must make several assumptions regarding program delivery and the timing of equipment replacement that may ultimately occur more rapidly (or more slowly) than currently forecasted.

Furthermore, while the lists of energy efficiency measures examined in this study analysis represent technologies available on the market today as well as a limited number of emerging technologies not currently offered by AES Indiana, these measure lists may not be exhaustive. The GDS Team acknowledges that new efficient technologies may become available over the course of the study timeframe that could produce efficiency gains and costs at different levels than those currently assumed.

Last, where possible, the GDS Team and AES Indiana collaborated to ensure consistency with assumptions and methodological considerations that are expected to be employed by during the program planning process. However, final program designs and implementation strategies may need additional flexibility to target specific or underserved markets, address equity concerns, or react to changing customer preferences.

1.5 POTENTIAL SAVINGS OVERVIEW

The purpose The following several sub-sections provide an overview of the energy efficiency potential and demand response potential. Chapters 4 and 5 of this report provide additional summary data and methodological considerations and descriptions.

	2027	2028	2029	2030	2031	2032
Energy (MWh)						
Technical	317,163	341,518	338,361	334,232	330,067	325,224
Economic	291,240	316,875	314,054	310,781	307,510	303,904
MAP	101,187	103,349	107,084	107,178	110,646	112,572
RAP	78,099	80,291	83,673	85,456	88,295	90,154
Enhanced RAP	89,032	91,017	94,281	94,695	97,635	99,416
Energy Savings (as % of Forecast)						
Technical	5.9%	6.3%	6.2%	6.1%	6.0%	5.9%
Economic	5.4%	5.8%	5.8%	5.7%	5.6%	5.5%
MAP	1.9%	1.9%	2.0%	2.0%	2.0%	2.0%
RAP	1.4%	1.5%	1.5%	1.6%	1.6%	1.6%
Enhanced RAP	1.6%	1.7%	1.7%	1.7%	1.8%	1.8%
MW						

Chapter 1 Introduction

	2027	2028	2029	2030	2031	2032
Technical	64	66	65	64	63	62
Economic	60	63	62	61	60	59
MAP	22	22	22	22	22	22
RAP	15	16	16	16	16	16
Enhanced RAP	18	18	18	18	18	18

1.5.2 Commercial and Industrial Energy Efficiency Potential

Figure 1-2 provides the technical, economic, MAP, RAP, and Enhanced RAP results for the 3-year, 10-year, and 19-year timeframes. The cumulative annual 3-year technical potential is 6.9% of forecasted sales, and the economic potential is 6.9% of forecasted sales. The cumulative annual 3-year MAP is 5.2%, the RAP is 4.1%, and the Enhanced RAP is 4.5% of forecasted sales. Over the duration of the study timeframe the technical and economic potential rise to 31% and 31% of forecasted sales, respectively (indicating nearly all C&I potential is cost-effective at modeled incentive levels). The MAP, RAP and Enhanced RAP increased to 19%, 16% and 17% of forecasted sales respectively, over the study timeframe. The gap between economic potential and MAP/RAP represents market barriers to prospective program participants, both financial and non-financial, to achieving the full amount of economic potential. The Enhanced RAP is greater than RAP as a result of higher incentive levels.

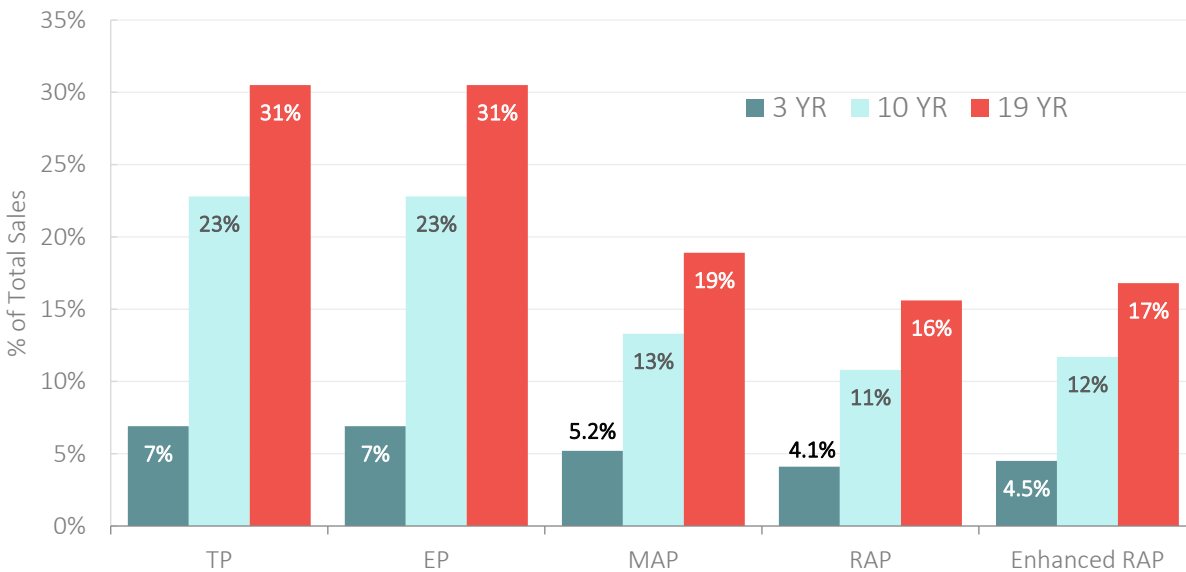


FIGURE 1-2: C&I ELECTRIC ENERGY CUMULATIVE ANNUAL POTENTIAL (% OF C&I SALES)

Table 1-2 provides the incremental annual technical, economic, MAP, RAP and Enhanced RAP energy savings, in total MWh and as a percentage of the sector-level sales forecast. The incremental RAP ranges from 1.0% to 1.5% per year over the next six years, while the Enhanced RAP ranges from 1.1% to 1.7%.

TABLE 1-2: C&I INCREMENTAL ANNUAL ENERGY EFFICIENCY POTENTIAL SUMMARY

	2027	2028	2029	2030	2031	2032
Energy (MWh)						
Technical	118,734	116,430	122,688	125,431	127,426	130,716
Economic	118,726	116,420	122,677	125,419	127,401	130,691
MAP	100,795	87,961	77,973	72,621	65,416	67,888
RAP	78,571	68,547	62,776	58,865	53,571	56,250
Enhanced RAP	88,534	76,827	68,947	64,041	57,881	58,695

Chapter 1 Introduction

	2027	2028	2029	2030	2031	2032
Energy Savings (as % of Forecast)						
Technical	2.3%	2.3%	2.4%	2.4%	2.5%	2.5%
Economic	2.3%	2.3%	2.4%	2.4%	2.5%	2.5%
MAP	2.0%	1.7%	1.5%	1.4%	1.3%	1.3%
RAP	1.5%	1.3%	1.2%	1.1%	1.0%	1.1%
Enhanced RAP	1.7%	1.5%	1.3%	1.2%	1.1%	1.1%
MW						
Technical	20	19	20	20	20	20
Economic	20	19	20	20	20	20
MAP	19	16	13	12	11	11
RAP	14	12	11	10	9	9
Enhanced RAP	16	14	12	11	9	9

1.5.3 Demand Response Potential

Figure 1-3 shows the cumulative annual RAP (MW) by sector. The residential sector RAP rises from 72 MW in 2027 to 156 MW in 2045. The commercial sector RAP starts at just 20 MW in 2027 but rises to 177 MW by 2045.

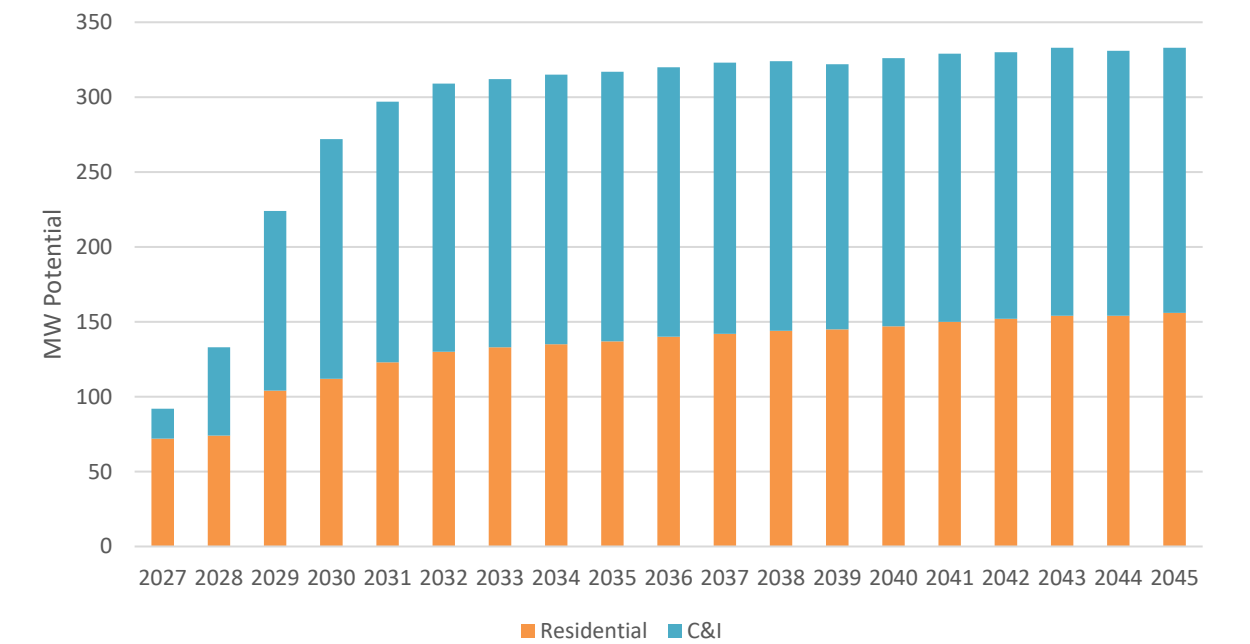


FIGURE 1-3: RESIDENTIAL AND COMMERCIAL DEMAND RESPONSE RAP

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 2024 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, February, and March of 2025 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.

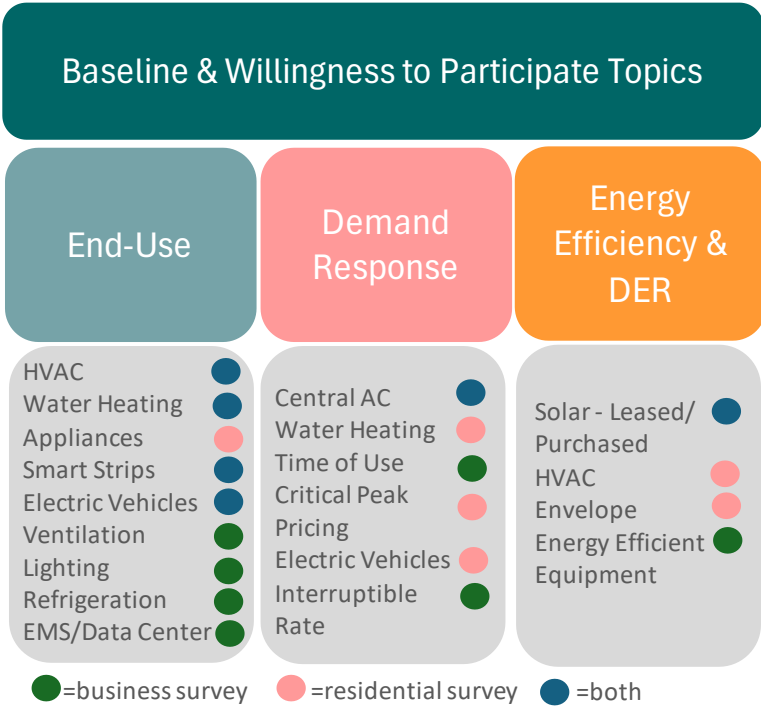


FIGURE 2-1: SURVEY SCOPE

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. All research samples excluded customers who have opted out of email communications from AES-IN, and the business survey sample additionally excluded customers who have opted out of energy efficiency programs with AES-IN.

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 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.

Chapter 2 Market Research

Table 2-1 provides the sampling targets and response outcomes.

Chapter 2 Market Research

TABLE 2-1: SURVEY SAMPLING TARGETS AND RESPONSE SUMMARY

Group	Design Confidence & Precision ¹	Sample Frame	Target Responses	Number of Responses ²	Achieved Precision ³
Baseline Surveys					
Residential	95/5	15,320	384	991	± 3.1%
C&I	90/10	7,718	68	257	± 5.1%
Willingness to Participate Surveys					
Residential – EE & Solar Modules	95/5	7,660	384	423	± 4.0%
Residential – DR & EV Modules	95/5	7,660	384	416	± 4.0%
C&I – EE & Solar Modules	90/10	3,718	68	88	± 8.8%
C&I – DR Modules	90/10	3,718	68	75	± 9.5%

1 – Represents % Confidence/% Relative Precision

2 – Represents total number of respondents, although not all respondents answered all questions

3 – Represents precision if every respondent answered a question, precision for each question will vary based on number of responses to that question

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 in residential online surveys.

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

Strata	Target Completes	Total Completed
Baseline End-Use Survey		
Multifamily	103	176
Non-Multifamily	281	625
Willingness to Participate Survey – DR & EV		
Multifamily	110	60
Non-Multifamily	274	164
Willingness to Participate Survey – EE & Solar		
Multifamily	113	60
Non-Multifamily	271	227

Chapter 2 Market Research

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 235 commercial and industrial customers, with 163 fully completing the baseline survey and 72 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.

Table 2-3 provides current information on the 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	65%	2%	10%	22%
Home Type – AES Customer Data	N/A	71%	1%	1%	27%
Own Home	62%	83%	65%	62%	0%
Multi-level Home	44%	48%	18%	57%	27%
Have Basement	33%	44%	6%	21%	8%
Over Four Occupants	8%	10%	18%	6%	5%
1,800 sq ft Home or Larger	31%	43%	24%	17%	2%
Have Crawlspace	32%	43%	35%	20%	8%

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	2.4	2.6	3.2	2.1	2.0
Electric Oven	0.8	0.7	0.8	0.9	0.8
Microwave Oven	0.9	1.0	0.9	1.0	0.8
Dishwasher	0.7	0.7	0.6	0.7	0.7
Sump Pump	0.3	0.4	0.5	0.1	0.0

Chapter 2 Market Research

Household Characteristics	Total	Single Family	Mobile Home	Duplex/ Triplex/ Condo	Apartment
Attic Fan	0.1	0.1	0.5	0.0	0.0
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	0.4	0.4	0.3	0.6	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 percentage of households that have emerging technologies such as heat pump water heaters, as well as the percentage of homes with insulation and air sealing needs.

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	56%	50%	76%	55%	73%
	Heat Pump WH (as a % of electric WH)	10%	4%	23%	11%	13%
Shell	Uninsulated Attic	8%	4%	12%	6%	20%
	Uninsulated Walls	46%	33%	65%	46%	83%
	Uninsulated Window Shutters	86%	83%	88%	84%	96%
	Uninsulated Bottom Floor	91%	88%	82%	91%	98%
	Single Pane Windows	63%	52%	88%	70%	92%
	No heating system pipe or duct insulation	85%	81%	88%	89%	95%
	Windows that are not caulked or weather stripped	56%	44%	76%	56%	86%
Appliance	In Unit Electric Clothes Washer	88%	95%	94%	95%	62%
	In Unit Electric Clothes Dryer	82%	87%	94%	91%	61%
	In Unit Gas Clothes Dryer	8%	10%	18%	4%	2%
	Electric Vehicle	3%	3%	6%	0%	1%
	PEV/EV Charger at Home	2%	3%	12%	0%	0%

Chapter 2 Market Research

2.3 BUSINESS MARKET DATA

Table 2-6 provides select demographic information in the business sector. Almost half of AES Indiana businesses own their own building, indicating the authority to make decisions on building appliances and other energy efficiency matters. Additionally, 60% of AES Indiana business buildings are more than 24 years old.

TABLE 2-6: COMMERCIAL BUILDING CHARACTERISTICS

Own	46%
Lease	51%
Manage Building	52%
Do not Manage Building	45%
% of Facilities Built Before 2001	60%
Average Size of Facility (Sq. Ft)	23,888
Average Weekday Hours of Operation	11.9
Average Weekend Hours of Operation	9.5

The penetration of different lighting fixtures in AES Indiana businesses is shown in Table 2-7. Low-Bay Linear fixtures are estimated to be in nearly 75% of all facilities. The table also includes the percentage of facilities with different lighting control types as well as the percentage 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)	High-Bay Linear	31%
	High-Bay Non-Linear	19%
	Low-Bay Linear	74%
	Low-Bay Non-Linear	59%
	Other	6%
Lighting (% of all Lighting)	High-Bay Linear	17%
	High-Bay Non-Linear	7%
	Low-Bay Linear	50%
	Low-Bay Non-Linear	24%
	Other	3%
Lighting Controls	Occupancy Sensors	19%
	% of Lighting Controlled	35%
	Daylight Dimming	4%
	% of Lighting Controlled	11%
	Time Controls	10%
	% of Lighting Controlled	43%
	Advanced Lighting Controls	1%
	% of Lighting Controlled	43%

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

End Use	Equipment	Penetration
Heating	Boiler	9%
	Furnace	56%
	Heat Pump	8%
	Electric Resistance	3%
	Unit Heater	5%
	Infrared	1%
Cooling	Packaged System AC	52%
	Split System AC	27%
	Heat Pump (Ducted)	8%
	Heat Pump (Ductless)	1%
	Chiller	3%
	Window AC	8%
Thermostats	Smart Thermostats	14%
	% of Space Controlled by Smart Thermostat	72%
Ventilation	Demand Controlled Ventilation	8%
	Vent Hoods	28%
	Vent Hoods with Demand Controlled Vent.	30%
Refrigeration	Has Commercial Refrigeration?	27%
	Ice Machines	20%
Smart Strips	Smart Strips (% of All Strips)	40%
Water Heating	Electric WH	44%
On-Site Generation	Renewable Energy Generation	0%
	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 by the GDS team.

TABLE 2-9: ADOPTION RATE CATEGORIES ANALYZED

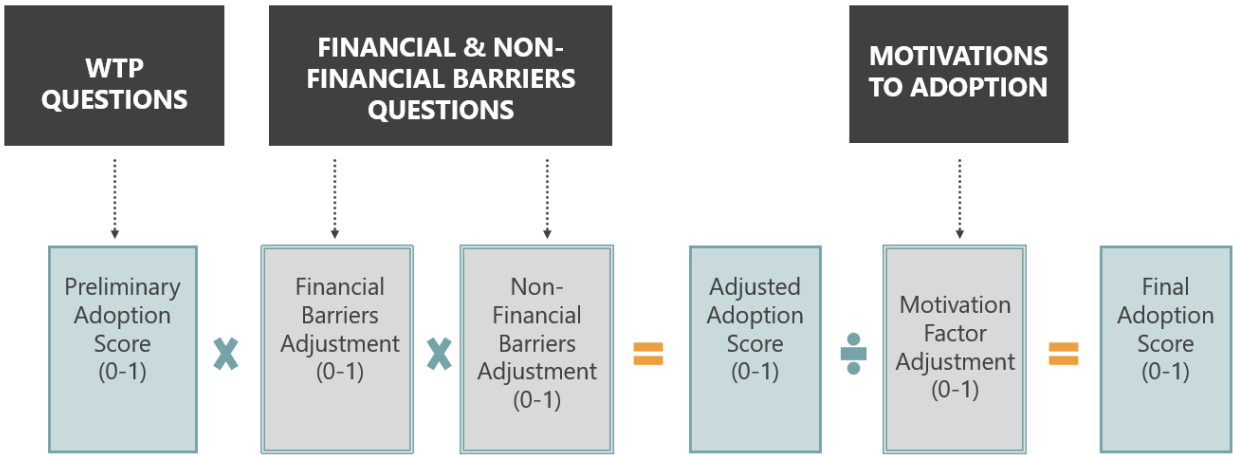
Willingness to Participate	EE End Uses	DR Programs
Residential Customers	Heating/Cooling Systems Insulation/Air Sealing Solar Panels Electric Vehicles	Thermostat Control Water Heater Control Time of Day Rate

Chapter 2
Market Research

Willingness to Participate	EE End Uses	DR Programs
Business Customers	Energy Efficient Equipment Solar Panels	Central AC Control Customized DR (Critical Peak Pricing) Interruptible Rate

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.

Chapter 2 Market Research**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	35%	51%	62%	74%	84%
Insulation/Air Sealing	16%	29%	42%	54%	69%
Solar Panels	9%	21%	36%	50%	64%
Electric Vehicles	11%	24%	38%	49%	57%

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 range between \$20 - \$60 for C/I customers. C/I customer annual incentive offering is dependent upon the size of the commercial AC system. 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	Enrollment Incentive	\$0	\$25	\$50	\$50	\$75
Market Rate	Annual Incentive	\$0	\$25	\$35	\$45	\$50
Central AC – Non-MF		28%	49%	63%	73%	79%
Central AC – MF		31%	48%	61%	70%	76%
Water Heat – Non-MF		17%	33%	46%	57%	64%
Water Heat – MF		24%	39%	51%	59%	66%
Income-Eligible						
Central AC – Non-MF		31%	48%	60%	65%	72%
Central AC – MF		34%	51%	57%	67%	78%
Water Heat – Non-MF		24%	35%	44%	48%	52%
Water Heat – MF		24%	32%	34%	38%	40%

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 – Non-MF	35%	40%	45%	51%
DR TOU – MF	38%	43%	47%	51%
Income-Eligible	\$0.08	\$0.06	\$0.04	\$0.03
DR-TOU – Non-MF	35%	38%	43%	47%
DR TOU – MF	41%	46%	52%	51%

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

Chapter 2 Market Research

the investment is a minor or major investment. Small businesses indicated a major investment to be on average approximately \$26,950. 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

Energy Efficient Equipment	Payback Performance (after incentive)				
	10 Years	5 Years	3 Years	1 Year	0 Years
Minor Investment	16%	38%	60%	77%	84%
Major Investment	19%	37%	60%	76%	84%
Solar Panels	Payback Performance (after incentive)				
	10 Years	5 Years	3 Years	1 Years	0 Years
Purchase	21%	34%	49%	61%	69%
Lease	9%	27%	37%	57%	60%

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	Sign-Up Bonus	\$100	\$150	\$100	\$150	\$200
	Annual Incentive	\$0	\$15	\$25	\$35	\$50
Central AC		34%	43%	56%	55%	68%
DR – Rates	Lower than current rate	5%	10%	20%	40%	
Critical Peak Pricing		25%	35%	42%	53%	
DR – Rates	Incentive \$/kW Shed	\$4	\$6	\$8	\$10	
Interruptible Rate		35%	40%	46%	52%	

3 Baseline Forecast

The load forecast is a critical input into AES Indiana's 2025 DSM Market Potential Study, having various uses in estimation of residential and business sector potential. Therefore, the GDS Team took considerable time and effort in reviewing AES-IN's most recent load forecast models and documentation in order to develop the forecast components needed for this analysis. This chapter describes the various 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 to generate 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 similar to 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 are inputs derived from the previous IRP study conducted by AES Indiana.

3.2 ADJUSTMENTS TO THE AES-INDIANA LOAD FORECAST

Before assessing the future potential for energy efficiency, demand response, or distributed energy resources in the AES Indiana service area, a few modifications to AES Indiana's 2024-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 (see 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.

3.2.2 Adjustment for Large C&I Opt-Out Customers

The 2024 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 percentage 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 27% of commercial energy sales and 84% of industrial energy sales due to large customer opt-out.

3.2.3 Reclassification of Load

The 2024 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 some businesses by Standard Industry Code (SIC). To reclassify AES Indiana C&I sector data, GDS mapped available industry codes to a specified building type and classified the building type as either commercial or industrial. Where a SIC code was not available, keyword matching and individual lookup methods were employed to determine the building types. 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 as a whole, it is only achievable by analyzing individual customer data.

AES Indiana forecast data was given for the following classes: residential, street lighting, small C&I and large C&I. Given the incongruity between customer classifications in the AES Indiana forecast and the reclassification classes, a direct comparison of commercial and industrial sector sales that were shifted cannot be made. Total forecasted energy sales across the small C&I and large C&I classes were reclassified using the resulting estimates from the individual customer data analysis. The result of this reclassification is shown in Table 3-1. 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.

TABLE 3-1: FORECAST RECLASSIFICATION AND OPT-OUT REMOVAL (MWH)

	Small C&I	Large C&I
AES-IN Base Forecast	1,886,866	6,181,912
Percent of C&I Total	23%	77%
	Commercial	Industrial
Reclassification of Load	6,585,215	1,483,563
Percent of C&I Total	82%	18%
Excluding Opt-Outs	4,776,875	238,485
Percent of C&I Total	95%	5%

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.

Chapter 3 Baseline Forecast

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 11,411 kWh per year for 2027. The “Other” end use is the 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 a typical residential home. The “Heating” end use is close behind, confirming the heavy presence of electric heat sources within the AES-IN service territory.

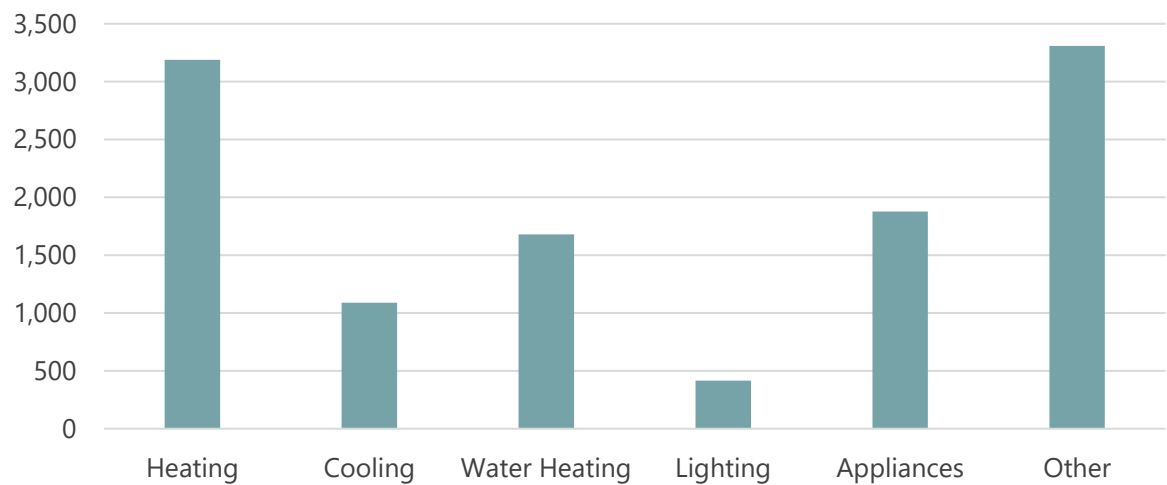


FIGURE 3-1 RESIDENTIAL ELECTRIC END-USE BREAKDOWN

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 to reclassify usage as commercial or industrial. Reclassification data, along with CBECS building type consumption tables, were then used to segment the forecast into building types. Figure 3-2 and Figure 3-3 provide a breakdown of commercial electric sales by building type and industrial sales by sector, with opt-out sales excluded.¹

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

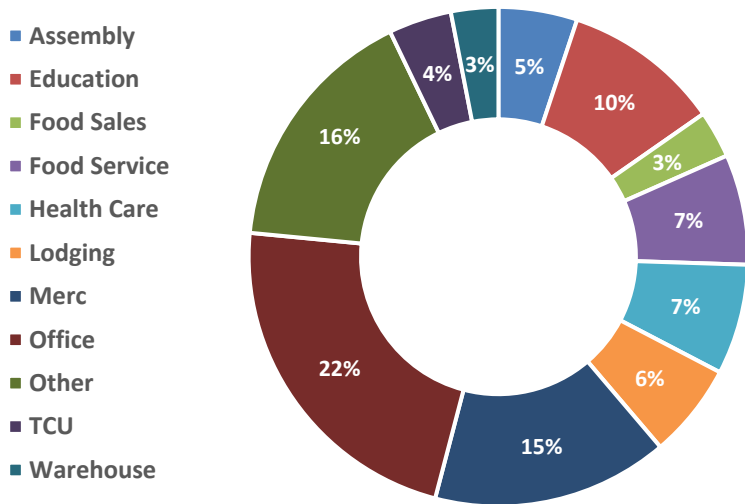


FIGURE 3-2: COMMERCIAL ELECTRIC SALES BREAKDOWN BY BUILDING TYPE

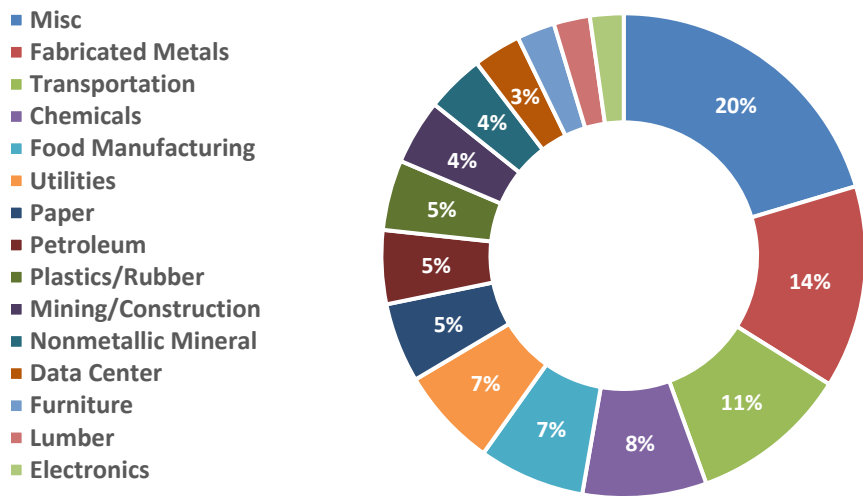


FIGURE 3-3: INDUSTRIAL ELECTRIC SALES BREAKDOWN BY BUILDING TYPE

Figure 3-4 provides an illustration of the leading end-uses across all building types in the commercial sector. Lighting, space heating/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 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.

Chapter 3 Baseline Forecast

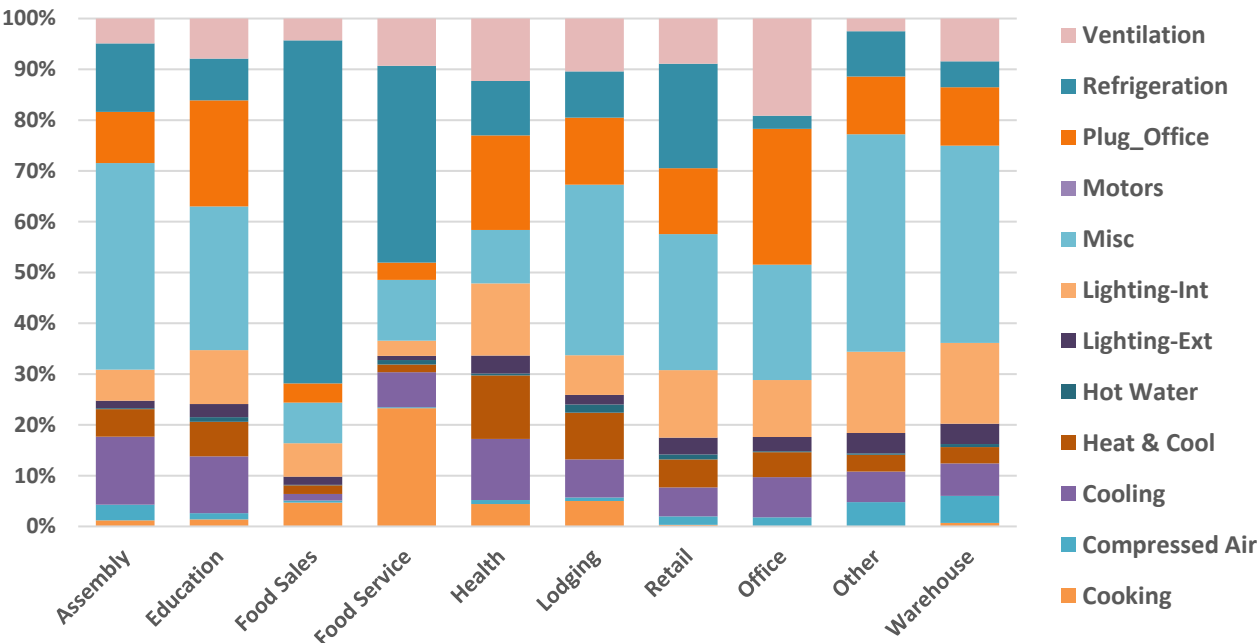


FIGURE 3-4: COMMERCIAL ELECTRIC END-USE BREAKDOWN BY BUILDING TYPE

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 3-5 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% Motors, 12% Process Heat, 10% HVAC, 8% Compressed Air, 7% Lighting, and 7% Process Refrigeration. The remaining 14% was split between other process and other facility loads.

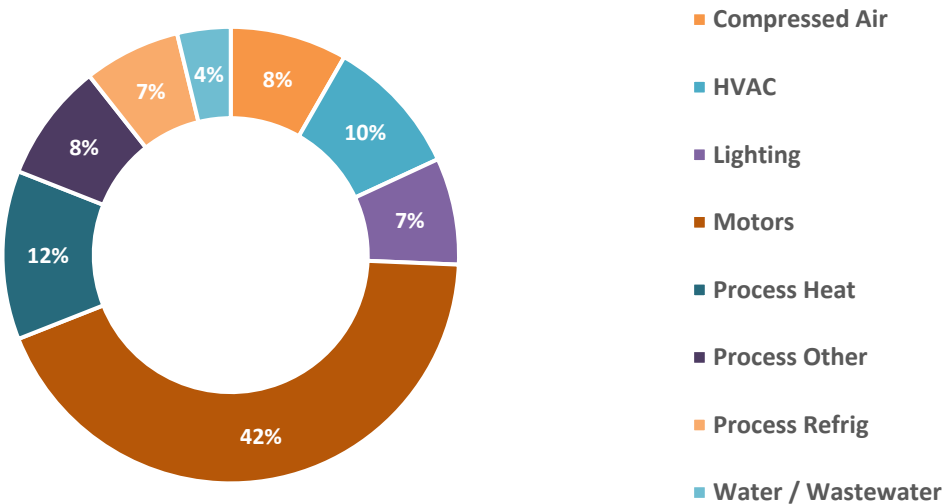


FIGURE 3-5: INDUSTRIAL ELECTRIC END-USE BREAKDOWN BY BUILDING TYPE

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 potential. This document describes the general steps and methods that were used at each stage of the analytical process necessary to produce the various estimates of energy efficiency potential.

Energy efficiency potential studies involve several analytical steps to produce estimates of each type of energy efficiency potential. This study utilizes benefit/cost screening tools for the residential and non-residential sectors to assess the cost-effectiveness of energy efficiency measures. These cost effectiveness screening tools are built-in to Excel-based models that integrate technology-specific impacts and costs, customer characteristics, and utility avoided cost forecasts. The modeling platform provides transparency to the estimation process. The major analytical steps and an overview of the potential savings are summarized below, and specific changes in methodology from one sector to another have been noted throughout this section.

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 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 3, 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.

Chapter 4 Energy Efficiency Potential Analysis

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

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 27% of total reclassified retail commercial sales have opted out of utility-funded electric energy efficiency programs, while 84% 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.

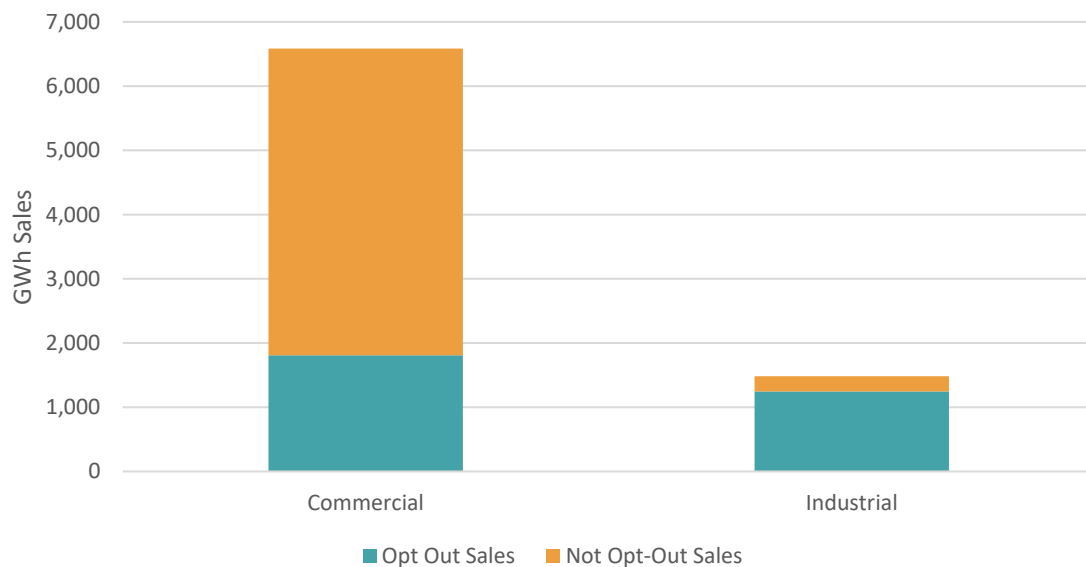


FIGURE 4-1: OPT-OUT SALES BY C&I SECTOR

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.

Chapter 4 Energy Efficiency Potential Analysis

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.

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 two potential study. Other data sources included ENERGY STAR unit shipment data and the EIA Residential Energy Consumption Survey data.² 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 2), 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.³ 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, some customers have disliked the water pressure associated with low flow showerheads and have removed them in favor of standard flow showerheads. These situations represent an opportunity to regain those savings with the installation of higher quality low flow showerhead measures.

Second, for measures categorized as market opportunity (i.e., replace-on-burnout), we assumed that between 40-50% 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 approximately half of the market is transformed, whereas the remaining portion 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 10-15% 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

² <https://www.eia.gov/consumption/residential/data/2020/>

³ Examples of secondary research include Energy Savings Potential RD&D Opportunities for Commercial Building Appliances. 2016. DOE and Energy Star Shipment Data.

Chapter 4 Energy Efficiency Potential Analysis

of these measures are more likely to be elective in nature, compared to market opportunity measures, which are more likely to be need-based. The uncertainty in these assumptions is appropriate, as they factor in a key component of natural customer decision making.

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, current AES Indiana program offerings, the Indiana TRM, the Illinois TRM, 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 311 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 1,974 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	148	631
Commercial	164	1,343
Total	312	1,974

4.3.2 Emerging Technologies

GDS considered several specific emerging technologies as part of analyzing future potential. In the residential sector, these technologies include smart outlets, energy recovery ventilators, connected and ultraefficient LEDs, advanced building shell and windows, 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, efficient dedicated outdoor air systems, integrated lighting and HVAC systems, and server virtualization. While this is not an exhaustive list of possible emerging technologies over the study timeframe, 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. To address this consideration, GDS also included a set of measures characterized in this study as "innovative" and are anticipated to potentially become commercially available during the study timeframe. These measures were phased into the study after 6 years, using the best available estimates of costs and savings to project long-term potential. While these may also be considered emerging technologies, the lack of commercial availability in the near-term necessitates a more long-term view of their potential, which is why GDS determined it was appropriate to include these measures but assume any savings would not accrue until 2033.

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 Indiana TRM, the Illinois TRM, the Michigan Energy Measures Database (MEMD), and EIA data for a large amount of the data requirements. Additional source

Chapter 4 Energy Efficiency Potential Analysis

documents included American Council for an Energy-Efficient Economy (ACEEE) research reports covering topics like emerging technologies.

Measure Savings: GDS relied on the Indiana TRM, the Illinois TRM, existing AES Indiana evaluation report findings to inform calculations supporting estimates of annual measure savings as a percentage of base equipment usage. For custom measures and measures not included in the Illinois TRM, GDS estimated savings from a variety of sources, including:

- MEMD, 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 the Indiana and Illinois TRMs and AES Indiana planning documents. GDS also used the following supplementary data sources:

- MEMD, and other regional/state TRMs
- Secondary sources such as the ACEEE, ENERGY STAR, and NREL⁴

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 the Indiana and Illinois TRMs:

- MEMD, 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 to 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.

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

⁴ National Renewable Energy Laboratory’s National Residential Energy Measures Database <https://remdb.nrel.gov/>

Chapter 4 Energy Efficiency Potential Analysis

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 subsequent inputs for integrated resource planning and preliminary program savings estimates.

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 the timeframe of the study.

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.

Chapter 4 Energy Efficiency Potential Analysis

EQUATION 4-1 CORE EQUATION FOR RESIDENTIAL SECTOR TECHNICAL POTENTIAL



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 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, but the analysis creates multiple measure permutations to account for varying impacts of different heating equipment types and have applied baseline saturations to reflect proportions of households with each heating equipment type.

Applicability Factor Adjustment. Combined measures into measure groups, where total applicability factor across measures is set to 100%. In instances where there are two (or more) competing technologies for the same electrical end use, such as central air conditioners with different tiers of efficiency, an applicability factor aids in determining the proportion of the available population assigned to each measure. In general, measure applicability was assigned based on cost-effectiveness screening results. For example, if one competing measure had a TRC benefit-cost ratio of 2.0, and another competing measure had a UCT ratio of 1.0, the measure with the higher TRC score would receive 66% applicability, with the secondary competing measure receiving the remaining 34% applicability.

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. For example, the savings from installing high efficiency space heating equipment in the residential sector would impact the baseline consumption that remaining building shell efficiency measures could affect.

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.

Chapter 4 Energy Efficiency Potential Analysis

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.⁵

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, incentive levels (as a % of incremental measure cost) were calculated for current measure offerings. GDS relied on the AES Indiana DSM plan estimates and AES Indiana evaluation reports files to map current measure offerings to their incentive levels.

- In the residential sector, incentives by program ranged from 43% to 100% and averaged 62%.
- In the non-residential sector, prescriptive incentives averaged 44% of the measure cost for interior lighting, 83% for exterior lighting and 61% for non-lighting measures.
- Custom measures received incentives equal to \$0.10 per first-year kWh saved (up to 50% of the measure cost).
- In the MAP scenario, incentives were increased up to 100% of the incremental measure cost.⁶

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 shapes⁷ 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 three achievable potential scenarios:

⁵ 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.*

⁶ 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.

⁷ 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.

Chapter 4 Energy Efficiency Potential Analysis

- **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 percentage of incremental measure costs) closely calibrated to historical levels but is not constrained by any previously determined spending levels.
- **Enhanced RAP** estimates achievable potential by adjusting incentive levels in the RAP scenario to increase participation beyond the RAP scenario while also considering implications related to cost-effectiveness. For this scenario, a maximum incentive was calculated to either cover a sector-specific lifetime cost per MWh (\$35 for non-residential and \$50 for residential) or 100% of the measure cost, whichever was less. There was also an incentive floor of 10% of measure cost. Effectively, it is a scenario that has savings and costs greater than the RAP scenario, but less than the MAP scenario.

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 the achievable scenarios. Table 4-3 presents the long-term market adoption rates at varied incentive levels used for the residential sector. Within the HVAC and Building Shell end-uses there is additional variation based on heating equipment type being replaced (e.g., heat pump or electric resistance heating). Behavior was set to 100% to reflect that the program design is typically opt-out and participation levels are dictated by the utility. GDS also adjusted the AES-Indiana-specific adoption curves to reflect observed differences in WTP between the income-qualified and market-rate customers. GDS then estimated initial year adoption rates by reviewing the current saturation levels of efficient technologies and (if necessary) calibrating the estimates of 2027 annual potential to recent historical levels achieved by AES Indiana's current DSM portfolio. This includes moving forward (accelerating) the adoption curve for measures in the Multifamily and Income-Qualified Weatherization programs, while moving backward for measures in the Efficient Products program.

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	12%	25%	32%	44%	57%
Water Heat – SF/LI	14%	26%	35%	47%	57%
Water Heat – MF/NLI	12%	22%	30%	38%	50%
Water Heat – MF/LI	32%	34%	28%	42%	52%

Chapter 4 Energy Efficiency Potential Analysis

End Use/Housing Type/Income	0% Incentive	25% Incentive	50% Incentive	75% Incentive	100% Incentive
HVAC Equip – SF/NLI	24%	39%	50%	61%	74%
HVAC Equip – SF/LI	20%	35%	47%	59%	74%
HVAC Equip – MF/NLI	14%	29%	39%	48%	60%
HVAC Equip – MF/LI	12%	27%	36%	46%	60%
Appliances – SF/NLI	13%	25%	35%	45%	59%
Appliances – SF/LI	11%	20%	35%	43%	59%
Appliances – MF/NLI	13%	24%	29%	39%	51%
Appliances – MF/LI	19%	26%	33%	43%	52%
HVAC Shell – SF/NLI	18%	37%	55%	69%	78%
HVAC Shell – SF/LI	11%	32%	47%	60%	70%
HVAC Shell – MF/NLI	15%	29%	41%	54%	67%
HVAC Shell – MF/LI	9%	25%	35%	48%	59%
Behavior	100%	100%	100%	100%	100%

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 15-year payback performance level to reflect reduced adoption rates for measures with long payback performance levels.

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

End-Use	15 Year Payback Period	10 Year Payback Period	5 Year Payback Period	3 Year Payback Period	1 Year Payback Period	0 Year Payback Period
Prescriptive Rebates Non-Lighting	11%	16%	38%	60%	77%	84%
Prescriptive Rebates Lighting	8%	12%	29%	45%	58%	63%
Custom	21%	32%	57%	75%	85%	88%

Similar to the residential sector, GDS then estimated initial year adoption rates by reviewing the current saturation levels of efficient technologies and calibrating the estimates of 2027 annual potential to recent historical levels. This included accelerating lighting and compressed air measures, while slowing the pace adoption for other measures like refrigeration and office plug load measures. 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) guidelines⁸, utility non-incentive costs were included in the overall assessment of cost-effectiveness of the achievable potential scenarios. Program non-

⁸ 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.

Chapter 4 Energy Efficiency Potential Analysis

incentive costs were calibrated to recent projected levels and set at the levels shown in Table 4-6 below. Non-incentive costs were then escalated annually at the rate of inflation.⁹

TABLE 4-5 NON-INCENTIVE COST ASSUMPTIONS – BY PROGRAM AND SECTOR

Sector	Program/End-Use	Cost per kWh
C&I	Prescriptive Rebates Non-Lighting	\$0.035
C&I	Prescriptive Rebates Lighting	\$0.123
C&I	Custom	\$0.107
Residential	Efficient Products	\$0.295
Residential	Home Energy Reports	\$0.091
Residential	Income Qualified Weatherization	\$0.196
Residential	Multifamily	\$0.310
Residential	School Education	\$0.154

4.5 RESIDENTIAL ENERGY EFFICIENCY POTENTIAL

This section provides the potential results for technical, economic, MAP, RAP and Enhanced RAP for the residential sector. Long-term and short-term results are provided, along with details regarding end-use and home type. Annual budget estimates and overall cost-effectiveness estimates associated with the achievable potential scenarios are also provided.

4.5.1 Scope of Measures & End Uses Analyzed

There were 148 total unique residential electric measures included in the analysis. Table 4-6 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 4-6: RESIDENTIAL ENERGY EFFICIENCY MEASURES – BY END USE

End-Use	Number of Unique Measures
Appliances	22
Behavior	2
HVAC	48
Lighting	9
New Construction	1
Plug Loads	5
Pool/Pump	2
Shell	47
Water Heating	12
Total	148

⁹ As noted earlier in the report, measure costs and utility incentives were not escalated over the analysis timeframe to keep those costs constant in nominal dollars.

Chapter 4 Energy Efficiency Potential Analysis

4.5.2 Summary of Residential Electric Potential

Figure 4-3 provides the technical, economic, MAP, RAP, and Enhanced RAP results for the 3-year, 10-year, and 19-year timeframes. The cumulative annual 3-year technical potential is 14.7% of forecasted sales, and the economic potential is 13.3% of forecasted sales. The cumulative annual 3-year MAP is 4.5%, the RAP is 3.3%, and the Enhanced RAP is 3.9% of forecasted sales. Over the duration of the study timeframe the technical and economic potential rise to 44% and 40% of forecasted sales, respectively. This indicates that a substantial portion of the technical potential is cost-effective. The MAP, RAP and Enhanced RAP increased to 21%, 16% and 19% of forecasted sales respectively, over the study timeframe. The gap between economic potential and MAP/RAP represents market barriers to prospective program participants, both financial and non-financial, to achieving the full amount of economic potential. The Enhanced RAP is greater than RAP as a result of higher incentive levels.

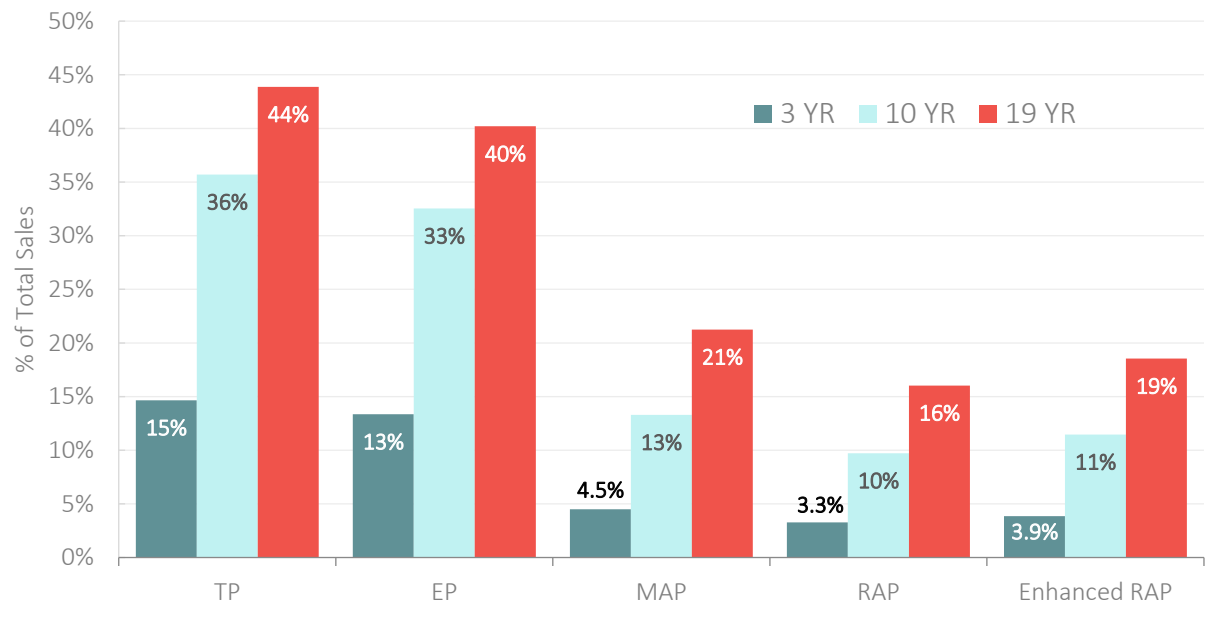


FIGURE 4-3: RESIDENTIAL ELECTRIC ENERGY CUMULATIVE ANNUAL POTENTIAL (% OF RESIDENTIAL SALES)

Table 4-7 provides additional detail regarding the cumulative annual technical, economic, MAP, RAP and Enhanced RAP energy savings, in total MWh and as a percentage of the sector-level sales forecast over 3-yr, 10-yr and 19-yr timeframes. The associated MW of demand savings are also provided.

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

	3 YR	10 YR	19 YR
Energy (MWh)			
Technical	806,455	2,038,770	2,651,354
Economic	734,398	1,857,874	2,429,613
MAP	247,349	759,152	1,284,386
RAP	179,785	555,381	968,945
Enhanced RAP	212,217	654,635	1,120,521
Energy Savings (as % of Forecast)			
Technical	14.7%	35.7%	43.9%
Economic	13.3%	32.5%	40.2%
MAP	4.5%	13.3%	21.3%
RAP	3.3%	9.7%	16.0%
Enhanced RAP	3.9%	11.5%	18.5%
MW			
Technical	166	400	478

Chapter 4 Energy Efficiency Potential Analysis

	3 YR	10 YR	19 YR
Economic	156	377	451
MAP	58	170	256
RAP	39	116	181
Enhanced RAP	47	134	206

Table 4-8 provides the incremental annual technical, economic, MAP, RAP and Enhanced RAP energy savings, in total MWh and as a percentage of the sector-level sales forecast. The incremental RAP ranges from 1.4% to 1.6% per year over the next six years, while the Enhanced RAP ranges from 1.6% to 1.8%.

TABLE 4-8: RESIDENTIAL INCREMENTAL ANNUAL ENERGY EFFICIENCY POTENTIAL SUMMARY

	2027	2028	2029	2030	2031	2032
Energy (MWh)						
Technical	317,163	341,518	338,361	334,232	330,067	325,224
Economic	291,240	316,875	314,054	310,781	307,510	303,904
MAP	101,187	103,349	107,084	107,178	110,646	112,572
RAP	78,099	80,291	83,673	85,456	88,295	90,154
Enhanced RAP	89,032	91,017	94,281	94,695	97,635	99,416
Energy Savings (as % of Forecast)						
Technical	5.9%	6.3%	6.2%	6.1%	6.0%	5.9%
Economic	5.4%	5.8%	5.8%	5.7%	5.6%	5.5%
MAP	1.9%	1.9%	2.0%	2.0%	2.0%	2.0%
RAP	1.4%	1.5%	1.5%	1.6%	1.6%	1.6%
Enhanced RAP	1.6%	1.7%	1.7%	1.7%	1.8%	1.8%
MW						
Technical	64	66	65	64	63	62
Economic	60	63	62	61	60	59
MAP	22	22	22	22	22	22
RAP	15	16	16	16	16	16
Enhanced RAP	18	18	18	18	18	18

4.5.3 Residential Technical, Economic and Achievable Potential

Figure 4-4 provides additional annual savings data for the technical and economic potential. The technical potential starts off at more than 317,000 MWh in 2027 and rises to 2.7 million MWh by 2045. The economic potential starts off at more than 291,000 MWh in 2027 and rises to more than 2.4 million MWh by 2045.

Chapter 4 Energy Efficiency Potential Analysis

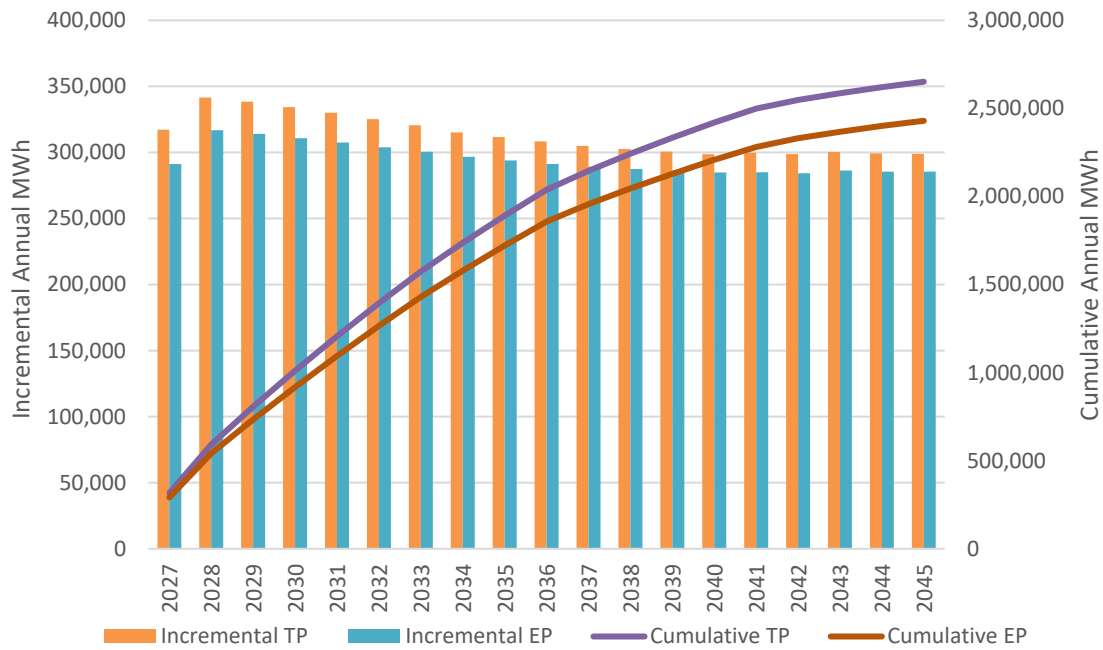


FIGURE 4-4: RESIDENTIAL TECHNICAL AND ECONOMIC ANNUAL POTENTIAL

Figure 4-5 provides the MAP, RAP and Enhanced RAP across the 19-yr timeframe of the study. The bars provide the respective incremental annual MAP, RAP and Enhanced RAP in MWh per year energy savings. The corresponding lines provide the respective incremental annual MAP, RAP and Enhanced RAP in MWh per year energy savings. The corresponding lines provide the cumulative annual MAP, RAP and Enhanced RAP as a percentage of forecasted annual sector sales. The incremental RAP rises from 78,000 MWh to as high as more than 119,000 MWh. The Enhanced RAP starts at 89,000 MWh and rises to more than 135,000 MWh, corresponding to 16.0% and 18.5% in cumulative annual savings for RAP and Enhanced RAP, respectively.

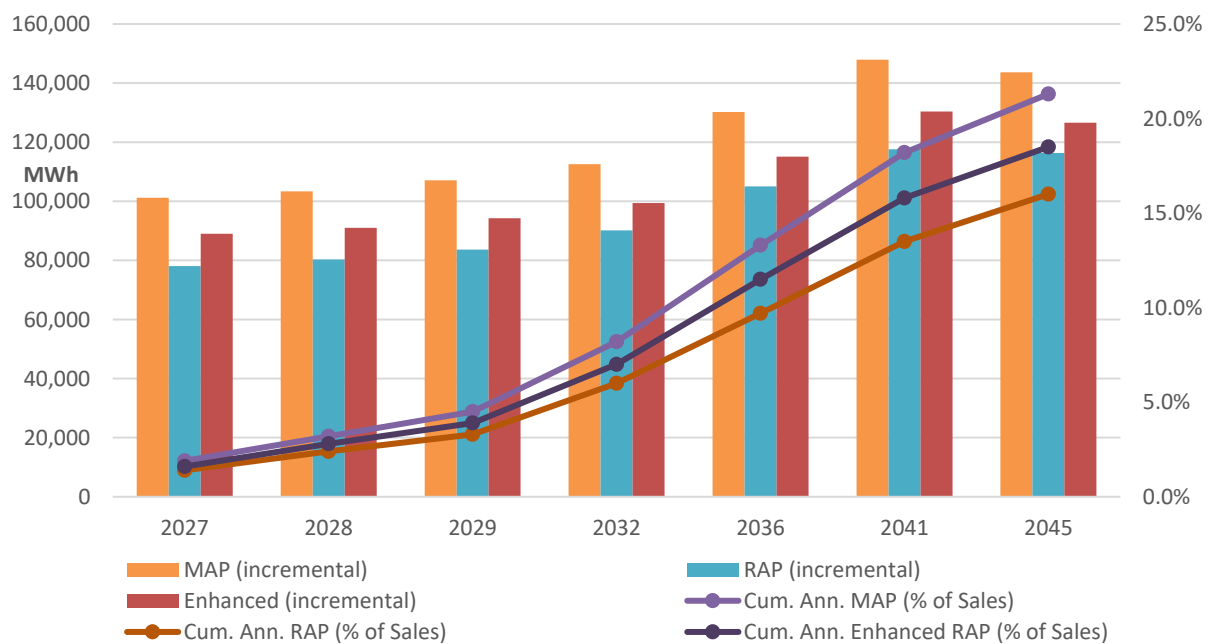


FIGURE 4-5: RESIDENTIAL ANNUAL ACHIEVABLE POTENTIAL

Chapter 4 Energy Efficiency Potential Analysis

Figure 4-6 provides a breakdown of the RAP potential in 2045 across end-uses and building type market segments. HVAC is the leading end-use accounting for 28% of the total. The Shell and Water Heating end-uses combine to account for an additional 37% of the RAP. Emerging and Innovative measures combined account for 18% of the RAP. The single-family housing segment represents 56% of the potential and the multifamily segment represents 23% of the potential. The new construction segment accounts for 3% of potential, and measures dedicated to low-income customers account for 18% of potential.

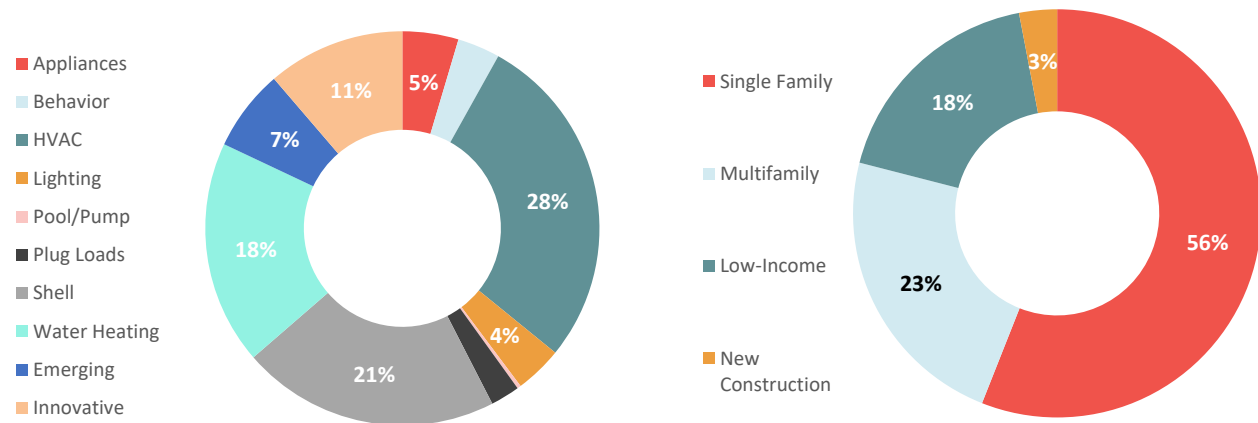


FIGURE 4-6: RESIDENTIAL POTENTIAL BY END-USE AND BUILDING TYPE – RAP 2045

Table 4-9 provides the incremental annual MAP, RAP and Enhanced RAP energy savings over the next six years. The Behavior end-use has the most potential on an incremental annual basis (home energy reports), followed by HVAC, Building Shell, and Water Heating.

TABLE 4-9: RESIDENTIAL ANNUAL MAP, RAP AND ENHANCED RAP BY END-USE

End-Use	2027	2028	2029	2030	2031	2032
MAP						
Appliances	3,144	3,688	4,095	4,457	4,813	5,251
Behavior	28,125	29,376	30,419	31,281	31,992	32,260
HVAC	31,335	30,019	29,386	27,244	27,288	27,631
Lighting	1,736	2,339	2,686	3,003	3,391	4,016
New Construction ¹⁰	0	0	0	0	0	0
Pool/Pump	202	243	286	326	362	395
Plug Loads	2,393	2,383	2,429	2,482	2,353	2,380
Shell	18,021	18,406	18,792	19,195	19,586	19,976
Water Heating	16,233	16,894	18,992	19,191	20,862	20,662
Total	101,187	103,349	107,084	107,178	110,646	112,572
RAP						
Appliances	2,620	3,012	3,337	3,632	3,912	4,214
Behavior	28,125	29,376	30,419	31,281	31,992	32,260

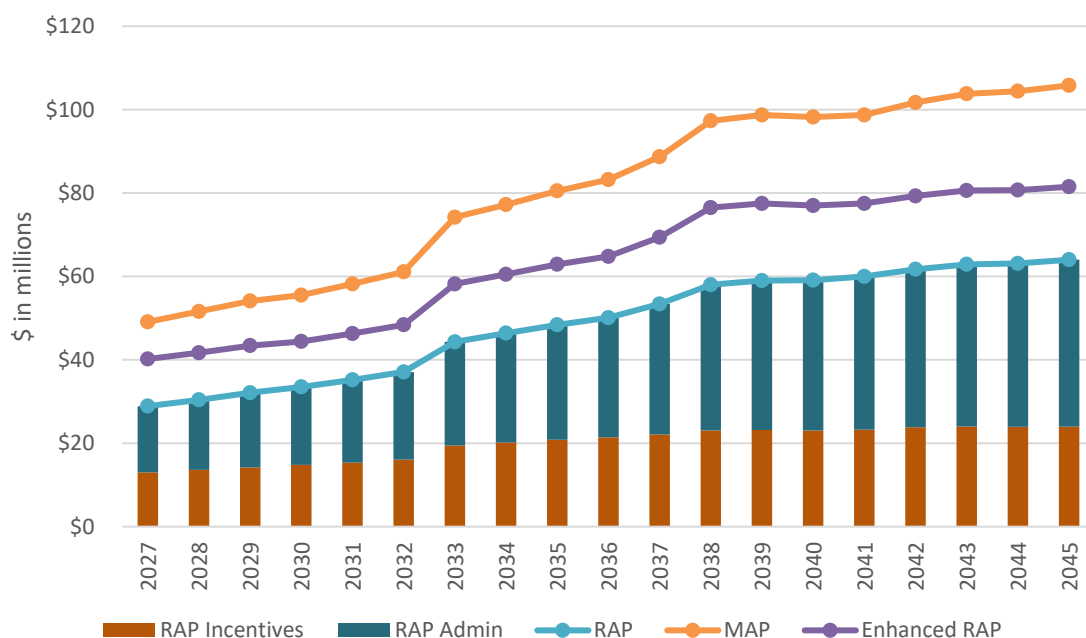
¹⁰ New Construction as an end-use refers to whole home new construction measures, which were found to be not cost-effective. There are cost-effective measures for the new construction vintage of customers, but there are within other end-uses.

Chapter 4 Energy Efficiency Potential Analysis

End-Use	2027	2028	2029	2030	2031	2032
HVAC	21,934	21,159	21,044	20,591	20,611	20,849
Lighting	1,020	1,346	1,555	1,753	1,987	2,328
New Construction	0	0	0	0	0	0
Pool/Pump	130	156	182	206	229	249
Plug Loads	2,155	2,090	2,086	2,095	1,939	1,955
Shell	12,803	13,319	13,830	14,338	14,836	15,330
Water Heating	9,312	9,833	11,219	11,559	12,789	12,970
Total	78,099	80,291	83,673	85,456	88,295	90,154
Enhanced RAP						
Appliances	2,916	3,431	3,810	4,147	4,481	4,901
Behavior	28,125	29,376	30,419	31,281	31,992	32,260
HVAC	26,678	25,293	24,617	22,803	22,662	22,785
Lighting	1,697	2,291	2,629	2,935	3,313	3,928
New Construction	0	0	0	0	0	0
Pool/Pump	131	159	187	214	239	262
Plug Loads	2,386	2,375	2,419	2,468	2,338	2,362
Shell	14,249	14,566	14,881	15,197	15,507	15,816
Water Heating	12,850	13,527	15,319	15,649	17,105	17,105
Total	89,032	91,017	94,281	94,695	97,635	99,416

4.5.4 Residential Achievable Potential Benefits & Costs

Figure 4-7 shows the annual budgets associated with the MAP, RAP and Enhanced RAP scenarios in the residential sector. The figure also shows a breakdown of the RAP budgets by incentives and admin costs each year. The MAP budgets increase from about \$49 million to close to \$106 million over the timeframe of the study. The RAP budgets increase from close to \$29 million up to \$64 million, with about 45% of spending on incentives and the remaining 55% on non-incentive costs at the outset of the study timeframe. The Enhanced RAP budgets increase from about \$40 million to close to \$82 million over the timeframe of the study.



Chapter 4 Energy Efficiency Potential Analysis

FIGURE 4-7: RESIDENTIAL ANNUAL BUDGETS – ACHIEVABLE POTENTIAL SCENARIOS

Table 4-10 provides the net present value (NPV) benefits and cost, as calculated using the UCT, across the 2027-2045 timeframe for the MAP, RAP and Enhanced RAP scenarios. The overall UCT ratio in the RAP scenario is 1.18. The overall UCT ratio in the MAP scenario is 0.98 due to higher assumed incentive costs. Similarly, the savings and costs in the Enhanced RAP are higher due to the increased incentives compared to the RAP scenario, and the Enhanced RAP UCT ratio is 1.01.

TABLE 4-10: RESIDENTIAL ACHIEVABLE POTENTIAL NPV BENEFITS & COSTS

Scenario	NPV Benefits	NPV Costs	UCT Ratio
MAP	\$819,182,500	\$833,095,858	0.98
RAP	\$589,955,178	\$500,044,046	1.18
Enhanced RAP	\$679,546,302	\$672,794,721	1.01

4.6 COMMERCIAL AND INDUSTRIAL ENERGY EFFICIENCY POTENTIAL

This section provides the potential results for technical, economic, MAP, RAP and Enhanced RAP for the C&I sector. Long-term and short-term results are provided, along with details regarding end-use and home type. Annual budget estimates and overall cost-effectiveness estimates associated with the achievable potential scenarios are also provided.

4.6.1 Scope of Measures & End Uses Analyzed

There were 163 total unique C&I electric measures included in the analysis. Table 4-11 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 4-11: C&I ENERGY EFFICIENCY MEASURES – BY END USE

End-Use	Number of Unique Measures
Compressed Air	8
Cooking	9
HVAC	31
Hot Water	3
Lighting	34
Plug Loads	10
Refrigeration	28
Miscellaneous	6
Whole Building	20
Motors	6
Process	9
Total	164

4.6.2 Summary of C&I Electric Potential

Figure 4-8 provides the technical, economic, MAP, RAP, and Enhanced RAP results for the 3-year, 10-year, and 19-year timeframes. The cumulative annual 3-year technical potential is 6.9% of forecasted sales, and the economic potential is 6.9% of forecasted sales. The cumulative annual 3-year MAP is 5.2%, the RAP is 4.1%, and the Enhanced RAP is 4.5% of forecasted sales. Over the duration of the study timeframe the technical and economic potential rise to 31% and 31% of forecasted sales, respectively (indicating nearly all C&I potential is cost-effective at modeled incentive levels). The MAP, RAP and Enhanced RAP increased to 19%, 16% and 17% of forecasted sales respectively, over the study timeframe. The gap between economic potential and MAP/RAP

Chapter 4 Energy Efficiency Potential Analysis

represents market barriers to prospective program participants, both financial and non-financial, to achieving the full amount of economic potential. The Enhanced RAP is greater than RAP as a result of higher incentive levels.

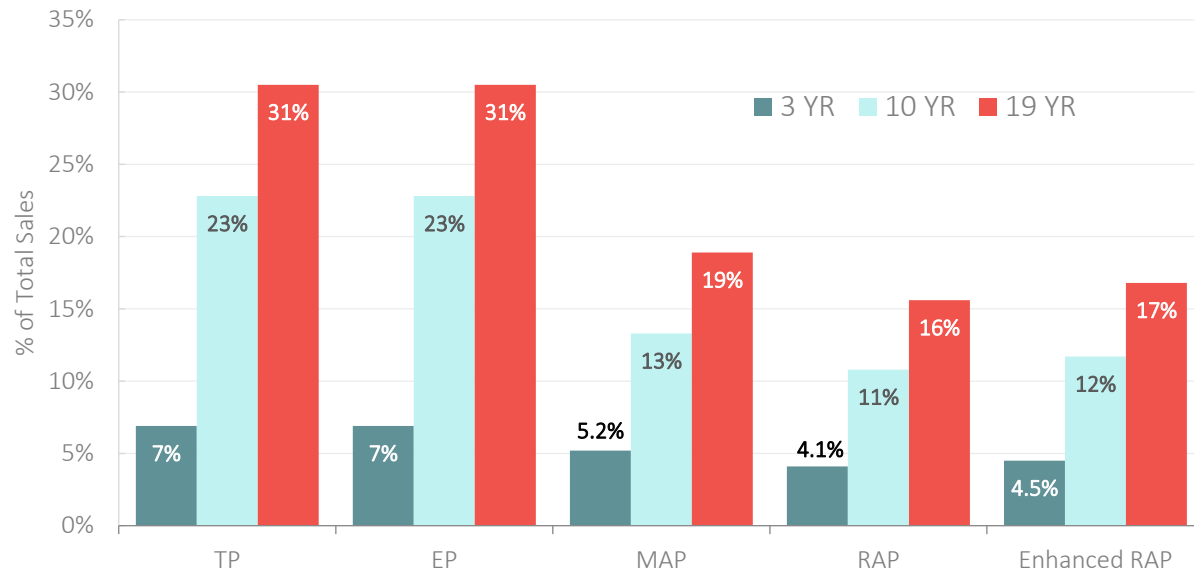


FIGURE 4-8: C&I ELECTRIC ENERGY CUMULATIVE ANNUAL POTENTIAL (% OF C&I SALES)

Table 4-12 provides additional detail regarding the cumulative annual technical, economic, MAP, RAP and Enhanced RAP energy savings, in total MWh and as a percentage of the sector-level sales forecast over 3-yr, 10-yr and 19-yr timeframes. The associated MW of demand savings are also provided.

TABLE 4-12: C&I CUMULATIVE ANNUAL ENERGY EFFICIENCY POTENTIAL SUMMARY

	3 YR	10 YR	19 YR
Energy (MWh)			
Technical	356,941	1,189,242	1,626,491
Economic	356,913	1,189,154	1,626,412
MAP	266,293	694,259	1,007,362
RAP	209,456	560,081	829,043
Enhanced RAP	233,896	611,027	892,745
Energy Savings (as % of Forecast)			
Technical	6.9%	22.8%	30.5%
Economic	6.9%	22.8%	30.5%
MAP	5.2%	13.3%	18.9%
RAP	4.1%	10.8%	15.6%
Enhanced RAP	4.6%	11.7%	17.0%
MW			
Technical	58	191	271
Economic	58	191	271
MAP	48	119	173
RAP	36	94	139
Enhanced RAP	41	103	150

Table 4-13 provides the incremental annual technical, economic, MAP, RAP and Enhanced RAP energy savings, in total MWh and as a percentage of the sector-level sales forecast. The incremental RAP ranges from 1.0% to 1.5% per year over the next six years, while the Enhanced RAP ranges from 1.1% to 1.7%.

Chapter 4 Energy Efficiency Potential Analysis

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

	2027	2028	2029	2030	2031	2032
Energy (MWh)						
Technical	118,734	116,430	122,688	125,431	127,426	130,716
Economic	118,726	116,420	122,677	125,419	127,401	130,691
MAP	100,795	87,961	77,973	72,621	65,416	67,888
RAP	78,571	68,547	62,776	58,865	53,571	56,250
Enhanced RAP	88,534	76,827	68,947	64,041	57,881	58,695
Energy Savings (as % of Forecast)						
Technical	2.3%	2.3%	2.4%	2.4%	2.5%	2.5%
Economic	2.3%	2.3%	2.4%	2.4%	2.5%	2.5%
MAP	2.0%	1.7%	1.5%	1.4%	1.3%	1.3%
RAP	1.5%	1.3%	1.2%	1.1%	1.0%	1.1%
Enhanced RAP	1.7%	1.5%	1.3%	1.2%	1.1%	1.1%
MW						
Technical	20	19	20	20	20	20
Economic	20	19	20	20	20	20
MAP	19	16	13	12	11	11
RAP	14	12	11	10	9	9
Enhanced RAP	16	14	12	11	9	9

4.6.3 C&I Technical, Economic and Achievable Potential

Figure 4-9 provides additional annual savings data for the technical and economic potential. The incremental annual technical and economic potential starts off at nearly 119,000 MWh in 2027 and rises to more than 180,000 MWh by 2042. The cumulative annual economic potential rises to more than 1.6 million MWh by 2045.¹¹

¹¹ Only the cumulative annual Economic Potential is shown since it is nearly identical to Technical Potential in the C&I sector.

Chapter 4 Energy Efficiency Potential Analysis

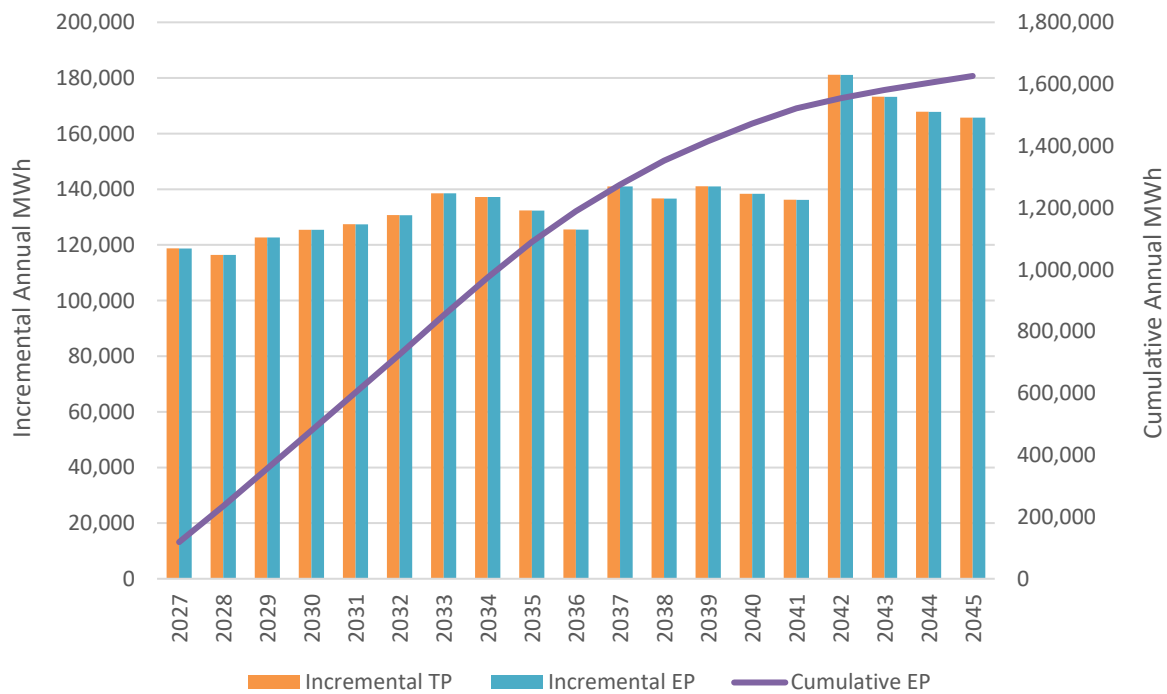


FIGURE 4-9: C&I TECHNICAL AND ECONOMIC ANNUAL POTENTIAL

Figure 4-10 provides the MAP, RAP and Enhanced RAP across the 19-yr timeframe of the study. The bars provide the respective incremental annual MAP, RAP and Enhanced RAP in MWh per year energy savings. The corresponding lines provide the cumulative annual MAP, RAP and Enhanced RAP as a percentage of forecasted annual sector sales. The incremental RAP ranges from 52,000 to 79,000 MWh. The Enhanced RAP ranges from 54,000 to 89,000 MWh, with a corresponding 15.6% and 16.8% in cumulative annual savings for RAP and Enhanced RAP, respectively.

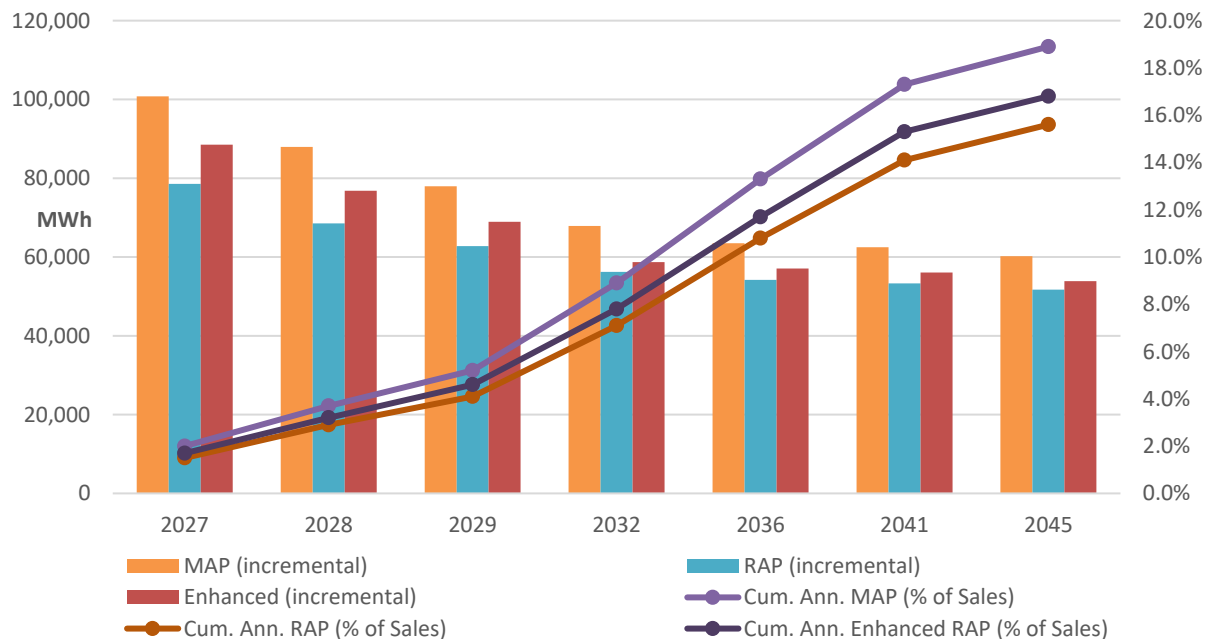


FIGURE 4-10: C&I ANNUAL ACHIEVABLE POTENTIAL

Figure 4-11 provides a breakdown of the RAP potential in 2045 across end-uses and building type market segments. Whole Building is the leading end-use accounting for 25% of the total, followed by Lighting at 24%.

Chapter 4 Energy Efficiency Potential Analysis

Plug Loads, Refrigeration, HVAC combine to account for an additional 37% of the total. The remaining 14% of the total is comprised of Compressed Air, Cooking, Hot Water, Miscellaneous, Motors and Process end-uses. The commercial sector accounts for about 98% of the total C&I potential, with the industrial sector at 2%. This is largely due to the high percentage of industrial sales associated with customers that opt-out of programs (Figure 4-1).

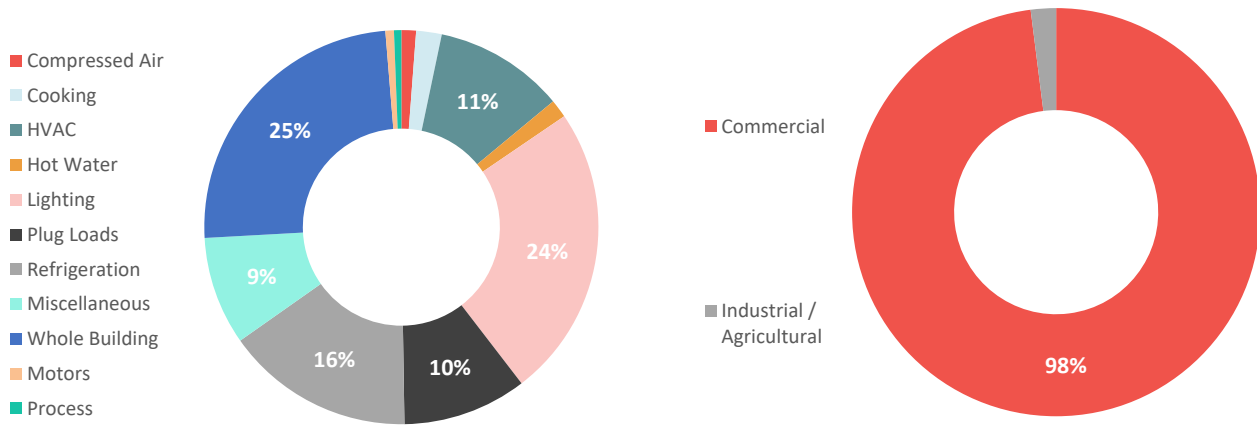


FIGURE 4-11: C&I POTENTIAL BY END-USE AND BUILDING TYPE – RAP 2045

Table 4-14 provides the incremental annual MAP, RAP and Enhanced RAP energy savings over the next six years. The Whole Building end-use provides the most savings consistently over the next six years, while Lighting also provides a majority of the savings at the outset of the study timeframe before steadily decreasing as the market continues to transform.

TABLE 4-14: C&I ANNUAL MAP, RAP AND ENHANCED RAP BY END-USE

End-Use	2027	2028	2029	2030	2031	2032
MAP						
Compressed Air	1,705	1,635	1,528	1,854	1,627	2,064
Cooking	91	162	241	328	424	539
HVAC	4,138	4,409	4,735	5,486	5,584	5,644
Hot Water	444	440	457	464	474	689
Lighting	59,326	49,254	36,430	28,875	19,711	15,086
Plug Loads	1,793	2,536	2,828	3,116	3,486	4,272
Refrigeration	5,181	6,370	6,965	7,353	7,722	9,872
Miscellaneous	6,125	7,381	8,566	9,508	10,045	10,108
Whole Building	21,454	15,172	15,568	14,798	15,479	18,746
Motors	280	317	347	474	492	498
Process	260	287	307	365	372	372
Total	100,795	87,961	77,973	72,621	65,416	67,888
RAP						
Compressed Air	1,416	1,335	1,225	1,553	1,334	1,691
Cooking	79	142	212	289	373	475
HVAC	3,047	3,253	3,513	4,140	4,247	4,335
Hot Water	415	410	425	429	436	639

Chapter 4 Energy Efficiency Potential Analysis

End-Use	2027	2028	2029	2030	2031	2032
Lighting	44,093	37,093	28,964	23,223	16,302	12,491
Plug Loads	1,684	2,368	2,621	2,872	3,199	3,909
Refrigeration	4,550	5,611	6,123	6,453	6,780	8,718
Miscellaneous	4,335	5,222	6,061	6,730	7,114	7,170
Whole Building	18,475	12,582	13,057	12,421	13,010	16,044
Motors	268	303	331	456	472	476
Process	208	229	244	299	304	303
Total	78,571	68,547	62,776	58,865	53,571	56,250
Enhanced RAP						
Compressed Air	1,427	1,359	1,258	1,547	1,341	1,731
Cooking	83	147	219	298	385	490
HVAC	3,398	3,634	3,915	4,546	4,639	4,696
Hot Water	413	407	421	426	432	634
Lighting	51,600	42,686	32,171	25,308	17,332	11,683
Plug Loads	1,657	2,290	2,604	2,864	3,198	3,908
Refrigeration	4,865	5,953	6,501	6,847	7,158	9,043
Miscellaneous	5,278	6,359	7,380	8,193	8,657	8,717
Whole Building	19,307	13,426	13,863	13,224	13,928	16,977
Motors	264	300	328	448	466	471
Process	242	267	285	339	346	346
Total	88,534	76,827	68,947	64,041	57,881	58,695

4.6.4 C&I Achievable Potential Benefits & Costs

Figure 4-12 shows the annual budgets associated with the MAP, RAP and Enhanced RAP scenarios in the C&I sector. The figure also shows a breakdown of the RAP budgets by incentives and admin costs each year. The MAP budgets range from about \$27 million to \$44 million over the timeframe of the study. The RAP budgets range from \$12 million to \$17 million, with about 61% of spending on incentives and the remaining 39% on non-incentive costs at the outset of the study timeframe. The Enhanced RAP budgets range from \$17 million to \$25 million.

Chapter 4 Energy Efficiency Potential Analysis

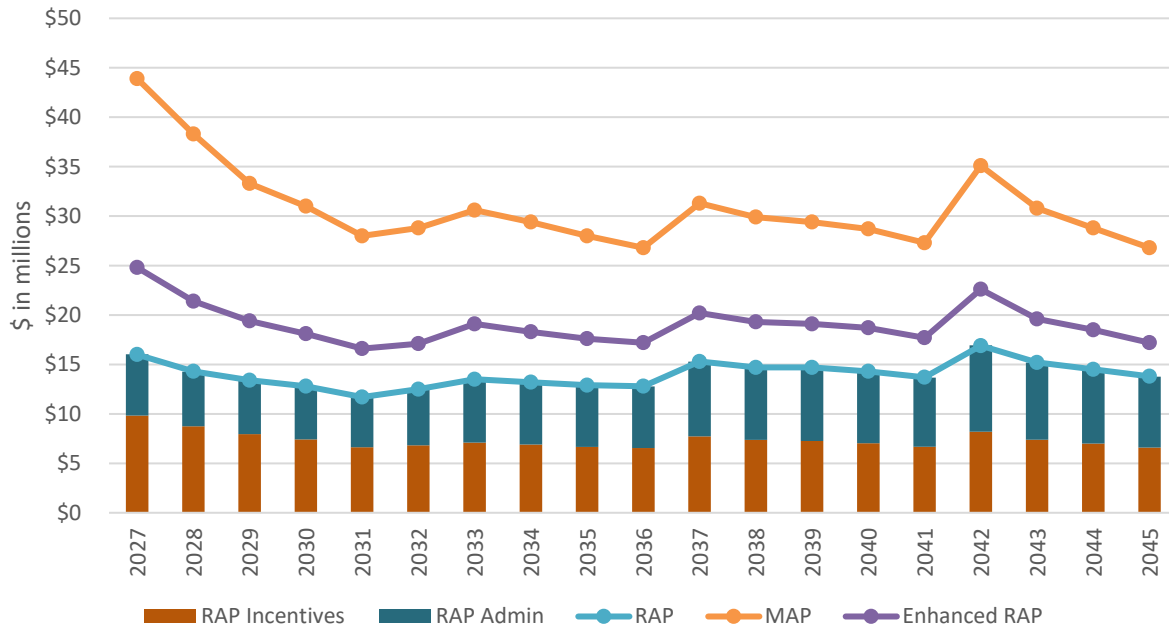


FIGURE 4-12: C&I ANNUAL BUDGETS – ACHIEVABLE POTENTIAL SCENARIOS

Table 4-15 provides the net present value (NPV) benefits and cost, as calculated using the UCT, across the 2027-2045 timeframe for the MAP, RAP and Enhanced RAP scenarios. The overall UCT ratio in the RAP scenario is 5.86. The overall UCT ratio in the MAP scenario is 3.22 due to higher assumed incentive costs. Similarly, the savings and costs in the Enhanced RAP are higher due to the increased incentives compared to the RAP scenario, and the Enhanced RAP UCT ratio is 4.59.

TABLE 4-15: C&I ACHIEVABLE POTENTIAL NPV BENEFITS & COSTS

Scenario	NPV Benefits	NPV Costs	UCT Ratio
MAP	\$1,149,126,785	\$356,413,123	3.22
RAP	\$923,940,927	\$157,686,550	5.86
Enhanced RAP	\$1,004,881,875	\$218,714,093	4.59

4.7 PROGRAM SAVINGS AND BUDGETS

This section provides annual savings and budgets associated with the achievable potential. The results are shown for both the RAP and Enhanced RAP scenarios. The savings reflect the application of NTG ratios to provide the results as net savings. Figure 4-13 and Figure 4-14 show the annual savings by program.¹²

¹² No Program measures are residential sector measures that are not currently offered by an existing AES program. Income Qualified HEAR denotes measures that are not offered by AES but were expected to be associated with federal rebates at the time of the analysis. These rebates are no longer expected to be available with the end of 2025 with the passage of Public Law No: 119-21 on July 4, 2025.

Chapter 4 Energy Efficiency Potential Analysis

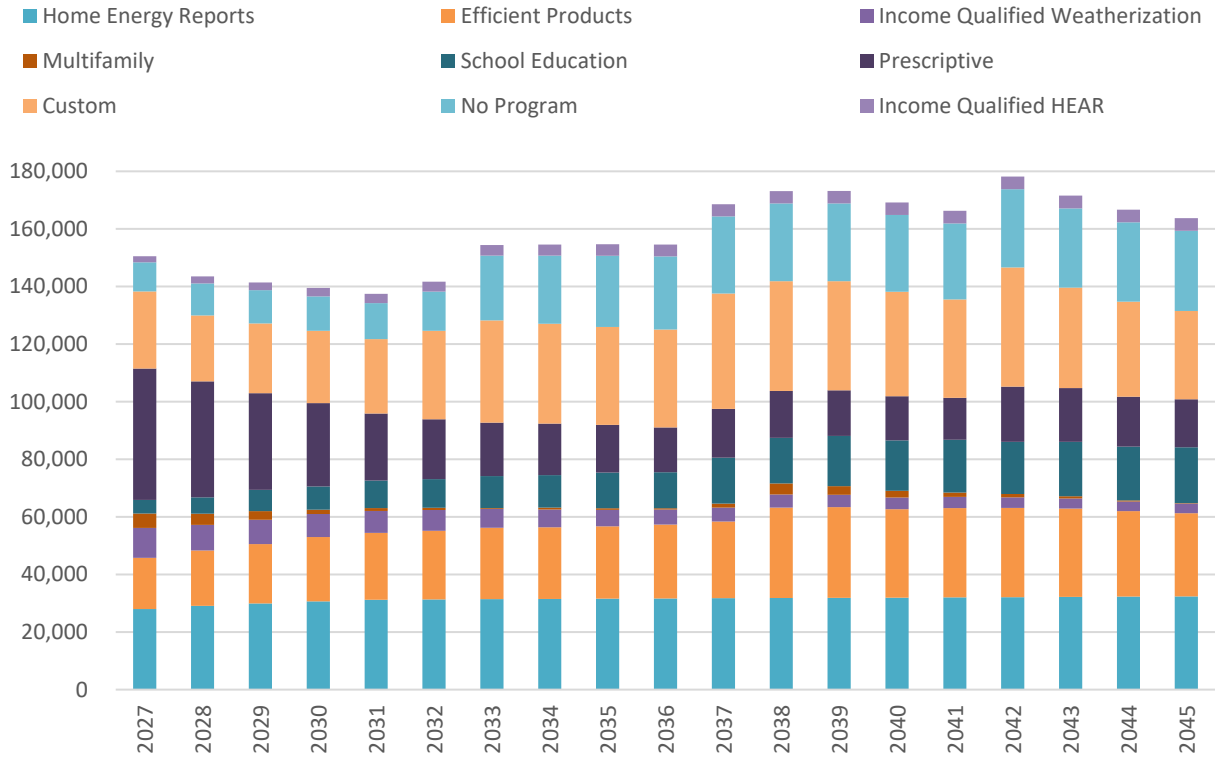


FIGURE 4-13: ANNUAL RAP SAVINGS BY PROGRAM (NET)

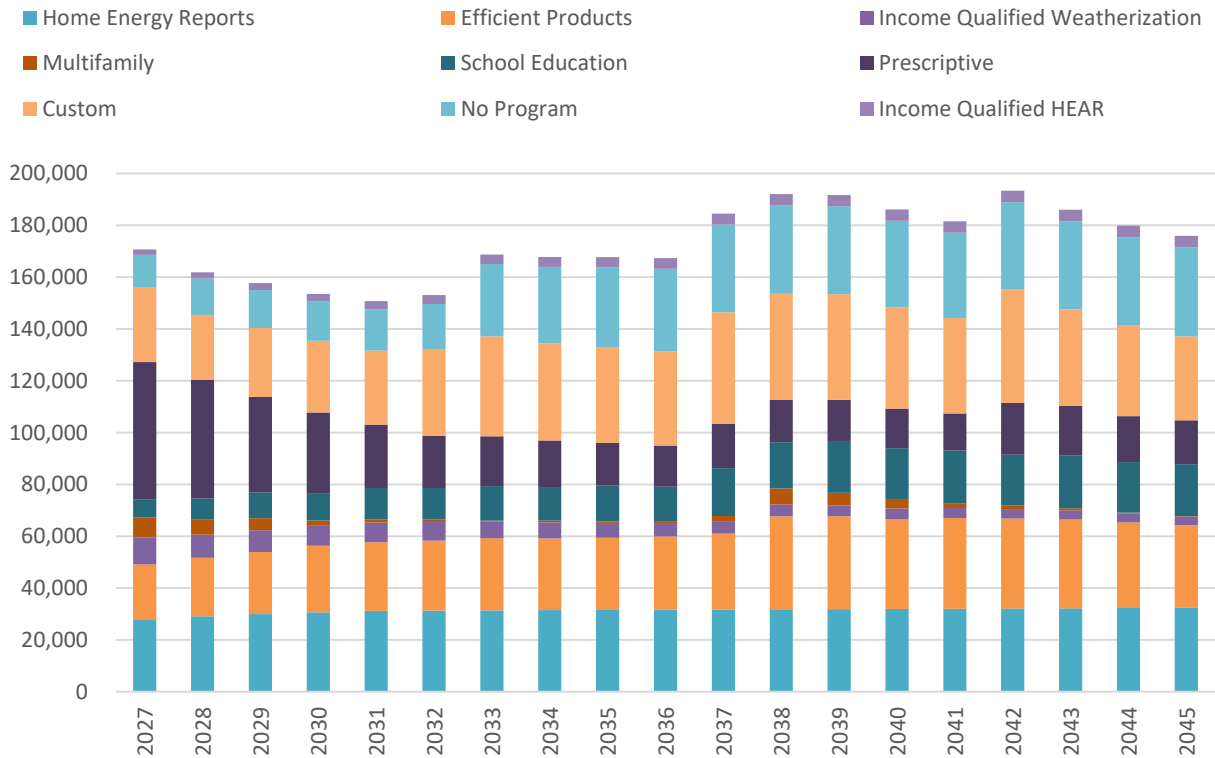


FIGURE 4-14: ANNUAL ENHANCED RAP SAVINGS BY PROGRAM (NET)

Chapter 4 Energy Efficiency Potential Analysis

In the RAP scenario, the total net program savings range from 137,000 MWh to 178,000 MWh, with the top four programs being the Residential Efficient Products and Home Energy Reports programs and the C&I Prescriptive and Custom programs. In the Enhanced RAP scenario, the total net program savings range from 151,000 MWh to 193,000 MWh.

Table 4-16 below shows the annual budgets by program in the RAP and Enhanced RAP scenarios. The total RAP budget ranges from approximately \$45 million in 2027 to \$50 million in 2032. The total Enhanced RAP budget ranges from approximately \$63 million in 2027 to \$66 million in 2032.

TABLE 4-16: ANNUAL PROGRAM BUDGETS – RAP AND ENHANCED RAP

End-Use	2027	2028	2029	2030	2031	2032
RAP						
Efficient Products	\$8,893,910	\$9,738,014	\$10,581,356	\$11,689,732	\$12,399,661	\$13,007,365
Home Energy Reports	\$2,546,522	\$2,705,289	\$2,849,364	\$2,980,750	\$3,102,285	\$3,183,896
IQW	\$6,513,527	\$6,079,997	\$5,926,759	\$5,777,942	\$5,639,232	\$5,509,131
Multifamily	\$1,904,186	\$1,520,122	\$1,200,178	\$642,680	\$428,741	\$346,807
School Education	\$858,622	\$1,096,330	\$1,500,466	\$1,712,532	\$2,093,384	\$2,272,344
No Program	\$5,921,403	\$6,615,738	\$6,984,853	\$7,320,252	\$7,756,658	\$8,556,930
IQ HEAR	\$2,228,580	\$2,616,061	\$3,012,510	\$3,410,730	\$3,804,880	\$4,189,407
Prescriptive	\$9,432,836	\$8,531,082	\$7,272,581	\$6,409,892	\$5,114,833	\$4,571,988
Custom	\$6,592,675	\$5,735,201	\$6,087,636	\$6,347,635	\$6,605,563	\$7,910,160
Total	\$44,892,262	\$44,637,833	\$45,415,704	\$46,292,144	\$46,945,238	\$49,548,028
Enhanced RAP						
Efficient Products	\$12,115,880	\$13,244,494	\$14,360,576	\$15,683,337	\$16,603,562	\$17,378,158
Home Energy Reports	\$2,546,522	\$2,705,289	\$2,849,364	\$2,980,750	\$3,102,285	\$3,183,896
IQW	\$9,071,877	\$8,488,183	\$8,186,503	\$7,902,425	\$7,647,715	\$7,422,585
Multifamily	\$3,251,868	\$2,557,689	\$1,987,203	\$766,824	\$522,407	\$416,352
School Education	\$1,382,853	\$1,602,243	\$2,063,505	\$2,220,776	\$2,616,731	\$2,694,173
No Program	\$9,676,603	\$10,646,227	\$11,154,394	\$11,614,946	\$12,219,446	\$13,343,607
IQ HEAR	\$2,232,499	\$2,620,504	\$3,017,425	\$3,416,050	\$3,810,535	\$4,195,329
Prescriptive	\$14,169,529	\$12,440,292	\$9,828,840	\$8,372,238	\$6,210,539	\$5,309,925
Custom	\$10,642,061	\$8,964,079	\$9,606,064	\$9,777,596	\$10,343,501	\$11,786,664
Total	\$65,089,691	\$63,268,999	\$63,053,876	\$62,734,941	\$63,076,721	\$65,730,689

Chapter 5 Demand Response Potential

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 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 Thermostat	The system operator can remotely raise the AC's thermostat set point during peak load conditions, lowering AC load or lowers space heater's set point, lowering heater 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, or the customer brings an existing thermostat and is only given an annual incentive (BYOT).	Residential and C&I Customers
DLC Water Heater Switch	The water heater is remotely shut off by the system operator for periods normally ranging from 2 to 4 hours using a load control switch.	Residential and C&I Customers
DLC Grid Enabled Water Heater	The grid-enabled water heater is equipped with a smart controller that allows the utility to remotely shut off the water heater for periods normally ranging from 2 to 4 hours.	Residential and C&I Customers
DLC Smart Appliances	Utility remotely sends signals to participating smart appliances that are internet-connected or integrated with the utility's DRMS. Devices can include smart dishwashers, clothes washers, clothes dryers, and plugs/outlets.	Residential 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. Participants 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

Chapter 5 Demand Response Potential

Demand Response Program Option	Program Description	Eligible Markets
DLC Electric Vehicle (Managed Charging Rewards)	DLC of electric vehicles relies on communication (i.e., “dispatch”) signals originating from a utility and sent to a vehicle or charger to control charging in a predetermined manner. Events last up to 6 hours (usually 2-4 hours).	Residential and C&I Customers
Electric Vehicle Time of Use Incentive (Off-Peak Charging Rewards)	Special rate service for electric vehicles that charge off-peak. Participants earn \$0.05 per kWh reported by enrolled Wi-Fi enabled device during off-peak home charging sessions. Off-peak hours are defined as 10PM to 6AM every day.	Residential and C&I Customers
Electric Vehicle EVX Rate	Legacy electric vehicle rate. Closed to new customers.	Residential Customers
Time of Use Rate	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
Peak Time Rebate	Customers are given a rebate for less consumption during times selected as critical periods.	Residential Customers
Behavioral DR	An opt-out program where alerts are sent to customers on peak-days via email, text, or app notification. Customers are encouraged to take simple steps to reduce usage, such as adjusting thermostats, delaying laundry or dishwasher use, turning off lights, and avoiding EV charging. Incentives are not paid for this type of program.	Residential Customers
Thermal Energy Storage 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.	Large C&I Customers
Load Curtailment	A discounted rate is offered to the customer for agreeing to interrupt or curtail load during peak period.	Large 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

Chapter 5 Demand Response Potential

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

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	Load Curtailment
2	Time of Use	Capacity Bidding	Capacity Bidding
3	Peak Time Rebate	Time of Use	Time of Use
4	Behavioral		

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*.¹³ Additionally, GDS reviewed the May 2017 National Standard Practice Manual published by the National Efficiency Screening Project.¹⁴ 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 costs 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.

¹³ Study was prepared by Synapse Energy Economics and the Regulatory Assistance Project, February 2013.

¹⁴ [National Standard Practice Manual for Assessing Cost-Effectiveness of Energy Efficiency Resources](#), May 18, 2017, Prepared by The National Efficiency Screening Project

Chapter 5 Demand Response Potential

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 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. A detailed table of assumptions and sources can be found in Appendix D.

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 other industry reports and evaluations or 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 11 years. Load control switches have a useful life of 10 years. This life was used for all direct load control measures using switches in this study. The life of a smart appliance was assumed to be 14 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 \$50 per new participant for marketing for

Chapter 5 Demand Response Potential

the DLC programs. Marketing costs are assumed to be 20% higher for MAP. All program costs were escalated each year by the general rate of inflation assumed for this study.

Saturation: For direct load control programs that control a specific end use, a saturation was applied to determine the number of eligible customers. For example, only customers with electric water heaters can participate in the water heating control program. Saturations from AES’s 2025 market research were used.

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 conducted a willingness to participate survey for the 2025 market research. These questions helped determine adoption rates for many of the demand response programs. For demand response programs that were not asked about in the survey, GDS reviewed industry data and program adoption levels from several utility demand response programs. 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.

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.

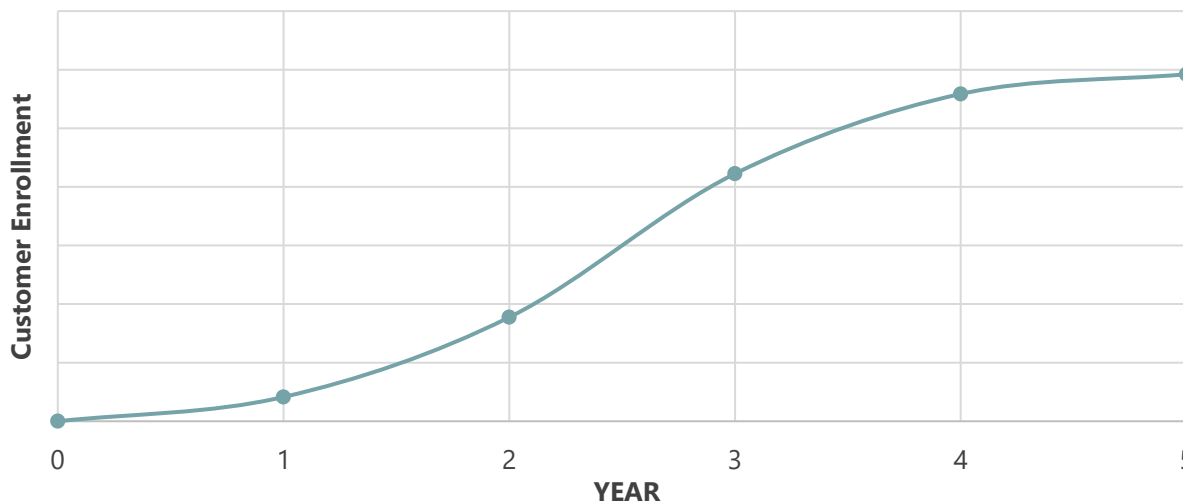


FIGURE 5-1: ILLUSTRATION OF S-SHAPED MARKET ADOPTION CURVE

5.1.3.2 Rate Program Assumptions

Load Reduction: Demand reductions were based on various secondary data sources including other industry reports and evaluations or 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 only equipment needed for rate programs 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 \$50 per new participant for marketing for

Chapter 5 Demand Response Potential

the rate programs. Marketing costs are assumed to be 20% higher for MAP. All program costs were escalated each year by the general rate of inflation assumed for this study.

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 show the achievable cumulative annual potential savings for the Years 1-3, 10 and 18. 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.

TABLE 5-3: ANNUAL MAP SAVINGS BY PROGRAM

Sector	Program	2027	2028	2029	2036	2045
Residential	DLC Central AC Switch - One Way	19	18	18	15	11
	DLC Central AC Switch - Two Way	3	3	3	2	2
	DLC Thermostat (Free Thermostat)	2	2	2	3	4
	DLC Thermostat (BYOT)	49	52	56	76	95
	DLC Water Heater Switch*	1	1	2	3	5
	DLC Grid-Enabled Water Heater*	1	4	8	11	10
	DLC Smart Appliances*	0	0	1	1	1
	DLC Room Air Conditioning*	0	1	3	3	3
	DLC Electric Vehicle*	0	0	0	3	9
	Electric Vehicle Time of Use Incentive*	0	1	1	6	18
	Electric Vehicle EVX Rate*	0	0	0	0	0
	Time of Use Rate	0	0	3	24	20
	Peak Time Rebate	0	0	3	19	16
	Behavioral Demand Response	0	0	22	13	11
	Battery Storage*	0	0	1	5	6
	Sector Total	76	84	122	185	211
C&I	DLC Central AC Switch - One Way*	0	0	0	0	0
	DLC Central AC Switch - Two Way	2	2	3	8	14
	DLC Thermostat (Free Thermostat)	1	2	4	6	6
	DLC Thermostat (BYOT)	1	1	2	4	6
	DLC Water Heater Switch	1	3	6	8	8

Chapter 5 Demand Response Potential

Sector	Program	2027	2028	2029	2036	2045
	DLC Grid-Enabled Water Heater	1	2	4	6	5
	DLC Lighting*	0	0	1	8	14
	DLC Electric Vehicle*	0	0	0	0	0
	Electric Vehicle Time of Use Incentive*	0	0	0	0	0
	Time of Use Rate	0	0	1	8	7
	Thermal Energy Storage Rate*	0	0	0	0	0
	Battery Storage*	0	0	0	0	1
	Capacity Bidding	10	31	62	78	62
	Load Curtailment	11	36	76	107	97
	Sector Total	26	78	159	233	220
Residential and C&I Total		102	162	281	418	432

TABLE 5-4: ANNUAL RAP SAVINGS BY PROGRAM

Sector	Program	2027	2028	2029	2036	2045
Residential	DLC Central AC Switch - One Way	19	19	18	16	13
	DLC Central AC Switch - Two Way	3	3	3	2	2
	DLC Thermostat (Free Thermostat)	2	2	2	2	2
	DLC Thermostat (BYOT)	46	47	48	53	57
	DLC Water Heater Switch*	1	1	1	3	4
	DLC Grid-Enabled Water Heater*	0	1	2	3	2
	DLC Smart Appliances*	0	0	0	0	0
	DLC Room Air Conditioning*	0	1	1	2	2
	DLC Electric Vehicle*	0	0	0	3	8
	Electric Vehicle Time of Use Incentive*	0	0	1	4	13
	Electric Vehicle EVX Rate	0	0	0	0	0
	Time of Use Rate	0	0	1	12	12
	Peak Time Rebate	0	0	2	17	16
	Behavioral Demand Response	0	0	23	19	18
	Battery Storage*	0	0	1	4	6
	Sector Total	72	74	104	140	156
C&I	DLC Central AC Switch - One Way*	0	0	0	0	0

Chapter 5 Demand Response Potential

Sector	Program	2027	2028	2029	2036	2045
	DLC Central AC Switch - Two Way	1	2	2	5	8
	DLC Thermostat (Free Thermostat)	0	1	3	4	4
	DLC Thermostat (BYOT)	1	1	1	3	4
	DLC Water Heater Switch	1	2	5	7	6
	DLC Grid-Enabled Water Heater	0	0	1	1	1
	DLC Lighting*	0	0	1	6	11
	DLC Electric Vehicle*	0	0	0	0	0
	Electric Vehicle Time of Use Incentive*	0	0	0	0	0
	Time of Use Rate	0	0	1	7	6
	Thermal Energy Storage Rate*	0	0	0	0	0
	Battery Storage*	0	0	0	0	1
	Capacity Bidding*	8	24	48	65	58
	Load Curtailment	9	28	58	83	77
	Sector Total	20	59	120	180	177
Residential and C&I Total		92	133	224	320	333

Programs that had end uses that could be run in multiple seasons were assumed to run year-round. Table 5-5 shows the potential MW savings for each season in the RAP scenario in the final year of the study. Programs marked with an asterisk were those that were found to not be cost-effective.

TABLE 5-5: RAP SEASONAL SAVINGS BY PROGRAM IN 2045

Sector	Program	Spring	Summer	Fall	Winter
Residential	DLC Central AC Switch - One Way	8	13	8	0
	DLC Central AC Switch - Two Way	1	2	1	0
	DLC Thermostat (Free Thermostat)	1	2	0	1
	DLC Thermostat (BYOT)	12	57	10	34
	DLC Water Heater Switch*	3	4	3	7
	DLC Grid-Enabled Water Heater*	2	2	2	4
	DLC Smart Appliances*	0	0	0	0
	DLC Room Air Conditioning*	1	2	1	0
	DLC Electric Vehicle*	5	8	5	15
	Electric Vehicle Time of Use Incentive*	8	13	8	11
	Electric Vehicle EVX Rate*	0	0	0	0
	Time of Use Rate	7	12	7	5
	Peak Time Rebate	10	16	10	10

Chapter 5 Demand Response Potential

Sector	Program	Spring	Summer	Fall	Winter
	Behavioral Demand Response	11	18	11	8
	Battery Storage*	3	6	3	6
	Sector Total	72	156	71	102
C&I	DLC Central AC Switch - One Way*	0	0	0	0
	DLC Central AC Switch - Two Way	7	8	8	0
	DLC Thermostat (Free Thermostat)	1	4	1	3
	DLC Thermostat (BYOT)	1	4	1	3
	DLC Water Heater Switch	6	6	6	6
	DLC Grid-Enabled Water Heater	1	1	1	1
	DLC Lighting*	10	11	10	8
	DLC Electric Vehicle*	0	0	0	0
	Electric Vehicle Time of Use Incentive*	0	0	0	0
	Time of Use Rate	6	6	6	2
	Thermal Energy Storage Rate*	0	0	0	0
	Battery Storage*	1	1	1	1
	Capacity Bidding	36	58	36	45
	Load Curtailment	70	77	72	58
	Sector Total	139	177	141	129
	Residential and C&I Total	211	333	212	231

Figure 5-2 shows the cumulative annual RAP (MW) by sector. The residential sector RAP rises from 72 MW in 2027 to 156 MW in 2045. The commercial sector RAP starts at just 20 MW in 2027 but rises to 177 MW by 2045.

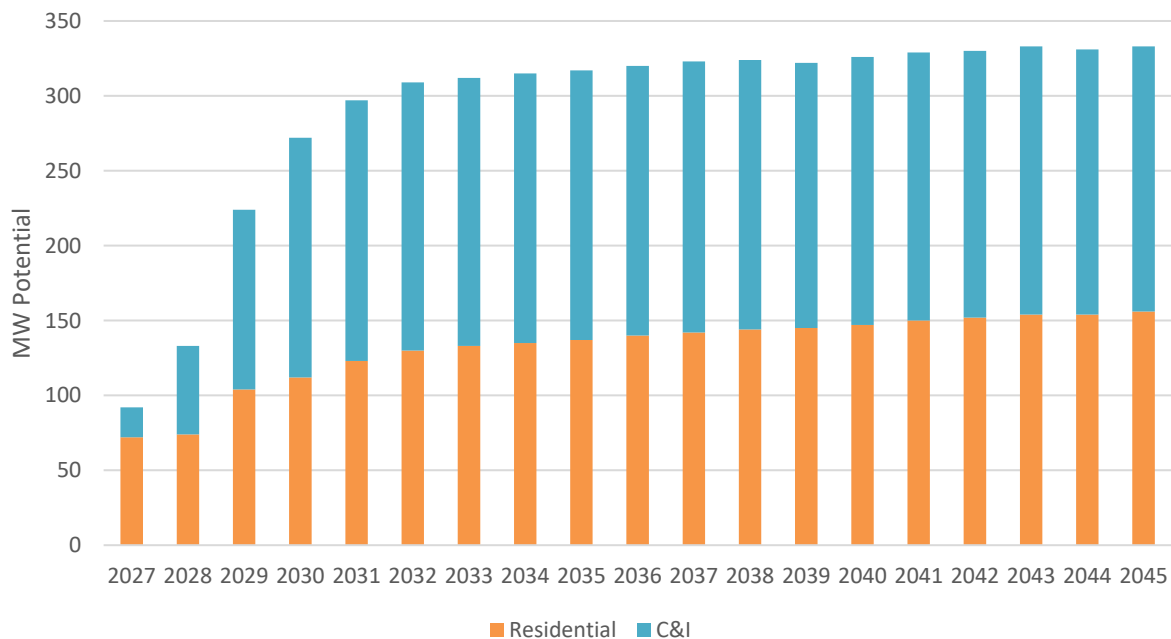


FIGURE 5-2: RESIDENTIAL AND COMMERCIAL DEMAND RESPONSE RAP

Chapter 5 Demand Response Potential

Figure 5-3 shows the cumulative annual RAP (MW) by program in the residential sector. The DLC HVAC programs (DLC Central AC Switch One & Two Way and DLC Thermostat options) collectively account for about 48% of the residential RAP, with the total RAP exceeding 156 MW by 2045. Programs marked with an asterisk were those that were found to not be cost-effective.

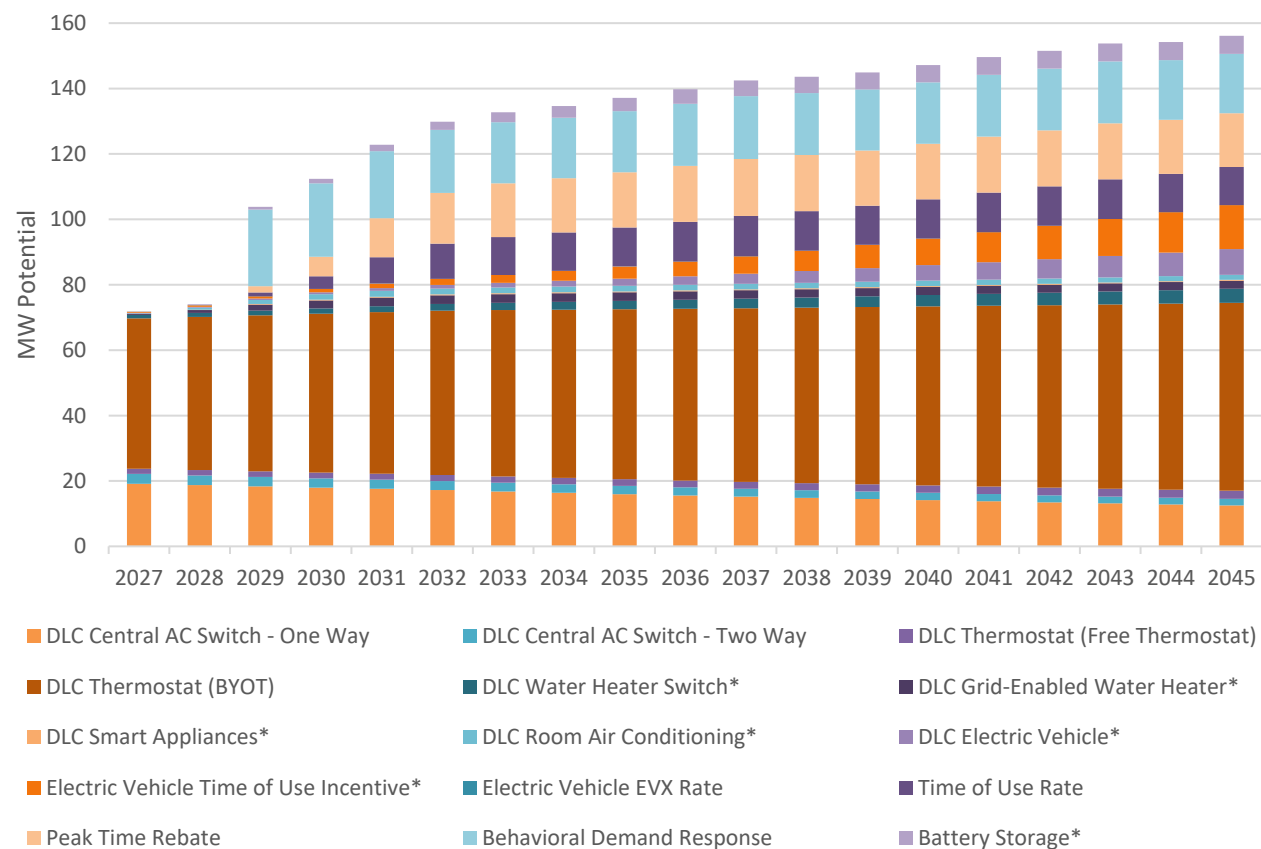


FIGURE 5-3: RESIDENTIAL SECTOR DEMAND RESPONSE RAP – BY PROGRAM

Figure 5-4 shows the cumulative annual RAP (MW) by program in the non-residential sector. The Load Curtailment program is the program with the highest potential and accounts for about 43% of the non-residential RAP, with the total RAP exceeding 176 MW by 2045. Programs marked with an asterisk were those that were found to not be cost-effective.

Chapter 5 Demand Response Potential

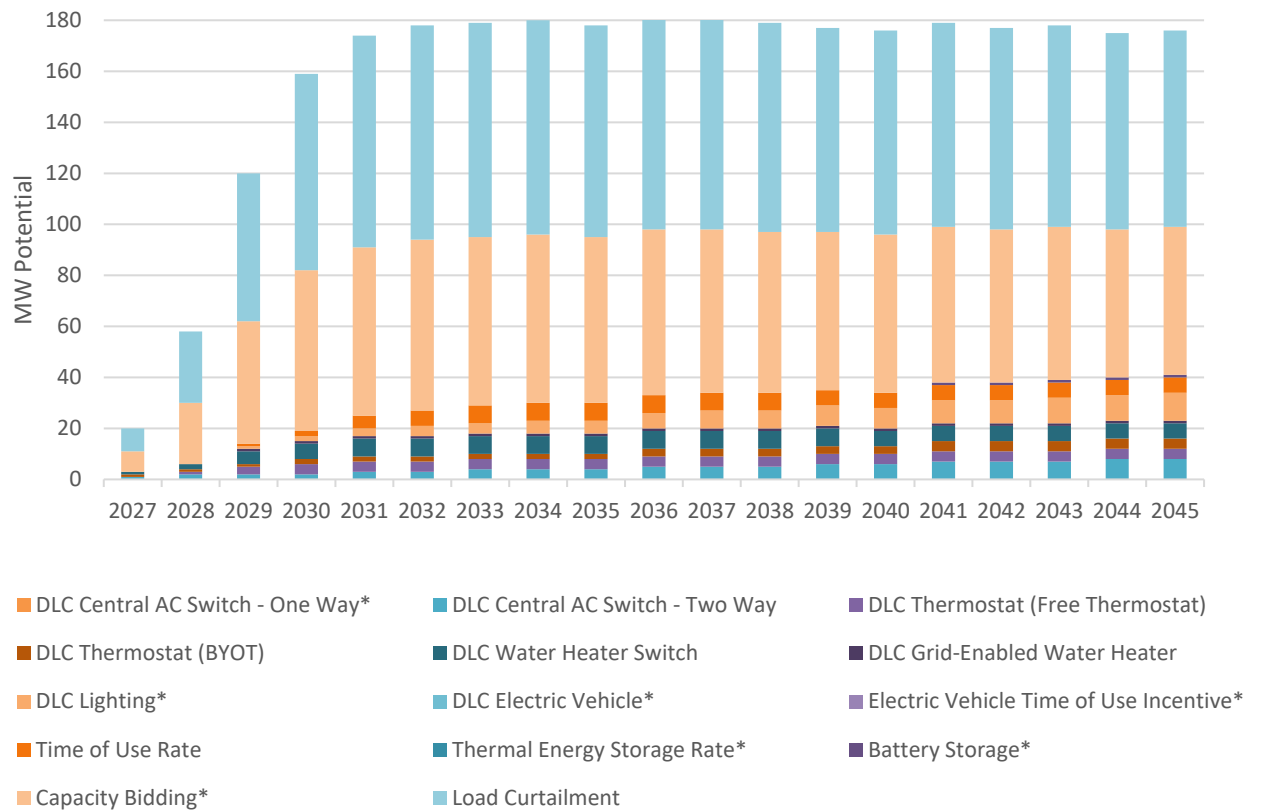


FIGURE 5-4 NON-RESIDENTIAL SECTOR DEMAND RESPONSE RAP – BY PROGRAM

5.3 BENEFITS & COSTS

Table 5-6 shows the MAP and RAP budget requirements (for all programs, cost-effective and not) across the 2027-2045 timeframe that would be required to achieve the cumulative annual potential.

TABLE 5-6: SUMMARY OF MAP AND RAP BUDGET REQUIREMENTS

Year	MAP	RAP
2027	\$17,667,987	\$13,173,386
2028	\$31,927,446	\$20,385,395
2029	\$57,114,010	\$36,698,683
2030	\$63,378,759	\$42,582,401
2031	\$63,392,737	\$45,111,688
2032	\$62,655,640	\$46,215,905
2033	\$63,068,532	\$47,275,929
2034	\$65,403,321	\$49,310,314
2035	\$68,731,131	\$51,870,361
2036	\$72,311,548	\$54,604,139
2037	\$79,216,382	\$58,816,156

Chapter 5 Demand Response Potential

Year	MAP	RAP
2038	\$86,919,755	\$62,210,230
2039	\$94,765,698	\$66,308,951
2040	\$96,481,075	\$69,182,277
2041	\$98,447,841	\$72,141,571
2042	\$103,104,638	\$75,728,089
2043	\$109,914,412	\$80,378,063
2044	\$114,114,288	\$84,086,851
2045	\$118,926,603	\$88,416,746

Figure 5-5 shows the annual RAP budgets by sector. The residential sector RAP rises from \$8 million in 2027 to \$49 million in 2045. The commercial sector RAP rises from \$5 million in 2027 to \$39 million in 2045.

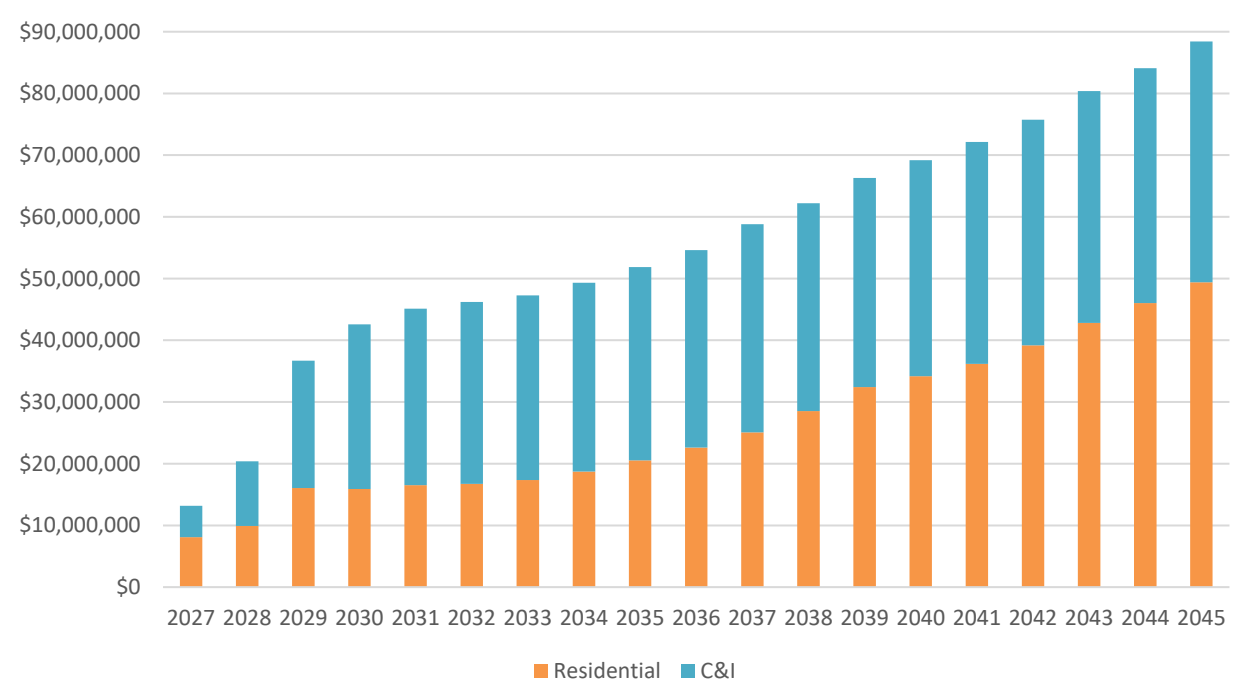


FIGURE 5-5 RESIDENTIAL AND COMMERCIAL DEMAND RESPONSE RAP

Table 5-7 and Table 5-8 show the MAP and RAP residential NPVs of the total benefits, and costs, along with the UCT ratio for each program for the length of the study.

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

Sector	Program	MAP UCT	MAP Benefits	MAP Utility Costs
Residential	DLC Central AC Switch - One Way	2.51	\$40,387,902	\$16,067,601
	DLC Central AC Switch - Two Way	2.01	\$6,402,710	\$3,192,977
	DLC Thermostat (Free Thermostat)	1.57	\$3,484,662	\$2,215,470

Chapter 5 Demand Response Potential

Sector	Program	MAP UCT	MAP Benefits	MAP Utility Costs
	DLC Thermostat (BYOT)	1.60	\$88,483,811	\$55,154,024
	DLC Water Heater Switch	0.17	\$7,983,811	\$47,272,561
	DLC Grid-Enabled Water Heater	0.52	\$24,727,572	\$47,522,861
	DLC Smart Appliances	0.07	\$1,932,403	\$29,508,675
	DLC Room Air Conditioning	0.31	\$7,681,988	\$24,484,938
	DLC Electric Vehicle	0.18	\$8,614,246	\$47,942,813
	Electric Vehicle Time of Use Incentive	0.20	\$13,187,002	\$65,079,843
	Electric Vehicle EVX Rate	0.99	\$46,310	\$46,675
	Time of Use Rate	4.89	\$29,321,879	\$5,993,196
	Peak Time Rebate	1.49	\$23,975,153	\$16,134,211
	Behavioral Demand Response	1.68	\$20,593,756	\$12,267,175
	Battery Storage	0.86	\$8,250,134	\$9,551,301
C&I	DLC Central AC Switch - One Way	0.27	\$229,812	\$858,618
	DLC Central AC Switch - Two Way	1.96	\$19,133,836	\$9,767,116
	DLC Thermostat (Free Thermostat)	3.78	\$7,113,772	\$1,879,584
	DLC Thermostat (BYOT)	2.15	\$4,276,121	\$1,990,472
	DLC Water Heater Switch	3.62	\$18,542,127	\$5,121,853
	DLC Grid-Enabled Water Heater	2.26	\$12,361,566	\$5,479,385
	DLC Lighting	0.60	\$28,416,936	\$47,029,076
	DLC Electric Vehicle	0.01	\$4,808	\$810,476
	Electric Vehicle Time of Use Incentive	0.01	\$9,126	\$998,950
	Time of Use Rate	7.79	\$11,491,445	\$1,475,631
	Thermal Energy Storage Rate	0.24	\$365,150	\$1,494,089
	Battery Storage	0.59	\$902,590	\$1,522,439
	Capacity Bidding	1.26	\$220,484,541	\$174,798,004
	Load Curtailment	2.15	\$281,925,891	\$131,042,609

TABLE 5-8 RAP NPV BENEFITS, COSTS, AND UCT RATIOS FOR EACH DEMAND RESPONSE PROGRAM

Sector	Program	RAP UCT	RAP Benefits	RAP Utility Costs
Residential	DLC Central AC Switch - One Way	2.64	\$42,424,968	\$16,067,601
	DLC Central AC Switch - Two Way	2.11	\$6,725,646	\$3,192,977
	DLC Thermostat (Free Thermostat)	1.54	\$2,424,831	\$1,578,994
	DLC Thermostat (BYOT)	1.83	\$63,849,108	\$34,837,129

Chapter 5 Demand Response Potential

Sector	Program	RAP UCT	RAP Benefits	RAP Utility Costs
	DLC Water Heater Switch	0.18	\$6,646,674	\$36,519,956
	DLC Grid-Enabled Water Heater	0.52	\$5,836,014	\$11,218,519
	DLC Smart Appliances	0.06	\$504,532	\$8,412,591
	DLC Room Air Conditioning	0.42	\$3,879,142	\$9,297,595
	DLC Electric Vehicle	0.19	\$7,408,705	\$38,802,827
	Electric Vehicle Time of Use Incentive	0.22	\$10,584,378	\$47,448,937
	Electric Vehicle EVX Rate	1.05	\$48,909	\$46,675
	Time of Use Rate	5.49	\$15,289,811	\$2,785,311
	Peak Time Rebate	1.53	\$21,369,448	\$13,935,459
	Behavioral Demand Response	1.79	\$28,800,892	\$16,046,726
	Battery Storage	0.95	\$7,688,755	\$8,064,952
C&I	DLC Central AC Switch - One Way	0.25	\$231,534	\$911,865
	DLC Central AC Switch - Two Way	1.85	\$11,160,214	\$6,036,565
	DLC Thermostat (Free Thermostat)	3.51	\$5,066,188	\$1,443,223
	DLC Thermostat (BYOT)	1.95	\$3,211,592	\$1,643,356
	DLC Water Heater Switch	3.64	\$14,594,158	\$4,014,128
	DLC Grid-Enabled Water Heater	1.63	\$2,888,112	\$1,771,406
	DLC Lighting	0.32	\$11,723,635	\$36,224,714
	DLC Electric Vehicle	0.00	\$2,491	\$685,790
	Electric Vehicle Time of Use Incentive	0.01	\$6,938	\$872,812
	Time of Use Rate	8.32	\$10,208,416	\$1,226,701
	Thermal Energy Storage Rate	0.12	\$183,859	\$1,487,239
	Battery Storage	0.59	\$820,972	\$1,388,507
	Capacity Bidding	0.91	\$131,348,070	\$145,070,835
	Load Curtailment	1.59	\$161,076,085	\$101,224,832

VOLUME II

Appendices

prepared for



OCTOBER 2025

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 additional detail regarding the cumulative annual technical, economic, MAP, RAP and Enhanced RAP energy savings, in total MWh and as a percentage of the sector-level sales forecast over 3-yr, 10-yr and 19-yr timeframes. The associated MW of demand savings are also provided.

TABLE A-1: C&I CUMULATIVE ANNUAL ENERGY EFFICIENCY POTENTIAL SUMMARY

	3 YR	10 YR	19 YR
Energy (MWh)			
Technical	538,924	1,784,802	2,444,555
Economic	538,885	1,784,682	2,444,447
MAP	414,840	1,050,097	1,500,441
RAP	327,063	846,702	1,232,802
Enhanced RAP	364,038	924,324	1,330,362
Energy Savings (as % of Forecast)			
Technical	6.5%	21.3%	28.6%
Economic	6.5%	21.3%	28.6%
MAP	5.0%	12.6%	17.5%
RAP	4.0%	10.1%	14.4%
Enhanced RAP	4.4%	11.1%	15.8%
MW			
Technical	87	293	430
Economic	87	293	430
MAP	74	186	271
RAP	56	146	217
Enhanced RAP	64	161	236

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, though total MWh savings are higher in the scenario in which opt-out customers are included in the analysis.

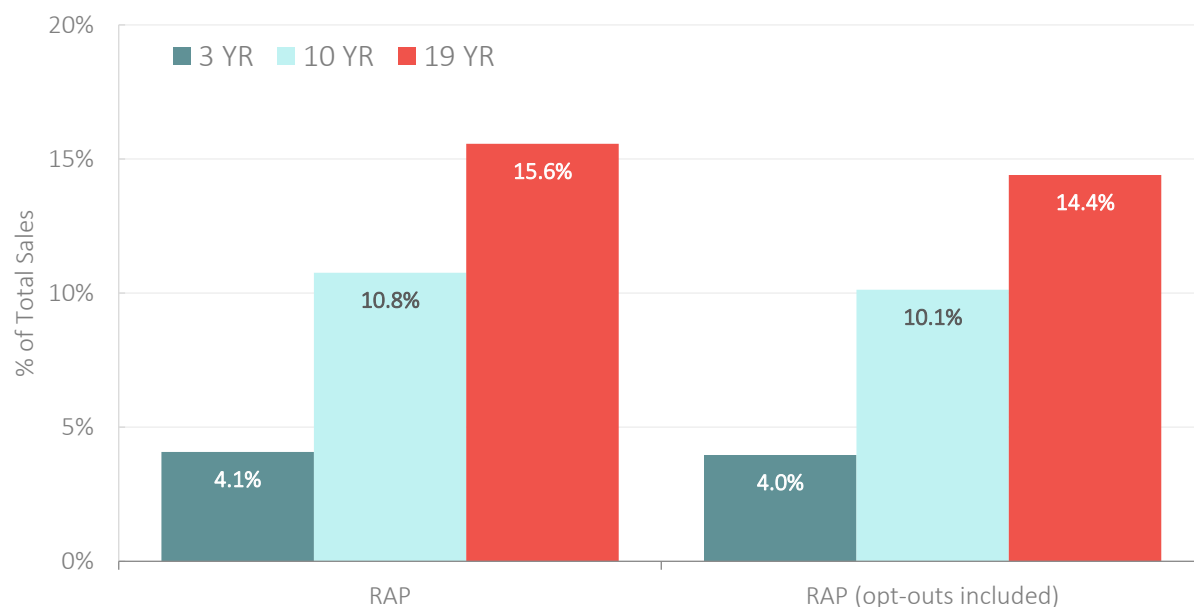


FIGURE A-1: C&I ELECTRIC ENERGY CUMULATIVE ANNUAL POTENTIAL (AS A % OF COMMERCIAL AND INDUSTRIAL SALES)

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 \$17 million, while the budgets in the RAP scenario with opt-out customers included range from \$19 million to \$26 million.

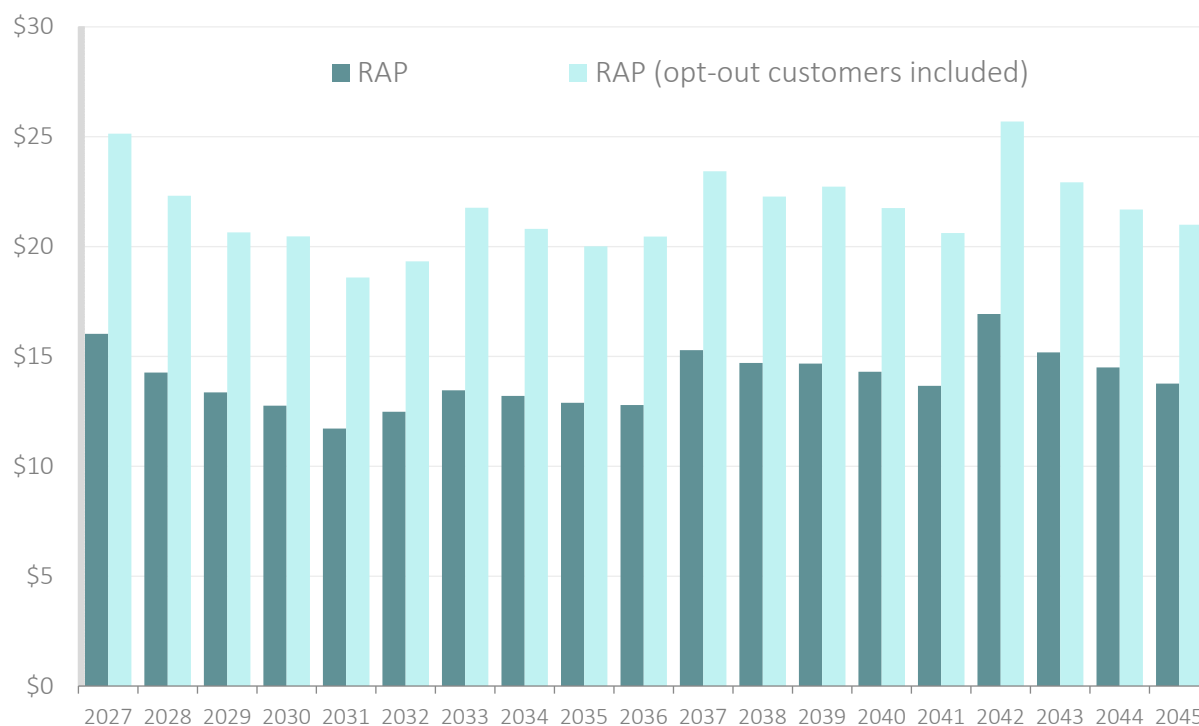


FIGURE A-2: C&I RAP BUDGETS – WITHOUT AND WITH OPT-OUT CUSTOMERS

B. Residential Energy Efficiency Assumptions

This table below provides a list of assumptions for the residential energy efficiency measures evaluated in the study.

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 (%)	End Use Measure Group	Base Saturation	EE Saturation	MAP Adoption Rate	RAP Adoption Rate	UCT Score	
1001	Appliances	ENERGY STAR Air Purifier	Efficient Products	SF	MO	512	58%	298	0.03	9	\$92	100%	54%	AIR PURIFIER-1	12%	36%	67.4%	44.5%	2.7	
1002	Appliances	ENERGY STAR Air Purifier	Efficient Products	SF	NC	512	58%	298	0.03	9	\$92	100%	54%	AIR PURIFIER-2	12%	0%	67.4%	44.5%	2.7	
1003	Appliances	ENERGY STAR Air Purifier	Efficient Products	MF	MO	512	58%	298	0.03	9	\$92	100%	54%	AIR PURIFIER-3	12%	36%	56.8%	40.6%	2.7	
1004	Appliances	ENERGY STAR Air Purifier	Efficient Products	MF	NC	512	58%	298	0.03	9	\$92	100%	54%	AIR PURIFIER-4	12%	0%	56.8%	40.6%	2.7	
1005	Appliances	ENERGY STAR Refrigerator	No Program	SF	MO	349	14%	49	0.01	15	\$9	100%	25%	REFRIGERATOR-1	112%	69%	67.4%	28.1%	15.4	
1006	Appliances	ENERGY STAR Refrigerator	No Program	SF	NC	349	14%	49	0.01	15	\$9	100%	25%	REFRIGERATOR-2	112%	0%	67.4%	28.1%	15.4	
1007	Appliances	ENERGY STAR Refrigerator	No Program	MF	MO	349	14%	49	0.01	15	\$9	100%	25%	REFRIGERATOR-3	99%	48%	56.8%	31.3%	15.4	
1008	Appliances	ENERGY STAR Refrigerator	No Program	MF	NC	349	14%	49	0.01	15	\$9	100%	25%	REFRIGERATOR-4	99%	0%	56.8%	31.3%	15.4	
1009	Appliances	CEE Tier 2 Refrigerator	No Program	SF	MO	349	19%	66	0.01	15	\$26	100%	25%	REFRIGERATOR-1	112%	69%	67.4%	28.1%	7.2	
1010	Appliances	CEE Tier 2 Refrigerator	No Program	SF	NC	349	19%	66	0.01	15	\$26	100%	25%	REFRIGERATOR-2	112%	0%	67.4%	28.1%	7.2	
1011	Appliances	CEE Tier 2 Refrigerator	No Program	MF	MO	349	19%	66	0.01	15	\$26	100%	25%	REFRIGERATOR-3	99%	48%	56.8%	31.3%	7.2	
1012	Appliances	CEE Tier 2 Refrigerator	No Program	MF	NC	349	19%	66	0.01	15	\$26	100%	25%	REFRIGERATOR-4	99%	0%	56.8%	31.3%	7.2	
1013	Appliances	CEE Tier 3 Refrigerator	No Program	SF	MO	349	24%	84	0.01	15	\$135	25%	25%	REFRIGERATOR-1	112%	69%	28.1%	28.1%	1.8	
1014	Appliances	CEE Tier 3 Refrigerator	No Program	SF	NC	349	24%	84	0.01	15	\$135	25%	25%	REFRIGERATOR-2	112%	0%	28.1%	28.1%	1.8	
1015	Appliances	CEE Tier 3 Refrigerator	No Program	MF	MO	349	24%	84	0.01	15	\$135	25%	25%	REFRIGERATOR-3	99%	48%	31.3%	31.3%	1.8	
1016	Appliances	CEE Tier 3 Refrigerator	No Program	MF	NC	349	24%	84	0.01	15	\$135	25%	25%	REFRIGERATOR-4	99%	0%	31.3%	31.3%	1.8	
1017	Appliances	Refrigerator Recycling	No Program	SF	Recycle	1,000	100%	1,000	0.12	7	\$50	100%	25%	RECYCLING-1	6%	0%	67.4%	28.1%	30.8	
1018	Appliances	Refrigerator Recycling	No Program	MF	Recycle	1,000	100%	1,000	0.12	7	\$50	100%	25%	RECYCLING-2	0%	0%	56.8%	31.3%	30.8	
1019	Appliances	Freezer Recycling	No Program	SF	Recycle	568	100%	568	0.07	7	\$50	100%	25%	RECYCLING-3	1%	0%	67.4%	28.1%	17.2	
1020	Appliances	Freezer Recycling	No Program	MF	Recycle	568	100%	568	0.07	7	\$50	100%	25%	RECYCLING-4	2%	0%	56.8%	31.3%	17.2	
1021	Appliances	Dehumidifier Recycling	No Program	SF	Recycle	534	100%	534	0.06	7	\$20	100%	25%	RECYCLING-5	2%	0%	67.4%	28.1%	40.5	
1022	Appliances	Dehumidifier Recycling	No Program	MF	Recycle	534	100%	534	0.06	7	\$20	100%	25%	RECYCLING-6	1%	0%	56.8%	31.3%	40.5	
1023	Appliances	ENERGY STAR Freezer - Chest	Efficient Products	SF	MO	272	10%	27	0.00	21	\$5	100%	100%	FREEZER-1	48%	28%	67.4%	67.4%	1.0	
1024	Appliances	ENERGY STAR Freezer - Chest	Efficient Products	SF	NC	272	10%	27	0.00	21	\$5	100%	100%	FREEZER-2	48%	0%	67.4%	67.4%	1.0	
1025	Appliances	ENERGY STAR Freezer - Chest	Efficient Products	MF	MO	272	10%	27	0.00	21	\$5	100%	100%	FREEZER-3	15%	9%	56.8%	56.8%	1.0	
1026	Appliances	ENERGY STAR Freezer - Chest	Efficient Products	MF	NC	272	10%	27	0.00	21	\$5	100%	100%	FREEZER-4	15%	0%	56.8%	56.8%	1.0	
1027	Appliances	ENERGY STAR Freezer - Compact Upright	Efficient Products	SF	MO	273	10%	27	0.00	10	\$5	100%	100%	FREEZER-1	48%	28%	67.4%	67.4%	0.6	
1028	Appliances	ENERGY STAR Freezer - Compact Upright	Efficient Products	SF	NC	273	10%	27	0.00	10	\$5	100%	100%	FREEZER-2	48%	0%	67.4%	67.4%	0.6	
1029	Appliances	ENERGY STAR Freezer - Compact Upright	Efficient Products	MF	MO	273	10%	27	0.00	10	\$5	100%	100%	FREEZER-3	15%	9%	56.8%	56.8%	0.6	
1030	Appliances	ENERGY STAR Freezer - Compact Upright	Efficient Products	MF	NC	273	10%	27	0.00	10	\$5	100%	100%	FREEZER-4	15%	0%	56.8%	56.8%	0.6	
1031	Appliances	ENERGY STAR Dehumidifier	Efficient Products	SF	MO	1,075	15%	157	0.04	17	\$9	100%	100%	DEHUMIDIFIER-1	28%	85%	67.4%	67.4%	5.9	
1032	Appliances	ENERGY STAR Dehumidifier	Efficient Products	SF	NC	1,075	15%	157	0.04	17	\$9	100%	100%	DEHUMIDIFIER-2	28%	0%	67.4%	67.4%	5.9	
1033	Appliances	ENERGY STAR Dehumidifier	Efficient Products	MF	MO	1,075	15%	157	0.04	17	\$9	100%	100%	DEHUMIDIFIER-3	8%	85%	56.8%	56.8%	5.9	
1034	Appliances	ENERGY STAR Dehumidifier	Efficient Products	MF	NC	1,075	15%	157	0.04	17	\$9	100%	100%	DEHUMIDIFIER-4	8%	0%	56.8%	56.8%	5.9	
1035	Appliances	ENERGY STAR Most Efficient Dehumidifier	Efficient Products	SF	MO	1,075	21%	230	0.05	17	\$12	100%	100%	DEHUMIDIFIER-1	28%	85%	67.4%	67.4%	8.6	
1036	Appliances	ENERGY STAR Most Efficient Dehumidifier	Efficient Products	SF	NC	1,075	21%	230	0.05	17	\$12	100%	100%	DEHUMIDIFIER-2	28%	0%	67.4%	67.4%	8.6	
1037	Appliances	ENERGY STAR Most Efficient Dehumidifier	Efficient Products	MF	MO	1,075	21%	230	0.05	17	\$12	100%	100%	DEHUMIDIFIER-3	8%	85%	56.8%	56.8%	8.6	
1038	Appliances	ENERGY STAR Most Efficient Dehumidifier	Efficient Products	MF	NC	1,075	21%	230	0.05	17	\$12	100%	100%	DEHUMIDIFIER-4	8%	0%	56.8%	56.8%	8.6	
1039	Appliances	ENERGY STAR Dishwasher	Efficient Products	SF	MO	307	22%	67	0.00	11	\$30	100%	100%	DISHWASHER-1	73%	50%	67.4%	67.4%	1.0	
1040	Appliances	ENERGY STAR Dishwasher	Efficient Products	SF	NC	307	22%	67	0.00	11	\$30	100%	100%	DISHWASHER-2	73%	0%	67.4%	67.4%	1.0	
1041	Appliances	ENERGY STAR Dishwasher	Efficient Products	MF	MO	307	22%	67	0.00	11	\$30	100%	100%	DISHWASHER-3	70%	34%	56.8%	56.8%	1.0	
1042	Appliances	ENERGY STAR Dishwasher	Efficient Products	MF	NC	307	22%	67	0.00	11	\$30	100%	100%	DISHWASHER-4	70%	0%	56.8%	56.8%	1.0	
1043	Appliances	ENERGY STAR Clothes Washer	Efficient Products	SF	MO	612	13%	79	0.01	14	\$87	57%	57%	LOTHES WASHER	95%	64%	45.8%	45.8%	1.0	
1044	Appliances	ENERGY STAR Clothes Washer	Efficient Products	SF	NC	612	13%	79	0.01	14	\$87	57%	57%	LOTHES WASHER	95%	0%	45.8%	45.8%	1.0	
1045	Appliances	ENERGY STAR Clothes Washer	Efficient Products	MF	MO	612	13%	79	0.01	14	\$87	57%	57%	LOTHES WASHER	62%	34%	40.5%	40.5%	1.0	
1046	Appliances	ENERGY STAR Clothes Washer	Efficient Products	MF	NC	612	13%	79	0.01	14	\$87	57%	57%	LOTHES WASHER	62%	0%	40.5%	40.5%	1.0	
1047	Appliances	CEE Tier 2 Clothes Washer	Efficient Products	SF	MO	612	23%	141	0.02	14	\$85	100%	59%	LOTHES WASHER	95%	64%	67.4%	46.4%	1.9	
1048	Appliances	CEE Tier 2 Clothes Washer	Efficient Products	SF	NC	612	23%	141	0.02	14	\$85	100%	59%	LOTHES WASHER	95%	0%	67.4%	46.4%	1.9	
1049	Appliances	CEE Tier 2 Clothes Washer	Efficient Products	MF	MO	612	23%	141	0.02	14	\$85	100%	59%	LOTHES WASHER	62%	34%	56.8%	40.4%	1.9	
1050	Appliances	CEE Tier 2 Clothes Washer	Efficient Products	MF	NC	612	23%	141	0.02	14	\$85	100%	59%	LOTHES WASHER	62%	0%	56.8%	40.4%	1.9	
1051	Appliances	CEE Advanced Tier Clothes Washer	Efficient Products	SF	MO	612	26%	158	0.02	14	\$99	100%	51%	LOTHES WASHER	95%	64%	67.4%	43.1%	2.1	
1052	Appliances	CEE Advanced Tier Clothes Washer	Efficient Products	SF	NC	612	26%	158	0.02	14	\$99	100%	51%	LOTHES WASHER	95%	0%	67.4%	43.1%	2.1	
1053	Appliances	CEE Advanced Tier Clothes Washer	Efficient Products	MF	MO	612	26%	158	0.02	14	\$99	100%	51%	LOTHES WASHER	62%	34%	56.8%	40.7%	2.1	
1054	Appliances	CEE Advanced Tier Clothes Washer	Efficient Products	MF	NC	612	26%	158	0.02	14	\$99	100%	51%	LOTHES WASHER	62%	0%	56.8%	40.7%	2.1	
1055	Appliances	ENERGY STAR Clothes Dryer (Electric)	Efficient Products	SF	MO	769	21%	160	0.02	16	\$152	75%	33%	CLOTHES DRYER-:	87%	55%	53.5%	32.1%	2.3	
1056	Appliances	ENERGY STAR Clothes Dryer (Electric)	Efficient Products	SF	NC	769	21%	160	0.02	16	\$152	75%	33%	CLOTHES DRYER-:	87%	0%	53.5%	32.1%	2.3	
1057	Appliances	ENERGY STAR Clothes Dryer (Electric)	Efficient Products	MF	MO	769	21%	160	0.02	16	\$152	75%	33%	CLOTHES DRYER-:	62%	33%	40.0%	34.0%	2.3	
1058	Appliances	ENERGY STAR Clothes Dryer (Electric)	Efficient Products	MF	NC	769	21%	160	0.02	16	\$152	75%	33%	CLOTHES DRYER-:	62%	0%	40.0%	34.0%	2.3	

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 (%)	End Use Measure Group	Base Saturation	EE Saturation	MAP Adoption Rate	RAP Adoption Rate	UCT Score	
1059	Appliances	Heat Pump Dryer	No Program	SF	MO	769	57%	435	0.06	16	\$900	25%	25%	CLOTHES DRYER-1	87%	55%	28.1%	28.1%	1.4	
1060	Appliances	Heat Pump Dryer	No Program	SF	NC	769	57%	435	0.06	16	\$900	25%	25%	CLOTHES DRYER-2	87%	0%	28.1%	28.1%	1.4	
1061	Appliances	Heat Pump Dryer	No Program	MF	MO	769	57%	435	0.06	16	\$900	25%	25%	CLOTHES DRYER-3	62%	33%	31.3%	31.3%	1.4	
1062	Appliances	Heat Pump Dryer	No Program	MF	NC	769	57%	435	0.06	16	\$900	25%	25%	CLOTHES DRYER-4	62%	0%	31.3%	31.3%	1.4	
1063	Appliances	Ultrasonic Clothes Dryer	No Program	SF	MO	769	10%	77	0.01	16	\$150	25%	25%	CLOTHES DRYER-5	87%	55%	28.1%	28.1%	1.6	
1064	Appliances	Ultrasonic Clothes Dryer	No Program	SF	NC	769	10%	77	0.01	16	\$150	25%	25%	CLOTHES DRYER-6	87%	0%	28.1%	28.1%	1.6	
1065	Appliances	Ultrasonic Clothes Dryer	No Program	MF	MO	769	10%	77	0.01	16	\$150	25%	25%	CLOTHES DRYER-7	62%	33%	31.3%	31.3%	1.6	
1066	Appliances	Ultrasonic Clothes Dryer	No Program	MF	NC	769	10%	77	0.01	16	\$150	25%	25%	CLOTHES DRYER-8	62%	0%	31.3%	31.3%	1.6	
1067	Appliances	Bolt-On Smart Dryer Sensor to Electric Dryer	No Program	SF	MO	769	5%	39	0.01	16	\$150	25%	25%	DRYER SENSOR-1	87%	16%	28.1%	28.1%	0.7	
1068	Appliances	Bolt-On Smart Dryer Sensor to Electric Dryer	No Program	SF	NC	769	5%	39	0.01	16	\$150	25%	25%	DRYER SENSOR-2	87%	0%	28.1%	28.1%	0.7	
1069	Appliances	Bolt-On Smart Dryer Sensor to Electric Dryer	No Program	MF	MO	769	5%	39	0.01	16	\$150	25%	25%	DRYER SENSOR-3	62%	10%	31.3%	31.3%	0.7	
1070	Appliances	Bolt-On Smart Dryer Sensor to Electric Dryer	No Program	MF	NC	769	5%	39	0.01	16	\$150	25%	25%	DRYER SENSOR-4	62%	0%	31.3%	31.3%	0.7	
1071	Appliances	Ozone Laundry	No Program	SF	MO	1,225	20%	242	0.03	8	\$300	25%	25%	OZONE-1	87%	0%	28.1%	28.1%	1.3	
1072	Appliances	Ozone Laundry	No Program	SF	NC	1,225	20%	242	0.03	8	\$300	25%	25%	OZONE-2	87%	0%	28.1%	28.1%	1.3	
1073	Appliances	Ozone Laundry	No Program	MF	MO	1,225	20%	242	0.03	8	\$300	25%	25%	OZONE-3	62%	0%	31.3%	31.3%	1.3	
1074	Appliances	Ozone Laundry	No Program	MF	NC	1,225	20%	242	0.03	8	\$300	25%	25%	OZONE-4	62%	0%	31.3%	31.3%	1.3	
1075	Appliances	Water Dispenser	Efficient Products	SF	MO	320	77%	246	0.03	10	\$60	100%	42%	WATER COOLER-1	5%	56%	67.4%	37.3%	4.8	
1076	Appliances	Water Dispenser	Efficient Products	SF	NC	320	77%	246	0.03	10	\$60	100%	42%	WATER COOLER-2	5%	0%	67.4%	37.3%	4.8	
1077	Appliances	Water Dispenser	Efficient Products	MF	MO	320	77%	246	0.03	10	\$60	100%	42%	WATER COOLER-3	5%	56%	56.8%	37.3%	4.8	
1078	Appliances	Water Dispenser	Efficient Products	MF	NC	320	77%	246	0.03	10	\$60	100%	42%	WATER COOLER-4	5%	0%	56.8%	37.3%	4.8	
1079	Appliances	Induction Cooktop	No Program	SF	MO	123	10%	12	0.00	16	\$687	25%	25%	COOKTOP-1	67%	45%	28.1%	28.1%	0.1	
1080	Appliances	Induction Cooktop	No Program	SF	NC	123	10%	12	0.00	16	\$687	25%	25%	COOKTOP-2	67%	0%	28.1%	28.1%	0.1	
1081	Appliances	Induction Cooktop	No Program	MF	MO	123	10%	12	0.00	16	\$687	25%	25%	COOKTOP-3	83%	37%	31.3%	31.3%	0.1	
1082	Appliances	Induction Cooktop	No Program	MF	NC	123	10%	12	0.00	16	\$687	25%	25%	COOKTOP-4	83%	0%	31.3%	31.3%	0.1	
2001	Behavior	Home Energy Reports	Home Energy Reports	SF	MO	13,160	1%	108	0.01	1	\$0	100%	100%	HER-1	100%	0%	100.0%	100.0%	1.0	
2002	Behavior	Home Energy Reports	Home Energy Reports	SF	NC	13,160	1%	108	0.01	1	\$0	100%	100%	HER-2	100%	0%	100.0%	100.0%	1.0	
2003	Behavior	Home Energy Reports	Home Energy Reports	MF	MO	6,580	2%	108	0.01	1	\$0	100%	100%	HER-3	100%	0%	100.0%	100.0%	1.0	
2004	Behavior	Home Energy Reports	Home Energy Reports	MF	NC	6,580	2%	108	0.01	1	\$0	100%	100%	HER-4	100%	0%	100.0%	100.0%	1.0	
2005	Behavior	Audit Recommendations	Efficient Products	SF	Retrofit	13,160	1%	188	0.02	1	\$0	100%	100%	AUDIT-1	100%	0%	100.0%	100.0%	1.0	
2006	Behavior	Audit Recommendations	Efficient Products	MF	Retrofit	6,580	3%	188	0.02	1	\$0	100%	100%	AUDIT-2	100%	0%	100.0%	100.0%	1.0	
2007	Behavior	Audit Recommendations	IQW	SF	Retrofit	13,160	1%	188	0.02	1	\$0	100%	100%	AUDIT-3	100%	0%	100.0%	100.0%	1.0	
2008	Behavior	Audit Recommendations	IQW	MF	Retrofit	6,580	3%	188	0.02	1	\$0	100%	100%	AUDIT-4	100%	0%	100.0%	100.0%	1.0	
3001	HVAC	Air Filter	Efficient Products	SF	Retrofit	13,160	1%	96	0.02	1	\$7	100%	14%	FILTER-1	98%	54%	74.3%	31.4%	8.2	
3002	HVAC	Air Filter	IQW	SF	Retrofit	13,160	1%	96	0.02	1	\$7	100%	100%	FILTER-2	94%	54%	74.1%	74.1%	1.1	
3003	HVAC	Air Filter	IQW	SF	Retrofit	13,160	1%	96	0.02	1	\$7	100%	100%	FILTER-2	94%	54%	74.1%	74.1%	1.1	
3004	HVAC	Air Filter	Efficient Products	MF	Retrofit	6,580	1%	96	0.02	1	\$7	100%	14%	FILTER-3	81%	54%	59.9%	21.1%	8.2	
3005	HVAC	Air Filter	IQW	MF	Retrofit	6,580	1%	96	0.02	1	\$7	100%	100%	FILTER-4	80%	54%	59.7%	59.7%	1.1	
3006	HVAC	Air Filter	Multifamily	MF	Retrofit	6,580	1%	96	0.02	1	\$7	100%	95%	FILTER-3	81%	54%	59.9%	57.6%	1.2	
3007	HVAC	Air Filter	Multifamily	MF	Retrofit	6,580	1%	96	0.02	1	\$7	100%	95%	FILTER-4	80%	54%	59.7%	57.0%	1.2	
3008	HVAC	Air Filter	IQW	MF	Retrofit	6,580	1%	96	0.02	1	\$7	100%	100%	FILTER-4	80%	54%	59.7%	59.7%	1.1	
3009	HVAC	ASHP Tune Up	Efficient Products	SF	Retrofit	6,219	5%	311	0.10	3	\$225	24%	24%	HP TUNE-1	16%	54%	46.6%	46.6%	1.7	
3010	HVAC	ASHP Tune Up	Efficient Products	MF	Retrofit	4,816	5%	241	0.08	3	\$225	24%	24%	HP TUNE-2	10%	54%	34.0%	34.0%	1.3	
3011	HVAC	Air Source Heat Pump 15.2 SEER2 - Heat pump baseline	Efficient Products	SF	MO	6,219	10%	606	0.12	16	\$135	100%	100%	HP-1	16%	36%	83.0%	83.0%	1.6	
3012	HVAC	Air Source Heat Pump 15.2 SEER2 - Heat pump baseline	Efficient Products	SF	NC	6,219	10%	606	0.12	16	\$135	100%	100%	HP-2	16%	0%	83.0%	83.0%	1.6	
3013	HVAC	Air Source Heat Pump 15.2 SEER2 - Heat pump baseline	Efficient Products	MF	MO	4,816	10%	475	0.09	16	\$135	100%	100%	HP-3	10%	36%	66.2%	66.2%	1.3	
3014	HVAC	Air Source Heat Pump 15.2 SEER2 - Heat pump baseline	Efficient Products	MF	NC	4,816	10%	475	0.09	16	\$135	100%	100%	HP-4	10%	0%	66.2%	66.2%	1.3	
3015	HVAC	Air Source Heat Pump 16.2 SEER2 - Heat pump baseline	Efficient Products	SF	MO	6,219	17%	1,074	0.23	16	\$421	100%	100%	HP-1	16%	36%	83.0%	83.0%	2.2	
3016	HVAC	Air Source Heat Pump 16.2 SEER2 - Heat pump baseline	Efficient Products	SF	NC	6,219	17%	1,074	0.23	16	\$421	100%	100%	HP-2	16%	0%	83.0%	83.0%	2.2	
3017	HVAC	Air Source Heat Pump 16.2 SEER2 - Heat pump baseline	Efficient Products	MF	MO	4,816	17%	841	0.19	16	\$421	100%	100%	HP-3	10%	36%	66.2%	66.2%	1.8	
3018	HVAC	Air Source Heat Pump 16.2 SEER2 - Heat pump baseline	Efficient Products	MF	NC	4,816	17%	841	0.19	16	\$421	100%	100%	HP-4	10%	0%	66.2%	66.2%	1.8	
3019	HVAC	Air Source Heat Pump 17.1 SEER2 - Heat pump baseline	Efficient Products	SF	MO	6,219	26%	1,595	0.33	16	\$630	100%	99%	HP-1	16%	36%	83.0%	82.9%	2.2	

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 (%)	End Use Measure Group	Base Saturation	EE Saturation	MAP Adoption Rate	RAP Adoption Rate	UCT Score
3020	HVAC	Air Source Heat Pump 17.1 SEER2 - Heat pump baseline	Efficient Products	SF	NC	6,219	26%	1,595	0.33	16	\$630	100%	99%	HP-2	16%	0%	83.0%	82.9%	2.2
3021	HVAC	Air Source Heat Pump 17.1 SEER2 - Heat pump baseline	Efficient Products	MF	MO	4,816	26%	1,250	0.26	16	\$630	100%	99%	HP-3	10%	36%	66.2%	66.0%	1.8
3022	HVAC	Air Source Heat Pump 17.1 SEER2 - Heat pump baseline	Efficient Products	MF	NC	4,816	26%	1,250	0.26	16	\$630	100%	99%	HP-4	10%	0%	66.2%	66.0%	1.8
3023	HVAC	Air Source Heat Pump 18.1 SEER2 - Heat pump baseline	Efficient Products	SF	MO	6,219	31%	1,911	0.42	16	\$855	100%	73%	HP-1	16%	36%	83.0%	78.7%	2.7
3024	HVAC	Air Source Heat Pump 18.1 SEER2 - Heat pump baseline	Efficient Products	SF	NC	6,219	31%	1,911	0.42	16	\$855	100%	73%	HP-2	16%	0%	83.0%	78.7%	2.7
3025	HVAC	Air Source Heat Pump 18.1 SEER2 - Heat pump baseline	Efficient Products	MF	MO	4,816	31%	1,496	0.33	16	\$855	100%	73%	HP-3	10%	36%	66.2%	62.2%	2.2
3026	HVAC	Air Source Heat Pump 18.1 SEER2 - Heat pump baseline	Efficient Products	MF	NC	4,816	31%	1,496	0.33	16	\$855	100%	73%	HP-4	10%	0%	66.2%	62.2%	2.2
3027	HVAC	Ground Source Heat Pump 20 SEER - Heat pump baseline	No Program	SF	MO	6,219	27%	1,682	0.57	25	\$5,186	25%	25%	HP-1	16%	36%	57.5%	57.5%	1.9
3028	HVAC	Ground Source Heat Pump 20 SEER - Heat pump baseline	No Program	SF	NC	6,219	27%	1,682	0.57	25	\$5,186	25%	25%	HP-2	16%	0%	57.5%	57.5%	1.9
3029	HVAC	Ductless Heat Pump 8.5 HSPF2 - Heat pump baseline	Efficient Products	SF	MO	6,219	10%	641	0.12	16	\$155	100%	100%	HP-1	16%	36%	83.0%	83.0%	1.5
3030	HVAC	Ductless Heat Pump 8.5 HSPF2 - Heat pump baseline	Efficient Products	SF	NC	6,219	10%	641	0.12	16	\$155	100%	100%	HP-2	16%	0%	83.0%	83.0%	1.5
3031	HVAC	Ductless Heat Pump 8.5 HSPF2 - Heat pump baseline	Efficient Products	MF	MO	4,816	10%	502	0.09	16	\$124	100%	100%	HP-3	10%	36%	66.2%	66.2%	1.2
3032	HVAC	Ductless Heat Pump 8.5 HSPF2 - Heat pump baseline	Efficient Products	MF	NC	4,816	10%	502	0.09	16	\$124	100%	100%	HP-4	10%	0%	66.2%	66.2%	1.2
3033	HVAC	Ductless Heat Pump 9.4 HSPF2 - Heat pump baseline	Efficient Products	SF	MO	6,219	18%	1,136	0.23	16	\$560	100%	63%	HP-1	16%	36%	83.0%	77.0%	2.8
3034	HVAC	Ductless Heat Pump 9.4 HSPF2 - Heat pump baseline	Efficient Products	SF	NC	6,219	18%	1,136	0.23	16	\$560	100%	63%	HP-2	16%	0%	83.0%	77.0%	2.8
3035	HVAC	Ductless Heat Pump 9.4 HSPF2 - Heat pump baseline	Efficient Products	MF	MO	4,816	18%	889	0.19	16	\$448	100%	78%	HP-3	10%	36%	66.2%	62.9%	2.2
3036	HVAC	Ductless Heat Pump 9.4 HSPF2 - Heat pump baseline	Efficient Products	MF	NC	4,816	18%	889	0.19	16	\$448	100%	78%	HP-4	10%	0%	66.2%	62.9%	2.2
3037	HVAC	Ductless Heat Pump 10.8 HSPF2 - Heat pump baseline	Efficient Products	SF	MO	6,219	27%	1,686	0.33	16	\$835	100%	69%	HP-1	16%	36%	83.0%	78.0%	2.5
3038	HVAC	Ductless Heat Pump 10.8 HSPF2 - Heat pump baseline	Efficient Products	SF	NC	6,219	27%	1,686	0.33	16	\$835	100%	69%	HP-2	16%	0%	83.0%	78.0%	2.5
3039	HVAC	Ductless Heat Pump 10.8 HSPF2 - Heat pump baseline	Efficient Products	MF	MO	4,816	27%	1,321	0.26	16	\$668	100%	86%	HP-3	10%	36%	66.2%	64.0%	2.0
3040	HVAC	Ductless Heat Pump 10.8 HSPF2 - Heat pump baseline	Efficient Products	MF	NC	4,816	27%	1,321	0.26	16	\$668	100%	86%	HP-4	10%	0%	66.2%	64.0%	2.0
3041	HVAC	Ductless Heat Pump 11.7 HSPF2 - Heat pump baseline	Efficient Products	SF	MO	6,219	32%	2,021	0.42	16	\$1,650	100%	47%	HP-1	16%	36%	83.0%	74.6%	2.3
3042	HVAC	Ductless Heat Pump 11.7 HSPF2 - Heat pump baseline	Efficient Products	SF	NC	6,219	32%	2,021	0.42	16	\$1,650	100%	47%	HP-2	16%	0%	83.0%	78.7%	2.3
3043	HVAC	Ductless Heat Pump 11.7 HSPF2 - Heat pump baseline	Efficient Products	MF	MO	4,816	33%	1,581	0.33	16	\$1,320	100%	59%	HP-3	10%	36%	66.2%	60.2%	1.8
3044	HVAC	Ductless Heat Pump 11.7 HSPF2 - Heat pump baseline	Efficient Products	MF	NC	4,816	33%	1,581	0.33	16	\$1,320	100%	59%	HP-4	10%	0%	66.2%	60.2%	1.8
3045	HVAC	Air Source Heat Pump 15.2 SEER2 - Electric furnace baseline	Efficient Products	SF	MO	11,093	64%	7,056	0.12	16	\$6,120	50%	5%	HP-5	23%	36%	62.9%	33.1%	10.4
3046	HVAC	Air Source Heat Pump 15.2 SEER2 - Electric furnace baseline	Efficient Products	SF	NC	11,093	64%	7,056	0.12	16	\$6,120	50%	5%	HP-6	23%	0%	63.1%	32.8%	10.4
3047	HVAC	Air Source Heat Pump 15.2 SEER2 - Electric furnace baseline	Efficient Products	MF	MO	8,715	65%	5,635	0.09	16	\$6,296	5%	5%	HP-7	64%	36%	30.8%	30.8%	8.5
3048	HVAC	Air Source Heat Pump 15.2 SEER2 - Electric furnace baseline	Efficient Products	MF	NC	8,715	65%	5,635	0.09	16	\$6,296	5%	5%	HP-8	64%	0%	30.5%	30.5%	8.5
3049	HVAC	Air Source Heat Pump 16.2 SEER2 - Electric furnace baseline	Efficient Products	SF	MO	11,093	68%	7,524	0.23	16	\$6,406	50%	7%	HP-5	23%	36%	62.5%	33.3%	9.0
3050	HVAC	Air Source Heat Pump 16.2 SEER2 - Electric furnace baseline	Efficient Products	SF	NC	11,093	68%	7,524	0.23	16	\$6,406	50%	7%	HP-6	23%	0%	62.6%	33.0%	9.0
3051	HVAC	Air Source Heat Pump 16.2 SEER2 - Electric furnace baseline	Efficient Products	MF	MO	8,715	69%	6,001	0.19	16	\$6,582	6%	6%	HP-7	64%	36%	31.0%	31.0%	7.3

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 (%)	End Use Measure Group	Base Saturation	EE Saturation	MAP Adoption Rate	RAP Adoption Rate	UCT Score
3052	HVAC	Air Source Heat Pump 16.2 SEER2 - Electric furnace baseline	Efficient Products	MF	NC	8,715	69%	6,001	0.19	16	\$6,582	6%	6%	HP-8	64%	0%	30.8%	30.8%	7.3
3053	HVAC	Air Source Heat Pump 17.1 SEER2 - Electric furnace baseline	Efficient Products	SF	MO	11,093	73%	8,045	0.33	16	\$6,615	50%	9%	HP-5	23%	36%	62.2%	34.7%	6.8
3054	HVAC	Air Source Heat Pump 17.1 SEER2 - Electric furnace baseline	Efficient Products	SF	NC	11,093	73%	8,045	0.33	16	\$6,615	50%	9%	HP-6	23%	0%	62.4%	34.4%	6.8
3055	HVAC	Air Source Heat Pump 17.1 SEER2 - Electric furnace baseline	Efficient Products	MF	MO	8,715	74%	6,410	0.26	16	\$6,791	50%	9%	HP-7	64%	36%	54.2%	32.2%	5.5
3056	HVAC	Air Source Heat Pump 17.1 SEER2 - Electric furnace baseline	Efficient Products	MF	NC	8,715	74%	6,410	0.26	16	\$6,791	50%	9%	HP-8	64%	0%	54.4%	31.9%	5.5
3057	HVAC	Air Source Heat Pump 18.1 SEER2 - Electric furnace baseline	Efficient Products	SF	MO	11,093	75%	8,361	0.42	16	\$6,840	50%	9%	HP-5	23%	36%	61.9%	34.1%	7.3
3058	HVAC	Air Source Heat Pump 18.1 SEER2 - Electric furnace baseline	Efficient Products	SF	NC	11,093	75%	8,361	0.42	16	\$6,840	50%	9%	HP-6	23%	0%	62.1%	33.8%	7.3
3059	HVAC	Air Source Heat Pump 18.1 SEER2 - Electric furnace baseline	Efficient Products	MF	MO	8,715	76%	6,656	0.33	16	\$7,016	50%	9%	HP-7	64%	36%	54.0%	31.7%	5.9
3060	HVAC	Air Source Heat Pump 18.1 SEER2 - Electric furnace baseline	Efficient Products	MF	NC	8,715	76%	6,656	0.33	16	\$7,016	50%	9%	HP-8	64%	0%	54.2%	31.4%	5.9
3061	HVAC	Ductless Heat Pump 8.5 HSPF2 - Electric furnace baseline	Efficient Products	SF	MO	11,093	52%	5,800	0.12	16	\$1,228	100%	29%	HP-5	23%	36%	77.9%	64.7%	8.1
3062	HVAC	Ductless Heat Pump 8.5 HSPF2 - Electric furnace baseline	Efficient Products	SF	NC	11,093	52%	5,800	0.12	16	\$1,228	100%	29%	HP-6	23%	0%	77.9%	64.5%	8.1
3063	HVAC	Ductless Heat Pump 8.5 HSPF2 - Electric furnace baseline	Efficient Products	MF	MO	8,715	53%	4,630	0.09	16	\$982	100%	36%	HP-7	64%	36%	66.4%	56.4%	6.6
3064	HVAC	Ductless Heat Pump 8.5 HSPF2 - Electric furnace baseline	Efficient Products	MF	NC	8,715	53%	4,630	0.09	16	\$982	100%	36%	HP-8	64%	0%	66.4%	56.3%	6.6
3065	HVAC	Ductless Heat Pump 9.4 HSPF2 - Electric furnace baseline	Efficient Products	SF	MO	11,093	57%	6,296	0.23	16	\$1,633	100%	21%	HP-5	23%	36%	77.9%	61.6%	9.4
3066	HVAC	Ductless Heat Pump 9.4 HSPF2 - Electric furnace baseline	Efficient Products	SF	NC	11,093	57%	6,296	0.23	16	\$1,633	100%	21%	HP-6	23%	0%	77.9%	61.5%	9.4
3067	HVAC	Ductless Heat Pump 9.4 HSPF2 - Electric furnace baseline	Efficient Products	MF	MO	8,715	58%	5,017	0.19	16	\$1,306	100%	27%	HP-7	64%	36%	66.4%	55.3%	7.6
3068	HVAC	Ductless Heat Pump 9.4 HSPF2 - Electric furnace baseline	Efficient Products	MF	NC	8,715	58%	5,017	0.19	16	\$1,306	100%	27%	HP-8	64%	0%	66.4%	55.2%	7.6
3069	HVAC	Ductless Heat Pump 10.8 HSPF2 - Electric furnace baseline	Efficient Products	SF	MO	11,093	62%	6,846	0.33	16	\$1,908	100%	30%	HP-5	23%	36%	77.9%	65.5%	6.5
3070	HVAC	Ductless Heat Pump 10.8 HSPF2 - Electric furnace baseline	Efficient Products	SF	NC	11,093	62%	6,846	0.33	16	\$1,908	100%	30%	HP-6	23%	0%	77.9%	65.4%	6.5
3071	HVAC	Ductless Heat Pump 10.8 HSPF2 - Electric furnace baseline	Efficient Products	MF	MO	8,715	63%	5,449	0.26	16	\$1,526	100%	38%	HP-7	64%	36%	66.4%	56.8%	5.2
3072	HVAC	Ductless Heat Pump 10.8 HSPF2 - Electric furnace baseline	Efficient Products	MF	NC	8,715	63%	5,449	0.26	16	\$1,526	100%	38%	HP-8	64%	0%	66.4%	56.7%	5.2
3073	HVAC	Ductless Heat Pump 11.7 HSPF2 - Electric furnace baseline	Efficient Products	SF	MO	11,093	65%	7,181	0.42	16	\$2,723	100%	28%	HP-5	23%	36%	77.9%	64.6%	5.2
3074	HVAC	Ductless Heat Pump 11.7 HSPF2 - Electric furnace baseline	Efficient Products	SF	NC	11,093	65%	7,181	0.42	16	\$2,723	100%	28%	HP-6	23%	0%	77.9%	64.5%	5.2
3075	HVAC	Ductless Heat Pump 11.7 HSPF2 - Electric furnace baseline	Efficient Products	MF	MO	8,715	66%	5,709	0.33	16	\$2,178	100%	36%	HP-7	64%	36%	66.4%	56.4%	4.2
3076	HVAC	Ductless Heat Pump 11.7 HSPF2 - Electric furnace baseline	Efficient Products	MF	NC	8,715	66%	5,709	0.33	16	\$2,178	100%	36%	HP-8	64%	0%	66.4%	56.3%	4.2
3077	HVAC	AC Tune Up	Efficient Products	SF	Retrofit	2,288	5%	114	0.11	3	\$225	12%	12%	AC TUNE-1	61%	54%	30.3%	30.3%	2.4
3078	HVAC	AC Tune Up	Efficient Products	MF	Retrofit	1,661	5%	83	0.08	3	\$225	12%	12%	AC TUNE-2	26%	54%	20.1%	20.1%	1.9
3079	HVAC	Ductless Heat Pump 8.5 HSPF2 - Electric baseboard baseline	Efficient Products	SF	MO	11,093	52%	5,800	0.12	16	\$1,228	100%	29%	HP-9	2%	36%	77.9%	39.1%	8.1
3080	HVAC	Ductless Heat Pump 8.5 HSPF2 - Electric baseboard baseline	Efficient Products	SF	NC	11,093	52%	5,800	0.12	16	\$1,228	100%	29%	HP-10	2%	0%	77.9%	38.7%	8.1
3081	HVAC	Ductless Heat Pump 8.5 HSPF2 - Electric baseboard baseline	Efficient Products	MF	MO	8,715	53%	4,630	0.09	16	\$982	100%	36%	HP-11	10%	36%	66.4%	36.9%	6.6
3082	HVAC	Ductless Heat Pump 8.5 HSPF2 - Electric baseboard baseline	Efficient Products	MF	NC	8,715	53%	4,630	0.09	16	\$982	100%	36%	HP-12	10%	0%	66.4%	36.7%	6.6
3083	HVAC	Ductless Heat Pump 9.4 HSPF2 - Electric baseboard baseline	Efficient Products	SF	MO	11,093	57%	6,296	0.23	16	\$1,633	100%	21%	HP-9	2%	36%	77.9%	30.2%	9.4
3084	HVAC	Ductless Heat Pump 9.4 HSPF2 - Electric baseboard baseline	Efficient Products	SF	NC	11,093	57%	6,296	0.23	16	\$1,633	100%	21%	HP-10	2%	0%	77.9%	29.7%	9.4

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 (%)	End Use Measure Group	Base Saturation	EE Saturation	MAP Adoption Rate	RAP Adoption Rate	UCT Score
3085	HVAC	Ductless Heat Pump 9.4 HSPF2 - Electric baseboard baseline	Efficient Products	MF	MO	8,715	58%	5,017	0.19	16	\$1,306	100%	27%	HP-11	10%	36%	66.4%	33.8%	7.6
3086	HVAC	Ductless Heat Pump 9.4 HSPF2 - Electric baseboard baseline	Efficient Products	MF	NC	8,715	58%	5,017	0.19	16	\$1,306	100%	27%	HP-12	10%	0%	66.4%	33.4%	7.6
3087	HVAC	Ductless Heat Pump 10.8 HSPF2 - Electric baseboard baseline	Efficient Products	SF	MO	11,093	62%	6,846	0.33	16	\$1,908	100%	30%	HP-9	2%	36%	77.9%	41.5%	6.5
3088	HVAC	Ductless Heat Pump 10.8 HSPF2 - Electric baseboard baseline	Efficient Products	SF	NC	11,093	62%	6,846	0.33	16	\$1,908	100%	30%	HP-10	2%	0%	77.9%	41.1%	6.5
3089	HVAC	Ductless Heat Pump 10.8 HSPF2 - Electric baseboard baseline	Efficient Products	MF	MO	8,715	63%	5,449	0.26	16	\$1,526	100%	38%	HP-11	10%	36%	66.4%	38.0%	5.2
3090	HVAC	Ductless Heat Pump 10.8 HSPF2 - Electric baseboard baseline	Efficient Products	MF	NC	8,715	63%	5,449	0.26	16	\$1,526	100%	38%	HP-12	10%	0%	66.4%	37.8%	5.2
3091	HVAC	Ductless Heat Pump 11.7 HSPF2 - Electric baseboard baseline	Efficient Products	SF	MO	11,093	65%	7,181	0.42	16	\$2,723	100%	28%	HP-9	2%	36%	77.9%	39.0%	5.2
3092	HVAC	Ductless Heat Pump 11.7 HSPF2 - Electric baseboard baseline	Efficient Products	SF	NC	11,093	65%	7,181	0.42	16	\$2,723	100%	28%	HP-10	2%	0%	77.9%	38.6%	5.2
3093	HVAC	Ductless Heat Pump 11.7 HSPF2 - Electric baseboard baseline	Efficient Products	MF	MO	8,715	66%	5,709	0.33	16	\$2,178	100%	36%	HP-11	10%	36%	66.4%	36.9%	4.2
3094	HVAC	Ductless Heat Pump 11.7 HSPF2 - Electric baseboard baseline	Efficient Products	MF	NC	8,715	66%	5,709	0.33	16	\$2,178	100%	36%	HP-12	10%	0%	66.4%	36.7%	4.2
3095	HVAC	Central Air Conditioner 15.2 SEER	Efficient Products	SF	MO	2,288	6%	128	0.12	18	\$1,070	33%	33%	CAC-1	61%	22%	59.1%	59.1%	0.9
3096	HVAC	Central Air Conditioner 15.2 SEER	Efficient Products	SF	NC	2,288	6%	128	0.12	18	\$1,070	33%	33%	CAC-2	61%	0%	60.0%	60.0%	0.9
3097	HVAC	Central Air Conditioner 15.2 SEER	Efficient Products	MF	MO	1,661	6%	93	0.09	18	\$1,070	33%	33%	CAC-3	26%	22%	48.1%	48.1%	0.7
3098	HVAC	Central Air Conditioner 15.2 SEER	Efficient Products	MF	NC	1,661	6%	93	0.09	18	\$1,070	33%	33%	CAC-4	26%	0%	46.6%	46.6%	0.7
3099	HVAC	Central Air Conditioner 16.2 SEER	Efficient Products	SF	MO	2,288	11%	253	0.23	18	\$1,270	31%	31%	CAC-1	61%	22%	55.5%	55.5%	1.6
3100	HVAC	Central Air Conditioner 16.2 SEER	Efficient Products	SF	NC	2,288	11%	253	0.23	18	\$1,270	31%	31%	CAC-2	61%	0%	56.3%	56.3%	1.6
3101	HVAC	Central Air Conditioner 16.2 SEER	Efficient Products	MF	MO	1,661	11%	184	0.19	18	\$1,270	31%	31%	CAC-3	26%	22%	44.7%	44.7%	1.2
3102	HVAC	Central Air Conditioner 16.2 SEER	Efficient Products	MF	NC	1,661	11%	184	0.19	18	\$1,270	31%	31%	CAC-4	26%	0%	43.4%	43.4%	1.2
3103	HVAC	Central Air Conditioner 17.2 SEER	Efficient Products	SF	MO	2,288	16%	364	0.34	18	\$1,470	50%	31%	CAC-1	61%	22%	62.6%	53.1%	2.0
3104	HVAC	Central Air Conditioner 17.2 SEER	Efficient Products	SF	NC	2,288	16%	364	0.34	18	\$1,470	50%	31%	CAC-2	61%	0%	62.6%	53.7%	2.0
3105	HVAC	Central Air Conditioner 17.2 SEER	Efficient Products	SF	MO	1,661	16%	264	0.27	18	\$1,470	31%	31%	CAC-3	26%	22%	42.4%	42.4%	1.6
3106	HVAC	Central Air Conditioner 17.2 SEER	Efficient Products	MF	NC	1,661	16%	264	0.27	18	\$1,470	31%	31%	CAC-4	26%	0%	41.3%	41.3%	1.6
3107	HVAC	Smart Thermostat - Heat pump baseline	Efficient Products	SF	Retrofit	6,219	8%	526	0.18	11	\$79	100%	63%	T-STAT-1	17%	39%	83.6%	66.9%	9.2
3108	HVAC	Smart Thermostat - Heat pump baseline	Efficient Products	SF	Retrofit	6,219	8%	526	0.18	11	\$79	100%	63%	T-STAT-1	17%	39%	83.6%	66.9%	9.2
3109	HVAC	Smart Thermostat - Heat pump baseline	IQW	SF	Retrofit	6,219	8%	526	0.18	11	\$79	100%	100%	T-STAT-2	15%	22%	83.2%	83.2%	5.8
3110	HVAC	Smart Thermostat - Heat pump baseline	IQW	SF	Retrofit	6,219	8%	526	0.18	11	\$79	100%	100%	T-STAT-2	15%	22%	83.2%	83.2%	5.8
3111	HVAC	Smart Thermostat - Heat pump baseline	IQW	SF	Retrofit	6,219	8%	526	0.18	11	\$79	100%	100%	T-STAT-2	15%	22%	83.2%	83.2%	1.8
3112	HVAC	Smart Thermostat - Heat pump baseline	Efficient Products	SF	NC	6,219	8%	526	0.18	11	\$79	100%	63%	T-STAT-3	16%	0%	83.0%	65.7%	9.2
3113	HVAC	Smart Thermostat - Heat pump baseline	Efficient Products	MF	Retrofit	4,816	8%	408	0.14	11	\$79	100%	63%	T-STAT-4	11%	19%	66.6%	51.4%	7.3
3114	HVAC	Smart Thermostat - Heat pump baseline	Efficient Products	MF	Retrofit	4,816	8%	408	0.14	11	\$79	100%	63%	T-STAT-4	11%	19%	66.6%	51.4%	7.3
3115	HVAC	Smart Thermostat - Heat pump baseline	Multifamily	MF	Retrofit	4,816	8%	408	0.14	11	\$79	100%	25%	T-STAT-4	11%	19%	66.6%	34.8%	18.6
3116	HVAC	Smart Thermostat - Heat pump baseline	IQW	MF	Retrofit	4,816	8%	408	0.14	11	\$79	100%	100%	T-STAT-5	10%	10%	66.1%	66.1%	4.6
3117	HVAC	Smart Thermostat - Heat pump baseline	IQW	MF	Retrofit	4,816	8%	408	0.14	11	\$79	100%	100%	T-STAT-5	10%	10%	66.1%	66.1%	4.6
3118	HVAC	Smart Thermostat - Heat pump baseline	Multifamily	MF	Retrofit	4,816	8%	408	0.14	11	\$79	100%	100%	T-STAT-5	10%	10%	66.1%	66.1%	4.6
3119	HVAC	Smart Thermostat - Heat pump baseline	IQW	MF	Retrofit	4,816	8%	408	0.14	11	\$79	100%	100%	T-STAT-5	10%	10%	66.1%	66.1%	1.5
3120	HVAC	Smart Thermostat - Heat pump baseline	Efficient Products	MF	NC	4,816	8%	408	0.14	11	\$79	100%	63%	T-STAT-6	10%	0%	66.2%	50.4%	7.3
3121	HVAC	Smart Thermostat - Furnace baseline	Efficient Products	SF	Retrofit	11,093	8%	941	0.18	11	\$79	100%	63%	T-STAT-7	18%	39%	77.9%	57.9%	12.2
3122	HVAC	Smart Thermostat - Furnace baseline	Efficient Products	SF	Retrofit	11,093	8%	941	0.18	11	\$79	100%	63%	T-STAT-7	18%	39%	77.9%	57.9%	12.2
3123	HVAC	Smart Thermostat - Furnace baseline	IQW	SF	Retrofit	11,093	8%	941	0.18	11	\$79	100%	100%	T-STAT-8	29%	22%	77.8%	77.8%	7.7
3124	HVAC	Smart Thermostat - Furnace baseline	IQW	SF	Retrofit	11,093	8%	941	0.18	11	\$79	100%	100%	T-STAT-8	29%	22%	77.8%	77.8%	7.7
3125	HVAC	Smart Thermostat - Furnace baseline	IQW	SF	Retrofit	11,093	8%	941	0.18	11	\$79	100%	100%	T-STAT-8	29%	22%	77.8%	77.8%	2.4
3126	HVAC	Smart Thermostat - Furnace baseline	Efficient Products	SF	NC	11,093	8%	941	0.18	11	\$79	100%	63%	T-STAT-9	23%	0%	77.9%	58.1%	12.2
3127	HVAC	Smart Thermostat - Furnace baseline	Efficient Products	MF	Retrofit	8,715	8%	739	0.14	11	\$79	100%	63%	T-STAT-10	61%	19%	66.4%	51.2%	9.7
3128	HVAC	Smart Thermostat - Furnace baseline	Efficient Products	MF	Retrofit	8,715	8%	739	0.14	11	\$79	100%	63%	T-STAT-10	61%	19%	66.4%	51.2%	9.7
3129	HVAC	Smart Thermostat - Furnace baseline	Multifamily	MF	Retrofit	8,715	8%	739	0.14	11	\$79	100%	25%	T-STAT-10	61%	19%	66.4%	32.0%	24.7
3130	HVAC	Smart Thermostat - Furnace baseline	IQW	MF	Retrofit	8,715	8%	739	0.14	11	\$79	100%	100%	T-STAT-11	59%	10%	62.0%	62.0%	6.2
3131	HVAC	Smart Thermostat - Furnace baseline	IQW	MF	Retrofit	8,715	8%	739	0.14	11	\$79	100%	100%	T-STAT-11	59%	10%	62.0%	62.0%	6.2
3132	HVAC	Smart Thermostat - Furnace baseline	Multifamily	MF	Retrofit	8,715	8%	739	0.14	11	\$79	100%	100%	T-STAT-11	59%	10%	62.0%	62.0%	6.2
3133	HVAC	Smart Thermostat - Furnace baseline	IQW	MF	Retrofit	8,715	8%	739	0.14	11	\$79	100%	100%	T-STAT-11	59%	10%	62.0%	62.0%	1.9
3134	HVAC	Smart Thermostat - Furnace baseline	Efficient Products	MF	NC	8,715	8%	739	0.14	11	\$79	100%	63%	T-STAT-12	64%	0%	66.4%	51.4%	9.7

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 (%)	End Use Measure Group	Base Saturation	EE Saturation	MAP Adoption Rate	RAP Adoption Rate	UCT Score
3135	HVAC	Smart Thermostat - Gas/CAC baseline	Efficient Products	SF	Retrofit	2,288	8%	192	0.18	11	\$79	100%	63%	T-STAT-13	61%	39%	80.4%	67.1%	6.8
3136	HVAC	Smart Thermostat - Gas/CAC baseline	Efficient Products	SF	Retrofit	2,288	8%	192	0.18	11	\$79	100%	63%	T-STAT-13	61%	39%	80.4%	67.1%	6.8
3137	HVAC	Smart Thermostat - Gas/CAC baseline	IQW	SF	Retrofit	2,288	8%	192	0.18	11	\$79	100%	100%	T-STAT-14	47%	22%	81.2%	81.2%	4.3
3138	HVAC	Smart Thermostat - Gas/CAC baseline	IQW	SF	Retrofit	2,288	8%	192	0.18	11	\$79	100%	100%	T-STAT-14	47%	22%	81.2%	81.2%	4.3
3139	HVAC	Smart Thermostat - Gas/CAC baseline	IQW	SF	Retrofit	2,288	8%	192	0.18	11	\$79	100%	100%	T-STAT-14	47%	22%	81.2%	81.2%	1.4
3140	HVAC	Smart Thermostat - Gas/CAC baseline	Efficient Products	SF	NC	2,288	8%	192	0.18	11	\$79	100%	63%	T-STAT-15	59%	0%	81.2%	66.9%	6.8
3141	HVAC	Smart Thermostat - Gas/CAC baseline	Efficient Products	MF	Retrofit	1,661	8%	140	0.14	11	\$79	100%	63%	T-STAT-16	5%	19%	67.1%	53.8%	5.3
3142	HVAC	Smart Thermostat - Gas/CAC baseline	Efficient Products	MF	Retrofit	1,661	8%	140	0.14	11	\$79	100%	63%	T-STAT-16	5%	19%	67.1%	53.8%	5.3
3143	HVAC	Smart Thermostat - Gas/CAC baseline	Multifamily	MF	Retrofit	1,661	8%	140	0.14	11	\$79	100%	25%	T-STAT-16	5%	19%	67.1%	34.2%	13.4
3144	HVAC	Smart Thermostat - Gas/CAC baseline	IQW	MF	Retrofit	1,661	8%	140	0.14	11	\$79	100%	100%	T-STAT-17	14%	10%	67.7%	67.7%	3.4
3145	HVAC	Smart Thermostat - Gas/CAC baseline	IQW	MF	Retrofit	1,661	8%	140	0.14	11	\$79	100%	100%	T-STAT-17	14%	10%	67.7%	67.7%	3.4
3146	HVAC	Smart Thermostat - Gas/CAC baseline	Multifamily	MF	Retrofit	1,661	8%	140	0.14	11	\$79	100%	100%	T-STAT-17	14%	10%	67.7%	67.7%	3.4
3147	HVAC	Smart Thermostat - Gas/CAC baseline	IQW	MF	Retrofit	1,661	8%	140	0.14	11	\$79	100%	100%	T-STAT-17	14%	10%	67.7%	67.7%	1.1
3148	HVAC	Smart Thermostat - Gas/CAC baseline	Efficient Products	MF	NC	1,661	8%	140	0.14	11	\$79	100%	63%	T-STAT-18	9%	0%	56.8%	39.1%	5.3
3149	HVAC	ECM HVAC Motor	No Program	SF	Retrofit	-	0%	666	0.07	6	\$350	50%	25%	ECM-1	97%	35%	50.0%	38.4%	2.5
3150	HVAC	ECM HVAC Motor	No Program	SF	NC	-	0%	666	0.07	6	\$350	50%	25%	ECM-2	97%	0%	50.0%	38.4%	2.5
3151	HVAC	ECM HVAC Motor	No Program	MF	Retrofit	-	0%	444	0.07	6	\$350	25%	25%	ECM-3	79%	35%	29.0%	29.0%	1.9
3152	HVAC	ECM HVAC Motor	No Program	MF	NC	-	0%	444	0.07	6	\$350	25%	25%	ECM-4	79%	0%	29.0%	29.0%	1.9
3153	HVAC	Programmable Thermostat - Heat pump baseline	IQW	SF	Retrofit	6,219	4%	252	0.00	16	\$40	100%	100%	T-STAT-2	15%	22%	83.2%	83.2%	2.8
3154	HVAC	Programmable Thermostat - Heat pump baseline	IQW	MF	Retrofit	4,816	4%	202	0.00	16	\$40	100%	100%	T-STAT-5	10%	10%	66.1%	66.1%	2.3
3155	HVAC	Programmable Thermostat - Furnace baseline	IQW	SF	Retrofit	11,093	5%	554	0.00	16	\$40	100%	100%	T-STAT-8	29%	22%	77.8%	77.8%	6.2
3156	HVAC	Programmable Thermostat - Furnace baseline	IQW	MF	Retrofit	8,715	5%	443	0.00	16	\$40	100%	100%	T-STAT-11	59%	10%	62.0%	62.0%	5.0
3157	HVAC	Programmable Thermostat - Gas/CAC baseline	IQW	SF	Retrofit	2,288	0%	0	0.00	16	\$40	100%	100%	T-STAT-14	47%	22%	81.2%	81.2%	0.0
3158	HVAC	Programmable Thermostat - Gas/CAC baseline	IQW	MF	Retrofit	1,661	0%	0	0.00	16	\$40	100%	100%	T-STAT-17	14%	10%	67.7%	67.7%	0.0
3159	HVAC	ENERGY STAR Room Air Conditioner	Efficient Products	SF	MO	1,396	6%	87	0.08	12	\$40	100%	63%	RAC-1	25%	53%	74.1%	55.3%	6.5
3160	HVAC	ENERGY STAR Room Air Conditioner	Efficient Products	SF	NC	1,396	6%	87	0.08	12	\$40	100%	63%	RAC-2	25%	0%	74.1%	55.3%	6.5
3161	HVAC	ENERGY STAR Room Air Conditioner	Efficient Products	MF	MO	1,267	6%	79	0.08	12	\$40	100%	63%	RAC-3	31%	53%	59.8%	43.1%	6.4
3162	HVAC	ENERGY STAR Room Air Conditioner	Efficient Products	MF	NC	1,267	6%	79	0.08	12	\$40	100%	63%	RAC-4	31%	0%	59.8%	43.1%	6.4
3163	HVAC	Room AC Recycling	No Program	SF	Recycle	989	100%	989	0.91	4	\$20	100%	25%	Room AC Recycle-	4%	0%	74.1%	38.4%	149.0
3164	HVAC	Room AC Recycling	No Program	MF	Recycle	898	100%	898	0.91	4	\$20	100%	25%	Room AC Recycle-	3%	0%	59.8%	29.0%	146.0
3165	HVAC	Smart Vents/Sensors - Heat pump baseline	No Program	SF	Retrofit	6,219	9%	560	0.10	15	\$1,625	25%	25%	Smart Vent-1	16%	16%	47.1%	47.1%	1.1
3166	HVAC	Smart Vents/Sensors - Heat pump baseline	No Program	SF	NC	6,219	9%	560	0.10	15	\$1,625	25%	25%	Smart Vent-2	16%	0%	47.1%	47.1%	1.1
3167	HVAC	Smart Vents/Sensors - Heat pump baseline	No Program	MF	Retrofit	4,816	9%	433	0.04	15	\$1,040	25%	25%	Smart Vent-3	10%	10%	34.5%	34.5%	1.0
3168	HVAC	Smart Vents/Sensors - Heat pump baseline	No Program	MF	NC	4,816	9%	433	0.04	15	\$1,040	25%	25%	Smart Vent-4	10%	0%	34.5%	34.5%	1.0
3169	HVAC	Smart Vents/Sensors - Furnace baseline	No Program	SF	Retrofit	11,093	9%	998	0.18	15	\$1,625	25%	25%	Smart Vent-5	23%	16%	34.0%	34.0%	1.9
3170	HVAC	Smart Vents/Sensors - Furnace baseline	No Program	SF	NC	11,093	9%	998	0.18	15	\$1,625	25%	25%	Smart Vent-6	23%	0%	34.0%	34.0%	1.9
3171	HVAC	Smart Vents/Sensors - Furnace baseline	No Program	MF	Retrofit	8,715	9%	784	0.07	15	\$1,040	25%	25%	Smart Vent-7	64%	10%	31.6%	31.6%	1.8
3172	HVAC	Smart Vents/Sensors - Furnace baseline	No Program	MF	NC	8,715	9%	784	0.07	15	\$1,040	25%	25%	Smart Vent-8	64%	0%	31.6%	31.6%	1.8
3173	HVAC	Smart Vents/Sensors - Gas/CAC baseline	No Program	SF	Retrofit	2,288	9%	206	0.08	15	\$1,625	25%	25%	Smart Vent-9	59%	16%	44.2%	44.2%	0.6
3174	HVAC	Smart Vents/Sensors - Gas/CAC baseline	No Program	SF	NC	2,288	9%	206	0.08	15	\$1,625	25%	25%	Smart Vent-10	59%	0%	44.2%	44.2%	0.6
3175	HVAC	Smart Vents/Sensors - Gas/CAC baseline	No Program	MF	Retrofit	1,661	9%	149	0.06	15	\$1,040	25%	25%	Smart Vent-11	9%	10%	20.1%	20.1%	0.7
3176	HVAC	Smart Vents/Sensors - Gas/CAC baseline	No Program	MF	NC	1,661	9%	149	0.06	15	\$1,040	25%	25%	Smart Vent-12	9%	0%	20.1%	20.1%	0.7
3177	HVAC	Whole House Attic Fan	No Program	SF	Retrofit	2,288	4%	82	0.01	15	\$1,128	25%	25%	WHAF-1	91%	16%	38.4%	38.4%	0.2
3178	HVAC	Whole House Attic Fan	No Program	SF	NC	2,288	4%	82	0.01	15	\$1,128	25%	25%	WHAF-2	91%	0%	38.4%	38.4%	0.2
3179	HVAC	Whole House Attic Fan	No Program	MF	Retrofit	1,661	5%	82	0.01	15	\$1,128	25%	25%	WHAF-3	85%	0%	29.0%	29.0%	0.2
3180	HVAC	Whole House Attic Fan	No Program	MF	NC	1,661	5%	82	0.01	15	\$1,128	25%	25%	WHAF-4	85%	0%	29.0%	29.0%	0.2
3181	HVAC	Attic Fan	No Program	SF	Retrofit	2,288	4%	87	0.18	15	\$125	100%	25%	AF-1	91%	12%	74.1%	38.4%	12.4
3182	HVAC	Attic Fan	No Program	SF	NC	2,288	4%	87	0.18	15	\$125	100%	25%	AF-2	91%	0%	74.1%	38.4%	12.4
3183	HVAC	Attic Fan	No Program	MF	Retrofit	422	8%	34	0.12	15	\$125	100%	25%	AF-3	85%	4%	59.8%	29.0%	8.0
3184	HVAC	Attic Fan	No Program	MF	NC	422	8%	34	0.12	15	\$125	100%	25%	AF-4	85%	0%	59.8%	29.0%	8.0
3185	HVAC	ENERGY STAR Bath Vent Fan	Efficient Products	SF	Retrofit	47	84%	39	0.05	19	\$48	100%	52%	BATH FAN-1	223%	22%	74.1%	50.9%	5.1
3186	HVAC	ENERGY STAR Bath Vent Fan	Efficient Products	SF	NC	47	84%	39	0.05	19	\$48	100%	52%	BATH FAN-2	223%	0%	74.1%	50.9%	5.1
3187	HVAC	ENERGY STAR Bath Vent Fan	Efficient Products	MF	Retrofit	47	84%	39	0.05	19	\$48	100%	52%	BATH FAN-3	145%	22%	59.8%	39.4%	5.1
3188	HVAC	ENERGY STAR Bath Vent Fan	Efficient Products	MF	NC	47	84%	39	0.05	19	\$48	100%	52%	BATH FAN-4	145%	0%	59.8%	39.4%	5.1
3189	HVAC	Energy Recovery Ventilator - Heat Pump	No Program	SF	Retrofit	6,219	12%	730	0.06	15	\$4,710	25%	25%	ERV-1	16%	0%	47.1%	47.1%	0.4
3190	HVAC	Energy Recovery Ventilator - Electric Resistance	No Program	SF	Retrofit	11,093	12%	1,354	0.10	15	\$4,710	25%	25%	ERV-2	20%	0%	34.0%	34.0%	0.7
3191	HVAC	Energy Recovery Ventilator - Heat Pump	No Program	SF	NC	6,219	12%	730	0.06	15	\$4,710	25%	25%	ERV-3	16%	0%	47.1%	47.1%	0.4

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 (%)	End Use Measure Group	Base Saturation	EE Saturation	MAP Adoption Rate	RAP Adoption Rate	UCT Score
3192	HVAC	Energy Recovery Ventilator - Electric Resistance	No Program	SF	NC	11,093	12%	1,354	0.10	15	\$4,710	25%	25%	ERV-4	20%	0%	34.0%	34.0%	0.7
3193	HVAC	Energy Recovery Ventilator - Heat Pump	No Program	MF	Retrofit	4,816	0%	3	0.00	15	\$4,710	25%	25%	ERV-5	10%	0%	34.5%	34.5%	0.0
3194	HVAC	Energy Recovery Ventilator - Electric Resistance	No Program	MF	Retrofit	8,715	4%	353	0.03	15	\$4,710	25%	25%	ERV-6	67%	0%	31.6%	31.6%	0.2
3195	HVAC	Energy Recovery Ventilator - Heat Pump	No Program	MF	NC	4,816	0%	3	0.00	15	\$4,710	25%	25%	ERV-7	10%	0%	34.5%	34.5%	0.0
3196	HVAC	Energy Recovery Ventilator - Electric Resistance	No Program	MF	NC	8,715	4%	353	0.03	15	\$4,710	25%	25%	ERV-8	67%	0%	31.6%	31.6%	0.2
3197	HVAC	Eco-Snap Air Conditioning	No Program	SF	MO	1,396	5%	75	0.05	15	\$80	100%	25%	RAC-1	25%	0%	74.1%	38.4%	6.4
3198	HVAC	Eco-Snap Air Conditioning	No Program	SF	NC	1,396	5%	75	0.05	15	\$80	100%	25%	RAC-2	25%	0%	74.1%	38.4%	6.4
3199	HVAC	Eco-Snap Air Conditioning	No Program	MF	MO	1,267	6%	75	0.05	15	\$80	100%	25%	RAC-3	31%	0%	59.8%	29.0%	6.4
3200	HVAC	Eco-Snap Air Conditioning	No Program	MF	NC	1,267	6%	75	0.05	15	\$80	100%	25%	RAC-4	31%	0%	59.8%	29.0%	6.4
3201	HVAC	Residential-Sized Sub-Wet Bulb Chiller	No Program	SF	MO	2,288	35%	801	0.50	20	\$1,950	75%	25%	CAC-1	61%	0%	61.2%	38.4%	3.2
3202	HVAC	Residential-Sized Sub-Wet Bulb Chiller	No Program	SF	NC	2,288	35%	801	0.50	20	\$1,950	75%	25%	CAC-2	61%	0%	61.2%	38.4%	3.2
3203	HVAC	Residential-Sized Sub-Wet Bulb Chiller	No Program	MF	MO	1,661	35%	581	0.50	20	\$1,950	50%	25%	CAC-3	26%	0%	38.7%	29.0%	3.0
3204	HVAC	Residential-Sized Sub-Wet Bulb Chiller	No Program	MF	NC	1,661	35%	581	0.50	20	\$1,950	50%	25%	CAC-4	26%	0%	38.7%	29.0%	3.0
3205	HVAC	Solar-Assisted Air Conditioning	No Program	SF	MO	2,288	30%	686	0.50	15	\$533	100%	25%	CAC-1	61%	0%	74.1%	38.4%	9.4
3206	HVAC	Solar-Assisted Air Conditioning	No Program	SF	NC	2,288	30%	686	0.50	15	\$533	100%	25%	CAC-2	61%	0%	74.1%	38.4%	9.4
3207	HVAC	Solar-Assisted Air Conditioning	No Program	MF	MO	1,661	30%	498	0.50	15	\$533	100%	25%	CAC-3	26%	0%	59.8%	29.0%	8.8
3208	HVAC	Solar-Assisted Air Conditioning	No Program	MF	NC	1,661	30%	498	0.50	15	\$533	100%	25%	CAC-4	26%	0%	59.8%	29.0%	8.8
3209	HVAC	Electro Caloric Heat Pump	No Program	SF	MO	8,255	33%	2,724	1.20	15	\$2,508	100%	25%	HP-1	16%	0%	83.0%	47.1%	5.6
3210	HVAC	Electro Caloric Heat Pump	No Program	SF	NC	8,255	33%	2,724	1.20	15	\$2,508	100%	25%	HP-2	16%	0%	83.0%	47.1%	5.6
3211	HVAC	Electro Caloric Heat Pump	No Program	MF	MO	5,503	33%	1,816	1.20	15	\$2,006	100%	25%	HP-3	10%	0%	66.2%	34.5%	6.3
3212	HVAC	Electro Caloric Heat Pump	No Program	MF	NC	5,503	33%	1,816	1.20	15	\$2,006	100%	25%	HP-4	10%	0%	66.2%	34.5%	6.3
4001	Lighting	LED Nightlights	Efficient Products	SF	MO	15	93%	14	0.00	8	\$3	100%	90%	NIGHT-1	132%	59%	59.3%	52.9%	1.3
4002	Lighting	LED Nightlights	School Education	SF	MO	15	93%	14	0.00	8	\$3	100%	45%	NIGHT-1	132%	59%	59.3%	32.9%	2.6
4003	Lighting	LED Nightlights	IQW	SF	MO	15	93%	14	0.00	8	\$3	100%	100%	NIGHT-2	132%	59%	58.9%	58.9%	1.2
4004	Lighting	LED Nightlights	School Education	SF	MO	15	93%	14	0.00	8	\$3	100%	45%	NIGHT-2	132%	59%	58.9%	31.6%	2.6
4005	Lighting	LED Nightlights	IQW	SF	MO	15	93%	14	0.00	8	\$3	100%	100%	NIGHT-2	132%	59%	58.9%	58.9%	1.2
4006	Lighting	LED Nightlights	Efficient Products	SF	NC	15	93%	14	0.00	8	\$3	100%	90%	NIGHT-3	132%	0%	67.4%	61.2%	1.3
4007	Lighting	LED Nightlights	Efficient Products	MF	MO	15	93%	14	0.00	8	\$3	100%	90%	LED-4	63%	59%	51.1%	45.6%	1.3
4008	Lighting	LED Nightlights	School Education	MF	MO	15	93%	14	0.00	8	\$3	100%	45%	LED-4	63%	59%	51.1%	27.7%	2.6
4009	Lighting	LED Nightlights	Multifamily	MF	MO	15	93%	14	0.00	8	\$3	100%	90%	LED-4	63%	59%	51.1%	45.6%	1.3
4010	Lighting	LED Nightlights	IQW	MF	MO	15	93%	14	0.00	8	\$3	100%	100%	LED-5	63%	59%	52.3%	52.3%	1.2
4011	Lighting	LED Nightlights	School Education	MF	MO	15	93%	14	0.00	8	\$3	100%	45%	LED-5	63%	59%	52.3%	31.4%	2.6
4012	Lighting	LED Nightlights	Multifamily	MF	MO	15	93%	14	0.00	8	\$3	100%	90%	LED-5	63%	59%	52.3%	48.0%	1.3
4013	Lighting	LED Nightlights	IQW	MF	MO	15	93%	14	0.00	8	\$3	100%	100%	LED-5	63%	59%	52.3%	52.3%	1.2
4014	Lighting	LED Nightlights	Efficient Products	MF	NC	15	93%	14	0.00	8	\$3	100%	90%	LED-6	63%	0%	56.8%	49.1%	1.3
4015	Lighting	Ceiling Fan	Efficient Products	SF	MO	110	75%	82	0.00	10	\$46	50%	25%	CFAN-1	257%	22%	42.9%	28.1%	2.4
4016	Lighting	Ceiling Fan	Efficient Products	SF	NC	110	75%	82	0.00	10	\$46	50%	25%	CFAN-2	257%	0%	42.9%	28.1%	2.4
4017	Lighting	Ceiling Fan	Efficient Products	MF	MO	110	75%	82	0.00	10	\$46	50%	25%	CFAN-3	96%	22%	40.7%	31.3%	2.4
4018	Lighting	Ceiling Fan	Efficient Products	MF	NC	110	75%	82	0.00	10	\$46	50%	25%	CFAN-4	96%	0%	40.7%	31.3%	2.4
4019	Lighting	Linear LED	No Program	SF	MO	41	45%	18	0.00	10	\$10	75%	25%	LINEAR-1	179%	59%	53.5%	28.1%	3.3
4020	Lighting	Linear LED	No Program	SF	NC	41	45%	18	0.00	10	\$10	75%	25%	LINEAR-2	179%	0%	53.5%	28.1%	3.3
4021	Lighting	Linear LED	No Program	MF	MO	41	45%	18	0.00	10	\$10	75%	25%	LINEAR-3	107%	59%	40.0%	31.3%	3.3
4022	Lighting	Linear LED	No Program	MF	NC	41	45%	18	0.00	9	\$10	75%	25%	LINEAR-4	107%	0%	40.0%	31.3%	3.1
4023	Lighting	Occupancy Sensor	No Program	SF	Retrofit	302	30%	89	0.01	10	\$30	100%	25%	SENSOR-1	100%	31%	67.4%	28.1%	5.4
4024	Lighting	Occupancy Sensor	No Program	SF	NC	302	30%	89	0.01	10	\$30	100%	25%	SENSOR-2	100%	0%	67.4%	28.1%	5.4
4025	Lighting	Occupancy Sensor	No Program	MF	Retrofit	302	30%	89	0.01	10	\$30	100%	25%	SENSOR-3	100%	31%	56.8%	31.3%	5.4
4026	Lighting	Occupancy Sensor	No Program	MF	NC	302	30%	89	0.01	10	\$30	100%	25%	SENSOR-4	100%	0%	56.8%	31.3%	5.4
4027	Lighting	Exterior Lighting Controls	No Program	SF	Retrofit	108	80%	86	0.00	10	\$3	100%	25%	ELC-1	233%	35%	67.4%	28.1%	37.7
4028	Lighting	Exterior Lighting Controls	No Program	SF	NC	108	80%	86	0.00	10	\$3	100%	25%	ELC-2	233%	0%	67.4%	28.1%	37.7
4029	Lighting	Exterior Lighting Controls	No Program	MF	Retrofit	108	80%	86	0.00	10	\$3	100%	25%	ELC-3	126%	35%	56.8%	31.3%	37.6
4030	Lighting	Exterior Lighting Controls	No Program	MF	NC	108	80%	86	0.00	10	\$3	100%	25%	ELC-4	126%	0%	56.8%	31.3%	37.6
4031	Lighting	EISA Exempt LED	No Program	SF	MO	11	50%	6	0.01	15	\$2	100%	25%	EISA BULB-1	100%	59%	67.4%	28.1%	31.0
4032	Lighting	EISA Exempt LED	No Program	SF	NC	11	50%	6	0.01	15	\$2	100%	25%	EISA BULB-2	100%	0%	67.4%	28.1%	31.0
4033	Lighting	EISA Exempt LED	No Program	MF	MO	11	50%	6	0.01	15	\$2	100%	25%	EISA BULB-3	100%	59%	56.8%	31.3%	31.0
4034	Lighting	EISA Exempt LED	No Program	MF	NC	11	50%	6	0.01	15	\$2	100%	25%	EISA BULB-4	100%	0%	56.8%	31.3%	31.0
4035	Lighting	Connected LED Lamps	No Program	SF	MO	9	33%	3	0.00	10	\$20	25%	25%	CONNECTED LED-	100%	59%	28.1%	28.1%	0.2
4036	Lighting	Connected LED Lamps	No Program	SF	NC	9	33%	3	0.00	10	\$20	25%	25%	CONNECTED LED-	100%	0%	28.1%	28.1%	0.2

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 (%)	End Use Measure Group	Base Saturation	EE Saturation	MAP Adoption Rate	RAP Adoption Rate	UCT Score
4037	Lighting	Connected LED Lamps	No Program	MF	MO	9	33%	3	0.00	10	\$20	25%	25%	CONNECTED LED-	100%	59%	31.3%	31.3%	0.2
4038	Lighting	Connected LED Lamps	No Program	MF	NC	9	33%	3	0.00	10	\$20	25%	25%	CONNECTED LED-	100%	0%	31.3%	31.3%	0.2
4039	Lighting	Ultra-Efficient LED	No Program	SF	MO	11	50%	6	0.01	20	\$3	100%	25%	UE LED-1	100%	59%	67.4%	28.1%	22.9
4040	Lighting	Ultra-Efficient LED	No Program	SF	NC	11	50%	6	0.01	20	\$3	100%	25%	UE LED-2	100%	0%	67.4%	28.1%	22.9
4041	Lighting	Ultra-Efficient LED	No Program	MF	MO	11	50%	5	0.01	20	\$3	100%	25%	UE LED-3	100%	59%	56.8%	31.3%	22.1
4042	Lighting	Ultra-Efficient LED	No Program	MF	NC	11	50%	5	0.01	20	\$3	100%	25%	UE LED-4	100%	0%	56.8%	31.3%	22.1
4043	Lighting	Advanced Lighting	No Program	SF	MO	2,000	10%	200	0.02	18	\$194	50%	25%	DVANCED LIGHT-	100%	0%	42.9%	28.1%	2.9
4044	Lighting	Advanced Lighting	No Program	SF	NC	2,000	10%	200	0.02	18	\$194	50%	25%	DVANCED LIGHT-	100%	0%	42.9%	28.1%	2.9
4045	Lighting	Advanced Lighting	No Program	MF	MO	1,000	10%	100	0.01	18	\$97	50%	25%	DVANCED LIGHT-	100%	0%	40.7%	31.3%	2.9
4046	Lighting	Advanced Lighting	No Program	MF	NC	1,000	10%	100	0.01	18	\$97	50%	25%	DVANCED LIGHT-	100%	0%	40.7%	31.3%	2.9
5001	New Construction	Integrated Design	No Program	SF	NC	13,160	50%	6,580	0.75	25	\$46,275	25%	25%	NC-1	100%	0%	36.3%	36.3%	0.5
5002	New Construction	Integrated Design	No Program	MF	NC	6,580	50%	3,290	0.38	25	\$22,075	25%	25%	NC-2	100%	0%	28.5%	28.5%	0.5
6001	Pool/Pump	Variable Speed Pool Pump	Efficient Products	SF	MO	1,159	26%	297	2.02	7	\$314	100%	16%	POOL-1	6%	36%	67.4%	23.9%	44.1
6002	Pool/Pump	Variable Speed Pool Pump	Efficient Products	SF	NC	1,159	26%	297	2.02	7	\$314	100%	16%	POOL-2	6%	0%	67.4%	23.9%	44.1
6003	Pool/Pump	Variable Speed Pool Pump	Efficient Products	MF	MO	1,159	26%	297	2.02	7	\$314	100%	16%	POOL-3	2%	36%	56.8%	25.9%	42.6
6004	Pool/Pump	Variable Speed Pool Pump	Efficient Products	MF	NC	1,159	26%	297	2.02	7	\$314	100%	16%	POOL-4	2%	0%	56.8%	25.9%	42.6
6005	Pool/Pump	Heat Pump Swimming Pool Heater	No Program	SF	MO	15,496	71%	11,068	0.00	15	\$1,916	100%	25%	POOL HEATER-1	1%	2%	67.4%	28.1%	9.9
6006	Pool/Pump	Heat Pump Swimming Pool Heater	No Program	SF	NC	15,496	71%	11,068	0.00	15	\$1,916	100%	25%	POOL HEATER-2	1%	0%	67.4%	28.1%	9.9
6007	Pool/Pump	Heat Pump Swimming Pool Heater	No Program	MF	MO	15,496	71%	11,068	0.00	15	\$1,916	100%	25%	POOL HEATER-3	0%	2%	56.8%	31.3%	0.0
6008	Pool/Pump	Heat Pump Swimming Pool Heater	No Program	MF	NC	15,496	71%	11,068	0.00	15	\$1,916	100%	25%	POOL HEATER-4	0%	0%	56.8%	31.3%	0.0
7001	Plug Loads	Smart Power Strips - Tier 1	Efficient Products	SF	Retrofit	466	12%	57	0.01	7	\$10	100%	100%	TIER 1 SS-1	178%	19%	67.4%	67.4%	1.7
7002	Plug Loads	Smart Power Strips - Tier 1	Efficient Products	SF	NC	466	12%	57	0.01	7	\$10	100%	100%	TIER 1 SS-2	178%	0%	67.4%	67.4%	1.7
7003	Plug Loads	Smart Power Strips - Tier 1	Efficient Products	MF	Retrofit	466	12%	57	0.01	7	\$10	100%	100%	TIER 1 SS-3	139%	10%	56.8%	56.8%	1.7
7004	Plug Loads	Smart Power Strips - Tier 1	Efficient Products	MF	NC	466	12%	57	0.01	7	\$10	100%	100%	TIER 1 SS-4	139%	0%	56.8%	56.8%	1.7
7005	Plug Loads	Smart Power Strips - Tier 2	Efficient Products	SF	Retrofit	466	29%	136	0.02	7	\$20	100%	65%	TIER 2 SS-1	100%	20%	59.3%	40.7%	4.8
7006	Plug Loads	Smart Power Strips - Tier 2	IQW	SF	Retrofit	466	29%	136	0.02	7	\$20	100%	100%	TIER 2 SS-2	100%	13%	58.9%	58.9%	3.1
7007	Plug Loads	Smart Power Strips - Tier 2	IQW	SF	Retrofit	466	29%	136	0.02	7	\$20	100%	100%	TIER 2 SS-2	100%	13%	58.9%	58.9%	2.5
7008	Plug Loads	Smart Power Strips - Tier 2	Efficient Products	SF	NC	466	29%	136	0.02	7	\$20	100%	65%	TIER 2 SS-3	100%	0%	67.4%	48.8%	4.8
7009	Plug Loads	Smart Power Strips - Tier 2	Efficient Products	MF	Retrofit	466	29%	136	0.02	7	\$20	100%	65%	TIER 2 SS-4	100%	12%	51.1%	34.4%	4.8
7010	Plug Loads	Smart Power Strips - Tier 2	Multifamily	MF	Retrofit	466	29%	136	0.02	7	\$20	100%	100%	TIER 2 SS-4	100%	12%	51.1%	51.1%	2.5
7011	Plug Loads	Smart Power Strips - Tier 2	IQW	MF	Retrofit	466	29%	136	0.02	7	\$20	100%	100%	TIER 2 SS-5	100%	12%	52.3%	52.3%	3.1
7012	Plug Loads	Smart Power Strips - Tier 2	Multifamily	MF	Retrofit	466	29%	136	0.02	7	\$20	100%	100%	TIER 2 SS-5	100%	12%	52.3%	52.3%	2.5
7013	Plug Loads	Smart Power Strips - Tier 2	IQW	MF	Retrofit	466	29%	136	0.02	7	\$20	100%	100%	TIER 2 SS-5	100%	12%	52.3%	52.3%	2.5
7014	Plug Loads	Smart Power Strips - Tier 2	Efficient Products	MF	NC	466	29%	136	0.02	7	\$20	100%	65%	TIER 2 SS-6	100%	0%	56.8%	40.3%	4.8
7015	Plug Loads	ENERGY STAR Television	No Program	SF	MO	286	25%	72	0.01	5	\$60	25%	25%	TV-1	270%	56%	28.1%	28.1%	1.4
7016	Plug Loads	ENERGY STAR Television	No Program	SF	NC	286	25%	72	0.01	5	\$60	25%	25%	TV-2	270%	0%	28.1%	28.1%	1.4
7017	Plug Loads	ENERGY STAR Television	No Program	MF	MO	286	25%	72	0.01	5	\$60	25%	25%	TV-3	207%	56%	31.3%	31.3%	1.4
7018	Plug Loads	ENERGY STAR Television	No Program	MF	NC	286	25%	72	0.01	5	\$60	25%	25%	TV-4	207%	0%	31.3%	31.3%	1.4
7019	Plug Loads	Smart Outlets	No Program	SF	Retrofit	466	11%	50	0.01	7	\$9	100%	25%	SMART SOCKET-1	100%	19%	67.4%	28.1%	9.1
7020	Plug Loads	Smart Outlets	No Program	SF	NC	466	11%	50	0.01	7	\$9	100%	25%	SMART SOCKET-2	100%	0%	67.4%	28.1%	9.1
7021	Plug Loads	Smart Outlets	No Program	MF	Retrofit	466	11%	50	0.01	7	\$9	100%	25%	SMART SOCKET-3	100%	10%	56.8%	31.3%	9.1
7022	Plug Loads	Smart Outlets	No Program	MF	NC	466	11%	50	0.01	7	\$9	100%	25%	SMART SOCKET-4	100%	0%	56.8%	31.3%	9.1
7023	Plug Loads	Level 2 Electric Vehicle Charger	No Program	SF	Retrofit	84	72%	61	0.01	10	\$47	50%	25%	EV-1	4%	64%	67.4%	67.4%	2.6
7024	Plug Loads	Level 2 Electric Vehicle Charger	No Program	SF	NC	84	72%	61	0.01	10	\$47	50%	25%	EV-2	4%	0%	67.4%	67.4%	2.6
7025	Plug Loads	Level 2 Electric Vehicle Charger	No Program	MF	Retrofit	84	72%	61	0.01	10	\$47	50%	25%	EV-3	1%	64%	56.8%	56.8%	2.6
7026	Plug Loads	Level 2 Electric Vehicle Charger	No Program	MF	NC	84	72%	61	0.01	10	\$47	50%	25%	EV-4	1%	0%	56.8%	56.8%	2.6
8001	Shell	Advanced Walls - Heat pump	No Program	SF	Retrofit	6,219	8%	466	0.08	20	\$2,470	25%	25%	WALL-1	17%	96%	47.4%	47.4%	0.7
8002	Shell	Advanced Walls - Heat pump	No Program	SF	Retrofit	6,219	8%	466	0.08	20	\$2,470	25%	25%	WALL-2	15%	96%	47.4%	47.4%	0.2
8003	Shell	Advanced Walls - Heat pump	No Program	MF	Retrofit	4,816	8%	361	0.03	20	\$1,581	25%	25%	WALL-3	11%	96%	34.8%	34.8%	0.7
8004	Shell	Advanced Walls - Heat pump	No Program	MF	Retrofit	4,816	8%	361	0.03	20	\$1,581	25%	25%	WALL-4	10%	96%	31.8%	31.8%	0.2
8005	Shell	Advanced Walls - Electric furnace	No Program	SF	Retrofit	11,093	8%	832	0.15	20	\$2,470	25%	25%	WALL-5	18%	96%	46.3%	46.3%	1.2
8006	Shell	Advanced Walls - Electric furnace	No Program	SF	Retrofit	11,093	8%	832	0.15	20	\$2,470	50%	25%	WALL-6	29%	96%	59.7%	43.3%	0.3
8007	Shell	Advanced Walls - Electric furnace	No Program	MF	Retrofit	8,715	8%	654	0.06	20	\$1,581	25%	25%	WALL-7	61%	96%	42.0%	42.0%	1.2
8008	Shell	Advanced Walls - Electric furnace	No Program	MF	Retrofit	8,715	8%	654	0.06	20	\$1,581	50%	25%	WALL-8	59%	96%	47.0%	33.9%	0.3
8009	Shell	Advanced Walls - Gas Heating	No Program	SF	Retrofit	2,288	8%	172	0.06	20	\$2,470	25%	25%	WALL-9	61%	96%	63.2%	63.2%	0.4
8010	Shell	Advanced Walls - Gas Heating	No Program	SF	Retrofit	2,288	8%	172	0.06	20	\$2,470	25%	25%	WALL-10	47%	96%	59.0%	59.0%	0.1
8011	Shell	Advanced Walls - Gas Heating	No Program	MF	Retrofit	1,661	8%	125	0.05	20	\$1,581	25%	25%	WALL-11	5%	96%	50.3%	50.3%	0.4

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 (%)	End Use Measure Group	Base Saturation	EE Saturation	MAP Adoption Rate	RAP Adoption Rate	UCT Score
8012	Shell	Advanced Walls - Gas Heating	No Program	MF	Retrofit	1,661	8%	125	0.05	20	\$1,581	25%	25%	WALL-12	14%	96%	47.0%	47.0%	0.1
8013	Shell	Air Sealing Inadequate Sealing - Heat pump	Efficient Products	SF	Retrofit	6,219	17%	1,062	0.19	20	\$467	100%	86%	AIR SEAL-1	17%	75%	83.6%	81.4%	2.5
8014	Shell	Air Sealing Inadequate Sealing - Heat pump	IQW	SF	Retrofit	6,219	17%	1,062	0.19	20	\$467	100%	100%	AIR SEAL-2	15%	75%	83.2%	83.2%	2.1
8015	Shell	Air Sealing Inadequate Sealing - Heat pump	Efficient Products	MF	Retrofit	4,816	10%	465	0.04	20	\$467	86%	86%	AIR SEAL-3	11%	94%	64.6%	64.6%	0.8
8016	Shell	Air Sealing Inadequate Sealing - Heat pump	IQW	MF	Retrofit	4,816	10%	465	0.04	20	\$467	100%	100%	AIR SEAL-4	10%	94%	66.1%	66.1%	0.7
8017	Shell	Air Sealing Inadequate Sealing - Electric furnace	Efficient Products	SF	Retrofit	11,093	14%	1,588	0.29	20	\$467	100%	86%	AIR SEAL-5	18%	75%	77.9%	75.6%	3.7
8018	Shell	Air Sealing Inadequate Sealing - Electric furnace	IQW	SF	Retrofit	11,093	14%	1,588	0.29	20	\$467	100%	100%	AIR SEAL-6	29%	75%	77.8%	77.8%	3.2
8019	Shell	Air Sealing Inadequate Sealing - Electric furnace	Efficient Products	MF	Retrofit	8,715	8%	697	0.06	20	\$467	100%	86%	AIR SEAL-7	61%	94%	66.4%	64.7%	1.3
8020	Shell	Air Sealing Inadequate Sealing - Electric furnace	IQW	MF	Retrofit	8,715	8%	697	0.06	20	\$467	100%	100%	AIR SEAL-8	59%	94%	62.0%	62.0%	1.1
8021	Shell	Air Sealing - Inadequate Sealing - Gas Heating	Efficient Products	SF	Retrofit	2,288	19%	424	0.15	20	\$467	100%	86%	AIR SEAL-9	61%	75%	80.4%	80.4%	1.4
8022	Shell	Air Sealing - Inadequate Sealing - Gas Heating	IQW	SF	Retrofit	2,288	19%	424	0.15	20	\$467	100%	100%	AIR SEAL-10	47%	75%	81.2%	81.2%	1.2
8023	Shell	Air Sealing - Inadequate Sealing - Gas Heating	Efficient Products	MF	Retrofit	1,661	11%	188	0.07	20	\$467	86%	86%	AIR SEAL-11	5%	94%	67.1%	67.1%	0.6
8024	Shell	Air Sealing - Inadequate Sealing - Gas Heating	IQW	MF	Retrofit	1,661	11%	188	0.07	20	\$467	100%	100%	AIR SEAL-12	14%	94%	67.7%	67.7%	0.5
8025	Shell	Can Foam	Efficient Products	SF	Retrofit	13,160	0%	16	0.00	15	\$3	100%	33%	FOAM-1	100%	75%	74.1%	43.9%	12.5
8026	Shell	Can Foam	Efficient Products	MF	Retrofit	6,580	0%	16	0.00	15	\$3	100%	33%	FOAM-2	100%	94%	59.8%	33.6%	9.8
8027	Shell	Caulk	Efficient Products	SF	Retrofit	13,160	0%	16	0.00	10	\$5	100%	25%	CAULK-1	100%	75%	74.1%	38.4%	7.5
8028	Shell	Caulk	Efficient Products	MF	Retrofit	6,580	0%	16	0.00	10	\$5	100%	25%	CAULK-2	100%	94%	59.8%	29.0%	6.0
8029	Shell	Outlet Gaskets	School Education	SF	Retrofit	13,160	0%	2	0.00	20	\$5	1%	1%	GASKET-1	100%	75%	27.6%	27.6%	26.5
8030	Shell	Outlet Gaskets	School Education	MF	Retrofit	6,580	0%	2	0.00	20	\$5	1%	1%	GASKET-2	100%	94%	5.2%	5.2%	26.5
8031	Shell	Door Sweep	Efficient Products	SF	Retrofit	13,160	0%	22	0.00	20	\$5	100%	55%	SWEEP-1	100%	75%	74.3%	52.3%	6.8
8032	Shell	Door Sweep	IQW	SF	Retrofit	13,160	0%	22	0.00	20	\$5	100%	100%	SWEEP-2	100%	75%	74.1%	74.1%	3.7
8033	Shell	Door Sweep	School Education	SF	Retrofit	13,160	0%	27	0.00	20	\$5	100%	38%	SWEEP-1	100%	75%	74.3%	47.7%	11.9
8034	Shell	Door Sweep	School Education	SF	Retrofit	13,160	0%	27	0.00	20	\$5	100%	38%	SWEEP-2	100%	75%	74.1%	43.4%	11.9
8035	Shell	Door Sweep	IQW	SF	Retrofit	13,160	1%	146	0.03	20	\$5	100%	91%	SWEEP-2	100%	75%	74.1%	68.4%	27.1
8036	Shell	Door Sweep	Efficient Products	MF	Retrofit	6,580	0%	22	0.00	20	\$5	100%	55%	SWEEP-3	100%	94%	59.9%	40.6%	5.3
8037	Shell	Door Sweep	IQW	MF	Retrofit	6,580	0%	22	0.00	20	\$5	100%	100%	SWEEP-4	100%	94%	59.7%	59.7%	2.9
8038	Shell	Door Sweep	School Education	MF	Retrofit	6,580	0%	27	0.00	20	\$5	100%	38%	SWEEP-3	100%	94%	59.9%	34.0%	9.3
8039	Shell	Door Sweep	School Education	MF	Retrofit	6,580	0%	27	0.00	20	\$5	100%	38%	SWEEP-4	100%	94%	59.7%	31.4%	9.3
8040	Shell	Door Sweep	Multifamily	MF	Retrofit	6,580	2%	146	0.01	20	\$5	100%	100%	SWEEP-3	100%	94%	59.9%	59.9%	10.6
8041	Shell	Door Sweep	Multifamily	MF	Retrofit	6,580	2%	146	0.01	20	\$5	100%	100%	SWEEP-4	100%	94%	59.7%	59.7%	10.6
8042	Shell	Door Sweep	IQW	MF	Retrofit	6,580	2%	146	0.01	20	\$5	100%	91%	SWEEP-4	100%	94%	59.7%	54.7%	21.1
8043	Shell	Attic Insulation - Inadequate Insulation - Heat pump	Efficient Products	SF	Retrofit	6,219	10%	602	0.11	30	\$1,243	50%	29%	ATTIC-1	17%	83%	70.1%	59.5%	1.9
8044	Shell	Attic Insulation - Inadequate Insulation - Heat pump	IQW	SF	Retrofit	6,219	10%	602	0.11	30	\$1,243	100%	100%	ATTIC-2	15%	75%	83.2%	83.2%	0.4
8045	Shell	Attic Insulation - Inadequate Insulation - Heat pump	Efficient Products	MF	Retrofit	4,816	12%	568	0.05	30	\$1,172	31%	31%	ATTIC-3	11%	79%	46.9%	46.9%	1.4
8046	Shell	Attic Insulation - Inadequate Insulation - Heat pump	IQW	MF	Retrofit	4,816	12%	568	0.05	30	\$1,172	100%	100%	ATTIC-4	10%	77%	66.1%	66.1%	0.3
8047	Shell	Attic Insulation - Inadequate Insulation - Electric furnace	Efficient Products	SF	Retrofit	11,093	8%	922	0.17	30	\$1,243	75%	29%	ATTIC-5	18%	83%	74.0%	49.6%	2.9
8048	Shell	Attic Insulation - Inadequate Insulation - Electric furnace	IQW	SF	Retrofit	11,093	8%	922	0.17	30	\$1,243	100%	100%	ATTIC-6	29%	75%	77.8%	77.8%	0.7
8049	Shell	Attic Insulation - Inadequate Insulation - Electric furnace	Efficient Products	MF	Retrofit	8,715	10%	869	0.08	30	\$1,172	50%	31%	ATTIC-7	61%	79%	54.3%	45.7%	2.1
8050	Shell	Attic Insulation - Inadequate Insulation - Electric furnace	IQW	MF	Retrofit	8,715	10%	869	0.08	30	\$1,172	100%	100%	ATTIC-8	59%	77%	62.0%	62.0%	0.5
8051	Shell	Attic Insulation - Inadequate Insulation - Gas Heating	Efficient Products	SF	Retrofit	2,288	14%	327	0.12	30	\$1,243	29%	29%	ATTIC-9	61%	83%	64.9%	64.9%	1.5
8052	Shell	Attic Insulation - Inadequate Insulation - Gas Heating	IQW	SF	Retrofit	2,288	14%	327	0.12	30	\$1,243	100%	100%	ATTIC-10	47%	75%	81.2%	81.2%	0.4
8053	Shell	Attic Insulation - Inadequate Insulation - Gas Heating	Efficient Products	MF	Retrofit	1,661	14%	239	0.09	30	\$1,172	31%	31%	ATTIC-11	5%	79%	52.6%	52.6%	1.1
8054	Shell	Attic Insulation - Inadequate Insulation - Gas Heating	IQW	MF	Retrofit	1,661	14%	239	0.09	30	\$1,172	100%	100%	ATTIC-12	14%	77%	67.7%	67.7%	0.3
8055	Shell	Duct Sealing - Inadequate Sealing - Heat pump	Efficient Products	SF	Retrofit	6,219	18%	1,105	0.20	20	\$910	100%	33%	DUCT-1	17%	78%	83.6%	61.5%	3.4
8056	Shell	Duct Sealing - Inadequate Sealing - Heat pump	IQW	SF	Retrofit	6,219	18%	1,105	0.20	20	\$910	100%	100%	DUCT-2	15%	78%	83.2%	83.2%	1.1
8057	Shell	Duct Sealing - Inadequate Sealing - Heat pump	Efficient Products	MF	Retrofit	4,816	15%	713	0.06	20	\$455	100%	66%	DUCT-3	11%	97%	66.6%	60.7%	1.7
8058	Shell	Duct Sealing - Inadequate Sealing - Heat pump	IQW	MF	Retrofit	4,816	15%	713	0.06	20	\$455	100%	100%	DUCT-4	10%	97%	66.1%	66.1%	1.1
8059	Shell	Duct Sealing - Inadequate Sealing - Electric furnace	Efficient Products	SF	Retrofit	11,093	15%	1,637	0.29	20	\$910	100%	33%	DUCT-5	18%	78%	77.9%	51.2%	5.1

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 (%)	End Use Measure Group	Base Saturation	EE Saturation	MAP Adoption Rate	RAP Adoption Rate	UCT Score	
8060	Shell	Duct Sealing - Inadequate Sealing - Electric furnace	IQW	SF	Retrofit	11,093	15%	1,637	0.29	20	\$910	100%	100%	DUCT-6	29%	78%	77.8%	77.8%	1.7	
8061	Shell	Duct Sealing - Inadequate Sealing - Electric furnace	Efficient Products	MF	Retrofit	8,715	12%	1,067	0.09	20	\$455	100%	66%	DUCT-7	61%	97%	66.4%	60.7%	2.6	
8062	Shell	Duct Sealing - Inadequate Sealing - Electric furnace	IQW	MF	Retrofit	8,715	12%	1,067	0.09	20	\$455	100%	100%	DUCT-8	59%	97%	62.0%	62.0%	1.7	
8063	Shell	Duct Sealing - Inadequate Sealing - Gas Heating	Efficient Products	SF	Retrofit	2,288	17%	386	0.14	20	\$910	50%	33%	DUCT-9	61%	78%	74.5%	66.9%	1.7	
8064	Shell	Duct Sealing - Inadequate Sealing - Gas Heating	IQW	SF	Retrofit	2,288	17%	386	0.14	20	\$910	100%	100%	DUCT-10	47%	78%	81.2%	81.2%	0.6	
8065	Shell	Duct Sealing - Inadequate Sealing - Gas Heating	Efficient Products	MF	Retrofit	1,661	14%	234	0.09	20	\$455	66%	66%	DUCT-11	5%	97%	65.8%	65.8%	1.1	
8066	Shell	Duct Sealing - Inadequate Sealing - Gas Heating	IQW	MF	Retrofit	1,661	14%	234	0.09	20	\$455	100%	100%	DUCT-12	14%	97%	67.7%	67.7%	0.7	
8067	Shell	Rim/Band Joist Insulation - Heat pump	No Program	SF	Retrofit	6,219	2%	120	0.02	30	\$208	50%	25%	RIM JOIST-1	16%	96%	68.8%	56.9%	2.6	
8068	Shell	Rim/Band Joist Insulation - Heat pump	No Program	MF	Retrofit	4,816	2%	120	0.01	30	\$121	75%	25%	RIM JOIST-2	10%	96%	62.5%	42.9%	3.5	
8069	Shell	Rim/Band Joist Insulation - Electric furnace	No Program	SF	Retrofit	11,093	2%	190	0.03	30	\$208	100%	25%	RIM JOIST-3	23%	96%	77.9%	46.2%	4.2	
8070	Shell	Rim/Band Joist Insulation - Electric furnace	No Program	MF	Retrofit	8,715	2%	190	0.02	30	\$121	100%	25%	RIM JOIST-4	64%	96%	66.4%	41.9%	5.5	
8071	Shell	Rim/Band Joist Insulation - Gas Heating	No Program	SF	Retrofit	2,288	1%	32	0.01	30	\$208	25%	25%	RIM JOIST-5	59%	96%	62.7%	62.7%	1.0	
8072	Shell	Rim/Band Joist Insulation - Gas Heating	No Program	MF	Retrofit	1,661	2%	32	0.01	30	\$121	25%	25%	RIM JOIST-6	9%	96%	34.6%	34.6%	1.8	
8073	Shell	Wall Insulation - Heat pump	No Program	SF	Retrofit	6,219	23%	1,405	0.25	30	\$1,539	100%	25%	WALL-1	17%	96%	83.6%	57.8%	4.2	
8074	Shell	Wall Insulation - Heat pump	IQW	SF	Retrofit	6,219	23%	1,405	0.25	30	\$1,539	100%	100%	WALL-2	15%	96%	83.2%	83.2%	0.5	
8075	Shell	Wall Insulation - Heat pump	No Program	MF	Retrofit	4,816	7%	331	0.03	30	\$363	75%	25%	WALL-3	11%	96%	63.2%	43.6%	3.2	
8076	Shell	Wall Insulation - Heat pump	IQW	MF	Retrofit	4,816	7%	331	0.03	30	\$363	100%	100%	WALL-4	10%	96%	66.1%	66.1%	0.4	
8077	Shell	Wall Insulation - Electric furnace	No Program	SF	Retrofit	11,093	20%	2,231	0.40	30	\$1,539	100%	25%	WALL-5	18%	96%	77.9%	46.3%	6.6	
8078	Shell	Wall Insulation - Electric furnace	IQW	SF	Retrofit	11,093	20%	2,231	0.40	30	\$1,539	100%	100%	WALL-6	29%	96%	77.8%	77.8%	0.8	
8079	Shell	Wall Insulation - Electric furnace	No Program	MF	Retrofit	8,715	6%	526	0.05	30	\$363	100%	25%	WALL-7	61%	96%	66.4%	42.0%	5.1	
8080	Shell	Wall Insulation - Electric furnace	IQW	MF	Retrofit	8,715	6%	526	0.05	30	\$363	100%	100%	WALL-8	59%	96%	62.0%	62.0%	0.6	
8081	Shell	Wall Insulation - Gas Heating	No Program	SF	Retrofit	2,288	16%	372	0.14	30	\$1,539	25%	25%	WALL-9	61%	96%	63.2%	63.2%	1.6	
8082	Shell	Wall Insulation - Gas Heating	IQW	SF	Retrofit	2,288	16%	372	0.14	30	\$1,539	100%	100%	WALL-10	47%	96%	81.2%	81.2%	0.2	
8083	Shell	Wall Insulation - Gas Heating	No Program	MF	Retrofit	1,661	7%	109	0.04	30	\$363	50%	25%	WALL-11	5%	96%	60.7%	50.3%	2.0	
8084	Shell	Wall Insulation - Gas Heating	IQW	MF	Retrofit	1,661	7%	109	0.04	30	\$363	100%	100%	WALL-12	14%	96%	67.7%	67.7%	0.2	
8085	Shell	Basement Sidewall Insulation - Heat pump	No Program	SF	Retrofit	6,219	14%	887	0.16	30	\$5,171	25%	25%	BASEMENT-1	16%	49%	54.9%	54.9%	0.8	
8086	Shell	Basement Sidewall Insulation - Heat pump	No Program	MF	Retrofit	4,816	9%	444	0.04	30	\$2,586	25%	25%	BASEMENT-2	10%	33%	42.9%	42.9%	0.6	
8087	Shell	Basement Sidewall Insulation - Electric furnace	No Program	SF	Retrofit	11,093	14%	1,544	0.28	30	\$5,171	25%	25%	BASEMENT-3	23%	49%	43.3%	43.3%	1.4	
8088	Shell	Basement Sidewall Insulation - Electric furnace	No Program	MF	Retrofit	8,715	9%	772	0.07	30	\$2,586	25%	25%	BASEMENT-4	64%	33%	41.9%	41.9%	1.0	
8089	Shell	Basement Sidewall Insulation - Gas Heating	No Program	SF	Retrofit	2,288	3%	70	0.03	30	\$5,171	25%	25%	BASEMENT-5	59%	49%	59.0%	59.0%	0.1	
8090	Shell	Basement Sidewall Insulation - Gas Heating	No Program	MF	Retrofit	1,661	2%	35	0.01	30	\$2,586	25%	25%	BASEMENT-6	9%	33%	34.6%	34.6%	0.1	
8091	Shell	Floor Insulation Above Crawlspce - Heat pump	No Program	SF	Retrofit	6,219	17%	1,032	0.19	30	\$961	100%	25%	FLOOR-1	16%	12%	83.0%	56.9%	4.9	
8092	Shell	Floor Insulation Above Crawlspce - Heat pump	No Program	MF	Retrofit	4,816	11%	516	0.05	30	\$905	50%	25%	FLOOR-2	10%	6%	53.3%	42.9%	2.0	
8093	Shell	Floor Insulation Above Crawlspce - Electric furnace	No Program	SF	Retrofit	11,093	16%	1,722	0.31	30	\$961	100%	25%	FLOOR-3	23%	12%	77.9%	46.2%	8.2	
8094	Shell	Floor Insulation Above Crawlspce - Electric furnace	No Program	MF	Retrofit	8,715	10%	861	0.08	30	\$905	75%	25%	FLOOR-4	64%	6%	63.5%	41.9%	3.3	
8095	Shell	Floor Insulation Above Crawlspce - Gas Heating	No Program	SF	Retrofit	2,288	7%	162	0.06	30	\$961	25%	25%	FLOOR-5	59%	12%	62.7%	62.7%	1.1	
8096	Shell	Floor Insulation Above Crawlspce - Gas Heating	No Program	MF	Retrofit	1,661	5%	81	0.03	30	\$905	25%	25%	FLOOR-6	9%	6%	34.6%	34.6%	0.6	
8097	Shell	ENERGY STAR Windows - Heat pump	No Program	SF	Retrofit	6,219	30%	1,856	0.33	20	\$2,159	75%	25%	WINDOW-1	16%	48%	79.0%	56.3%	3.2	
8098	Shell	ENERGY STAR Windows - Heat pump	No Program	MF	Retrofit	4,816	22%	1,080	0.10	20	\$1,256	50%	25%	WINDOW-2	10%	8%	53.3%	42.9%	2.5	
8099	Shell	ENERGY STAR Windows - Electric furnace	No Program	SF	Retrofit	11,093	29%	3,165	0.57	20	\$2,159	100%	25%	WINDOW-3	23%	48%	77.9%	45.3%	5.4	
8100	Shell	ENERGY STAR Windows - Electric furnace	No Program	MF	Retrofit	8,715	21%	1,842	0.16	20	\$1,256	100%	25%	WINDOW-4	64%	8%	66.4%	41.9%	4.2	
8101	Shell	ENERGY STAR Windows - Gas Heating	No Program	SF	Retrofit	2,288	14%	330	0.12	20	\$2,159	25%	25%	WINDOW-5	59%	48%	61.7%	61.7%	0.8	
8102	Shell	ENERGY STAR Windows - Gas Heating	No Program	MF	Retrofit	1,661	11%	185	0.07	20	\$1,256	25%	25%	WINDOW-6	9%	8%	34.6%	34.6%	0.8	
8103	Shell	Thin Triple Windows - Heat pump	No Program	SF	Retrofit	6,219	8%	484	0.09	40	\$12,964	25%	25%	WINDOW-1	16%	48%	49.8%	49.8%	0.2	
8104	Shell	Thin Triple Windows - Heat pump	No Program	MF	Retrofit	4,816	6%	282	0.02	40	\$8,297	25%	25%	WINDOW-2	10%	8%	39.5%	39.5%	0.1	
8105	Shell	Thin Triple Windows - Electric furnace	No Program	SF	Retrofit	11,093	7%	817	0.15	40	\$12,964	25%	25%	WINDOW-3	23%	48%	38.2%	38.2%	0.3	
8106	Shell	Thin Triple Windows - Electric furnace	No Program	MF	Retrofit	8,715	5%	475	0.04	40	\$8,297	25%	25%	WINDOW-4	64%	8%	33.9%	33.9%	0.2	
8107	Shell	Thin Triple Windows - Gas heating	No Program	SF	Retrofit	2,288	8%	186	0.07	40	\$12,964	25%	25%	WINDOW-5	59%	48%	48.5%	48.5%	0.1	
8108	Shell	Thin Triple Windows - Gas heating	No Program	MF	Retrofit	1,661	7%	108	0.04	40	\$8,297	25%	25%	WINDOW-6	9%	8%	23.0%	23.0%	0.1	
8109	Shell	Window Insulation	School Education	SF	Retrofit	13,160	0%	46	0.01	1	\$5	100%	100%	WINDOW INS-1	100%	17%	74.1%	74.1%	0.8	
8110	Shell	Window Insulation	School Education	MF	Retrofit	6,580	1%	46	0.00	1	\$5	100%	100%	WINDOW INS-2	100%	4%	59.8%	59.8%	0.6	
8111	Shell	Insulated Cellular Shades - Heat pump	No Program	SF	Retrofit	6,219	3%	197	0.04	10	\$600	25%	25%	SHADES-1	16%	17%	56.9%	56.9%	0.8	
8112	Shell	Insulated Cellular Shades - Heat pump	No Program	MF	Retrofit	4,816	4%	187	0.02	10	\$240	25%	25%	SHADES-2	10%	4%	42.9%	42.9%	1.5	
8113	Shell	Insulated Cellular Shades - Electric furnace	No Program	SF	Retrofit	11,093	3%	324	0.06	10	\$600	25%	25%	SHADES-3	23%	17%	46.2%	46.2%	1.3	

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 (%)	End Use Measure Group	Base Saturation	EE Saturation	MAP Adoption Rate	RAP Adoption Rate	UCT Score
8114	Shell	Insulated Cellular Shades - Electric furnace	No Program	MF	Retrofit	8,715	4%	314	0.03	10	\$240	50%	25%	SHADES-4	64%	4%	54.5%	41.9%	2.5
8115	Shell	Insulated Cellular Shades - Gas Heating / CAC	No Program	SF	Retrofit	2,288	6%	130	0.05	10	\$600	25%	25%	SHADES-5	59%	17%	62.7%	62.7%	0.7
8116	Shell	Insulated Cellular Shades - Gas Heating / CAC	No Program	MF	Retrofit	1,661	6%	95	0.04	10	\$240	25%	25%	SHADES-6	9%	4%	34.6%	34.6%	1.3
8117	Shell	Multifamily Whole Building Aerosol Sealing - Heat pump	No Program	MF	Retrofit	4,816	15%	703	0.06	20	\$533	75%	25%	AEROSOL-1	10%	94%	62.5%	42.9%	3.8
8118	Shell	Multifamily Whole Building Aerosol Sealing - Electric furnace	No Program	MF	Retrofit	8,715	15%	1,301	0.12	20	\$533	100%	25%	AEROSOL-2	64%	94%	66.4%	41.9%	7.0
8119	Shell	Multifamily Whole Building Aerosol Sealing - Gas Heating / CAC	No Program	MF	Retrofit	1,661	0%	0	0.00	20	\$533	100%	25%	AEROSOL-3	9%	94%	56.8%	34.6%	0.0
8120	Shell	Basement Wall Insulation - Nanoinsulation	No Program	SF	Retrofit	13,160	6%	724	0.13	25	\$1,327	50%	25%	NANO-1	100%	0%	59.0%	47.4%	2.3
8121	Shell	Basement Wall Insulation - Nanoinsulation	No Program	MF	Retrofit	6,580	6%	362	0.03	25	\$1,327	25%	25%	NANO-2	100%	0%	36.5%	36.5%	0.9
8122	Shell	Ceiling / Attic Insulation - Nanoinsulation	No Program	SF	Retrofit	13,160	20%	2,632	0.47	25	\$6,310	25%	25%	NANO-3	100%	0%	44.1%	44.1%	1.7
8123	Shell	Ceiling / Attic Insulation - Nanoinsulation	No Program	MF	Retrofit	6,580	20%	1,316	0.12	25	\$6,310	25%	25%	NANO-4	100%	0%	33.7%	33.7%	0.7
8124	Shell	Crawlspace Insulation - Nanoinsulation	No Program	SF	Retrofit	13,160	30%	3,948	0.71	25	\$1,313	100%	25%	NANO-5	100%	0%	74.1%	47.4%	12.6
8125	Shell	Crawlspace Insulation - Nanoinsulation	No Program	MF	Retrofit	6,580	30%	1,974	0.17	25	\$1,313	100%	25%	NANO-6	100%	0%	59.8%	36.5%	4.9
8126	Shell	Floor Insulation - Nanoinsulation	No Program	SF	Retrofit	13,160	2%	263	0.05	25	\$1,269	25%	25%	NANO-7	100%	0%	47.4%	47.4%	0.9
8127	Shell	Floor Insulation - Nanoinsulation	No Program	MF	Retrofit	6,580	2%	132	0.01	25	\$1,269	25%	25%	NANO-8	100%	0%	36.5%	36.5%	0.3
8128	Shell	Rim and Band Joist Insulation - Nanoinsulation	No Program	SF	Retrofit	13,160	2%	263	0.05	25	\$169	100%	25%	NANO-9	100%	0%	74.1%	47.4%	6.5
8129	Shell	Rim and Band Joist Insulation - Nanoinsulation	No Program	MF	Retrofit	6,580	2%	132	0.01	25	\$169	50%	25%	NANO-10	100%	0%	46.3%	36.5%	2.5
8130	Shell	Wall Insulation - Nanoinsulation	No Program	SF	Retrofit	13,160	14%	1,842	0.33	25	\$3,426	50%	25%	NANO-11	100%	0%	59.0%	47.4%	2.2
8131	Shell	Wall Insulation - Nanoinsulation	No Program	MF	Retrofit	6,580	14%	921	0.08	25	\$3,426	25%	25%	NANO-12	100%	0%	36.5%	36.5%	0.9
9001	Water Heating	Heat Pump Water Heater-electric resistance heat	Efficient Products	SF	MO	3,242	57%	1,855	0.09	15	\$1,030	75%	63%	HPWH-1	21%	6%	52.4%	50.5%	1.5
9002	Water Heating	Heat Pump Water Heater-electric resistance heat	Efficient Products	SF	NC	3,242	57%	1,855	0.09	15	\$1,030	75%	63%	HPWH-2	21%	0%	60.3%	58.2%	1.5
9003	Water Heating	Heat Pump Water Heater-electric resistance heat	Efficient Products	MF	MO	3,045	56%	1,707	0.08	15	\$1,030	75%	63%	HPWH-3	51%	19%	45.9%	44.6%	1.4
9004	Water Heating	Heat Pump Water Heater-electric resistance heat	Efficient Products	MF	NC	3,045	56%	1,707	0.08	15	\$1,030	75%	63%	HPWH-4	51%	0%	50.0%	50.5%	1.4
9005	Water Heating	Heat Pump Water Heater-heat pump heat	Efficient Products	SF	MO	3,242	57%	1,863	0.09	15	\$1,030	75%	63%	HPWH-5	17%	6%	52.4%	50.5%	1.5
9006	Water Heating	Heat Pump Water Heater-heat pump heat	Efficient Products	SF	NC	3,242	57%	1,863	0.09	15	\$1,030	75%	63%	HPWH-6	17%	0%	60.3%	58.2%	1.5
9007	Water Heating	Heat Pump Water Heater-heat pump heat	Efficient Products	MF	MO	3,045	56%	1,714	0.08	15	\$1,030	75%	63%	HPWH-7	11%	19%	45.9%	44.6%	1.4
9008	Water Heating	Heat Pump Water Heater-heat pump heat	Efficient Products	MF	NC	3,045	56%	1,714	0.08	15	\$1,030	75%	63%	HPWH-8	11%	0%	50.0%	50.5%	1.4
9009	Water Heating	Heat Pump Water Heater-gas heat	Efficient Products	SF	MO	3,242	53%	1,732	0.08	15	\$1,030	75%	63%	HPWH-9	1%	6%	52.4%	50.5%	1.4
9010	Water Heating	Heat Pump Water Heater-gas heat	Efficient Products	SF	NC	3,242	53%	1,732	0.08	15	\$1,030	75%	63%	HPWH-10	1%	0%	60.3%	58.2%	1.4
9011	Water Heating	Heat Pump Water Heater-gas heat	Efficient Products	MF	MO	3,045	57%	1,722	0.08	15	\$1,030	75%	63%	HPWH-11	0%	19%	45.9%	44.6%	1.4
9012	Water Heating	Heat Pump Water Heater-gas heat	Efficient Products	MF	NC	3,045	57%	1,722	0.08	15	\$1,030	75%	63%	HPWH-12	0%	0%	50.0%	50.5%	1.4
9013	Water Heating	Thermostatic Restrictor Shower Valve	Efficient Products	SF	Retrofit	3,242	2%	80	0.00	10	\$35	75%	69%	TRSV-1	68%	14%	51.9%	48.5%	1.3
9014	Water Heating	Thermostatic Restrictor Shower Valve	Efficient Products	SF	NC	3,242	2%	80	0.00	10	\$35	75%	69%	TRSV-2	68%	0%	51.9%	48.5%	1.3
9015	Water Heating	Thermostatic Restrictor Shower Valve	Efficient Products	MF	Retrofit	3,045	2%	65	0.00	10	\$35	69%	69%	TRSV-3	80%	5%	39.8%	39.8%	1.1
9016	Water Heating	Thermostatic Restrictor Shower Valve	Efficient Products	MF	NC	3,045	2%	65	0.00	10	\$35	69%	69%	TRSV-4	80%	0%	39.8%	39.8%	1.1
9017	Water Heating	Drain water Heat Recovery	No Program	SF	Retrofit	3,242	17%	538	0.05	30	\$744	50%	25%	DWHR-1	39%	1%	39.6%	27.9%	2.6
9018	Water Heating	Drain water Heat Recovery	No Program	SF	NC	3,242	17%	538	0.05	30	\$744	50%	25%	DWHR-2	39%	0%	39.6%	27.9%	2.6
9019	Water Heating	Drain water Heat Recovery	No Program	MF	Retrofit	3,045	14%	439	0.05	30	\$744	50%	25%	DWHR-3	61%	1%	42.3%	29.7%	2.3
9020	Water Heating	Drain water Heat Recovery	No Program	MF	NC	3,045	14%	439	0.05	30	\$744	50%	25%	DWHR-4	61%	0%	42.3%	29.7%	2.3
9021	Water Heating	Shower Timer	School Education	SF	Retrofit	3,242	1%	43	0.01	2	\$5	100%	32%	ST-1	68%	1%	64.6%	30.9%	5.1
9022	Water Heating	Shower Timer	School Education	SF	NC	3,242	1%	43	0.01	2	\$5	100%	32%	ST-2	68%	0%	64.6%	30.9%	5.1
9023	Water Heating	Shower Timer	School Education	MF	Retrofit	3,045	1%	43	0.01	2	\$5	100%	32%	ST-3	80%	0%	55.7%	32.8%	5.1
9024	Water Heating	Shower Timer	School Education	MF	NC	3,045	1%	43	0.01	2	\$5	100%	32%	ST-4	80%	0%	55.7%	32.8%	5.1
9025	Water Heating	Low Flow Showerhead 1.5 gpm	Efficient Products	SF	Retrofit	3,242	8%	271	0.03	10	\$7	100%	71%	LFSH-1	88%	20%	56.9%	41.8%	25.5
9026	Water Heating	Low Flow Showerhead 1.5 gpm	School Education	SF	Retrofit	3,242	8%	271	0.03	10	\$7	100%	48%	LFSH-1	88%	20%	56.9%	31.7%	38.1
9027	Water Heating	Low Flow Showerhead 1.5 gpm	IQW	SF	Retrofit	3,242	8%	271	0.03	10	\$7	100%	100%	LFSH-2	111%	11%	56.5%	56.5%	18.2
9028	Water Heating	Low Flow Showerhead 1.5 gpm	School Education	SF	Retrofit	3,242	8%	271	0.03	10	\$7	100%	48%	LFSH-2	111%	11%	56.5%	34.2%	38.1
9029	Water Heating	Low Flow Showerhead 1.5 gpm	IQW	SF	Retrofit	3,242	8%	271	0.03	10	\$12	100%	100%	LFSH-2	111%	11%	56.5%	56.5%	6.9
9030	Water Heating	Low Flow Showerhead 1.5 gpm	Efficient Products	SF	NC	3,242	8%	271	0.03	10	\$7	100%	71%	LFSH-3	68%	0%	64.6%	50.0%	25.5
9031	Water Heating	Low Flow Showerhead 1.5 gpm	Efficient Products	MF	Retrofit	2,660	7%	193	0.02	10	\$7	100%	71%	LFSH-4	107%	7%	50.1%	36.7%	19.3
9032	Water Heating	Low Flow Showerhead 1.5 gpm	School Education	MF	Retrofit	2,660	7%	193	0.02	10	\$7	100%	48%	LFSH-4	107%	7%	50.1%	29.6%	28.7
9033	Water Heating	Low Flow Showerhead 1.5 gpm	Multifamily	MF	Retrofit	2,660	7%	193	0.02	10	\$12	100%	25%	LFSH-4	107%	7%	50.1%	22.1%	32.1
9034	Water Heating	Low Flow Showerhead 1.5 gpm	IQW	MF	Retrofit	2,660	7%	193	0.02	10	\$7	100%	100%	LFSH-5	115%	6%	52.3%	52.3%	13.8
9035	Water Heating	Low Flow Showerhead 1.5 gpm	School Education	MF	Retrofit	2,660	7%	193	0.02	10	\$7	100%	48%	LFSH-5	115%	6%	52.3%	28.1%	28.7
9036	Water Heating	Low Flow Showerhead 1.5 gpm	Multifamily	MF	Retrofit	2,660	7%	193	0.02	10	\$12	100%	100%	LFSH-5	115%	6%	52.3%	52.3%	8.0
9037	Water Heating	Low Flow Showerhead 1.5 gpm	IQW	MF	Retrofit	2,660	7%	193	0.02	10	\$12	100%	100%	LFSH-5	115%	6%	52.3%	52.3%	5.2

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 (%)	End Use Measure Group	Base Saturation	EE Saturation	MAP Adoption Rate	RAP Adoption Rate	UCT Score	
9038	Water Heating	Low Flow Showerhead 1.5 gpm	Efficient Products	MF	NC	2,660	7%	193	0.02	10	\$7	100%	71%	LFSH-6	80%	0%	55.7%	39.5%	19.3	
9039	Water Heating	Kitchen Faucet Aerator 1.5 gpm	Efficient Products	SF	Retrofit	3,242	7%	239	0.05	10	\$3	100%	100%	KITCH-1	51%	21%	56.9%	56.9%	48.9	
9040	Water Heating	Kitchen Faucet Aerator 1.5 gpm	School Education	SF	Retrofit	3,242	7%	239	0.05	10	\$3	100%	55%	KITCH-1	51%	21%	56.9%	34.4%	88.9	
9041	Water Heating	Kitchen Faucet Aerator 1.5 gpm	IQW	SF	Retrofit	3,242	7%	239	0.05	10	\$3	100%	100%	KITCH-2	64%	17%	56.5%	56.5%	48.9	
9042	Water Heating	Kitchen Faucet Aerator 1.5 gpm	School Education	SF	Retrofit	3,242	7%	239	0.05	10	\$3	100%	55%	KITCH-2	64%	17%	56.5%	37.2%	88.9	
9043	Water Heating	Kitchen Faucet Aerator 1.5 gpm	IQW	SF	Retrofit	3,242	7%	239	0.05	10	\$8	100%	13%	KITCH-2	64%	17%	56.5%	18.7%	146.7	
9044	Water Heating	Kitchen Faucet Aerator 1.5 gpm	Efficient Products	SF	NC	3,242	7%	239	0.05	10	\$3	100%	100%	KITCH-3	39%	0%	64.6%	64.6%	48.9	
9045	Water Heating	Kitchen Faucet Aerator 1.5 gpm	Efficient Products	MF	Retrofit	2,660	7%	195	0.05	10	\$3	100%	100%	KITCH-4	82%	7%	50.1%	50.1%	43.8	
9046	Water Heating	Kitchen Faucet Aerator 1.5 gpm	School Education	MF	Retrofit	2,660	7%	195	0.05	10	\$3	100%	55%	KITCH-4	82%	7%	50.1%	31.8%	79.7	
9047	Water Heating	Kitchen Faucet Aerator 1.5 gpm	Multifamily	MF	Retrofit	2,660	7%	195	0.05	10	\$8	100%	25%	KITCH-4	82%	7%	50.1%	22.1%	65.7	
9048	Water Heating	Kitchen Faucet Aerator 1.5 gpm	IQW	MF	Retrofit	2,660	7%	195	0.05	10	\$3	100%	100%	KITCH-5	88%	6%	52.3%	52.3%	43.8	
9049	Water Heating	Kitchen Faucet Aerator 1.5 gpm	School Education	MF	Retrofit	2,660	7%	195	0.05	10	\$3	100%	55%	KITCH-5	88%	6%	52.3%	30.0%	79.7	
9050	Water Heating	Kitchen Faucet Aerator 1.5 gpm	Multifamily	MF	Retrofit	2,660	7%	195	0.05	10	\$8	100%	100%	KITCH-5	88%	6%	52.3%	52.3%	16.4	
9051	Water Heating	Kitchen Faucet Aerator 1.5 gpm	IQW	MF	Retrofit	2,660	7%	195	0.05	10	\$8	100%	13%	KITCH-5	88%	6%	52.3%	33.0%	131.4	
9052	Water Heating	Kitchen Faucet Aerator 1.5 gpm	Efficient Products	MF	NC	2,660	7%	177	0.04	10	\$3	100%	100%	KITCH-6	61%	0%	55.7%	55.7%	39.7	
9053	Water Heating	Bathroom Aerator 1.0 gpm	Efficient Products	SF	Retrofit	3,242	1%	49	0.07	10	\$3	100%	100%	BATH-1	113%	21%	56.9%	56.9%	37.1	
9054	Water Heating	Bathroom Aerator 1.0 gpm	School Education	SF	Retrofit	3,242	1%	49	0.07	10	\$3	100%	55%	BATH-1	113%	21%	56.9%	34.4%	67.4	
9055	Water Heating	Bathroom Aerator 1.0 gpm	IQW	SF	Retrofit	3,242	1%	49	0.07	10	\$3	100%	100%	BATH-2	143%	17%	56.5%	56.5%	37.1	
9056	Water Heating	Bathroom Aerator 1.0 gpm	School Education	SF	Retrofit	3,242	1%	49	0.07	10	\$3	100%	55%	BATH-2	143%	17%	56.5%	37.2%	67.4	
9057	Water Heating	Bathroom Aerator 1.0 gpm	IQW	SF	Retrofit	3,242	1%	49	0.07	10	\$8	100%	13%	BATH-2	143%	17%	56.5%	18.7%	111.2	
9058	Water Heating	Bathroom Aerator 1.0 gpm	Efficient Products	SF	NC	3,242	1%	49	0.07	10	\$3	100%	100%	BATH-3	87%	0%	64.6%	64.6%	37.1	
9059	Water Heating	Bathroom Aerator 1.0 gpm	Efficient Products	MF	Retrofit	2,660	1%	40	0.04	10	\$3	100%	100%	BATH-4	120%	7%	50.1%	50.1%	21.7	
9060	Water Heating	Bathroom Aerator 1.0 gpm	School Education	MF	Retrofit	2,660	1%	40	0.04	10	\$3	100%	55%	BATH-4	120%	7%	50.1%	31.8%	39.5	
9061	Water Heating	Bathroom Aerator 1.0 gpm	Multifamily	MF	Retrofit	2,660	1%	40	0.04	10	\$8	100%	25%	BATH-4	120%	7%	50.1%	22.1%	32.6	
9062	Water Heating	Bathroom Aerator 1.0 gpm	IQW	MF	Retrofit	2,660	1%	40	0.04	10	\$3	100%	100%	BATH-5	128%	6%	52.3%	52.3%	21.7	
9063	Water Heating	Bathroom Aerator 1.0 gpm	School Education	MF	Retrofit	2,660	1%	40	0.04	10	\$3	100%	55%	BATH-5	128%	6%	52.3%	30.0%	39.5	
9064	Water Heating	Bathroom Aerator 1.0 gpm	Multifamily	MF	Retrofit	2,660	1%	40	0.04	10	\$8	100%	100%	BATH-5	128%	6%	52.3%	52.3%	8.1	
9065	Water Heating	Bathroom Aerator 1.0 gpm	IQW	MF	Retrofit	2,660	1%	40	0.04	10	\$8	100%	13%	BATH-5	128%	6%	52.3%	33.0%	65.1	
9066	Water Heating	Bathroom Aerator 1.0 gpm	Efficient Products	MF	NC	2,660	1%	40	0.04	10	\$3	100%	100%	BATH-6	89%	0%	55.7%	55.7%	21.7	
9067	Water Heating	Pipe Wrap	Efficient Products	SF	Retrofit	3,242	8%	247	0.03	12	\$18	100%	6%	PIPE-1	51%	13%	56.9%	14.2%	138.6	
9068	Water Heating	Pipe Wrap	School Education	SF	Retrofit	3,242	8%	247	0.03	12	\$18	100%	4%	PIPE-1	51%	13%	56.9%	13.8%	175.4	
9069	Water Heating	Pipe Wrap	School Education	SF	Retrofit	3,242	8%	247	0.03	12	\$18	100%	4%	PIPE-2	64%	8%	56.5%	15.2%	175.4	
9070	Water Heating	Pipe Wrap	IQW	SF	Retrofit	3,242	8%	247	0.03	12	\$18	100%	50%	PIPE-2	64%	8%	56.5%	35.1%	15.4	
9071	Water Heating	Pipe Wrap	IQW	SF	Retrofit	3,242	8%	247	0.03	12	\$18	100%	100%	PIPE-2	64%	8%	56.5%	56.5%	7.7	
9072	Water Heating	Pipe Wrap	Efficient Products	MF	Retrofit	2,660	9%	247	0.03	12	\$18	100%	6%	PIPE-3	82%	3%	50.1%	13.4%	138.3	
9073	Water Heating	Pipe Wrap	School Education	MF	Retrofit	2,660	9%	247	0.03	12	\$18	100%	4%	PIPE-3	82%	3%	50.1%	13.1%	175.1	
9074	Water Heating	Pipe Wrap	School Education	MF	Retrofit	2,660	9%	247	0.03	12	\$18	100%	4%	PIPE-4	88%	8%	52.3%	32.2%	175.1	
9075	Water Heating	Pipe Wrap	IQW	MF	Retrofit	2,660	9%	247	0.03	12	\$18	100%	50%	PIPE-4	88%	8%	52.3%	27.6%	15.4	
9076	Water Heating	Pipe Wrap	IQW	MF	Retrofit	2,660	9%	247	0.03	12	\$18	100%	100%	PIPE-4	88%	8%	52.3%	52.3%	7.7	
9077	Water Heating	Water Heater Temperature Setback	School Education	SF	Retrofit	3,242	4%	121	0.01	2	\$5	100%	25%	WH TEMP-1	51%	21%	56.9%	24.9%	12.8	
9078	Water Heating	Water Heater Temperature Setback	School Education	SF	Retrofit	3,242	4%	121	0.01	2	\$5	100%	100%	WH TEMP-2	64%	17%	56.5%	56.5%	3.2	
9079	Water Heating	Water Heater Temperature Setback	IQW	SF	Retrofit	3,242	4%	121	0.01	2	\$5	100%	100%	WH TEMP-2	64%	17%	56.5%	56.5%	1.6	
9080	Water Heating	Water Heater Temperature Setback	School Education	MF	Retrofit	2,660	5%	121	0.01	2	\$5	100%	25%	WH TEMP-3	82%	7%	50.1%	22.1%	12.8	
9081	Water Heating	Water Heater Temperature Setback	School Education	MF	Retrofit	2,660	5%	121	0.01	2	\$5	100%	100%	WH TEMP-4	88%	10%	52.3%	52.3%	3.2	
9082	Water Heating	Water Heater Temperature Setback	IQW	MF	Retrofit	2,660	5%	121	0.01	2	\$5	100%	100%	WH TEMP-4	88%	10%	52.3%	52.3%	1.6	
9083	Water Heating	Recirculating Pump Controls	No Program	SF	MO	3,242	15%	484	0.04	15	\$222	100%	25%	RECIRC-1	39%	36%	64.6%	27.9%	5.1	
9084	Water Heating	Recirculating Pump Controls	No Program	SF	NC	3,242	15%	484	0.04	15	\$222	100%	25%	RECIRC-2	39%	0%	64.6%	27.9%	5.1	
9085	Water Heating	Recirculating Pump Controls	No Program	MF	MO	2,660	17%	460	0.03	15	\$222	100%	25%	RECIRC-3	61%	36%	55.7%	29.7%	4.7	
9086	Water Heating	Recirculating Pump Controls	No Program	MF	NC	2,660	17%	460	0.03	15	\$222	100%	25%	RECIRC-4	61%	0%	55.7%	29.7%	4.7	
3213	HVAC	Air Source Heat Pump 15.2 SEER2 - Electric furnace baseline	Income Qualified HEAF	SF	MO	11,093	64%	7,056	0.12	16	\$8,500	75%	35%	HP-12	23%	36%	72.6%	46.8%	1.1	
3214	HVAC	Air Source Heat Pump 15.2 SEER2 - Electric furnace baseline	Income Qualified HEAF	MF	MO	8,715	65%	5,635	0.09	16	\$8,200	50%	37%	HP-14	64%	36%	45.3%	37.7%	0.9	
3215	HVAC	Air Source Heat Pump 16.2 SEER2 - Electric furnace baseline	Income Qualified HEAF	SF	MO	11,093	68%	7,524	0.23	16	\$8,786	75%	34%	HP-12	23%	36%	72.3%	45.7%	1.3	
3216	HVAC	Air Source Heat Pump 16.2 SEER2 - Electric furnace baseline	Income Qualified HEAF	MF	MO	8,715	69%	6,001	0.19	16	\$8,486	50%	35%	HP-14	64%	36%	44.9%	36.7%	1.0	
3217	HVAC	Air Source Heat Pump 17.1 SEER2 - Electric furnace baseline	Income Qualified HEAF	SF	MO	11,093	73%	8,045	0.33	16	\$8,995	75%	33%	HP-12	23%	36%	72.1%	45.0%	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 (%)	End Use Measure Group	Base Saturation	EE Saturation	MAP Adoption Rate	RAP Adoption Rate	UCT Score
3218	HVAC	Air Source Heat Pump 17.1 SEER2 - Electric furnace baseline	Income Qualified HEAF	MF	MO	8,715	74%	6,410	0.26	16	\$8,695	75%	35%	HP-14	64%	36%	57.3%	36.1%	1.1
3219	HVAC	Air Source Heat Pump 18.1 SEER2 - Electric furnace baseline	Income Qualified HEAF	SF	MO	11,093	75%	8,361	0.42	16	\$9,220	75%	33%	HP-12	23%	36%	71.8%	44.3%	1.5
3220	HVAC	Air Source Heat Pump 18.1 SEER2 - Electric furnace baseline	Income Qualified HEAF	MF	MO	8,715	76%	6,656	0.33	16	\$8,920	75%	34%	HP-14	64%	36%	57.1%	35.5%	1.2
3221	HVAC	Ductless Heat Pump 8.5 HSPF2 - Electric furnace baseline	Income Qualified HEAF	SF	MO	11,093	52%	5,800	0.12	16	\$3,608	100%	83%	HP-12	23%	36%	77.8%	74.6%	0.9
3222	HVAC	Ductless Heat Pump 8.5 HSPF2 - Electric furnace baseline	Income Qualified HEAF	MF	MO	8,715	53%	4,630	0.09	16	\$2,886	100%	100%	HP-14	64%	36%	62.0%	62.0%	0.8
3223	HVAC	Ductless Heat Pump 9.4 HSPF2 - Electric furnace baseline	Income Qualified HEAF	SF	MO	11,093	57%	6,296	0.23	16	\$4,013	100%	75%	HP-12	23%	36%	77.8%	73.1%	1.1
3224	HVAC	Ductless Heat Pump 9.4 HSPF2 - Electric furnace baseline	Income Qualified HEAF	MF	MO	8,715	58%	5,017	0.19	16	\$3,210	100%	93%	HP-14	64%	36%	62.0%	60.9%	0.9
3225	HVAC	Ductless Heat Pump 10.8 HSPF2 - Electric furnace baseline	Income Qualified HEAF	SF	MO	11,093	62%	6,846	0.33	16	\$4,288	100%	70%	HP-12	23%	36%	77.8%	71.8%	1.2
3226	HVAC	Ductless Heat Pump 10.8 HSPF2 - Electric furnace baseline	Income Qualified HEAF	MF	MO	8,715	63%	5,449	0.26	16	\$3,430	100%	87%	HP-14	64%	36%	62.0%	59.9%	1.0
3227	HVAC	Ductless Heat Pump 11.7 HSPF2 - Electric furnace baseline	Income Qualified HEAF	SF	MO	11,093	65%	7,181	0.42	16	\$5,103	100%	59%	HP-12	23%	36%	77.8%	68.2%	1.3
3228	HVAC	Ductless Heat Pump 11.7 HSPF2 - Electric furnace baseline	Income Qualified HEAF	MF	MO	8,715	66%	5,709	0.33	16	\$4,082	100%	73%	HP-14	64%	36%	62.0%	57.7%	1.1
3229	HVAC	Ductless Heat Pump 8.5 HSPF2 - Electric baseboard baseline	Income Qualified HEAF	SF	MO	11,093	52%	5,800	0.12	16	\$3,608	100%	83%	HP-17	2%	36%	77.8%	68.3%	0.9
3230	HVAC	Ductless Heat Pump 8.5 HSPF2 - Electric baseboard baseline	Income Qualified HEAF	MF	MO	8,715	53%	4,630	0.09	16	\$2,886	100%	100%	HP-19	10%	36%	62.0%	62.0%	0.8
3231	HVAC	Ductless Heat Pump 9.4 HSPF2 - Electric baseboard baseline	Income Qualified HEAF	SF	MO	11,093	57%	6,296	0.23	16	\$4,013	100%	75%	HP-17	2%	36%	77.8%	63.9%	1.1
3232	HVAC	Ductless Heat Pump 9.4 HSPF2 - Electric baseboard baseline	Income Qualified HEAF	MF	MO	8,715	58%	5,017	0.19	16	\$3,210	100%	93%	HP-19	10%	36%	62.0%	58.7%	0.9
3233	HVAC	Ductless Heat Pump 10.8 HSPF2 - Electric baseboard baseline	Income Qualified HEAF	SF	MO	11,093	62%	6,846	0.33	16	\$4,288	100%	70%	HP-17	2%	36%	77.8%	60.0%	1.2
3234	HVAC	Ductless Heat Pump 10.8 HSPF2 - Electric baseboard baseline	Income Qualified HEAF	MF	MO	8,715	63%	5,449	0.26	16	\$3,430	100%	87%	HP-19	10%	36%	62.0%	55.8%	1.0
3235	HVAC	Ductless Heat Pump 11.7 HSPF2 - Electric baseboard baseline	Income Qualified HEAF	SF	MO	11,093	65%	7,181	0.42	16	\$5,103	100%	59%	HP-17	2%	36%	77.8%	52.0%	1.3
3236	HVAC	Ductless Heat Pump 11.7 HSPF2 - Electric baseboard baseline	Income Qualified HEAF	MF	MO	8,715	66%	5,709	0.33	16	\$4,082	100%	73%	HP-19	10%	36%	62.0%	49.3%	1.1
9087	Water Heating	Heat Pump Water Heater-electric resistance heat	Income Qualified HEAF	SF	MO	3,242	57%	1,855	0.09	15	\$2,062	100%	100%	HPWH-13	21%	6%	56.5%	56.5%	0.5
9088	Water Heating	Heat Pump Water Heater-electric resistance heat	Income Qualified HEAF	MF	MO	3,045	56%	1,707	0.08	15	\$2,062	100%	100%	HPWH-14	51%	19%	52.3%	52.3%	0.4
9089	Water Heating	Heat Pump Water Heater-heat pump heat	Income Qualified HEAF	SF	MO	3,242	57%	1,863	0.09	15	\$2,062	100%	100%	HPWH-15	17%	6%	56.5%	56.5%	0.5
9090	Water Heating	Heat Pump Water Heater-heat pump heat	Income Qualified HEAF	MF	MO	3,045	56%	1,714	0.08	15	\$2,062	100%	100%	HPWH-16	11%	19%	52.3%	52.3%	0.4
9091	Water Heating	Heat Pump Water Heater-gas heat	Income Qualified HEAF	SF	MO	3,242	53%	1,732	0.08	15	\$2,062	100%	100%	HPWH-17	1%	6%	56.5%	56.5%	0.4
9092	Water Heating	Heat Pump Water Heater-gas heat	Income Qualified HEAF	MF	MO	3,045	57%	1,722	0.08	15	\$2,062	100%	100%	HPWH-18	0%	19%	52.3%	52.3%	0.4

C. Commercial and Industrial Energy Efficiency Assumptions

This table below provides a list of assumptions for the commercial and industrial energy efficiency measures evaluated in the study.

Appendix C: C&I Measure Assumptions

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Appendix C: C&I Measure Assumptions

Measure #	End-Use	Measure Name	Program	Building Type	Replacement Type (TOS=Time of Sale)	Unit	Base Annual Electric	% Elec Savings	Per Unit Elec Savings	Per Unit Summer kW	Per Unit Winter 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
73	Cooking	Insulated Holding Cabinets	Biz - Custom	Food Sales	TOS	per unit	1,478	37%	545	0.06	0.07	12	\$1,000	5%	5%	15%	6	3%	16%	22.7%	22.7%	23.3%	5.8
74	Cooking	Insulated Holding Cabinets	Biz - Custom	Food Service	TOS	per unit	1,478	37%	545	0.06	0.09	12	\$1,000	5%	5%	15%	6	3%	16%	22.7%	22.7%	23.3%	5.9
75	Cooking	Insulated Holding Cabinets	Biz - Custom	Health	TOS	per unit	1,478	37%	545	0.06	0.06	12	\$1,000	5%	5%	15%	6	3%	16%	22.7%	22.7%	23.3%	5.8
76	Cooking	Insulated Holding Cabinets	Biz - Custom	Lodging	TOS	per unit	1,478	37%	545	0.06	0.05	12	\$1,000	5%	5%	15%	6	3%	16%	22.7%	22.7%	23.3%	5.8
77	Cooking	Insulated Holding Cabinets	Biz - Custom	Retail	TOS	per unit	1,478	37%	545	0.06	0.07	12	\$1,000	5%	5%	15%	6	3%	16%	22.7%	22.7%	23.3%	5.9
78	Cooking	Insulated Holding Cabinets	Biz - Custom	Office	TOS	per unit	1,478	37%	545	0.06	0.06	12	\$1,000	5%	5%	15%	6	3%	16%	22.7%	22.7%	23.3%	5.9
79	Cooking	Insulated Holding Cabinets	Biz - Custom	Warehouse	TOS	per unit	1,478	37%	545	0.06	0.06	12	\$1,000	5%	5%	15%	6	3%	16%	22.7%	22.7%	23.3%	5.9
80	Cooking	Insulated Holding Cabinets	Biz - Custom	Other	TOS	per unit	1,478	37%	545	0.06	0.06	12	\$1,000	5%	5%	15%	6	3%	16%	22.7%	22.7%	23.3%	5.8
81	Compressed Air	Efficient Air Compressors (VSD)	Biz - Prescriptive	Assembly	TOS	per 10 hp	23,742	21%	4,935	1.28	0.59	13	\$3,368	100%	28%	43%	2	100%	20%	63.0%	36.3%	40.8%	4.5
82	Compressed Air	Efficient Air Compressors (VSD)	Biz - Prescriptive	Education	TOS	per 10 hp	23,742	21%	4,935	1.28	0.56	13	\$3,368	100%	28%	43%	2	100%	20%	63.0%	36.3%	40.8%	4.4
83	Compressed Air	Efficient Air Compressors (VSD)	Biz - Prescriptive	Food Sales	TOS	per 10 hp	23,742	21%	4,935	1.28	0.57	13	\$3,368	100%	28%	43%	2	100%	20%	63.0%	36.3%	40.8%	4.4
84	Compressed Air	Efficient Air Compressors (VSD)	Biz - Prescriptive	Food Service	TOS	per 10 hp	23,742	21%	4,935	1.28	0.59	13	\$3,368	100%	28%	43%	2	100%	20%	63.0%	36.3%	40.8%	4.5
85	Compressed Air	Efficient Air Compressors (VSD)	Biz - Prescriptive	Health	TOS	per 10 hp	23,742	21%	4,935	1.28	0.56	13	\$3,368	100%	28%	43%	2	100%	20%	63.0%	36.3%	40.8%	4.5
86	Compressed Air	Efficient Air Compressors (VSD)	Biz - Prescriptive	Lodging	TOS	per 10 hp	23,742	21%	4,935	1.28	0.64	13	\$3,368	100%	28%	43%	2	100%	20%	63.0%	36.3%	40.8%	4.5
87	Compressed Air	Efficient Air Compressors (VSD)	Biz - Prescriptive	Retail	TOS	per 10 hp	23,742	21%	4,935	1.28	0.57	13	\$3,368	100%	28%	43%	2	100%	20%	63.0%	36.3%	40.8%	4.5
88	Compressed Air	Efficient Air Compressors (VSD)	Biz - Prescriptive	Office	TOS	per 10 hp	23,742	21%	4,935	1.28	0.56	13	\$3,368	100%	28%	43%	2	100%	20%	63.0%	36.3%	40.8%	4.4
89	Compressed Air	Efficient Air Compressors (VSD)	Biz - Prescriptive	Warehouse	TOS	per 10 hp	23,742	21%	4,935	1.28	0.54	13	\$3,368	100%	28%	43%	2	100%	20%	63.0%	36.3%	40.8%	4.4
90	Compressed Air	Efficient Air Compressors (VSD)	Biz - Prescriptive	Other	TOS	per 10 hp	23,742	21%	4,935	1.28	0.58	13	\$3,368	100%	28%	43%	2	100%	20%	63.0%	36.3%	40.8%	4.5
91	Compressed Air	Efficient Air Nozzles	Biz - Custom	Assembly	TOS	per unit (1/4")	1,130	50%	565	0.15	0.07	15	\$57	100%	79%	10%	4	5%	20%	63.0%	62.0%	58.7%	11.8
92	Compressed Air	Efficient Air Nozzles	Biz - Custom	Education	TOS	per unit (1/4")	1,130	50%	565	0.15	0.06	15	\$57	100%	79%	10%	4	5%	20%	63.0%	62.0%	58.7%	11.8
93	Compressed Air	Efficient Air Nozzles	Biz - Custom	Food Sales	TOS	per unit (1/4")	1,130	50%	565	0.15	0.06	15	\$57	100%	79%	10%	4	5%	20%	63.0%	62.0%	58.7%	11.8
94	Compressed Air	Efficient Air Nozzles	Biz - Custom	Food Service	TOS	per unit (1/4")	1,130	50%	565	0.15	0.07	15	\$57	100%	79%	10%	4	5%	20%	63.0%	62.0%	58.7%	11.9
95	Compressed Air	Efficient Air Nozzles	Biz - Custom	Health	TOS	per unit (1/4")	1,130	50%	565	0.15	0.06	15	\$57	100%	79%	10%	4	5%	20%	63.0%	62.0%	58.7%	11.8
96	Compressed Air	Efficient Air Nozzles	Biz - Custom	Lodging	TOS	per unit (1/4")	1,130	50%	565	0.15	0.07	15	\$57	100%	79%	10%	4	5%	20%	63.0%	62.0%	58.7%	11.8
97	Compressed Air	Efficient Air Nozzles	Biz - Custom	Retail	TOS	per unit (1/4")	1,130	50%	565	0.15	0.07	15	\$57	100%	79%	10%	4	5%	20%	63.0%	62.0%	58.7%	11.8
98	Compressed Air	Efficient Air Nozzles	Biz - Custom	Office	TOS	per unit (1/4")	1,130	50%	565	0.15	0.06	15	\$57	100%	79%	10%	4	5%	20%	63.0%	62.0%	58.7%	11.8
99	Compressed Air	Efficient Air Nozzles	Biz - Custom	Warehouse	TOS	per unit (1/4")	1,130	50%	565	0.15	0.06	15	\$57	100%	79%	10%	4	5%	20%	63.0%	62.0%	58.7%	11.8
100	Compressed Air	Efficient Air Nozzles	Biz - Custom	Other	TOS	per unit (1/4")	1,130	50%	565	0.15	0.07	15	\$57	100%	79%	10%	4	5%	20%	63.0%	62.0%	58.7%	11.8
101	Compressed Air	No Loss Condensate Drain	Biz - Prescriptive	Assembly	RET	per unit	476,154	0%	1,970	0.30	0.23	10	\$244	100%	100%	11%	3	100%	5%	84.0%	84.0%	77.0%	2.2
102	Compressed Air	No Loss Condensate Drain	Biz - Prescriptive	Education	RET	per unit	476,154	0%	1,970	0.30	0.22	10	\$244	100%	100%	11%	3	100%	5%	84.0%	84.0%	77.0%	2.2
103	Compressed Air	No Loss Condensate Drain	Biz - Prescriptive	Food Sales	RET	per unit	476,154	0%	1,970	0.30	0.23	10	\$244	100%	100%	11%	3	100%	5%	84.0%	84.0%	77.0%	2.2
104	Compressed Air	No Loss Condensate Drain	Biz - Prescriptive	Food Service	RET	per unit	476,154	0%	1,970	0.30	0.23	10	\$244	100%	100%	11%	3	100%	5%	84.0%	84.0%	77.0%	2.2
105	Compressed Air	No Loss Condensate Drain	Biz - Prescriptive	Health	RET	per unit	476,154	0%	1,970	0.30	0.22	10	\$244	100%	100%	11%	3	100%	5%	84.0%	84.0%	77.0%	2.2
106	Compressed Air	No Loss Condensate Drain	Biz - Prescriptive	Lodging	RET	per unit	476,154	0%	1,970	0.30	0.25	10	\$244	100%	100%	11%	3	100%	5%	84.0%	84.0%	77.0%	2.2
107	Compressed Air	No Loss Condensate Drain	Biz - Prescriptive	Retail	RET	per unit	476,154	0%	1,970	0.30	0.23	10	\$244	100%	100%	11%	3	100%	5%	84.0%	84.0%	77.0%	2.2
108	Compressed Air	No Loss Condensate Drain	Biz - Prescriptive	Office	RET	per unit	476,154	0%	1,970	0.30	0.23	10	\$244	100%	100%	11%	3	100%	5%	84.0%	84.0%	77.0%	2.2
109	Compressed Air	No Loss Condensate Drain	Biz - Prescriptive	Warehouse	RET	per unit	476,154	0%	1,970	0.30	0.21	10	\$244	100%	100%	11%	3	100%	5%	84.0%	84.0%	77.0%	2.2
110	Compressed Air	No Loss Condensate Drain	Biz - Prescriptive	Other	RET	per unit	476,154	0%	1,970	0.30	0.23	10	\$244	100%	100%	11%	3	100%	5%	84.0%	84.0%	77.0%	2.2
111	Compressed Air	Compressed Air Leak Repair	Biz - Custom	Assembly	RET	per kWh	6	17%	1	0.00	0.00	3	\$0	100%	100%	10%	1	100%	39%	63.0%	63.0%	59.6%	2.6
112	Compressed Air	Compressed Air Leak Repair	Biz - Custom	Education	RET	per kWh	6	17%	1	0.00	0.00	3	\$0	100%	100%	10%	1	100%	39%	63.0%	63.0%	59.6%	2.3
113	Compressed Air	Compressed Air Leak Repair	Biz - Custom	Food Sales	RET	per kWh	6	17%	1	0.00	0.00	3	\$0	100%	100%	10%	1	100%	39%	63.0%	63.0%	59.6%	2.7
114	Compressed Air	Compressed Air Leak Repair	Biz - Custom	Food Service	RET	per kWh	6	17%	1	0.00	0.00	3	\$0	100%	100%	10%	1	100%	39%	63.0%	63.0%	59.6%	3.0
115	Compressed Air	Compressed Air Leak Repair	Biz - Custom	Health	RET	per kWh	6	17%	1	0.00	0.00	3	\$0	100%	100%	10%	1	100%	39%	63.0%	63.0%	59.6%	2.5
116	Compressed Air	Compressed Air Leak Repair	Biz - Custom	Lodging	RET	per kWh	6	17%	1	0.00	0.00	3	\$0	100%	100%	10%	1	100%	39%	63.0%	63.0%	59.6%	2.4
117	Compressed Air	Compressed Air Leak Repair	Biz - Custom	Retail	RET	per kWh	6	17%	1	0.00	0.00	3	\$0	100%	100%	10%	1	100%	39%	63.0%	63.0%	59.6%	2.7
118	Compressed Air	Compressed Air Leak Repair	Biz - Custom	Office	RET	per kWh	6	17%	1	0.00	0.00	3	\$0	100%	100%	10%	1	100%	39%	63.0%	63.0%	59.6%	2.4
119	Compressed Air	Compressed Air Leak Repair	Biz - Custom	Warehouse	RET	per kWh	6	17%	1	0.00	0.00	3	\$0	100%	100%	10%	1	100%	39%	63.0%	63.0%	59.6%	2.6
120	Compressed Air	Compressed Air Leak Repair	Biz - Custom	Other	RET	per kWh	6	17%	1	0.00	0.00	3	\$0	100%	100%	10%	1	100%	39%	63.0%	63.0%	59.6%	2.6
121	Compressed Air	Retro-commissioning, Compressed Air Optimization	Biz - CustomRCx	Assembly	RET	per kWh	5	21%	1	0.00	0.00	5	\$0	100%	36%	50%	1	100%	15%	63.0%	56.0%	57.8%	4.0
122	Compressed Air	Retro-commissioning, Compressed Air Optimization	Biz - CustomRCx	Education	RET	per kWh	5	21%	1	0.00	0.00	5	\$0	100%	36%	50%	1	100%	15%	63.0%	56.0%	57.8%	3.5
123	Compressed Air	Retro-commissioning, Compressed Air Optimization	Biz - CustomRCx	Food Sales	RET	per kWh	5	21%	1	0.00	0.00	5	\$0	100%	36%	50%	1	100%	15%	63.0%	56.0%	57.8%	4.1
124	Compressed Air	Retro-commissioning, Compressed Air Optimization	Biz - CustomRCx	Food Service	RET	per kWh	5	21%	1	0.00	0.00	5	\$0	100%	36%	50%	1	100%	15%	63.0%	56.0%	57.8%	4.6
125	Compressed Air	Retro-commissioning, Compressed Air Optimization	Biz - CustomRCx	Health	RET	per kWh	5	21%	1	0.00	0.00	5	\$0	100%	36%	50%	1	100%	15%	63.0%	56.0%	57.8%	3.8
126	Compressed Air	Retro-commissioning, Compressed Air Optimization	Biz - CustomRCx	Lodging	RET	per kWh	5	21%	1	0.00	0.00	5	\$0	100%	36%	50%	1	100%	15%	63.0%	56.0%	57.8%	3.7
127	Compressed Air	Retro-commissioning, Compressed Air Optimization	Biz - CustomRCx	Retail	RET	per kWh	5	21%	1	0.00	0.00	5	\$0	100%	36%	50%	1	100%	15%	63.0%	56.0%	57.8%	4.2
128	Compressed Air	Retro-commissioning, Compressed Air Optimization	Biz - CustomRCx	Office	RET	per kWh	5	21%	1	0.00	0.00	5	\$0	100%	36%	50%	1	100%	15%	63.0%	56.0%	57.8%	3.7
129	Compressed Air	Retro-commissioning, Compressed Air Optimization	Biz - CustomRCx	Warehouse	RET	per kWh	5	21%	1	0.00	0.00	5	\$0	100%	36%	50%	1	100%	15%	63.0%	56.0%	57.8%	4.0
130	Compressed Air	Retro-commissioning, Compressed Air Optimization	Biz - CustomRCx	Other	RET	per kWh	5	21%	1	0.00	0.00	5	\$0	100%	36%	50%	1	100%	15%	63.0%	56.0%	57.8%	3.9
131	Cooling	Air Conditioner - Tier 1 (15.2 SEER2) (<5 Tons)	Biz - Prescriptive	Assembly	TOS	per ton	759	9%	67	0.03	0.00	15	\$63	100%	100%	35%	5	23%	5%	84.0%	84.0%	35.6%	1.2
132	Cooling	Air Conditioner - Tier 1 (15.2 SEER2) (<5 Tons)	Biz - Prescriptive	Education	TOS	per ton	548	9%	49	0.03	0.00	15	\$63	100%	100%	25%	5	0%	5%	84.0%	84.0%	24.0%	1.1
133	Cooling	Air Conditioner - Tier 1 (15.2 SEER2) (<5 Tons)	Biz - Prescriptive	Food Sales	TOS	per ton	932	9%	83	0.03	0.00	15	\$63	100%	100%	43%	5	23%	5%	84.0%	84.0%	49.3%	1.2
134	Cooling	Air Conditioner - Tier 1 (15.2 SEER2) (<5 Tons)	Biz - Prescriptive	Food Service	TOS	per ton	1,031	9%	92	0.03	0.00	15	\$63	100%	100%	47%	5	25%	5%	84.0%	84.0%	56.6%</	

Appendix C: C&I Measure Assumptions

Measure #	End-Use	Measure Name	Program	Building Type	Replacement Type (TOS=Time of Sale)	Unit	Base Annual Electric	% Elec Savings	Per Unit Elec Savings	Per Unit Summer kW	Per Unit Winter 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
144	Cooling	Air Conditioner - Tier 2 (16 SEER2) (<5 Tons)	Biz - Prescriptive	Food Service	TOS	per ton	1,031	13%	139	0.05	0.00	15	\$127	100%	63%	35%	5	25%	5%	84.0%	59.1%	36.3%	1.9
145	Cooling	Air Conditioner - Tier 2 (16 SEER2) (<5 Tons)	Biz - Prescriptive	Health	TOS	per ton	1,219	13%	164	0.05	0.00	15	\$127	100%	63%	42%	5	0%	5%	84.0%	63.3%	47.8%	2.1
146	Cooling	Air Conditioner - Tier 2 (16 SEER2) (<5 Tons)	Biz - Prescriptive	Lodging	TOS	per ton	1,177	13%	158	0.05	0.01	15	\$127	100%	63%	40%	5	0%	5%	84.0%	62.5%	45.0%	2.1
147	Cooling	Air Conditioner - Tier 2 (16 SEER2) (<5 Tons)	Biz - Prescriptive	Retail	TOS	per ton	628	13%	84	0.05	0.00	15	\$127	100%	63%	21%	5	22%	5%	84.0%	37.7%	19.4%	1.7
148	Cooling	Air Conditioner - Tier 2 (16 SEER2) (<5 Tons)	Biz - Prescriptive	Office	TOS	per ton	1,890	13%	254	0.05	0.01	15	\$127	100%	63%	65%	5	6%	5%	84.0%	71.2%	71.8%	2.5
149	Cooling	Air Conditioner - Tier 2 (16 SEER2) (<5 Tons)	Biz - Prescriptive	Warehouse	TOS	per ton	294	13%	40	0.05	0.00	15	\$127	75%	63%	10%	5	38%	5%	31.5%	19.4%	15.0%	1.4
150	Cooling	Air Conditioner - Tier 2 (16 SEER2) (<5 Tons)	Biz - Prescriptive	Other	TOS	per ton	996	13%	134	0.05	0.00	15	\$127	100%	63%	34%	5	0%	5%	84.0%	57.9%	35.0%	1.9
151	Cooling	Air Conditioner - 15.7 IEER (5-20 Tons)	Biz - Prescriptive	Assembly	TOS	per ton	735	9%	68	0.03	0.00	15	\$63	100%	79%	35%	1	21%	5%	84.0%	70.7%	35.7%	1.9
152	Cooling	Air Conditioner - 15.7 IEER (5-20 Tons)	Biz - Prescriptive	Education	TOS	per ton	530	9%	49	0.03	0.00	15	\$63	100%	79%	25%	1	27%	5%	84.0%	64.9%	24.0%	1.7
153	Cooling	Air Conditioner - 15.7 IEER (5-20 Tons)	Biz - Prescriptive	Food Sales	TOS	per ton	903	9%	83	0.03	0.00	15	\$63	100%	79%	43%	1	19%	5%	84.0%	73.4%	49.6%	2.0
154	Cooling	Air Conditioner - 15.7 IEER (5-20 Tons)	Biz - Prescriptive	Food Service	TOS	per ton	999	9%	92	0.03	0.00	15	\$63	100%	79%	47%	1	21%	5%	84.0%	74.6%	56.8%	2.1
155	Cooling	Air Conditioner - 15.7 IEER (5-20 Tons)	Biz - Prescriptive	Health	TOS	per ton	1,181	9%	109	0.03	0.00	15	\$63	100%	79%	56%	1	28%	5%	84.0%	76.3%	65.7%	2.2
156	Cooling	Air Conditioner - 15.7 IEER (5-20 Tons)	Biz - Prescriptive	Lodging	TOS	per ton	1,140	9%	105	0.03	0.00	15	\$63	100%	79%	54%	1	13%	5%	84.0%	75.9%	64.1%	2.2
157	Cooling	Air Conditioner - 15.7 IEER (5-20 Tons)	Biz - Prescriptive	Retail	TOS	per ton	608	9%	56	0.03	0.00	15	\$63	100%	79%	29%	1	17%	5%	84.0%	67.6%	27.9%	1.8
158	Cooling	Air Conditioner - 15.7 IEER (5-20 Tons)	Biz - Prescriptive	Office	TOS	per ton	1,830	9%	168	0.03	0.00	15	\$63	100%	79%	71%	1	28%	5%	84.0%	79.1%	77.0%	2.7
159	Cooling	Air Conditioner - 15.7 IEER (5-20 Tons)	Biz - Prescriptive	Warehouse	TOS	per ton	285	9%	26	0.03	0.00	15	\$63	100%	79%	13%	1	31%	5%	84.0%	43.4%	15.0%	1.5
160	Cooling	Air Conditioner - 15.7 IEER (5-20 Tons)	Biz - Prescriptive	Other	TOS	per ton	965	9%	89	0.03	0.00	15	\$63	100%	79%	46%	1	28%	5%	84.0%	74.2%	54.4%	2.0
161	Cooling	Air Conditioner - 17.3 IEER (5-20 Tons)	Biz - Prescriptive	Assembly	TOS	per ton	735	17%	127	0.06	0.00	15	\$127	100%	39%	32%	1	21%	5%	84.0%	35.8%	33.1%	3.5
162	Cooling	Air Conditioner - 17.3 IEER (5-20 Tons)	Biz - Prescriptive	Education	TOS	per ton	530	17%	92	0.06	0.00	15	\$127	100%	39%	23%	1	27%	5%	84.0%	26.5%	21.8%	3.2
163	Cooling	Air Conditioner - 17.3 IEER (5-20 Tons)	Biz - Prescriptive	Food Sales	TOS	per ton	903	17%	157	0.06	0.00	15	\$127	100%	39%	40%	1	19%	5%	84.0%	43.8%	44.2%	3.8
164	Cooling	Air Conditioner - 17.3 IEER (5-20 Tons)	Biz - Prescriptive	Food Service	TOS	per ton	999	17%	173	0.06	0.00	15	\$127	100%	39%	44%	1	21%	5%	84.0%	48.5%	52.0%	3.9
165	Cooling	Air Conditioner - 17.3 IEER (5-20 Tons)	Biz - Prescriptive	Health	TOS	per ton	1,181	17%	205	0.06	0.00	15	\$127	100%	39%	52%	1	28%	5%	84.0%	55.4%	62.6%	4.1
166	Cooling	Air Conditioner - 17.3 IEER (5-20 Tons)	Biz - Prescriptive	Lodging	TOS	per ton	1,140	17%	198	0.06	0.01	15	\$127	100%	39%	50%	1	13%	5%	84.0%	54.0%	60.8%	4.1
167	Cooling	Air Conditioner - 17.3 IEER (5-20 Tons)	Biz - Prescriptive	Retail	TOS	per ton	608	17%	105	0.06	0.00	15	\$127	100%	39%	27%	1	17%	5%	84.0%	30.8%	24.8%	3.3
168	Cooling	Air Conditioner - 17.3 IEER (5-20 Tons)	Biz - Prescriptive	Office	TOS	per ton	1,830	17%	317	0.06	0.01	15	\$127	100%	39%	73%	1	28%	5%	84.0%	66.8%	77.0%	5.1
169	Cooling	Air Conditioner - 17.3 IEER (5-20 Tons)	Biz - Prescriptive	Warehouse	TOS	per ton	285	17%	49	0.06	0.00	15	\$127	100%	39%	13%	1	31%	5%	84.0%	15.9%	15.0%	2.9
170	Cooling	Air Conditioner - 17.3 IEER (5-20 Tons)	Biz - Prescriptive	Other	TOS	per ton	965	17%	167	0.06	0.00	15	\$127	100%	39%	43%	1	28%	5%	84.0%	47.0%	49.4%	3.8
171	Cooling	Air Conditioner - 14.3 IEER (20+ Tons)	Biz - Prescriptive	Assembly	TOS	per ton	809	9%	74	0.04	0.00	15	\$19	100%	100%	57%	2	21%	5%	84.0%	84.0%	77.0%	2.0
172	Cooling	Air Conditioner - 14.3 IEER (20+ Tons)	Biz - Prescriptive	Education	TOS	per ton	583	9%	53	0.04	0.00	15	\$19	100%	100%	69%	2	27%	5%	84.0%	84.0%	77.0%	1.9
173	Cooling	Air Conditioner - 14.3 IEER (20+ Tons)	Biz - Prescriptive	Food Sales	TOS	per ton	993	9%	90	0.04	0.00	15	\$19	100%	100%	48%	2	19%	5%	84.0%	84.0%	77.0%	2.2
174	Cooling	Air Conditioner - 14.3 IEER (20+ Tons)	Biz - Prescriptive	Food Service	TOS	per ton	1,099	9%	100	0.04	0.00	15	\$19	100%	100%	42%	2	21%	5%	84.0%	84.0%	77.0%	2.2
175	Cooling	Air Conditioner - 14.3 IEER (20+ Tons)	Biz - Prescriptive	Health	TOS	per ton	1,299	9%	118	0.04	0.00	15	\$19	100%	100%	32%	2	28%	5%	84.0%	84.0%	77.0%	2.4
176	Cooling	Air Conditioner - 14.3 IEER (20+ Tons)	Biz - Prescriptive	Lodging	TOS	per ton	1,254	9%	114	0.04	0.00	15	\$19	100%	100%	34%	2	13%	5%	84.0%	84.0%	77.0%	2.4
177	Cooling	Air Conditioner - 14.3 IEER (20+ Tons)	Biz - Prescriptive	Retail	TOS	per ton	669	9%	61	0.04	0.00	15	\$19	100%	100%	65%	2	17%	5%	84.0%	84.0%	77.0%	1.9
178	Cooling	Air Conditioner - 14.3 IEER (20+ Tons)	Biz - Prescriptive	Office	TOS	per ton	2,013	9%	183	0.04	0.00	15	\$19	100%	100%	10%	2	28%	5%	84.0%	84.0%	78.1%	2.9
179	Cooling	Air Conditioner - 14.3 IEER (20+ Tons)	Biz - Prescriptive	Warehouse	TOS	per ton	313	9%	28	0.04	0.00	15	\$19	100%	100%	48%	2	31%	5%	84.0%	84.0%	58.6%	1.7
180	Cooling	Air Conditioner - 14.3 IEER (20+ Tons)	Biz - Prescriptive	Other	TOS	per ton	1,061	9%	96	0.04	0.00	15	\$19	100%	100%	44%	2	28%	5%	84.0%	84.0%	77.0%	2.2
181	Cooling	Air Conditioner - 15.6 IEER (20+ Tons)	Biz - Prescriptive	Assembly	TOS	per ton	809	17%	135	0.07	0.00	15	\$38	100%	100%	61%	2	21%	5%	84.0%	84.0%	77.0%	3.7
182	Cooling	Air Conditioner - 15.6 IEER (20+ Tons)	Biz - Prescriptive	Education	TOS	per ton	583	17%	97	0.07	0.00	15	\$38	100%	100%	72%	2	27%	5%	84.0%	84.0%	77.0%	3.4
183	Cooling	Air Conditioner - 15.6 IEER (20+ Tons)	Biz - Prescriptive	Food Sales	TOS	per ton	993	17%	166	0.07	0.00	15	\$38	100%	100%	52%	2	19%	5%	84.0%	84.0%	77.0%	4.0
184	Cooling	Air Conditioner - 15.6 IEER (20+ Tons)	Biz - Prescriptive	Food Service	TOS	per ton	1,099	17%	183	0.07	0.00	15	\$38	100%	100%	47%	2	21%	5%	84.0%	84.0%	77.0%	4.1
185	Cooling	Air Conditioner - 15.6 IEER (20+ Tons)	Biz - Prescriptive	Health	TOS	per ton	1,299	17%	216	0.07	0.00	15	\$38	100%	100%	37%	2	28%	5%	84.0%	84.0%	77.0%	4.4
186	Cooling	Air Conditioner - 15.6 IEER (20+ Tons)	Biz - Prescriptive	Lodging	TOS	per ton	1,254	17%	209	0.07	0.01	15	\$38	100%	100%	40%	2	13%	5%	84.0%	84.0%	77.0%	4.3
187	Cooling	Air Conditioner - 15.6 IEER (20+ Tons)	Biz - Prescriptive	Retail	TOS	per ton	669	17%	111	0.07	0.00	15	\$38	100%	100%	68%	2	17%	5%	84.0%	84.0%	77.0%	3.5
188	Cooling	Air Conditioner - 15.6 IEER (20+ Tons)	Biz - Prescriptive	Office	TOS	per ton	2,013	17%	336	0.07	0.01	15	\$38	100%	100%	10%	2	28%	5%	84.0%	84.0%	77.5%	5.3
189	Cooling	Air Conditioner - 15.6 IEER (20+ Tons)	Biz - Prescriptive	Warehouse	TOS	per ton	313	17%	52	0.07	0.00	15	\$38	100%	100%	44%	2	31%	5%	84.0%	84.0%	52.6%	3.0
190	Cooling	Air Conditioner - 15.6 IEER (20+ Tons)	Biz - Prescriptive	Other	TOS	per ton	1,061	17%	177	0.07	0.00	15	\$38	100%	100%	49%	2	28%	5%	84.0%	84.0%	77.0%	4.1
191	Cooling	PTAC - 7,000 to 15,000 Btuh	Biz - Prescriptive	Assembly	TOS	per ton	1,107	10%	115	0.06	0.00	8	\$84	100%	65%	29%	7	0%	20%	84.0%	65.9%	40.7%	1.8
192	Cooling	PTAC - 7,000 to 15,000 Btuh	Biz - Prescriptive	Education	TOS	per ton	798	10%	83	0.06	0.00	8	\$84	100%	65%	21%	7	0%	20%	84.0%	57.9%	36.0%	1.6
193	Cooling	PTAC - 7,000 to 15,000 Btuh	Biz - Prescriptive	Food Sales	TOS	per ton	1,359	10%	141	0.06	0.00	8	\$84	100%	65%	35%	7	38%	20%	84.0%	69.6%	54.4%	1.9
194	Cooling	PTAC - 7,000 to 15,000 Btuh	Biz - Prescriptive	Food Service	TOS	per ton	1,503	10%	156	0.06	0.00	8	\$84	100%	65%	39%	7	33%	20%	84.0%	71.1%	60.1%	2.0
195	Cooling	PTAC - 7,000 to 15,000 Btuh	Biz - Prescriptive	Health	TOS	per ton	1,777	10%	184	0.06	0.00	8	\$84	100%	65%	46%	7	0%	20%	84.0%	73.3%	66.5%	2.1
196	Cooling	PTAC - 7,000 to 15,000 Btuh	Biz - Prescriptive	Lodging	TOS	per ton	1,716	10%	178	0.06	0.01	8	\$84	100%	65%	45%	7	15%	20%	84.0%	72.9%	65.2%	2.1
197	Cooling	PTAC - 7,000 to 15,000 Btuh	Biz - Prescriptive	Retail	TOS	per ton	915	10%	95	0.06	0.00	8	\$84	100%	65%	24%	7	19%	20%	84.0%	61.8%	36.0%	1.7
198	Cooling	PTAC - 7,000 to 15,000 Btuh	Biz - Prescriptive	Office	TOS	per ton	2,755	10%	285	0.06	0.01	8	\$84	100%	65%	63%	7	6%	20%	84.0%	77.5%	77.0%	2.6
199	Cooling	PTAC - 7,000 to 15,000 Btuh	Biz - Prescriptive	Warehouse	TOS	per ton	429	10%	44	0.06	0.00	8	\$84	75%	65%	11%	7	0%	20%	45.7%	36.0%	28.4%	1.4
200	Cooling	PTAC - 7,000 to 15,000 Btuh	Biz - Prescriptive	Other	TOS	per ton	1,453	10%	150	0.06	0.00	8	\$84	100%	65%	38%	7	0%	20%	84.0%	70.6%	58.2%	2.0
201	Cooling	Comprehensive Rooftop Unit Quality Maintenance (AC Tune-up)	Biz - Custom	Assembly	RET	per ton	992	5%	50	0.02	0.00	3	\$35	50%	14%	13%	3	42%	50%	65.0%	60.0%	60.0%	3.8
202	Cooling	Comprehensive Rooftop Unit Quality Maintenance (AC Tune-up)	Biz - Custom	Education	RET	per ton	715	5%	36	0.02	0.00	3	\$35	10%	10%	10%	3	55%	50%	59.3%	59.3%	59.3%	4.7
203	Cooling	Comprehensive Rooftop Unit Quality Maintenance (AC Tune-up)	Biz - Custom	Food Sales	RET	per ton	1,218	5%	61	0.02	0.00	3	\$35	50%	17%	16%	3						

Appendix C: C&I Measure Assumptions

Measure #	End-Use	Measure Name	Program	Building Type	Replacement	Unit	Base Annual Electric	% Elec Savings	Per Unit Elec Savings	Per Unit Summer kW	Per Unit Winter 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
					Type (TOG*Time of Sale)																		
215	Cooling	Cooling Tower Water Side Economizer	Biz - Custom	Health	RET	per ton	751	19%	140	0.04	0.00	10	\$4,883	0%	0%	10%	10	4%	10%	17.1%	17.1%	17.1%	7.6
216	Cooling	Cooling Tower Water Side Economizer	Biz - Custom	Lodging	RET	per ton	725	19%	136	0.04	0.01	10	\$4,883	0%	0%	10%	10	5%	10%	17.1%	17.1%	17.1%	7.5
217	Cooling	Cooling Tower Water Side Economizer	Biz - Custom	Retail	RET	per ton	387	19%	72	0.04	0.00	10	\$4,883	0%	0%	10%	10	3%	10%	17.1%	17.1%	17.1%	10.2
218	Cooling	Cooling Tower Water Side Economizer	Biz - Custom	Office	RET	per ton	1,165	19%	218	0.08	0.01	10	\$4,883	0%	0%	10%	10	3%	10%	17.1%	17.1%	17.1%	8.4
219	Cooling	Cooling Tower Water Side Economizer	Biz - Custom	Warehouse	RET	per ton	181	19%	34	0.02	0.00	10	\$4,883	0%	0%	10%	10	0%	10%	17.1%	17.1%	17.1%	9.6
220	Cooling	Cooling Tower Water Side Economizer	Biz - Custom	Other	RET	per ton	614	19%	115	0.05	0.00	10	\$4,883	0%	0%	10%	10	4%	10%	17.1%	17.1%	17.1%	9.1
221	Cooling	Air Cooled Chiller	Biz - Custom	Assembly	TOS	per ton	759	10%	76	0.04	0.00	23	\$265	50%	3%	12%	8	31%	5%	12.5%	12.5%	12.5%	18.0
222	Cooling	Air Cooled Chiller	Biz - Custom	Education	TOS	per ton	548	10%	55	0.04	0.00	23	\$265	2%	2%	10%	8	41%	5%	12.5%	12.5%	12.5%	23.0
223	Cooling	Air Cooled Chiller	Biz - Custom	Food Sales	TOS	per ton	933	10%	94	0.04	0.00	23	\$265	50%	4%	14%	8	0%	5%	14.2%	12.5%	12.5%	15.6
224	Cooling	Air Cooled Chiller	Biz - Custom	Food Service	TOS	per ton	1,032	10%	104	0.04	0.00	23	\$265	50%	4%	16%	8	0%	5%	15.1%	12.5%	12.5%	14.6
225	Cooling	Air Cooled Chiller	Biz - Custom	Health	TOS	per ton	1,220	10%	122	0.04	0.00	23	\$265	50%	5%	19%	8	39%	5%	16.9%	12.5%	12.5%	13.1
226	Cooling	Air Cooled Chiller	Biz - Custom	Lodging	TOS	per ton	1,178	10%	118	0.04	0.00	23	\$265	50%	4%	18%	8	42%	5%	16.3%	12.5%	12.5%	13.5
227	Cooling	Air Cooled Chiller	Biz - Custom	Retail	TOS	per ton	628	10%	63	0.04	0.00	23	\$265	2%	2%	10%	8	23%	5%	12.5%	12.5%	12.5%	20.7
228	Cooling	Air Cooled Chiller	Biz - Custom	Office	TOS	per ton	1,891	10%	190	0.04	0.00	23	\$265	50%	7%	29%	8	29%	5%	27.8%	15.0%	19.4%	10.3
229	Cooling	Air Cooled Chiller	Biz - Custom	Warehouse	TOS	per ton	294	10%	30	0.04	0.00	23	\$265	1%	1%	10%	8	0%	5%	12.5%	12.5%	12.5%	38.5
230	Cooling	Air Cooled Chiller	Biz - Custom	Other	TOS	per ton	997	10%	100	0.04	0.00	23	\$265	50%	4%	15%	8	39%	5%	14.8%	12.5%	12.5%	14.9
231	Cooling	Water Cooled Chiller	Biz - Custom	Assembly	TOS	per ton	468	10%	46	0.02	0.00	23	\$62	100%	7%	30%	9	4%	5%	63.0%	15.4%	21.2%	18.0
232	Cooling	Water Cooled Chiller	Biz - Custom	Education	TOS	per ton	337	10%	33	0.02	0.00	23	\$62	100%	5%	22%	9	5%	5%	63.0%	12.5%	13.9%	23.0
233	Cooling	Water Cooled Chiller	Biz - Custom	Food Sales	TOS	per ton	575	10%	57	0.02	0.00	23	\$62	100%	9%	37%	9	0%	5%	63.0%	19.6%	24.5%	15.6
234	Cooling	Water Cooled Chiller	Biz - Custom	Food Service	TOS	per ton	636	10%	63	0.02	0.00	23	\$62	100%	10%	41%	9	0%	5%	63.0%	22.6%	27.6%	14.6
235	Cooling	Water Cooled Chiller	Biz - Custom	Health	TOS	per ton	751	10%	75	0.02	0.00	23	\$62	100%	12%	48%	9	4%	5%	63.0%	24.0%	37.6%	13.1
236	Cooling	Water Cooled Chiller	Biz - Custom	Lodging	TOS	per ton	725	10%	72	0.02	0.00	23	\$62	100%	12%	47%	9	5%	5%	63.0%	24.0%	35.3%	13.5
237	Cooling	Water Cooled Chiller	Biz - Custom	Retail	TOS	per ton	387	10%	38	0.02	0.00	23	\$62	100%	6%	25%	9	3%	5%	63.0%	13.5%	15.6%	20.7
238	Cooling	Water Cooled Chiller	Biz - Custom	Office	TOS	per ton	1,165	10%	116	0.02	0.00	23	\$62	100%	19%	75%	9	3%	5%	63.0%	37.0%	56.4%	10.3
239	Cooling	Water Cooled Chiller	Biz - Custom	Warehouse	TOS	per ton	181	10%	18	0.02	0.00	23	\$62	100%	3%	12%	9	0%	5%	63.0%	12.5%	12.5%	38.5
240	Cooling	Water Cooled Chiller	Biz - Custom	Other	TOS	per ton	614	10%	61	0.02	0.00	23	\$62	100%	10%	40%	9	4%	5%	63.0%	21.6%	26.6%	14.9
241	Cooling	Smart Thermostat	Biz - Prescriptive	Assembly	RET	per thermostat	4,309	14%	610	0.17	0.01	11	\$175	100%	57%	62%	6	23%	17%	84.0%	76.0%	77.0%	4.6
242	Cooling	Smart Thermostat	Biz - Prescriptive	Education	RET	per thermostat	3,109	14%	440	0.17	0.00	11	\$175	100%	57%	67%	6	0%	17%	84.0%	72.3%	75.3%	4.0
243	Cooling	Smart Thermostat	Biz - Prescriptive	Food Sales	RET	per thermostat	5,293	14%	750	0.17	0.00	11	\$175	100%	57%	53%	6	23%	17%	84.0%	77.6%	77.0%	5.1
244	Cooling	Smart Thermostat	Biz - Prescriptive	Food Service	RET	per thermostat	5,854	14%	829	0.17	0.02	11	\$175	100%	57%	48%	6	25%	17%	84.0%	78.2%	77.0%	5.4
245	Cooling	Smart Thermostat	Biz - Prescriptive	Health	RET	per thermostat	6,921	14%	980	0.17	0.01	11	\$175	100%	57%	38%	6	0%	17%	84.0%	79.1%	77.0%	5.8
246	Cooling	Smart Thermostat	Biz - Prescriptive	Lodging	RET	per thermostat	6,682	14%	946	0.17	0.04	11	\$175	100%	57%	41%	6	0%	17%	84.0%	79.0%	77.0%	5.8
247	Cooling	Smart Thermostat	Biz - Prescriptive	Retail	RET	per thermostat	3,564	14%	505	0.17	0.00	11	\$175	100%	57%	68%	6	22%	17%	84.0%	74.0%	77.0%	4.3
248	Cooling	Smart Thermostat	Biz - Prescriptive	Office	RET	per thermostat	10,729	14%	1,519	0.17	0.04	11	\$175	100%	57%	10%	6	6%	17%	84.0%	80.9%	77.4%	7.7
249	Cooling	Smart Thermostat	Biz - Prescriptive	Warehouse	RET	per thermostat	1,669	14%	236	0.17	0.00	11	\$175	100%	57%	36%	6	38%	17%	84.0%	61.0%	45.5%	3.3
250	Cooling	Smart Thermostat	Biz - Prescriptive	Other	RET	per thermostat	5,657	14%	801	0.17	0.02	11	\$175	100%	57%	50%	6	0%	17%	84.0%	78.0%	77.0%	5.3
251	Cooling	Window Film	Biz - Custom	Assembly	RET	per 100 sq ft	6,364	4%	280	0.12	0.01	10	\$154	100%	18%	45%	11	100%	25%	63.0%	40.0%	46.7%	9.2
252	Cooling	Window Film	Biz - Custom	Education	RET	per 100 sq ft	6,364	4%	280	0.12	0.00	10	\$154	100%	18%	45%	11	100%	25%	63.0%	40.0%	46.7%	9.4
253	Cooling	Window Film	Biz - Custom	Food Sales	RET	per 100 sq ft	6,364	4%	280	0.18	0.00	10	\$154	100%	18%	45%	11	100%	25%	63.0%	40.0%	46.7%	12.5
254	Cooling	Window Film	Biz - Custom	Food Service	RET	per 100 sq ft	6,364	4%	280	0.13	0.01	10	\$154	100%	18%	45%	11	100%	25%	63.0%	40.0%	46.7%	9.8
255	Cooling	Window Film	Biz - Custom	Health	RET	per 100 sq ft	6,364	4%	280	0.09	0.00	10	\$154	100%	18%	45%	11	100%	25%	63.0%	40.0%	46.7%	7.6
256	Cooling	Window Film	Biz - Custom	Lodging	RET	per 100 sq ft	6,364	4%	280	0.09	0.01	10	\$154	100%	18%	45%	11	100%	25%	63.0%	40.0%	46.7%	7.5
257	Cooling	Window Film	Biz - Custom	Retail	RET	per 100 sq ft	6,364	4%	280	0.14	0.00	10	\$154	100%	18%	45%	11	100%	25%	63.0%	40.0%	46.7%	10.2
258	Cooling	Window Film	Biz - Custom	Office	RET	per 100 sq ft	6,364	4%	280	0.10	0.01	10	\$154	100%	18%	45%	11	100%	25%	63.0%	40.0%	46.7%	8.4
259	Cooling	Window Film	Biz - Custom	Warehouse	RET	per 100 sq ft	6,364	4%	280	0.13	0.00	10	\$154	100%	18%	45%	11	100%	25%	63.0%	40.0%	46.7%	9.6
260	Cooling	Window Film	Biz - Custom	Other	RET	per 100 sq ft	6,364	4%	280	0.12	0.01	10	\$154	100%	18%	45%	11	100%	25%	63.0%	40.0%	46.7%	9.1
261	Cooling	Secondary Windows	Biz - Custom	Assembly	RET	per 100 sq ft	6,364	0%	0	0.00	0.00	30	\$3,200	100%	0%	100%	11	100%	25%	63.0%	63.0%	63.0%	2.0
262	Cooling	Secondary Windows	Biz - Custom	Education	RET	per 100 sq ft	6,364	7%	449	0.20	0.00	30	\$3,200	1%	1%	10%	11	100%	25%	30.9%	30.9%	30.9%	18.9
263	Cooling	Secondary Windows	Biz - Custom	Food Sales	RET	per 100 sq ft	6,364	0%	0	0.00	0.00	30	\$3,200	100%	0%	100%	11	100%	25%	63.0%	63.0%	63.0%	2.0
264	Cooling	Secondary Windows	Biz - Custom	Food Service	RET	per 100 sq ft	6,364	6%	397	0.18	0.01	30	\$3,200	1%	1%	10%	11	100%	25%	30.9%	30.9%	30.9%	19.7
265	Cooling	Secondary Windows	Biz - Custom	Health	RET	per 100 sq ft	6,364	8%	526	0.16	0.01	30	\$3,200	2%	2%	10%	11	100%	25%	30.9%	30.9%	30.9%	15.0
266	Cooling	Secondary Windows	Biz - Custom	Lodging	RET	per 100 sq ft	6,364	7%	457	0.14	0.02	30	\$3,200	1%	1%	10%	11	100%	25%	30.9%	30.9%	30.9%	14.9
267	Cooling	Secondary Windows	Biz - Custom	Retail	RET	per 100 sq ft	6,364	7%	464	0.23	0.00	30	\$3,200	1%	1%	10%	11	100%	25%	30.9%	30.9%	30.9%	20.5
268	Cooling	Secondary Windows	Biz - Custom	Office	RET	per 100 sq ft	6,364	7%	439	0.16	0.01	30	\$3,200	1%	1%	10%	11	100%	25%	30.9%	30.9%	30.9%	16.8
269	Cooling	Secondary Windows	Biz - Custom	Warehouse	RET	per 100 sq ft	6,364	0%	0	0.00	0.00	30	\$3,200	100%	0%	100%	11	100%	25%	63.0%	63.0%	63.0%	2.0
270	Cooling	Secondary Windows	Biz - Custom	Other	RET	per 100 sq ft	6,364	0%	0	0.00	0.00	30	\$3,200	100%	0%	100%	11	100%	25%	63.0%	63.0%	63.0%	2.0
271	Cooling	Triple Pane Windows	Biz - Custom	Assembly	TOS	per 100 sq ft	6,364	6%	382	0.16	0.01	30	\$700	100%	5%	24%	11	100%	2%	63.0%	9.8%	11.7%	18.5
272	Cooling	Triple Pane Windows	Biz - Custom	Education	TOS	per 100 sq ft	6,364	6%	382	0.17	0.00	30	\$700	100%	5%	24%	11	100%	2%	63.0%	9.8%	11.7%	18.9
273	Cooling	Triple Pane Windows	Biz - Custom	Food Sales	TOS	per 100 sq ft	6,364	6%	382	0.25	0.00	30	\$700	100%	5%	24%	11	100%	2%	63.0%	9.8%	11.7%	25.5
274	Cooling	Triple Pane Windows	Biz - Custom	Food Service	TOS	per 100 sq ft	6,364	6%	382	0.18	0.01	30	\$700	100%	5%	24%	11	100%	2%	63.0%	9.8%	11.7%	19.7
275	Cooling	Triple Pane Windows	Biz - Custom	Health	TOS	per 100 sq ft	6,364	6%	382	0.12	0.01	30	\$700	75%	5%	24%	11	100%	2%	35.4%	9.8%	11.7%	15.0
276	Cooling	Triple Pane Windows	Biz - Custom	Lodging	TOS	per 100 sq ft	6,364	6%	382	0.12	0.02	30	\$700	75%	5%	24%	11	100%	2%	35.4%	9.8%	11.7%	14.9
277	Cooling	Triple Pane Windows	Biz - Custom	Retail	TOS	per 100 sq ft	6,364	6%	382	0.19	0.00	30	\$700	100%	5%	24%	11	100%	2%	63.0%	9.8%	11.7%	20.5
278	Cooling	Triple Pane Windows	Biz - Custom	Office	TOS	per 100 sq ft	6,364	6%	382	0.14													

Appendix C: C&I Measure Assumptions

Measure #	End-Use	Measure Name	Program	Building Type	Replacement Type (TOS=Time of Sale)	Unit	Base Annual Electric	% Elec Savings	Per Unit Elec Savings	Per Unit Summer kW	Per Unit Winter 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
286	Cooling	Energy Recovery Ventilator	Biz - Custom	Lodging	RET	per ton	1,254	0%	0	0.00	0.00	15	\$1,500	100%	0%	100%	4	27%	2%	63.0%	63.0%	63.0%	2.0
287	Cooling	Energy Recovery Ventilator	Biz - Custom	Retail	RET	per ton	669	5%	35	0.02	0.00	15	\$1,500	0%	0%	10%	4	33%	2%	9.8%	9.8%	9.8%	13.6
288	Cooling	Energy Recovery Ventilator	Biz - Custom	Office	RET	per ton	2,013	16%	327	0.12	0.01	15	\$1,500	2%	2%	10%	4	55%	2%	9.8%	9.8%	9.8%	11.2
289	Cooling	Energy Recovery Ventilator	Biz - Custom	Warehouse	RET	per ton	313	0%	0	0.00	0.00	15	\$1,500	100%	0%	100%	4	62%	2%	63.0%	63.0%	63.0%	2.0
290	Cooling	Energy Recovery Ventilator	Biz - Custom	Other	RET	per ton	1,061	0%	0	0.00	0.00	15	\$1,500	100%	0%	100%	4	57%	2%	63.0%	63.0%	63.0%	2.0
291	Heating	Heat Pump -16 SEER (<5 Tons)	Biz - Prescriptive	Assembly	TOS	per ton	3,737	25%	927	0.10	0.21	15	\$100	100%	60%	10%	1	20%	15%	84.0%	81.3%	77.0%	10.4
292	Heating	Heat Pump -16 SEER (<5 Tons)	Biz - Prescriptive	Education	TOS	per ton	2,620	25%	650	0.09	0.17	15	\$100	100%	60%	29%	1	0%	15%	84.0%	80.1%	77.0%	8.0
293	Heating	Heat Pump -16 SEER (<5 Tons)	Biz - Prescriptive	Food Sales	TOS	per ton	3,416	25%	843	0.09	0.22	15	\$100	100%	60%	10%	1	23%	15%	84.0%	81.0%	77.2%	9.6
294	Heating	Heat Pump -16 SEER (<5 Tons)	Biz - Prescriptive	Food Service	TOS	per ton	3,178	25%	780	0.09	0.16	15	\$100	100%	60%	14%	1	24%	15%	84.0%	80.7%	77.0%	8.9
295	Heating	Heat Pump -16 SEER (<5 Tons)	Biz - Prescriptive	Health	TOS	per ton	3,863	25%	949	0.09	0.20	15	\$100	100%	60%	10%	1	0%	15%	84.0%	81.3%	78.0%	10.2
296	Heating	Heat Pump -16 SEER (<5 Tons)	Biz - Prescriptive	Lodging	TOS	per ton	3,850	25%	947	0.09	0.22	15	\$100	100%	60%	10%	1	0%	15%	84.0%	81.3%	78.0%	10.3
297	Heating	Heat Pump -16 SEER (<5 Tons)	Biz - Prescriptive	Retail	TOS	per ton	2,800	25%	694	0.09	0.15	15	\$100	100%	60%	24%	1	20%	15%	84.0%	80.3%	77.0%	8.3
298	Heating	Heat Pump -16 SEER (<5 Tons)	Biz - Prescriptive	Office	TOS	per ton	6,197	25%	1,524	0.09	0.33	15	\$100	100%	60%	10%	1	4%	15%	84.0%	82.3%	80.2%	14.8
299	Heating	Heat Pump -16 SEER (<5 Tons)	Biz - Prescriptive	Warehouse	TOS	per ton	2,443	25%	611	0.09	0.15	15	\$100	100%	60%	33%	1	13%	15%	84.0%	79.8%	77.0%	7.7
300	Heating	Heat Pump -16 SEER (<5 Tons)	Biz - Prescriptive	Other	TOS	per ton	3,743	25%	924	0.09	0.21	15	\$100	100%	60%	10%	1	0%	15%	84.0%	81.2%	77.8%	10.1
301	Heating	Heat Pump -15.0 IEER COP 3.6 (65,000-134,000 Btu/hr)	Biz - Prescriptive	Assembly	TOS	per ton	2,595	7%	189	0.09	0.04	15	\$100	100%	60%	61%	2	13%	15%	84.0%	69.1%	69.6%	4.6
302	Heating	Heat Pump -15.0 IEER COP 3.6 (65,000-134,000 Btu/hr)	Biz - Prescriptive	Education	TOS	per ton	1,826	7%	136	0.09	0.04	15	\$100	100%	60%	44%	2	22%	15%	84.0%	62.8%	52.0%	4.1
303	Heating	Heat Pump -15.0 IEER COP 3.6 (65,000-134,000 Btu/hr)	Biz - Prescriptive	Food Sales	TOS	per ton	2,469	9%	232	0.09	0.06	15	\$100	100%	60%	74%	2	13%	15%	84.0%	72.2%	77.0%	4.9
304	Heating	Heat Pump -15.0 IEER COP 3.6 (65,000-134,000 Btu/hr)	Biz - Prescriptive	Food Service	TOS	per ton	2,364	11%	257	0.09	0.05	15	\$100	100%	60%	72%	2	14%	15%	84.0%	73.5%	77.0%	5.1
305	Heating	Heat Pump -15.0 IEER COP 3.6 (65,000-134,000 Btu/hr)	Biz - Prescriptive	Health	TOS	per ton	2,859	11%	303	0.09	0.06	15	\$100	100%	60%	67%	2	15%	15%	84.0%	75.3%	77.0%	5.4
306	Heating	Heat Pump -15.0 IEER COP 3.6 (65,000-134,000 Btu/hr)	Biz - Prescriptive	Lodging	TOS	per ton	2,834	10%	293	0.09	0.07	15	\$100	100%	60%	68%	2	8%	15%	84.0%	75.0%	77.0%	5.4
307	Heating	Heat Pump -15.0 IEER COP 3.6 (65,000-134,000 Btu/hr)	Biz - Prescriptive	Retail	TOS	per ton	1,969	8%	156	0.09	0.03	15	\$100	100%	60%	51%	2	10%	15%	84.0%	65.7%	61.0%	4.3
308	Heating	Heat Pump -15.0 IEER COP 3.6 (65,000-134,000 Btu/hr)	Biz - Prescriptive	Office	TOS	per ton	4,560	10%	470	0.09	0.10	15	\$100	100%	60%	48%	2	13%	15%	84.0%	78.6%	77.0%	6.7
309	Heating	Heat Pump -15.0 IEER COP 3.6 (65,000-134,000 Btu/hr)	Biz - Prescriptive	Warehouse	TOS	per ton	1,614	5%	73	0.09	0.02	15	\$100	100%	60%	24%	2	7%	15%	84.0%	38.4%	30.5%	3.6
310	Heating	Heat Pump -15.0 IEER COP 3.6 (65,000-134,000 Btu/hr)	Biz - Prescriptive	Other	TOS	per ton	2,665	9%	248	0.09	0.06	15	\$100	100%	60%	73%	2	11%	15%	84.0%	73.0%	77.0%	5.0
311	Heating	Heat Pump -14.5 IEER COP 3.5 (135,000-239,000 Btu/hr)	Biz - Prescriptive	Assembly	TOS	per ton	2,697	8%	206	0.10	0.05	15	\$100	100%	60%	67%	3	12%	15%	84.0%	70.5%	73.1%	5.0
312	Heating	Heat Pump -14.5 IEER COP 3.5 (135,000-239,000 Btu/hr)	Biz - Prescriptive	Education	TOS	per ton	1,877	8%	149	0.10	0.04	15	\$100	100%	60%	48%	3	22%	15%	84.0%	64.7%	58.2%	4.5
313	Heating	Heat Pump -14.5 IEER COP 3.5 (135,000-239,000 Btu/hr)	Biz - Prescriptive	Food Sales	TOS	per ton	2,537	10%	254	0.10	0.07	15	\$100	100%	60%	72%	3	12%	15%	84.0%	73.3%	77.0%	5.4
314	Heating	Heat Pump -14.5 IEER COP 3.5 (135,000-239,000 Btu/hr)	Biz - Prescriptive	Food Service	TOS	per ton	2,427	12%	280	0.10	0.06	15	\$100	100%	60%	69%	3	13%	15%	84.0%	74.5%	77.0%	5.5
315	Heating	Heat Pump -14.5 IEER COP 3.5 (135,000-239,000 Btu/hr)	Biz - Prescriptive	Health	TOS	per ton	2,936	11%	331	0.10	0.07	15	\$100	100%	60%	64%	3	14%	15%	84.0%	76.2%	77.0%	5.9
316	Heating	Heat Pump -14.5 IEER COP 3.5 (135,000-239,000 Btu/hr)	Biz - Prescriptive	Lodging	TOS	per ton	2,911	11%	320	0.10	0.08	15	\$100	100%	60%	65%	3	8%	15%	84.0%	75.8%	77.0%	5.9
317	Heating	Heat Pump -14.5 IEER COP 3.5 (135,000-239,000 Btu/hr)	Biz - Prescriptive	Retail	TOS	per ton	2,023	8%	171	0.10	0.04	15	\$100	100%	60%	55%	3	10%	15%	84.0%	67.4%	65.2%	4.7
318	Heating	Heat Pump -14.5 IEER COP 3.5 (135,000-239,000 Btu/hr)	Biz - Prescriptive	Office	TOS	per ton	4,883	11%	514	0.10	0.11	15	\$100	100%	60%	43%	3	13%	15%	84.0%	79.0%	77.0%	7.4
319	Heating	Heat Pump -14.5 IEER COP 3.5 (135,000-239,000 Btu/hr)	Biz - Prescriptive	Warehouse	TOS	per ton	1,661	5%	80	0.10	0.02	15	\$100	100%	60%	26%	3	7%	15%	84.0%	43.0%	32.0%	4.0
320	Heating	Heat Pump -14.5 IEER COP 3.5 (135,000-239,000 Btu/hr)	Biz - Prescriptive	Other	TOS	per ton	2,769	10%	271	0.10	0.06	15	\$100	100%	60%	70%	3	11%	15%	84.0%	74.1%	77.0%	5.5
321	Heating	Heat Pump -12 IEER 3.4 COP (>239,000 Btu/hr)	Biz - Prescriptive	Assembly	TOS	per ton	2,790	10%	271	0.14	0.06	15	\$100	100%	60%	70%	4	12%	15%	84.0%	74.1%	77.0%	6.5
322	Heating	Heat Pump -12 IEER 3.4 COP (>239,000 Btu/hr)	Biz - Prescriptive	Education	TOS	per ton	1,964	10%	195	0.14	0.05	15	\$100	100%	60%	63%	4	22%	15%	84.0%	69.7%	70.9%	5.9
323	Heating	Heat Pump -12 IEER 3.4 COP (>239,000 Btu/hr)	Biz - Prescriptive	Food Sales	TOS	per ton	2,665	12%	332	0.14	0.09	15	\$100	100%	60%	63%	4	12%	15%	84.0%	76.2%	77.0%	7.1
324	Heating	Heat Pump -12 IEER 3.4 COP (>239,000 Btu/hr)	Biz - Prescriptive	Food Service	TOS	per ton	2,657	14%	368	0.14	0.08	15	\$100	100%	60%	60%	4	13%	15%	84.0%	77.1%	77.0%	7.3
325	Heating	Heat Pump -12 IEER 3.4 COP (>239,000 Btu/hr)	Biz - Prescriptive	Health	TOS	per ton	3,092	14%	435	0.14	0.09	15	\$100	100%	60%	52%	4	14%	15%	84.0%	78.1%	77.0%	7.7
326	Heating	Heat Pump -12 IEER 3.4 COP (>239,000 Btu/hr)	Biz - Prescriptive	Lodging	TOS	per ton	3,063	14%	420	0.14	0.10	15	\$100	100%	60%	54%	4	8%	15%	84.0%	77.9%	77.0%	7.7
327	Heating	Heat Pump -12 IEER 3.4 COP (>239,000 Btu/hr)	Biz - Prescriptive	Retail	TOS	per ton	2,119	11%	224	0.14	0.05	15	\$100	100%	60%	72%	4	10%	15%	84.0%	71.7%	76.0%	6.1
328	Heating	Heat Pump -12 IEER 3.4 COP (>239,000 Btu/hr)	Biz - Prescriptive	Office	TOS	per ton	4,928	14%	674	0.14	0.15	15	\$100	100%	60%	26%	4	13%	15%	84.0%	80.2%	77.0%	9.7
329	Heating	Heat Pump -12 IEER 3.4 COP (>239,000 Btu/hr)	Biz - Prescriptive	Warehouse	TOS	per ton	1,728	6%	105	0.14	0.03	15	\$100	100%	60%	34%	4	7%	15%	84.0%	54.8%	34.8%	5.2
330	Heating	Heat Pump -12 IEER 3.4 COP (>239,000 Btu/hr)	Biz - Prescriptive	Other	TOS	per ton	2,907	12%	355	0.14	0.08	15	\$100	100%	60%	61%	4	11%	15%	84.0%	76.8%	77.0%	7.2
331	Heating	Geothermal HP - 20 EER < 135kbtu	Biz - Prescriptive	Assembly	TOS	per ton	3,702	48%	1,767	0.18	0.41	25	\$8,338	3%	3%	10%	5	3%	15%	24.0%	24.0%	24.0%	6.6
332	Heating	Geothermal HP - 20 EER < 135kbtu	Biz - Prescriptive	Education	TOS	per ton	2,599	48%	1,239	0.18	0.32	25	\$8,338	3%	3%	10%	5	4%	15%	24.0%	24.0%	24.0%	5.2
333	Heating	Geothermal HP - 20 EER < 135kbtu	Biz - Prescriptive	Food Sales	TOS	per ton	3,437	47%	1,615	0.18	0.43	25	\$8,338	3%	3%	10%	5	6%	15%	24.0%	24.0%	24.0%	6.3
334	Heating	Geothermal HP - 20 EER < 135kbtu	Biz - Prescriptive	Food Service	TOS	per ton	3,233	46%	1,502	0.18	0.31	25	\$8,338	3%	3%	10%	5	9%	15%	24.0%	24.0%	24.0%	5.8
335	Heating	Geothermal HP - 20 EER < 135kbtu	Biz - Prescriptive	Health	TOS	per ton	3,922	47%	1,826	0.18	0.38	25	\$8,338	3%	3%	10%	5	0%	15%	24.0%	24.0%	24.0%	6.6
336	Heating	Geothermal HP - 20 EER < 135kbtu	Biz - Prescriptive	Lodging	TOS	per ton	3,901	47%	1,820	0.18	0.43	25	\$8,338	3%	3%	10%	5	6%	15%	24.0%	24.0%	24.0%	6.7
337	Heating	Geothermal HP - 20 EER < 135kbtu	Biz - Prescriptive	Retail	TOS	per ton	2,787	48%	1,324	0.18	0.29	25	\$8,338	3%	3%	10%	5	5%	15%	24.0%	24.0%	24.0%	5.4
338	Heating	Geothermal HP - 20 EER < 135kbtu	Biz - Prescriptive	Office	TOS	per ton	6,277	47%	2,929	0.18	0.64	25	\$8,338	3%	3%	15%	5	3%	15%	24.0%	24.0%	24.0%	9.5
339	Heating	Geothermal HP - 20 EER < 135kbtu	Biz - Prescriptive	Warehouse	TOS	per ton	2,377	49%	1,156	0.18	0.28	25	\$8,338	3%	3%	10%	5	0%	15%	24.0%	24.0%	24.0%	5.0
340	Heating	Geothermal HP - 20 EER < 135kbtu	Biz - Prescriptive	Other	TOS	per ton	3,759	47%	1,770	0.18	0.40	25	\$8,338	3%	3%	10%	5	0%	15%	24.0%	24.0%	24.0%	6.6
341	Heating	PTHP - 7,000 to 15,000 Btuh	Biz - Prescriptive	Assembly	TOS	per ton	1,979	44%	872	0.03	0.20	15	\$84	100%	65%	10%	6	0%	15%	84.0%	81.9%	78.5%	8.6
342	Heating	PTHP - 7,000 to 15,000 Btuh	Biz - Prescriptive	Education	TOS	per ton	5,027	57%	2,869	0.03	0.75	15	\$84	100%	65%	10%	6	0%	15%	84.0%	83.4%	82.3%	25.9
343	Heating	PTHP - 7,000 to 15,000 Btuh	Biz - Prescriptive	Food Sales	TOS	per ton	6,386	54%	3,461	0.03	0.92	15	\$84	100%									

Appendix C: C&I Measure Assumptions

Measure #	End-Use	Measure Name	Program	Building Type	Replacement Type (TOS=Time of Sale)	Unit	Base Annual Electric	% Elec Savings	Per Unit Elec Savings	Per Unit Summer kW	Per Unit Winter 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
357	Heating	High Speed Overhead Doors	Biz - Custom	Retail	TOS	per garage door	50,000	1%	500	0.08	0.11	20	\$201	100%	25%	73%	7	100%	2%	63.0%	46.7%	57.8%	9.4
358	Heating	High Speed Overhead Doors	Biz - Custom	Office	TOS	per garage door	50,000	1%	500	0.06	0.11	20	\$201	100%	25%	73%	7	100%	2%	63.0%	46.7%	57.8%	8.4
359	Heating	High Speed Overhead Doors	Biz - Custom	Warehouse	TOS	per garage door	50,000	1%	500	0.08	0.12	20	\$201	100%	25%	73%	7	100%	2%	63.0%	46.7%	57.8%	9.2
360	Heating	High Speed Overhead Doors	Biz - Custom	Other	TOS	per garage door	50,000	1%	500	0.07	0.11	20	\$201	100%	25%	73%	7	100%	2%	63.0%	46.7%	57.8%	8.9
361	Ventilation	Pump and Fan Variable Frequency Drive Controls (Pumps)	Biz - Prescriptive	Assembly	TOS	per HP	1,503	28%	417	0.19	0.06	15	\$198	100%	45%	68%	1	35%	64%	84.0%	71.2%	73.7%	6.3
362	Ventilation	Pump and Fan Variable Frequency Drive Controls (Pumps)	Biz - Prescriptive	Education	TOS	per HP	2,296	28%	637	0.19	0.05	15	\$198	100%	45%	65%	1	45%	77%	84.0%	81.6%	81.6%	7.2
363	Ventilation	Pump and Fan Variable Frequency Drive Controls (Pumps)	Biz - Prescriptive	Food Sales	TOS	per HP	3,823	28%	1,060	0.19	0.24	15	\$198	100%	45%	41%	1	0%	20%	84.0%	77.5%	77.0%	9.8
364	Ventilation	Pump and Fan Variable Frequency Drive Controls (Pumps)	Biz - Prescriptive	Food Service	TOS	per HP	1,611	28%	447	0.19	0.05	15	\$198	100%	45%	73%	1	0%	11%	84.0%	66.8%	76.2%	6.4
365	Ventilation	Pump and Fan Variable Frequency Drive Controls (Pumps)	Biz - Prescriptive	Health	TOS	per HP	4,349	28%	1,206	0.19	0.06	15	\$198	100%	45%	33%	1	43%	72%	84.0%	78.3%	77.6%	9.7
366	Ventilation	Pump and Fan Variable Frequency Drive Controls (Pumps)	Biz - Prescriptive	Lodging	TOS	per HP	3,628	28%	1,006	0.19	0.12	15	\$198	100%	45%	44%	1	47%	10%	84.0%	77.1%	77.0%	9.1
367	Ventilation	Pump and Fan Variable Frequency Drive Controls (Pumps)	Biz - Prescriptive	Retail	TOS	per HP	1,675	28%	465	0.19	0.13	15	\$198	100%	45%	74%	1	26%	8%	84.0%	67.5%	77.0%	6.7
368	Ventilation	Pump and Fan Variable Frequency Drive Controls (Pumps)	Biz - Prescriptive	Office	TOS	per HP	3,090	28%	857	0.19	0.06	15	\$198	100%	45%	52%	1	32%	13%	84.0%	75.7%	77.0%	8.2
369	Ventilation	Pump and Fan Variable Frequency Drive Controls (Pumps)	Biz - Prescriptive	Warehouse	TOS	per HP	538	28%	149	0.19	0.01	15	\$198	100%	45%	24%	1	0%	26%	84.0%	40.7%	40.6%	4.9
370	Ventilation	Pump and Fan Variable Frequency Drive Controls (Pumps)	Biz - Prescriptive	Other	TOS	per HP	2,088	28%	579	0.19	0.08	15	\$198	100%	45%	68%	1	43%	33%	84.0%	71.0%	77.0%	7.0
371	Ventilation	Pump and Fan Variable Frequency Drive Controls (Fans)	Biz - Prescriptive	Assembly	RET	per 5 HP motor	7,655	29%	4,516	0.80	0.55	15	\$2,250	100%	20%	65%	2	65%	64%	84.0%	71.2%	72.0%	7.9
372	Ventilation	Pump and Fan Variable Frequency Drive Controls (Fans)	Biz - Prescriptive	Education	RET	per 5 HP motor	7,655	29%	4,516	0.81	0.62	15	\$2,250	100%	20%	65%	2	55%	77%	84.0%	81.6%	81.6%	8.0
373	Ventilation	Pump and Fan Variable Frequency Drive Controls (Fans)	Biz - Prescriptive	Food Sales	RET	per 5 HP motor	16,266	29%	9,596	1.40	1.35	15	\$2,250	100%	20%	53%	2	100%	20%	84.0%	71.0%	77.0%	15.6
374	Ventilation	Pump and Fan Variable Frequency Drive Controls (Fans)	Biz - Prescriptive	Food Service	RET	per 5 HP motor	13,903	29%	8,202	1.24	1.07	15	\$2,250	100%	20%	60%	2	100%	11%	84.0%	68.5%	77.0%	13.5
375	Ventilation	Pump and Fan Variable Frequency Drive Controls (Fans)	Biz - Prescriptive	Health	RET	per 5 HP motor	11,306	29%	6,510	0.84	0.73	15	\$2,250	100%	20%	68%	2	57%	72%	84.0%	77.6%	77.6%	9.9
376	Ventilation	Pump and Fan Variable Frequency Drive Controls (Fans)	Biz - Prescriptive	Lodging	RET	per 5 HP motor	10,560	29%	6,229	1.21	0.64	15	\$2,250	100%	20%	70%	2	53%	10%	84.0%	63.2%	77.0%	11.2
377	Ventilation	Pump and Fan Variable Frequency Drive Controls (Fans)	Biz - Prescriptive	Retail	RET	per 5 HP motor	13,400	29%	7,905	1.45	0.84	15	\$2,250	100%	20%	61%	2	74%	8%	84.0%	67.9%	77.0%	14.1
378	Ventilation	Pump and Fan Variable Frequency Drive Controls (Fans)	Biz - Prescriptive	Office	RET	per 5 HP motor	6,786	29%	4,003	0.61	0.45	15	\$2,250	100%	20%	58%	2	68%	13%	84.0%	48.0%	67.1%	6.5
379	Ventilation	Pump and Fan Variable Frequency Drive Controls (Fans)	Biz - Prescriptive	Warehouse	RET	per 5 HP motor	13,008	29%	7,674	1.20	0.92	15	\$2,250	100%	20%	62%	2	100%	26%	84.0%	67.4%	77.0%	12.7
380	Ventilation	Pump and Fan Variable Frequency Drive Controls (Fans)	Biz - Prescriptive	Other	RET	per 5 HP motor	11,883	29%	7,010	1.21	0.84	15	\$2,250	100%	20%	66%	2	57%	33%	84.0%	65.7%	77.0%	12.1
381	Ventilation	Switch Reluctance Motors	Biz - Custom	Assembly	TOS	per 10HP	48,244	31%	14,763	2.15	2.16	15	\$528	100%	100%	10%	2	35%	1%	63.0%	63.0%	61.5%	7.3
382	Ventilation	Switch Reluctance Motors	Biz - Custom	Education	TOS	per 10HP	26,808	31%	8,203	1.83	0.70	15	\$528	100%	100%	10%	2	45%	1%	63.0%	63.0%	60.2%	8.7
383	Ventilation	Switch Reluctance Motors	Biz - Custom	Food Sales	TOS	per 10HP	56,966	31%	17,432	0.00	3.97	15	\$528	100%	100%	10%	2	0%	1%	63.0%	63.0%	61.7%	4.6
384	Ventilation	Switch Reluctance Motors	Biz - Custom	Food Service	TOS	per 10HP	48,691	31%	14,899	3.17	1.61	15	\$528	100%	100%	10%	2	0%	1%	63.0%	63.0%	61.5%	8.5
385	Ventilation	Switch Reluctance Motors	Biz - Custom	Health	TOS	per 10HP	38,649	31%	11,826	2.36	0.59	15	\$528	100%	100%	10%	2	43%	1%	63.0%	63.0%	61.1%	8.2
386	Ventilation	Switch Reluctance Motors	Biz - Custom	Lodging	TOS	per 10HP	36,982	31%	11,316	1.34	1.30	15	\$528	100%	100%	10%	2	47%	1%	63.0%	63.0%	61.0%	6.7
387	Ventilation	Switch Reluctance Motors	Biz - Custom	Retail	TOS	per 10HP	46,930	31%	14,361	0.39	3.98	15	\$528	100%	100%	10%	2	26%	1%	63.0%	63.0%	61.4%	5.2
388	Ventilation	Switch Reluctance Motors	Biz - Custom	Office	TOS	per 10HP	23,765	31%	7,272	1.24	0.55	15	\$528	100%	100%	10%	2	32%	1%	63.0%	63.0%	59.9%	7.6
389	Ventilation	Switch Reluctance Motors	Biz - Custom	Warehouse	TOS	per 10HP	45,557	31%	13,940	2.45	1.32	15	\$528	100%	100%	10%	2	0%	1%	63.0%	63.0%	61.4%	7.8
390	Ventilation	Switch Reluctance Motors	Biz - Custom	Other	TOS	per 10HP	41,616	31%	12,734	1.91	1.68	15	\$528	100%	100%	10%	2	43%	1%	63.0%	63.0%	61.2%	7.4
391	Ventilation	Cogged V-Belt (Synchronous)	Biz - Custom	Assembly	TOS	per 5 HP motor	24,122	3%	748	0.09	0.09	15	\$137	100%	55%	40%	3	65%	10%	63.0%	59.0%	61.7%	6.9
392	Ventilation	Cogged V-Belt (Synchronous)	Biz - Custom	Education	TOS	per 5 HP motor	13,404	3%	416	0.09	0.06	15	\$137	100%	30%	67%	3	55%	10%	63.0%	50.8%	57.8%	8.9
393	Ventilation	Cogged V-Belt (Synchronous)	Biz - Custom	Food Sales	TOS	per 5 HP motor	28,483	3%	883	0.09	0.12	15	\$137	100%	65%	29%	3	100%	10%	63.0%	60.4%	57.8%	6.5
394	Ventilation	Cogged V-Belt (Synchronous)	Biz - Custom	Food Service	TOS	per 5 HP motor	24,345	3%	755	0.09	0.10	15	\$137	100%	55%	39%	3	100%	10%	63.0%	59.1%	57.8%	6.9
395	Ventilation	Cogged V-Belt (Synchronous)	Biz - Custom	Health	TOS	per 5 HP motor	19,324	3%	599	0.09	0.07	15	\$137	100%	44%	52%	3	57%	10%	63.0%	56.7%	57.8%	7.4
396	Ventilation	Cogged V-Belt (Synchronous)	Biz - Custom	Lodging	TOS	per 5 HP motor	18,491	3%	573	0.09	0.06	15	\$137	100%	42%	54%	3	53%	10%	63.0%	56.1%	57.8%	7.5
397	Ventilation	Cogged V-Belt (Synchronous)	Biz - Custom	Retail	TOS	per 5 HP motor	23,465	3%	727	0.09	0.09	15	\$137	100%	53%	42%	3	74%	10%	63.0%	58.8%	57.8%	7.0
398	Ventilation	Cogged V-Belt (Synchronous)	Biz - Custom	Office	TOS	per 5 HP motor	11,883	3%	368	0.09	0.04	15	\$137	100%	27%	70%	3	68%	10%	63.0%	48.4%	57.8%	9.4
399	Ventilation	Cogged V-Belt (Synchronous)	Biz - Custom	Warehouse	TOS	per 5 HP motor	22,778	3%	706	0.09	0.08	15	\$137	100%	52%	43%	3	100%	10%	63.0%	58.5%	57.8%	7.0
400	Ventilation	Cogged V-Belt (Synchronous)	Biz - Custom	Other	TOS	per 5 HP motor	20,808	3%	645	0.09	0.08	15	\$137	100%	47%	48%	3	57%	10%	63.0%	57.6%	57.8%	7.3
401	WholeBldg_HVAC	Demand Control Ventilation	Biz - Prescriptive	Assembly	RET	per 1000 sq ft	1,920	3%	398	0.06	0.05	10	\$236	75%	42%	42%	3	100%	10%	74.1%	58.9%	58.7%	2.3
402	WholeBldg_HVAC	Demand Control Ventilation	Biz - Prescriptive	Education	RET	per 1000 sq ft	1,920	3%	377	0.08	0.04	10	\$236	100%	42%	40%	3	100%	10%	84.0%	57.0%	55.3%	2.4
403	WholeBldg_HVAC	Demand Control Ventilation	Biz - Prescriptive	Food Sales	RET	per 1000 sq ft	0	2%	450	0.07	0.05	10	\$236	100%	42%	47%	3	100%	10%	84.0%	62.2%	64.2%	2.5
404	WholeBldg_HVAC	Demand Control Ventilation	Biz - Prescriptive	Food Service	RET	per 1000 sq ft	2,550	1%	626	0.13	0.07	10	\$236	100%	42%	66%	3	100%	10%	84.0%	68.8%	75.6%	4.0
405	WholeBldg_HVAC	Demand Control Ventilation	Biz - Prescriptive	Health	RET	per 1000 sq ft	305	3%	554	0.09	0.05	10	\$236	100%	42%	58%	3	100%	10%	84.0%	66.6%	71.6%	3.1
406	WholeBldg_HVAC	Demand Control Ventilation	Biz - Prescriptive	Lodging	RET	per 1000 sq ft	2,045	3%	937	0.13	0.12	10	\$236	100%	42%	56%	3	100%	10%	84.0%	74.3%	77.0%	5.1
407	WholeBldg_HVAC	Demand Control Ventilation	Biz - Prescriptive	Retail	RET	per 1000 sq ft	1,663	3%	339	0.07	0.04	10	\$236	75%	42%	36%	3	100%	10%	72.1%	53.0%	48.4%	2.2
408	WholeBldg_HVAC	Demand Control Ventilation	Biz - Prescriptive	Office	RET	per 1000 sq ft	1,313	2%	280	0.04	0.03	10	\$236	50%	42%	29%	3	100%	10%	50.9%	44.5%	36.2%	1.5
409	WholeBldg_HVAC	Demand Control Ventilation	Biz - Prescriptive	Warehouse	RET	per 1000 sq ft	0	3%	518	0.08	0.06	10	\$236	100%	42%	55%	3	100%	10%	84.0%	65.3%	69.6%	2.9
410	WholeBldg_HVAC	Demand Control Ventilation	Biz - Prescriptive	Other	RET	per 1000 sq ft	1,925	2%	398	0.06	0.05	10	\$236	75%	42%	42%	3	100%	10%	74.1%	58.9%	58.7%	2.3
411	WholeBldg_HVAC	High Efficiency DOAS	Biz - Custom	Assembly	RET	per sq ft	7	25%	2	0.00	0.00	15	\$15	1%	1%	10%	4	100%	1%	8.8%	8.8%	8.8%	7.5
412	WholeBldg_HVAC	High Efficiency DOAS	Biz - Custom	Education	RET	per sq ft	7	25%	2	0.00	0.00	15	\$15	1%	1%	10%	4	100%	1%	8.8%	8.8%	8.8%	8.5
413	WholeBldg_HVAC	High Efficiency DOAS	Biz - Custom	Food Sales	RET	per sq ft	7	25%	2	0.00	0.00	15	\$15	1%	1%	10%	4	100%	1%	8.8%	8.8%	8.8%	7.4
414	WholeBldg_HVAC	High Efficiency DOAS	Biz - Custom	Food Service	RET	per sq ft	7	25%	2	0.00	0.00	15	\$15	1%	1%	10%	4	100%	1%	8.8%	8.8%	8.8%	8.5
415	WholeBldg_HVAC	High Efficiency DOAS	Biz - Custom	Health	RET	per sq ft	7	25%	2	0.00	0.00	15	\$15	1%	1%	10%	4	100%	1%	8.8%	8.8%	8.8%	7.3
416	WholeBldg_HVAC	High Efficiency DOAS	Biz - Custom	Lodging	RET	per sq ft	7	25%	2	0.00	0.00	15	\$15	1%	1%	10%	4	100%	1%	8.8%	8.8%	8.8%	7.1
417	WholeBldg_HVAC	High Efficiency DOAS	Biz - Custom	Retail	RET	per sq ft	7	25%	2	0.00	0.00	15	\$15	1%	1%	10%	4	100%	1%	8.8%	8.8%	8.8%	8.7
418	WholeBldg																						

Appendix C: C&I Measure Assumptions

Measure #	End-Use	Measure Name	Program	Building Type	Replacement Type (TOS=Time of Sale)	Unit	Base Annual Electric	% Elec Savings	Per Unit Elec Savings	Per Unit Summer kW	Per Unit Winter 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
428	WholeBldg_HVAC	HVAC - Energy Management System	Biz - Custom	Office	RET	per kWh	13	8%	1	0.00	0.00	15	\$0	100%	25%	73%	1	55%	6%	63.0%	46.7%	57.8%	7.3
429	WholeBldg_HVAC	HVAC - Energy Management System	Biz - Custom	Warehouse	RET	per kWh	13	8%	1	0.00	0.00	15	\$0	100%	25%	73%	1	62%	6%	63.0%	46.7%	57.8%	7.3
430	WholeBldg_HVAC	HVAC - Energy Management System	Biz - Custom	Other	RET	per kWh	13	8%	1	0.00	0.00	15	\$0	100%	25%	73%	1	57%	6%	63.0%	46.7%	57.8%	7.5
431	WholeBldg_HVAC	GREM Controls	Biz - Prescriptive	Assembly	RET	er HVAC controll	0	0%	0	0.00	0.00	15	\$0	100%	0%	100%	2	0%	20%	84.0%	84.0%	84.0%	2.0
432	WholeBldg_HVAC	GREM Controls	Biz - Prescriptive	Education	RET	er HVAC controll	0	0%	0	0.00	0.00	15	\$0	100%	0%	100%	2	0%	20%	84.0%	84.0%	84.0%	2.0
433	WholeBldg_HVAC	GREM Controls	Biz - Prescriptive	Food Sales	RET	er HVAC controll	0	0%	0	0.00	0.00	15	\$0	100%	0%	100%	2	0%	20%	84.0%	84.0%	84.0%	2.0
434	WholeBldg_HVAC	GREM Controls	Biz - Prescriptive	Food Service	RET	er HVAC controll	0	0%	0	0.00	0.00	15	\$0	100%	0%	100%	2	0%	20%	84.0%	84.0%	84.0%	2.0
435	WholeBldg_HVAC	GREM Controls	Biz - Prescriptive	Health	RET	er HVAC controll	0	0%	0	0.00	0.00	15	\$0	100%	0%	100%	2	0%	20%	84.0%	84.0%	84.0%	2.0
436	WholeBldg_HVAC	GREM Controls	Biz - Prescriptive	Lodging	RET	er HVAC controll	4,853	19%	936	0.13	0.12	15	\$260	100%	77%	60%	2	75%	20%	84.0%	79.9%	77.0%	3.3
437	WholeBldg_HVAC	GREM Controls	Biz - Prescriptive	Retail	RET	er HVAC controll	0	0%	0	0.00	0.00	15	\$0	100%	0%	100%	2	0%	20%	84.0%	84.0%	84.0%	2.0
438	WholeBldg_HVAC	GREM Controls	Biz - Prescriptive	Office	RET	er HVAC controll	0	0%	0	0.00	0.00	15	\$0	100%	0%	100%	2	0%	20%	84.0%	84.0%	84.0%	2.0
439	WholeBldg_HVAC	GREM Controls	Biz - Prescriptive	Warehouse	RET	er HVAC controll	0	0%	0	0.00	0.00	15	\$0	100%	0%	100%	2	0%	20%	84.0%	84.0%	84.0%	2.0
440	WholeBldg_HVAC	GREM Controls	Biz - Prescriptive	Other	RET	er HVAC controll	0	0%	0	0.00	0.00	15	\$0	100%	0%	100%	2	0%	20%	84.0%	84.0%	84.0%	2.0
441	WholeBldg_HVAC	Retro-commissioning_Bld Optimization	Biz - CustomRCx	Assembly	RET	per kWh	13	8%	1	0.00	0.00	5	\$0	100%	83%	10%	6	100%	15%	63.0%	62.0%	57.8%	3.4
442	WholeBldg_HVAC	Retro-commissioning_Bld Optimization	Biz - CustomRCx	Education	RET	per kWh	13	8%	1	0.00	0.00	5	\$0	100%	83%	10%	6	100%	15%	63.0%	62.0%	57.8%	3.8
443	WholeBldg_HVAC	Retro-commissioning_Bld Optimization	Biz - CustomRCx	Food Sales	RET	per kWh	13	8%	1	0.00	0.00	5	\$0	100%	83%	10%	6	100%	15%	63.0%	62.0%	57.8%	3.3
444	WholeBldg_HVAC	Retro-commissioning_Bld Optimization	Biz - CustomRCx	Food Service	RET	per kWh	13	8%	1	0.00	0.00	5	\$0	100%	83%	10%	6	100%	15%	63.0%	62.0%	57.8%	3.8
445	WholeBldg_HVAC	Retro-commissioning_Bld Optimization	Biz - CustomRCx	Health	RET	per kWh	13	8%	1	0.00	0.00	5	\$0	100%	83%	10%	6	100%	15%	63.0%	62.0%	57.8%	3.3
446	WholeBldg_HVAC	Retro-commissioning_Bld Optimization	Biz - CustomRCx	Lodging	RET	per kWh	13	8%	1	0.00	0.00	5	\$0	100%	83%	10%	6	100%	15%	63.0%	62.0%	57.8%	3.2
447	WholeBldg_HVAC	Retro-commissioning_Bld Optimization	Biz - CustomRCx	Retail	RET	per kWh	13	8%	1	0.00	0.00	5	\$0	100%	83%	10%	6	100%	15%	63.0%	62.0%	57.8%	3.8
448	WholeBldg_HVAC	Retro-commissioning_Bld Optimization	Biz - CustomRCx	Office	RET	per kWh	13	8%	1	0.00	0.00	5	\$0	100%	83%	10%	6	100%	15%	63.0%	62.0%	57.8%	3.3
449	WholeBldg_HVAC	Retro-commissioning_Bld Optimization	Biz - CustomRCx	Warehouse	RET	per kWh	13	8%	1	0.00	0.00	5	\$0	100%	83%	10%	6	100%	15%	63.0%	62.0%	57.8%	3.3
450	WholeBldg_HVAC	Retro-commissioning_Bld Optimization	Biz - CustomRCx	Other	RET	per kWh	13	8%	1	0.00	0.00	5	\$0	100%	83%	10%	6	100%	15%	63.0%	62.0%	57.8%	3.3
451	WholeBldg_HVAC	Commercial Weatherstripping	Biz - Custom	Assembly	RET	per linear ft	556	2%	11	0.00	0.00	10	\$8	75%	14%	35%	5	100%	25%	53.7%	40.0%	40.0%	5.7
452	WholeBldg_HVAC	Commercial Weatherstripping	Biz - Custom	Education	RET	per linear ft	699	2%	14	0.00	0.00	10	\$8	100%	17%	43%	5	100%	25%	63.0%	40.0%	45.4%	6.4
453	WholeBldg_HVAC	Commercial Weatherstripping	Biz - Custom	Food Sales	RET	per linear ft	970	2%	19	0.00	0.00	10	\$8	100%	24%	60%	5	100%	25%	63.0%	46.0%	54.6%	5.6
454	WholeBldg_HVAC	Commercial Weatherstripping	Biz - Custom	Food Service	RET	per linear ft	308	2%	6	0.00	0.00	10	\$8	8%	8%	19%	5	100%	25%	33.5%	33.5%	35.2%	6.4
455	WholeBldg_HVAC	Commercial Weatherstripping	Biz - Custom	Health	RET	per linear ft	916	2%	18	0.00	0.00	10	\$8	100%	23%	57%	5	100%	25%	63.0%	44.5%	53.2%	5.6
456	WholeBldg_HVAC	Commercial Weatherstripping	Biz - Custom	Lodging	RET	per linear ft	1,021	2%	20	0.00	0.00	10	\$8	100%	26%	63%	5	100%	25%	63.0%	47.2%	55.8%	5.4
457	WholeBldg_HVAC	Commercial Weatherstripping	Biz - Custom	Retail	RET	per linear ft	889	2%	18	0.00	0.00	10	\$8	100%	22%	55%	5	100%	25%	63.0%	43.5%	52.4%	6.5
458	WholeBldg_HVAC	Commercial Weatherstripping	Biz - Custom	Office	RET	per linear ft	696	2%	14	0.00	0.00	10	\$8	75%	17%	43%	5	100%	25%	55.8%	40.0%	45.2%	5.5
459	WholeBldg_HVAC	Commercial Weatherstripping	Biz - Custom	Warehouse	RET	per linear ft	765	2%	15	0.00	0.00	10	\$8	100%	19%	48%	5	100%	25%	63.0%	40.0%	48.2%	5.5
460	WholeBldg_HVAC	Commercial Weatherstripping	Biz - Custom	Other	RET	per linear ft	674	2%	13	0.00	0.00	10	\$8	75%	17%	42%	5	100%	25%	55.5%	40.0%	43.8%	5.7
461	Hot Water	Heat Pump Water Heater	Biz - Prescriptive	Assembly	TOS	per 100 gal cap	10,591	73%	7,766	1.11	1.55	15	\$1,797	100%	28%	52%	1	100%	0%	84.0%	72.6%	77.0%	11.7
462	Hot Water	Heat Pump Water Heater	Biz - Prescriptive	Education	TOS	per 100 gal cap	17,641	73%	12,936	1.85	2.58	15	\$1,797	100%	28%	21%	1	100%	9%	84.0%	77.6%	77.0%	19.5
463	Hot Water	Heat Pump Water Heater	Biz - Prescriptive	Food Sales	TOS	per 100 gal cap	16,398	73%	12,025	1.72	1.87	15	\$1,797	100%	28%	26%	1	100%	0%	84.0%	77.1%	77.0%	17.9
464	Hot Water	Heat Pump Water Heater	Biz - Prescriptive	Food Service	TOS	per 100 gal cap	19,318	73%	14,166	2.03	2.20	15	\$1,797	100%	28%	13%	1	100%	17%	84.0%	78.2%	77.0%	21.1
465	Hot Water	Heat Pump Water Heater	Biz - Prescriptive	Health	TOS	per 100 gal cap	24,473	73%	17,947	2.57	1.96	15	\$1,797	100%	28%	10%	1	100%	25%	84.0%	79.4%	78.3%	26.1
466	Hot Water	Heat Pump Water Heater	Biz - Prescriptive	Lodging	TOS	per 100 gal cap	22,206	73%	16,284	2.33	3.15	15	\$1,797	100%	28%	10%	1	100%	23%	84.0%	78.9%	77.7%	23.9
467	Hot Water	Heat Pump Water Heater	Biz - Prescriptive	Retail	TOS	per 100 gal cap	16,398	73%	12,025	1.72	1.05	15	\$1,797	100%	28%	26%	1	100%	9%	84.0%	77.1%	77.0%	17.4
468	Hot Water	Heat Pump Water Heater	Biz - Prescriptive	Office	TOS	per 100 gal cap	15,870	73%	11,638	1.67	1.81	15	\$1,797	100%	28%	29%	1	100%	9%	84.0%	76.9%	77.0%	17.3
469	Hot Water	Heat Pump Water Heater	Biz - Prescriptive	Warehouse	TOS	per 100 gal cap	10,591	73%	7,766	1.11	1.20	15	\$1,797	100%	28%	52%	1	100%	0%	84.0%	72.6%	77.0%	11.6
470	Hot Water	Heat Pump Water Heater	Biz - Prescriptive	Other	TOS	per 100 gal cap	17,237	73%	12,640	1.81	1.96	15	\$1,797	100%	28%	23%	1	100%	14%	84.0%	77.5%	77.0%	18.8
471	Hot Water	Low Flow Faucet Aerator	Biz - Custom	Assembly	RET	per unit	502	25%	128	0.04	0.03	10	\$8	100%	100%	10%	2	15%	85%	89.5%	88.0%	88.0%	8.1
472	Hot Water	Low Flow Faucet Aerator	Biz - Custom	Education	RET	per unit	602	25%	153	0.06	0.03	10	\$8	100%	100%	10%	2	15%	85%	89.5%	88.0%	88.0%	9.2
473	Hot Water	Low Flow Faucet Aerator	Biz - Custom	Food Sales	RET	per unit	366	25%	93	0.01	0.01	10	\$8	100%	100%	10%	2	15%	85%	89.5%	88.0%	88.0%	5.7
474	Hot Water	Low Flow Faucet Aerator	Biz - Custom	Food Service	RET	per unit	1,273	16%	209	0.03	0.03	10	\$8	100%	100%	10%	2	15%	85%	89.5%	88.0%	88.0%	5.4
475	Hot Water	Low Flow Faucet Aerator	Biz - Custom	Health	RET	per unit	1,649	25%	420	0.05	0.05	10	\$14	100%	100%	10%	2	15%	85%	89.5%	88.0%	88.0%	5.0
476	Hot Water	Low Flow Faucet Aerator	Biz - Custom	Lodging	RET	per unit	156	25%	40	0.00	0.01	10	\$8	100%	50%	45%	2	15%	85%	89.5%	88.0%	88.0%	4.1
477	Hot Water	Low Flow Faucet Aerator	Biz - Custom	Retail	RET	per unit	367	25%	94	0.01	0.01	10	\$8	100%	100%	10%	2	15%	85%	89.5%	88.0%	88.0%	5.5
478	Hot Water	Low Flow Faucet Aerator	Biz - Custom	Office	RET	per unit	544	25%	139	0.04	0.02	10	\$8	100%	100%	10%	2	15%	85%	89.5%	88.0%	88.0%	7.9
479	Hot Water	Low Flow Faucet Aerator	Biz - Custom	Warehouse	RET	per unit	251	25%	64	0.02	0.01	10	\$8	100%	80%	12%	2	15%	85%	89.5%	88.0%	88.0%	8.2
480	Hot Water	Low Flow Faucet Aerator	Biz - Custom	Other	RET	per unit	502	25%	128	0.04	0.02	10	\$8	100%	100%	10%	2	15%	85%	89.5%	88.0%	88.0%	8.1
481	Hot Water	Pre-Rinse Spray Valves - DI	Biz - Custom	Assembly	RET	per unit	18,059	54%	9,789	0.00	1.95	5	\$54	100%	100%	10%	3	15%	72%	80.4%	77.6%	77.6%	2.3
482	Hot Water	Pre-Rinse Spray Valves - DI	Biz - Custom	Education	RET	per unit	18,059	54%	9,789	0.00	1.95	5	\$54	100%	100%	10%	3	15%	72%	80.4%	77.6%	77.6%	2.3
483	Hot Water	Pre-Rinse Spray Valves - DI	Biz - Custom	Food Sales	RET	per unit	18,059	54%	9,789	0.00	1.52	5	\$54	100%	100%	10%	3	20%	72%	80.4%	77.6%	77.6%	2.3
484	Hot Water	Pre-Rinse Spray Valves - DI	Biz - Custom	Food Service	RET	per unit	18,059	54%	9,789	0.00	1.52	5	\$54	100%	100%	10%	3	20%	72%	80.4%	77.6%	77.6%	2.3
485	Hot Water	Pre-Rinse Spray Valves - DI	Biz - Custom	Health	RET	per unit	18,059	54%	9,789	0.00	1.07	5	\$54	100%	100%	10%	3	20%	72%	80.4%	77.6%	77.6%	2.2
486	Hot Water	Pre-Rinse Spray Valves - DI	Biz - Custom	Lodging	RET	per unit	18,059	54%	9,789	0.00	1.89	5	\$54	100%	100%	10%	3	15%	72%	80.4%	77.6%	77.6%	2.2
487	Hot Water	Pre-Rinse Spray Valves - DI	Biz - Custom	Retail	RET	per unit	18,059	54%	9,789	0.00	0.85	5	\$54	100%	100%	10%	3	15%	72%	80.4%	77.6%	77.6%	2.1
488	Hot Water	Pre-Rinse Spray Valves - DI	Biz - Custom	Office	RET	per unit	18,059	54%	9,789	0.00	1.52	5	\$54	100%	100%	10%	3	15%	72%	80.4%	77.6%	77.6%	2.3
489	Hot Water	Pre-Rinse Spray Valves - DI	Biz - Custom	Warehouse	RET	per unit	18,059	54%	9,789	0.00	1.52	5	\$54	100%	100%	10%	3	15%	72%	80.4%	77.6%	77.6%	2.3
490	Hot Water	Pre-Rinse Spray Valves - DI	Biz - Custom	Other	RET	per unit	18,059	54%	9,789	0.0													

Appendix C: C&I Measure Assumptions

Measure #	End-Use	Measure Name	Program	Building Type	Replacement Type (TOS=Time of Sale)	Unit	Base Annual Electric	% Elec Savings	Per Unit Elec Savings	Per Unit Summer kW	Per Unit Winter 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
499	Lighting_Ext	Ext LED Replacing 100W MH (24/7)	Biz - Prescriptive	Warehouse	RET	per unit	996	76%	755	0.09	0.09	10	\$97	100%	52%	14%	1	13%	60%	88.2%	86.2%	84.7%	7.5
500	Lighting_Ext	Ext LED Replacing 100W MH (24/7)	Biz - Prescriptive	Other	RET	per unit	996	76%	755	0.09	0.09	10	\$97	100%	52%	14%	1	13%	60%	88.2%	86.2%	84.7%	7.5
501	Lighting_Ext	Ext LED Replacing 175W MH (24/7)	Biz - Prescriptive	Assembly	RET	per unit	1,744	71%	1,239	0.14	0.15	10	\$124	100%	100%	10%	2	13%	60%	88.2%	88.2%	85.3%	4.9
502	Lighting_Ext	Ext LED Replacing 175W MH (24/7)	Biz - Prescriptive	Education	RET	per unit	1,744	71%	1,239	0.14	0.15	10	\$124	100%	100%	10%	2	13%	60%	88.2%	88.2%	85.3%	4.9
503	Lighting_Ext	Ext LED Replacing 175W MH (24/7)	Biz - Prescriptive	Food Sales	RET	per unit	1,744	71%	1,239	0.14	0.16	10	\$124	100%	100%	10%	2	13%	60%	88.2%	88.2%	85.3%	4.9
504	Lighting_Ext	Ext LED Replacing 175W MH (24/7)	Biz - Prescriptive	Food Service	RET	per unit	1,744	71%	1,239	0.14	0.15	10	\$124	100%	100%	10%	2	13%	60%	88.2%	88.2%	85.3%	4.9
505	Lighting_Ext	Ext LED Replacing 175W MH (24/7)	Biz - Prescriptive	Health	RET	per unit	1,744	71%	1,239	0.14	0.15	10	\$124	100%	100%	10%	2	13%	60%	88.2%	88.2%	85.3%	4.9
506	Lighting_Ext	Ext LED Replacing 175W MH (24/7)	Biz - Prescriptive	Lodging	RET	per unit	1,744	71%	1,239	0.14	0.14	10	\$124	100%	100%	10%	2	13%	60%	88.2%	88.2%	85.3%	4.9
507	Lighting_Ext	Ext LED Replacing 175W MH (24/7)	Biz - Prescriptive	Retail	RET	per unit	1,744	71%	1,239	0.14	0.15	10	\$124	100%	100%	10%	2	13%	60%	88.2%	88.2%	85.3%	4.9
508	Lighting_Ext	Ext LED Replacing 175W MH (24/7)	Biz - Prescriptive	Office	RET	per unit	1,744	71%	1,239	0.14	0.15	10	\$124	100%	100%	10%	2	13%	60%	88.2%	88.2%	85.3%	4.9
509	Lighting_Ext	Ext LED Replacing 175W MH (24/7)	Biz - Prescriptive	Warehouse	RET	per unit	1,744	71%	1,239	0.14	0.15	10	\$124	100%	100%	10%	2	13%	60%	88.2%	88.2%	85.3%	4.9
510	Lighting_Ext	Ext LED Replacing 175W MH (24/7)	Biz - Prescriptive	Other	RET	per unit	1,744	71%	1,239	0.14	0.15	10	\$124	100%	100%	10%	2	13%	60%	88.2%	88.2%	85.3%	4.9
511	Lighting_Ext	Ext LED Replacing 250W MH (24/7)	Biz - Prescriptive	Assembly	RET	per unit	2,490	67%	1,659	0.19	0.19	10	\$134	100%	93%	10%	3	13%	60%	88.2%	88.0%	85.9%	6.6
512	Lighting_Ext	Ext LED Replacing 250W MH (24/7)	Biz - Prescriptive	Education	RET	per unit	2,490	67%	1,659	0.19	0.19	10	\$134	100%	93%	10%	3	13%	60%	88.2%	88.0%	85.9%	6.6
513	Lighting_Ext	Ext LED Replacing 250W MH (24/7)	Biz - Prescriptive	Food Sales	RET	per unit	2,490	67%	1,659	0.19	0.21	10	\$134	100%	93%	10%	3	13%	60%	88.2%	88.0%	85.9%	6.6
514	Lighting_Ext	Ext LED Replacing 250W MH (24/7)	Biz - Prescriptive	Food Service	RET	per unit	2,490	67%	1,659	0.19	0.20	10	\$134	100%	93%	10%	3	13%	60%	88.2%	88.0%	85.9%	6.6
515	Lighting_Ext	Ext LED Replacing 250W MH (24/7)	Biz - Prescriptive	Health	RET	per unit	2,490	67%	1,659	0.19	0.20	10	\$134	100%	93%	10%	3	13%	60%	88.2%	88.0%	85.9%	6.6
516	Lighting_Ext	Ext LED Replacing 250W MH (24/7)	Biz - Prescriptive	Lodging	RET	per unit	2,490	67%	1,659	0.19	0.19	10	\$134	100%	93%	10%	3	13%	60%	88.2%	88.0%	85.9%	6.6
517	Lighting_Ext	Ext LED Replacing 250W MH (24/7)	Biz - Prescriptive	Retail	RET	per unit	2,490	67%	1,659	0.19	0.20	10	\$134	100%	93%	10%	3	13%	60%	88.2%	88.0%	85.9%	6.6
518	Lighting_Ext	Ext LED Replacing 250W MH (24/7)	Biz - Prescriptive	Office	RET	per unit	2,490	67%	1,659	0.19	0.19	10	\$134	100%	93%	10%	3	13%	60%	88.2%	88.0%	85.9%	6.6
519	Lighting_Ext	Ext LED Replacing 250W MH (24/7)	Biz - Prescriptive	Warehouse	RET	per unit	2,490	67%	1,659	0.19	0.20	10	\$134	100%	93%	10%	3	13%	60%	88.2%	88.0%	85.9%	6.6
520	Lighting_Ext	Ext LED Replacing 250W MH (24/7)	Biz - Prescriptive	Other	RET	per unit	2,490	67%	1,659	0.19	0.19	10	\$134	100%	93%	10%	3	13%	60%	88.2%	88.0%	85.9%	6.6
521	Lighting_Ext	Ext LED Replacing 400W MH (24/7)	Biz - Prescriptive	Assembly	RET	per unit	3,984	65%	2,570	0.29	0.30	10	\$196	100%	89%	10%	4	13%	60%	88.2%	87.9%	86.0%	7.3
522	Lighting_Ext	Ext LED Replacing 400W MH (24/7)	Biz - Prescriptive	Education	RET	per unit	3,984	65%	2,570	0.29	0.30	10	\$196	100%	89%	10%	4	13%	60%	88.2%	87.9%	86.0%	7.3
523	Lighting_Ext	Ext LED Replacing 400W MH (24/7)	Biz - Prescriptive	Food Sales	RET	per unit	3,984	65%	2,570	0.29	0.33	10	\$196	100%	89%	10%	4	13%	60%	88.2%	87.9%	86.0%	7.3
524	Lighting_Ext	Ext LED Replacing 400W MH (24/7)	Biz - Prescriptive	Food Service	RET	per unit	3,984	65%	2,570	0.29	0.30	10	\$196	100%	89%	10%	4	13%	60%	88.2%	87.9%	86.0%	7.3
525	Lighting_Ext	Ext LED Replacing 400W MH (24/7)	Biz - Prescriptive	Health	RET	per unit	3,984	65%	2,570	0.29	0.30	10	\$196	100%	89%	10%	4	13%	60%	88.2%	87.9%	86.0%	7.3
526	Lighting_Ext	Ext LED Replacing 400W MH (24/7)	Biz - Prescriptive	Lodging	RET	per unit	3,984	65%	2,570	0.29	0.30	10	\$196	100%	89%	10%	4	13%	60%	88.2%	87.9%	86.0%	7.3
527	Lighting_Ext	Ext LED Replacing 400W MH (24/7)	Biz - Prescriptive	Retail	RET	per unit	3,984	65%	2,570	0.29	0.30	10	\$196	100%	89%	10%	4	13%	60%	88.2%	87.9%	86.0%	7.3
528	Lighting_Ext	Ext LED Replacing 400W MH (24/7)	Biz - Prescriptive	Office	RET	per unit	3,984	65%	2,570	0.29	0.30	10	\$196	100%	89%	10%	4	13%	60%	88.2%	87.9%	86.0%	7.3
529	Lighting_Ext	Ext LED Replacing 400W MH (24/7)	Biz - Prescriptive	Warehouse	RET	per unit	3,984	65%	2,570	0.29	0.30	10	\$196	100%	89%	10%	4	13%	60%	88.2%	87.9%	86.0%	7.3
530	Lighting_Ext	Ext LED Replacing 400W MH (24/7)	Biz - Prescriptive	Other	RET	per unit	3,984	65%	2,570	0.29	0.30	10	\$196	100%	89%	10%	4	13%	60%	88.2%	87.9%	86.0%	7.3
531	Lighting_Ext	Ext LED Replacing 1000W MH (24/7)	Biz - Prescriptive	Assembly	RET	per unit	9,467	70%	6,666	0.76	0.78	10	\$319	100%	78%	10%	5	13%	60%	88.2%	87.9%	86.8%	13.2
532	Lighting_Ext	Ext LED Replacing 1000W MH (24/7)	Biz - Prescriptive	Education	RET	per unit	9,467	70%	6,666	0.76	0.78	10	\$319	100%	78%	10%	5	13%	60%	88.2%	87.9%	86.8%	13.2
533	Lighting_Ext	Ext LED Replacing 1000W MH (24/7)	Biz - Prescriptive	Food Sales	RET	per unit	9,467	70%	6,666	0.76	0.84	10	\$319	100%	78%	10%	5	13%	60%	88.2%	87.9%	86.8%	13.3
534	Lighting_Ext	Ext LED Replacing 1000W MH (24/7)	Biz - Prescriptive	Food Service	RET	per unit	9,467	70%	6,666	0.76	0.79	10	\$319	100%	78%	10%	5	13%	60%	88.2%	87.9%	86.8%	13.2
535	Lighting_Ext	Ext LED Replacing 1000W MH (24/7)	Biz - Prescriptive	Health	RET	per unit	9,467	70%	6,666	0.76	0.79	10	\$319	100%	78%	10%	5	13%	60%	88.2%	87.9%	86.8%	13.2
536	Lighting_Ext	Ext LED Replacing 1000W MH (24/7)	Biz - Prescriptive	Lodging	RET	per unit	9,467	70%	6,666	0.76	0.78	10	\$319	100%	78%	10%	5	13%	60%	88.2%	87.9%	86.8%	13.2
537	Lighting_Ext	Ext LED Replacing 1000W MH (24/7)	Biz - Prescriptive	Retail	RET	per unit	9,467	70%	6,666	0.76	0.78	10	\$319	100%	78%	10%	5	13%	60%	88.2%	87.9%	86.8%	13.2
538	Lighting_Ext	Ext LED Replacing 1000W MH (24/7)	Biz - Prescriptive	Office	RET	per unit	9,467	70%	6,666	0.76	0.78	10	\$319	100%	78%	10%	5	13%	60%	88.2%	87.9%	86.8%	13.2
539	Lighting_Ext	Ext LED Replacing 1000W MH (24/7)	Biz - Prescriptive	Warehouse	RET	per unit	9,467	70%	6,666	0.76	0.78	10	\$319	100%	78%	10%	5	13%	60%	88.2%	87.9%	86.8%	13.2
540	Lighting_Ext	Ext LED Replacing 1000W MH (24/7)	Biz - Prescriptive	Other	RET	per unit	9,467	70%	6,666	0.76	0.78	10	\$319	100%	78%	10%	5	13%	60%	88.2%	87.9%	86.8%	13.2
541	Lighting_Ext	Ext LED Replacing 100W MH (D2D)	Biz - Prescriptive	Assembly	RET	per unit	489	76%	370	0.00	0.04	16	\$97	100%	52%	58%	6	7%	60%	88.2%	84.0%	84.7%	3.3
542	Lighting_Ext	Ext LED Replacing 100W MH (D2D)	Biz - Prescriptive	Education	RET	per unit	489	76%	370	0.00	0.04	16	\$97	100%	52%	58%	6	7%	60%	88.2%	84.0%	84.7%	3.3
543	Lighting_Ext	Ext LED Replacing 100W MH (D2D)	Biz - Prescriptive	Food Sales	RET	per unit	489	76%	370	0.00	0.05	16	\$97	100%	52%	58%	6	7%	60%	88.2%	84.0%	84.7%	3.3
544	Lighting_Ext	Ext LED Replacing 100W MH (D2D)	Biz - Prescriptive	Food Service	RET	per unit	489	76%	370	0.00	0.04	16	\$97	100%	52%	58%	6	7%	60%	88.2%	84.0%	84.7%	3.3
545	Lighting_Ext	Ext LED Replacing 100W MH (D2D)	Biz - Prescriptive	Health	RET	per unit	489	76%	370	0.00	0.04	16	\$97	100%	52%	58%	6	7%	60%	88.2%	84.0%	84.7%	3.3
546	Lighting_Ext	Ext LED Replacing 100W MH (D2D)	Biz - Prescriptive	Lodging	RET	per unit	489	76%	370	0.00	0.04	16	\$97	100%	52%	58%	6	7%	60%	88.2%	84.0%	84.7%	3.3
547	Lighting_Ext	Ext LED Replacing 100W MH (D2D)	Biz - Prescriptive	Retail	RET	per unit	489	76%	370	0.00	0.04	16	\$97	100%	52%	58%	6	7%	60%	88.2%	84.0%	84.7%	3.3
548	Lighting_Ext	Ext LED Replacing 100W MH (D2D)	Biz - Prescriptive	Office	RET	per unit	489	76%	370	0.00	0.04	16	\$97	100%	52%	58%	6	7%	60%	88.2%	84.0%	84.7%	3.3
549	Lighting_Ext	Ext LED Replacing 100W MH (D2D)	Biz - Prescriptive	Warehouse	RET	per unit	489	76%	370	0.00	0.04	16	\$97	100%	52%	58%	6	7%	60%	88.2%	84.0%	84.7%	3.3
550	Lighting_Ext	Ext LED Replacing 100W MH (D2D)	Biz - Prescriptive	Other	RET	per unit	489	76%	370	0.00	0.04	16	\$97	100%	52%	58%	6	7%	60%	88.2%	84.0%	84.7%	3.3
551	Lighting_Ext	Ext LED Replacing 175W MH (D2D)	Biz - Prescriptive	Assembly	RET	per unit	856	71%	608	0.00	0.07	16	\$124	100%	100%	46%	7	7%	60%	88.2%	88.2%	84.7%	2.2
552	Lighting_Ext	Ext LED Replacing 175W MH (D2D)	Biz - Prescriptive	Education	RET	per unit	856	71%	608	0.00	0.07	16	\$124	100%	100%	46%	7	7%	60%	88.2%	88.2%	84.7%	2.2
553	Lighting_Ext	Ext LED Replacing 175W MH (D2D)	Biz - Prescriptive	Food Sales	RET	per unit	856	71%	608	0.00	0.08	16	\$124	100%	100%	46%	7	7%	60%	88.2%	88.2%	84.7%	2.2
554	Lighting_Ext	Ext LED Replacing 175W MH (D2D)	Biz - Prescriptive	Food Service	RET	per unit	856	71%	608	0.00	0.07	16	\$124	100%	100%	46%	7	7%	60%	88.2%	88.2%	84.7%	2.2
555	Lighting_Ext	Ext LED Replacing 175W MH (D2D)	Biz - Prescriptive	Health	RET	per unit	856	71%	608	0.00	0.07	16	\$124	100%	100%	46%	7	7%	60%	88.2%	88.2%	84.7%	2.2
556	Lighting_Ext	Ext LED Replacing 175W MH (D2D)	Biz - Prescriptive	Lodging	RET	per unit	856	71%	608	0.00	0.07	16	\$124	100%	100%	46%	7	7%	60%	88.2%	88.2%	84.7%	2.2
557	Lighting_Ext	Ext LED Replacing 175W MH (D2D)	Biz - Prescriptive	Retail	RET	per unit	856	71%	608	0.00	0.07	16	\$124	100%	100%	46%	7	7%	60%				

Appendix C: C&I Measure Assumptions

Measure #	End-Use	Measure Name	Program	Building Type	Replacement Type (TOS=Time of Sale)	Unit	Base Annual Electric	% Elec Savings	Per Unit Elec Savings	Per Unit Summer kW	Per Unit Winter 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	Lighting_Ext	Ext LED Replacing 250W MH (D2D)	Biz - Prescriptive	Other	RET	per unit	1,222	67%	814	0.00	0.10	16	\$134	100%	93%	33%	8	7%	60%	88.2%	87.8%	84.7%	2.9
571	Lighting_Ext	Ext LED Replacing 400W MH (D2D)	Biz - Prescriptive	Assembly	RET	per unit	1,956	65%	1,262	0.00	0.15	16	\$196	100%	89%	29%	9	7%	60%	88.2%	87.7%	84.7%	3.2
572	Lighting_Ext	Ext LED Replacing 400W MH (D2D)	Biz - Prescriptive	Education	RET	per unit	1,956	65%	1,262	0.00	0.15	16	\$196	100%	89%	29%	9	7%	60%	88.2%	87.7%	84.7%	3.2
573	Lighting_Ext	Ext LED Replacing 400W MH (D2D)	Biz - Prescriptive	Food Sales	RET	per unit	1,956	65%	1,262	0.00	0.16	16	\$196	100%	89%	29%	9	7%	60%	88.2%	87.7%	84.7%	3.2
574	Lighting_Ext	Ext LED Replacing 400W MH (D2D)	Biz - Prescriptive	Food Service	RET	per unit	1,956	65%	1,262	0.00	0.15	16	\$196	100%	89%	29%	9	7%	60%	88.2%	87.7%	84.7%	3.2
575	Lighting_Ext	Ext LED Replacing 400W MH (D2D)	Biz - Prescriptive	Health	RET	per unit	1,956	65%	1,262	0.00	0.15	16	\$196	100%	89%	29%	9	7%	60%	88.2%	87.7%	84.7%	3.2
576	Lighting_Ext	Ext LED Replacing 400W MH (D2D)	Biz - Prescriptive	Lodging	RET	per unit	1,956	65%	1,262	0.00	0.15	16	\$196	100%	89%	29%	9	7%	60%	88.2%	87.7%	84.7%	3.2
577	Lighting_Ext	Ext LED Replacing 400W MH (D2D)	Biz - Prescriptive	Retail	RET	per unit	1,956	65%	1,262	0.00	0.15	16	\$196	100%	89%	29%	9	7%	60%	88.2%	87.7%	84.7%	3.2
578	Lighting_Ext	Ext LED Replacing 400W MH (D2D)	Biz - Prescriptive	Office	RET	per unit	1,956	65%	1,262	0.00	0.15	16	\$196	100%	89%	29%	9	7%	60%	88.2%	87.7%	84.7%	3.2
579	Lighting_Ext	Ext LED Replacing 400W MH (D2D)	Biz - Prescriptive	Warehouse	RET	per unit	1,956	65%	1,262	0.00	0.15	16	\$196	100%	89%	29%	9	7%	60%	88.2%	87.7%	84.7%	3.2
580	Lighting_Ext	Ext LED Replacing 400W MH (D2D)	Biz - Prescriptive	Other	RET	per unit	1,956	65%	1,262	0.00	0.15	16	\$196	100%	89%	29%	9	7%	60%	88.2%	87.7%	84.7%	3.2
581	Lighting_Ext	Ext LED Replacing 1000W MH (D2D)	Biz - Prescriptive	Assembly	RET	per unit	4,647	70%	3,272	0.00	0.38	16	\$319	100%	78%	10%	10	7%	60%	88.2%	87.5%	85.4%	5.8
582	Lighting_Ext	Ext LED Replacing 1000W MH (D2D)	Biz - Prescriptive	Education	RET	per unit	4,647	70%	3,272	0.00	0.38	16	\$319	100%	78%	10%	10	7%	60%	88.2%	87.5%	85.4%	5.8
583	Lighting_Ext	Ext LED Replacing 1000W MH (D2D)	Biz - Prescriptive	Food Sales	RET	per unit	4,647	70%	3,272	0.00	0.41	16	\$319	100%	78%	10%	10	7%	60%	88.2%	87.5%	85.4%	5.9
584	Lighting_Ext	Ext LED Replacing 1000W MH (D2D)	Biz - Prescriptive	Food Service	RET	per unit	4,647	70%	3,272	0.00	0.39	16	\$319	100%	78%	10%	10	7%	60%	88.2%	87.5%	85.4%	5.8
585	Lighting_Ext	Ext LED Replacing 1000W MH (D2D)	Biz - Prescriptive	Health	RET	per unit	4,647	70%	3,272	0.00	0.39	16	\$319	100%	78%	10%	10	7%	60%	88.2%	87.5%	85.4%	5.8
586	Lighting_Ext	Ext LED Replacing 1000W MH (D2D)	Biz - Prescriptive	Lodging	RET	per unit	4,647	70%	3,272	0.00	0.38	16	\$319	100%	78%	10%	10	7%	60%	88.2%	87.5%	85.4%	5.8
587	Lighting_Ext	Ext LED Replacing 1000W MH (D2D)	Biz - Prescriptive	Retail	RET	per unit	4,647	70%	3,272	0.00	0.38	16	\$319	100%	78%	10%	10	7%	60%	88.2%	87.5%	85.4%	5.8
588	Lighting_Ext	Ext LED Replacing 1000W MH (D2D)	Biz - Prescriptive	Office	RET	per unit	4,647	70%	3,272	0.00	0.38	16	\$319	100%	78%	10%	10	7%	60%	88.2%	87.5%	85.4%	5.8
589	Lighting_Ext	Ext LED Replacing 1000W MH (D2D)	Biz - Prescriptive	Warehouse	RET	per unit	4,647	70%	3,272	0.00	0.39	16	\$319	100%	78%	10%	10	7%	60%	88.2%	87.5%	85.4%	5.8
590	Lighting_Ext	Ext LED Replacing 1000W MH (D2D)	Biz - Prescriptive	Other	RET	per unit	4,647	70%	3,272	0.00	0.38	16	\$319	100%	78%	10%	10	7%	60%	88.2%	87.5%	85.4%	5.8
591	Lighting_Int	LED Interior Direction (Track lighting / Wall-Wash Fixture)	Biz - Prescriptive	Assembly	RET	per unit	126	74%	93	0.02	0.01	15	\$59	100%	17%	51%	1	19%	60%	88.2%	68.0%	75.9%	8.4
592	Lighting_Int	LED Interior Direction (Track lighting / Wall-Wash Fixture)	Biz - Prescriptive	Education	RET	per unit	127	74%	94	0.03	0.01	15	\$59	100%	17%	51%	1	11%	60%	88.2%	68.0%	76.1%	9.4
593	Lighting_Int	LED Interior Direction (Track lighting / Wall-Wash Fixture)	Biz - Prescriptive	Food Sales	RET	per unit	220	74%	162	0.03	0.02	12	\$59	100%	17%	70%	1	8%	60%	88.2%	76.2%	84.7%	10.9
594	Lighting_Int	LED Interior Direction (Track lighting / Wall-Wash Fixture)	Biz - Prescriptive	Food Service	RET	per unit	230	74%	170	0.03	0.02	12	\$59	100%	17%	68%	1	5%	60%	88.2%	76.8%	84.7%	11.8
595	Lighting_Int	LED Interior Direction (Track lighting / Wall-Wash Fixture)	Biz - Prescriptive	Health	RET	per unit	251	74%	185	0.02	0.02	12	\$59	100%	17%	65%	1	16%	60%	88.2%	77.9%	84.7%	10.8
596	Lighting_Int	LED Interior Direction (Track lighting / Wall-Wash Fixture)	Biz - Prescriptive	Lodging	RET	per unit	178	74%	131	0.02	0.02	15	\$59	100%	17%	72%	1	15%	60%	88.2%	71.4%	84.0%	10.2
597	Lighting_Int	LED Interior Direction (Track lighting / Wall-Wash Fixture)	Biz - Prescriptive	Retail	RET	per unit	171	74%	126	0.03	0.02	15	\$59	100%	17%	69%	1	4%	60%	88.2%	70.2%	83.2%	11.1
598	Lighting_Int	LED Interior Direction (Track lighting / Wall-Wash Fixture)	Biz - Prescriptive	Office	RET	per unit	126	74%	93	0.02	0.01	15	\$59	100%	17%	51%	1	4%	60%	88.2%	68.0%	75.7%	8.3
599	Lighting_Int	LED Interior Direction (Track lighting / Wall-Wash Fixture)	Biz - Prescriptive	Warehouse	RET	per unit	122	74%	90	0.03	0.01	15	\$59	100%	17%	49%	1	2%	60%	88.2%	68.0%	75.0%	9.5
600	Lighting_Int	LED Interior Direction (Track lighting / Wall-Wash Fixture)	Biz - Prescriptive	Other	RET	per unit	140	74%	103	0.03	0.01	15	\$59	100%	17%	56%	1	7%	60%	88.2%	68.0%	76.6%	9.4
601	Lighting_Int	LED Linear Replacement Lamps (Replacing T8)	Biz - Prescriptive	Assembly	RET	per unit	91	51%	47	0.01	0.01	10	\$15	100%	17%	66%	2	46%	60%	88.2%	77.8%	84.7%	12.7
602	Lighting_Int	LED Linear Replacement Lamps (Replacing T8)	Biz - Prescriptive	Education	RET	per unit	92	51%	47	0.01	0.01	10	\$15	100%	17%	65%	2	69%	60%	88.2%	77.9%	84.7%	14.2
603	Lighting_Int	LED Linear Replacement Lamps (Replacing T8)	Biz - Prescriptive	Food Sales	RET	per unit	159	51%	82	0.01	0.01	10	\$15	100%	17%	40%	2	53%	60%	88.2%	82.8%	84.7%	19.3
604	Lighting_Int	LED Linear Replacement Lamps (Replacing T8)	Biz - Prescriptive	Food Service	RET	per unit	166	51%	85	0.02	0.01	10	\$15	100%	17%	37%	2	64%	60%	88.2%	83.1%	84.7%	20.9
605	Lighting_Int	LED Linear Replacement Lamps (Replacing T8)	Biz - Prescriptive	Health	RET	per unit	181	51%	93	0.01	0.01	10	\$15	100%	17%	32%	2	43%	60%	88.2%	83.6%	84.7%	19.2
606	Lighting_Int	LED Linear Replacement Lamps (Replacing T8)	Biz - Prescriptive	Lodging	RET	per unit	128	51%	66	0.01	0.01	10	\$15	100%	17%	52%	2	44%	60%	88.2%	81.2%	84.7%	15.6
607	Lighting_Int	LED Linear Replacement Lamps (Replacing T8)	Biz - Prescriptive	Retail	RET	per unit	123	51%	63	0.01	0.01	10	\$15	100%	17%	53%	2	63%	60%	88.2%	80.9%	84.7%	16.8
608	Lighting_Int	LED Linear Replacement Lamps (Replacing T8)	Biz - Prescriptive	Office	RET	per unit	91	51%	47	0.01	0.00	10	\$15	100%	17%	66%	2	55%	60%	88.2%	77.7%	84.7%	12.6
609	Lighting_Int	LED Linear Replacement Lamps (Replacing T8)	Biz - Prescriptive	Warehouse	RET	per unit	88	51%	45	0.01	0.00	10	\$15	100%	17%	67%	2	37%	60%	88.2%	77.4%	84.7%	14.4
610	Lighting_Int	LED Linear Replacement Lamps (Replacing T8)	Biz - Prescriptive	Other	RET	per unit	101	51%	52	0.01	0.01	10	\$15	100%	17%	62%	2	62%	60%	88.2%	78.9%	84.7%	14.3
611	Lighting_Int	LED Troffers (Replacing 1-Lamp T8)	Biz - Prescriptive	Assembly	RET	per unit	94	34%	32	0.01	0.00	15	\$22	100%	55%	47%	2	46%	60%	88.2%	75.8%	72.2%	2.4
612	Lighting_Int	LED Troffers (Replacing 1-Lamp T8)	Biz - Prescriptive	Education	RET	per unit	95	34%	32	0.01	0.00	15	\$22	100%	55%	47%	2	69%	60%	88.2%	75.9%	72.2%	2.7
613	Lighting_Int	LED Troffers (Replacing 1-Lamp T8)	Biz - Prescriptive	Food Sales	RET	per unit	164	34%	56	0.01	0.01	12	\$22	100%	55%	71%	2	53%	60%	88.2%	81.6%	84.5%	3.1
614	Lighting_Int	LED Troffers (Replacing 1-Lamp T8)	Biz - Prescriptive	Food Service	RET	per unit	172	34%	58	0.01	0.01	12	\$22	100%	55%	71%	2	64%	60%	88.2%	82.0%	84.7%	3.4
615	Lighting_Int	LED Troffers (Replacing 1-Lamp T8)	Biz - Prescriptive	Health	RET	per unit	187	34%	64	0.01	0.01	12	\$22	100%	55%	68%	2	43%	60%	88.2%	82.6%	84.7%	3.1
616	Lighting_Int	LED Troffers (Replacing 1-Lamp T8)	Biz - Prescriptive	Lodging	RET	per unit	133	34%	45	0.01	0.01	15	\$22	100%	55%	66%	2	44%	60%	88.2%	79.8%	82.3%	2.9
617	Lighting_Int	LED Troffers (Replacing 1-Lamp T8)	Biz - Prescriptive	Retail	RET	per unit	127	34%	43	0.01	0.01	15	\$22	100%	55%	64%	2	63%	60%	88.2%	79.4%	81.4%	3.2
618	Lighting_Int	LED Troffers (Replacing 1-Lamp T8)	Biz - Prescriptive	Office	RET	per unit	94	34%	32	0.01	0.00	15	\$22	100%	55%	47%	2	55%	60%	88.2%	75.7%	71.9%	2.4
619	Lighting_Int	LED Troffers (Replacing 1-Lamp T8)	Biz - Prescriptive	Warehouse	RET	per unit	91	34%	31	0.01	0.00	15	\$22	100%	55%	46%	2	37%	60%	88.2%	75.3%	70.4%	2.7
620	Lighting_Int	LED Troffers (Replacing 1-Lamp T8)	Biz - Prescriptive	Other	RET	per unit	104	34%	35	0.01	0.00	15	\$22	100%	55%	52%	2	62%	60%	88.2%	77.1%	76.4%	2.7
621	Lighting_Int	LED Troffers (Replacing 2-Lamp T8)	Biz - Prescriptive	Assembly	RET	per unit	184	51%	95	0.02	0.01	15	\$61	100%	30%	50%	2	46%	60%	88.2%	68.0%	75.4%	4.7
622	Lighting_Int	LED Troffers (Replacing 2-Lamp T8)	Biz - Prescriptive	Education	RET	per unit	186	51%	96	0.03	0.01	15	\$61	100%	30%	51%	2	69%	60%	88.2%	68.0%	75.7%	5.3
623	Lighting_Int	LED Troffers (Replacing 2-Lamp T8)	Biz - Prescriptive	Food Sales	RET	per unit	321	51%	165	0.03	0.02	12	\$61	100%	30%	70%	2	53%	60%	88.2%	78.0%	84.7%	6.2
624	Lighting_Int	LED Troffers (Replacing 2-Lamp T8)	Biz - Prescriptive	Food Service	RET	per unit	336	51%	173	0.03	0.02	12	\$61	100%	30%	69%	2	64%	60%	88.2%	78.6%	84.7%	6.7
625	Lighting_Int	LED Troffers (Replacing 2-Lamp T8)	Biz - Prescriptive	Health	RET	per unit	366	51%	188	0.02	0.02	12	\$61	100%	30%	66%	2	43%	60%	88.2%	79.5%	84.7%	6.1
626	Lighting_Int	LED Troffers (Replacing 2-Lamp T8)	Biz - Prescriptive	Lodging	RET	per unit	260	51%	133	0.02	0.02	15	\$61	100%	30%	71%	2	44%	60%	88.2%	75.3%	83.7%	5.8
627	Lighting_Int	LED Troffers (Replacing 2-Lamp T8)	Biz - Prescriptive	Retail	RET	per unit	249	51%	128	0.03	0.02	15	\$61	100%	30%	68%	2	63%	60%	88.2%	74.6%	82.8%	6.3
628	Lighting_Int	LED Troffers (Replacing 2-Lamp T8)	Biz - Prescriptive	Office	RET	per unit	183	51%	94	0.02	0.01	15	\$61	100%	30%	50%	2	55%	60%	88.2%	68.0%	75.3%	4.7
629	Lighting_Int	LED Troffers (Replacing 2-Lamp T8)	Biz - Prescriptive	Warehouse	RET	per unit	179	51%	92	0.03	0.01	15	\$61	100%	30%	49%	2	37%	60%	88.2%	68.0%	74.1%	5.4
630	Lighting_Int	LED Troffers (Replacing 2-Lamp T8)	Biz - Prescriptive	Other	RET	per unit	204	51%	105	0.03	0.01	15	\$61</										

Appendix C: C&I Measure Assumptions

Measure #	End-Use	Measure Name	Program	Building Type	Replacement Type (TOS=Time of Sale)	Unit	Base Annual Electric	% Elec Savings	Per Unit Elec Savings	Per Unit Summer kW	Per Unit Winter 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
641	Lighting_Int	LED Troffers (Replacing 4-Lamp T8)	Biz - Prescriptive	Assembly	RET	per unit	364	54%	198	0.05	0.03	15	\$104	100%	38%	61%	2	46%	60%	88.2%	75.3%	80.6%	4.4
642	Lighting_Int	LED Troffers (Replacing 4-Lamp T8)	Biz - Prescriptive	Education	RET	per unit	367	54%	199	0.06	0.02	15	\$104	100%	38%	62%	2	69%	60%	88.2%	75.4%	80.8%	5.0
643	Lighting_Int	LED Troffers (Replacing 4-Lamp T8)	Biz - Prescriptive	Food Sales	RET	per unit	634	54%	344	0.06	0.04	12	\$104	100%	38%	64%	2	53%	60%	88.2%	81.3%	84.7%	5.8
644	Lighting_Int	LED Troffers (Replacing 4-Lamp T8)	Biz - Prescriptive	Food Service	RET	per unit	664	54%	360	0.07	0.05	12	\$104	100%	38%	62%	2	64%	60%	88.2%	81.7%	84.7%	6.3
645	Lighting_Int	LED Troffers (Replacing 4-Lamp T8)	Biz - Prescriptive	Health	RET	per unit	724	54%	393	0.05	0.04	12	\$104	100%	38%	58%	2	43%	60%	88.2%	82.4%	84.7%	5.7
646	Lighting_Int	LED Troffers (Replacing 4-Lamp T8)	Biz - Prescriptive	Lodging	RET	per unit	513	54%	278	0.05	0.03	15	\$104	100%	38%	71%	2	44%	60%	88.2%	79.4%	84.7%	5.4
647	Lighting_Int	LED Troffers (Replacing 4-Lamp T8)	Biz - Prescriptive	Retail	RET	per unit	493	54%	267	0.06	0.04	15	\$104	100%	38%	72%	2	63%	60%	88.2%	79.0%	84.7%	5.9
648	Lighting_Int	LED Troffers (Replacing 4-Lamp T8)	Biz - Prescriptive	Office	RET	per unit	362	54%	197	0.05	0.02	15	\$104	100%	38%	61%	2	55%	60%	88.2%	75.2%	80.5%	4.4
649	Lighting_Int	LED Troffers (Replacing 4-Lamp T8)	Biz - Prescriptive	Warehouse	RET	per unit	353	54%	191	0.06	0.02	15	\$104	100%	38%	60%	2	37%	60%	88.2%	74.7%	79.9%	5.1
650	Lighting_Int	LED Troffers (Replacing 4-Lamp T8)	Biz - Prescriptive	Other	RET	per unit	403	54%	219	0.05	0.03	15	\$104	100%	38%	68%	2	62%	60%	88.2%	76.6%	82.8%	5.0
651	Lighting_Int	LED Linear Ambient Fixture (<6000 lumens, replacing T8)	Biz - Prescriptive	Assembly	RET	per unit	184	50%	92	0.02	0.01	15	\$47	100%	32%	64%	2	46%	60%	88.2%	74.0%	81.6%	5.5
652	Lighting_Int	LED Linear Ambient Fixture (<6000 lumens, replacing T8)	Biz - Prescriptive	Education	RET	per unit	185	50%	93	0.03	0.01	15	\$47	100%	32%	65%	2	69%	60%	88.2%	74.2%	81.7%	6.2
653	Lighting_Int	LED Linear Ambient Fixture (<6000 lumens, replacing T8)	Biz - Prescriptive	Food Sales	RET	per unit	320	50%	161	0.03	0.02	12	\$47	100%	32%	62%	2	53%	60%	88.2%	80.9%	84.7%	7.2
654	Lighting_Int	LED Linear Ambient Fixture (<6000 lumens, replacing T8)	Biz - Prescriptive	Food Service	RET	per unit	335	50%	169	0.03	0.02	12	\$47	100%	32%	60%	2	64%	60%	88.2%	81.3%	84.7%	7.8
655	Lighting_Int	LED Linear Ambient Fixture (<6000 lumens, replacing T8)	Biz - Prescriptive	Health	RET	per unit	365	50%	184	0.02	0.02	12	\$47	100%	32%	57%	2	43%	60%	88.2%	82.0%	84.7%	7.2
656	Lighting_Int	LED Linear Ambient Fixture (<6000 lumens, replacing T8)	Biz - Prescriptive	Lodging	RET	per unit	259	50%	130	0.02	0.02	15	\$47	100%	32%	69%	2	44%	60%	88.2%	78.8%	84.7%	6.8
657	Lighting_Int	LED Linear Ambient Fixture (<6000 lumens, replacing T8)	Biz - Prescriptive	Retail	RET	per unit	249	50%	125	0.03	0.02	15	\$47	100%	32%	71%	2	63%	60%	88.2%	78.4%	84.7%	7.3
658	Lighting_Int	LED Linear Ambient Fixture (<6000 lumens, replacing T8)	Biz - Prescriptive	Office	RET	per unit	183	50%	92	0.02	0.01	15	\$47	100%	32%	64%	2	55%	60%	88.2%	73.8%	81.4%	5.5
659	Lighting_Int	LED Linear Ambient Fixture (<6000 lumens, replacing T8)	Biz - Prescriptive	Warehouse	RET	per unit	178	50%	90	0.03	0.01	15	\$47	100%	32%	62%	2	37%	60%	88.2%	73.1%	80.9%	6.3
660	Lighting_Int	LED Linear Ambient Fixture (<6000 lumens, replacing T8)	Biz - Prescriptive	Other	RET	per unit	203	50%	102	0.02	0.01	15	\$47	100%	32%	71%	2	62%	60%	88.2%	75.9%	83.7%	6.2
661	Lighting_Int	LED Linear Ambient Fixture (>6000 lumens, replacing T5HO)	Biz - Prescriptive	Assembly	RET	per unit	485	53%	258	0.06	0.03	15	\$152	100%	30%	55%	2	46%	60%	88.2%	68.0%	77.8%	5.1
662	Lighting_Int	LED Linear Ambient Fixture (>6000 lumens, replacing T5HO)	Biz - Prescriptive	Education	RET	per unit	489	53%	260	0.08	0.03	15	\$152	100%	30%	55%	2	69%	60%	88.2%	68.3%	78.0%	5.8
663	Lighting_Int	LED Linear Ambient Fixture (>6000 lumens, replacing T5HO)	Biz - Prescriptive	Food Sales	RET	per unit	844	53%	449	0.08	0.05	12	\$152	100%	30%	68%	2	53%	60%	88.2%	79.0%	84.7%	6.7
664	Lighting_Int	LED Linear Ambient Fixture (>6000 lumens, replacing T5HO)	Biz - Prescriptive	Food Service	RET	per unit	884	53%	470	0.09	0.06	12	\$152	100%	30%	66%	2	64%	60%	88.2%	79.5%	84.7%	7.3
665	Lighting_Int	LED Linear Ambient Fixture (>6000 lumens, replacing T5HO)	Biz - Prescriptive	Health	RET	per unit	964	53%	513	0.06	0.05	12	\$152	100%	30%	63%	2	43%	60%	88.2%	80.3%	84.7%	6.7
666	Lighting_Int	LED Linear Ambient Fixture (>6000 lumens, replacing T5HO)	Biz - Prescriptive	Lodging	RET	per unit	683	53%	363	0.06	0.04	15	\$152	100%	30%	74%	2	44%	60%	88.2%	76.6%	84.7%	6.3
667	Lighting_Int	LED Linear Ambient Fixture (>6000 lumens, replacing T5HO)	Biz - Prescriptive	Retail	RET	per unit	656	53%	349	0.08	0.05	15	\$152	100%	30%	74%	2	63%	60%	88.2%	76.0%	84.6%	6.8
668	Lighting_Int	LED Linear Ambient Fixture (>6000 lumens, replacing T5HO)	Biz - Prescriptive	Office	RET	per unit	482	53%	256	0.06	0.03	15	\$152	100%	30%	55%	2	55%	60%	88.2%	68.0%	77.7%	5.1
669	Lighting_Int	LED Linear Ambient Fixture (>6000 lumens, replacing T5HO)	Biz - Prescriptive	Warehouse	RET	per unit	470	53%	250	0.08	0.03	15	\$152	100%	30%	53%	2	37%	60%	88.2%	68.0%	77.0%	5.9
670	Lighting_Int	LED Linear Ambient Fixture (>6000 lumens, replacing T5HO)	Biz - Prescriptive	Other	RET	per unit	536	53%	285	0.07	0.04	15	\$152	100%	30%	61%	2	62%	60%	88.2%	71.3%	80.3%	5.8
671	Lighting_Int	LED Low-Bay Fixture	Biz - Prescriptive	Assembly	RET	per unit	508	67%	340	0.08	0.04	15	\$43	100%	93%	13%	3	5%	60%	88.2%	87.9%	84.7%	7.6
672	Lighting_Int	LED Low-Bay Fixture	Biz - Prescriptive	Education	RET	per unit	512	67%	343	0.10	0.04	15	\$43	100%	93%	12%	3	8%	60%	88.2%	87.9%	84.7%	8.6
673	Lighting_Int	LED Low-Bay Fixture	Biz - Prescriptive	Food Sales	RET	per unit	883	67%	592	0.11	0.07	12	\$43	100%	93%	10%	3	6%	60%	88.2%	88.0%	86.1%	10.0
674	Lighting_Int	LED Low-Bay Fixture	Biz - Prescriptive	Food Service	RET	per unit	926	67%	620	0.12	0.08	12	\$43	100%	93%	10%	3	7%	60%	88.2%	88.1%	86.2%	10.8
675	Lighting_Int	LED Low-Bay Fixture	Biz - Prescriptive	Health	RET	per unit	1,009	67%	676	0.08	0.07	12	\$43	100%	93%	10%	3	5%	60%	88.2%	88.1%	86.4%	9.9
676	Lighting_Int	LED Low-Bay Fixture	Biz - Prescriptive	Lodging	RET	per unit	715	67%	479	0.09	0.06	15	\$43	100%	93%	10%	3	5%	60%	88.2%	88.0%	85.6%	9.4
677	Lighting_Int	LED Low-Bay Fixture	Biz - Prescriptive	Retail	RET	per unit	687	67%	460	0.10	0.07	15	\$43	100%	93%	10%	3	7%	60%	88.2%	88.0%	85.5%	10.1
678	Lighting_Int	LED Low-Bay Fixture	Biz - Prescriptive	Office	RET	per unit	505	67%	338	0.08	0.04	15	\$43	100%	93%	13%	3	6%	60%	88.2%	87.9%	84.7%	7.6
679	Lighting_Int	LED Low-Bay Fixture	Biz - Prescriptive	Warehouse	RET	per unit	492	67%	330	0.10	0.04	15	\$43	100%	93%	15%	3	4%	60%	88.2%	87.9%	84.7%	8.7
680	Lighting_Int	LED Low-Bay Fixture	Biz - Prescriptive	Other	RET	per unit	561	67%	376	0.09	0.05	15	\$43	100%	93%	10%	3	7%	60%	88.2%	88.0%	84.9%	8.6
681	Lighting_Int	LED High-Bay Fixture (Replacing T8 High Bay)	Biz - Prescriptive	Assembly	RET	per unit	950	57%	542	0.13	0.07	15	\$48	100%	100%	10%	4	6%	60%	88.2%	88.2%	85.7%	6.5
682	Lighting_Int	LED High-Bay Fixture (Replacing T8 High Bay)	Biz - Prescriptive	Education	RET	per unit	958	57%	546	0.16	0.07	15	\$48	100%	100%	10%	4	6%	60%	88.2%	88.2%	85.7%	7.3
683	Lighting_Int	LED High-Bay Fixture (Replacing T8 High Bay)	Biz - Prescriptive	Food Sales	RET	per unit	1,654	57%	943	0.17	0.11	12	\$48	100%	100%	10%	4	23%	60%	88.2%	88.2%	86.7%	8.5
684	Lighting_Int	LED High-Bay Fixture (Replacing T8 High Bay)	Biz - Prescriptive	Food Service	RET	per unit	1,734	57%	988	0.18	0.13	12	\$48	100%	100%	10%	4	3%	60%	88.2%	88.2%	86.8%	9.2
685	Lighting_Int	LED High-Bay Fixture (Replacing T8 High Bay)	Biz - Prescriptive	Health	RET	per unit	1,890	57%	1,077	0.13	0.11	12	\$48	100%	100%	10%	4	7%	60%	88.2%	88.2%	86.9%	8.4
686	Lighting_Int	LED High-Bay Fixture (Replacing T8 High Bay)	Biz - Prescriptive	Lodging	RET	per unit	1,339	57%	764	0.14	0.09	15	\$48	100%	100%	10%	4	0%	60%	88.2%	88.2%	86.4%	8.0
687	Lighting_Int	LED High-Bay Fixture (Replacing T8 High Bay)	Biz - Prescriptive	Retail	RET	per unit	1,286	57%	733	0.16	0.11	15	\$48	100%	100%	10%	4	14%	60%	88.2%	88.2%	86.3%	8.6
688	Lighting_Int	LED High-Bay Fixture (Replacing T8 High Bay)	Biz - Prescriptive	Office	RET	per unit	946	57%	539	0.13	0.06	15	\$48	100%	100%	10%	4	19%	60%	88.2%	88.2%	85.6%	6.4
689	Lighting_Int	LED High-Bay Fixture (Replacing T8 High Bay)	Biz - Prescriptive	Warehouse	RET	per unit	921	57%	525	0.17	0.06	15	\$48	100%	100%	10%	4	38%	60%	88.2%	88.2%	85.6%	7.4
690	Lighting_Int	LED High-Bay Fixture (Replacing T8 High Bay)	Biz - Prescriptive	Other	RET	per unit	1,051	57%	600	0.15	0.07	15	\$48	100%	100%	10%	4	5%	60%	88.2%	88.2%	85.9%	7.3
691	Lighting_Int	LED High-Bay Fixture (Replacing Metal Halide)	Biz - Prescriptive	Assembly	RET	per unit	3,815	72%	2,758	0.65	0.35	15	\$188	100%	80%	10%	5	17%	45%	88.2%	87.8%	86.2%	16.5
692	Lighting_Int	LED High-Bay Fixture (Replacing Metal Halide)	Biz - Prescriptive	Education	RET	per unit	3,847	72%	2,781	0.81	0.34	15	\$188	100%	80%	10%	5	2%	45%	88.2%	87.8%	86.3%	18.6
693	Lighting_Int	LED High-Bay Fixture (Replacing Metal Halide)	Biz - Prescriptive	Food Sales	RET	per unit	6,639	72%	4,801	0.85	0.57	12	\$188	100%	80%	10%	5	9%	45%	88.2%	87.9%	87.1%	21.6
694	Lighting_Int	LED High-Bay Fixture (Replacing Metal Halide)	Biz - Prescriptive	Food Service	RET	per unit	6,958	72%	5,031	0.94	0.66	12	\$188	100%	80%	10%	5	1%	45%	88.2%	88.0%	87.1%	23.3
695	Lighting_Int	LED High-Bay Fixture (Replacing Metal Halide)	Biz - Prescriptive	Health	RET	per unit	7,584	72%	5,484	0.67	0.56	12	\$188	100%	80%	10%	5	1%	45%	88.2%	88.0%	87.2%	21.3
696	Lighting_Int	LED High-Bay Fixture (Replacing Metal Halide)	Biz - Prescriptive	Lodging	RET	per unit	5,375	72%	3,886	0.69	0.45	15	\$188	100%	80%	10%	5	1%	45%	88.2%	87.9%	86.8%	20.2
697	Lighting_Int	LED High-Bay Fixture (Replacing Metal Halide)	Biz - Prescriptive	Retail	RET	per unit	5,163	72%	3,733	0.83	0.54	15	\$188	100%	80%	10%	5	8%	45%	88.2%	87.9%	86.8%	21.9
698	Lighting_Int	LED High-Bay Fixture (Replacing Metal Halide)	Biz - Prescriptive	Office	RET	per unit	3,795	72%	2,744	0.65	0.29	15	\$188	100%	80%	10%	5	11%	45%	88.2%	87.8%	86.2%	16.4
699	Lighting_Int	LED High-Bay Fixture (Replacing Metal Halide)	Biz - Prescriptive	Warehouse	RET	per unit	3,698	72%	2,674	0.85	0.29	15	\$188	100%	80%	10%	5	19%	45%	88.2%	87.7%	86.2%	18.8
700	Lighting_Int	LED High-Bay Fixture (Replacing Metal Halide)	Biz - Prescriptive	Other	RET	per unit	4,220	72%	3,051	0.74	0.38	15	\$188	100%	80%	10%	5	4%	45%	88.2%	87.8%	86.4%	18.6
701	Lighting_Int	LED Exit Sign	Biz - Prescriptive	Assembly	RET	per unit	66	71%	47	0.01	0.01	5	\$33	31%	31%								

Appendix C: C&I Measure Assumptions

Measure #	End-Use	Measure Name	Program	Building Type	Replacement Type (TOS=Time of Sale)	Unit	Base Annual Electric	% Elec Savings	Per Unit Elec Savings	Per Unit Summer kW	Per Unit Winter 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
712	Lighting_Int	Fluorescent Delamping	Biz - Prescriptive	Education	RET	per unit	82	100%	82	0.02	0.01	11	\$19	100%	5%	51%	6	69%	0%	84.0%	69.0%	77.0%	66.1
713	Lighting_Int	Fluorescent Delamping	Biz - Prescriptive	Food Sales	RET	per unit	141	100%	141	0.03	0.02	11	\$19	100%	5%	16%	6	53%	0%	84.0%	75.9%	77.0%	89.6
714	Lighting_Int	Fluorescent Delamping	Biz - Prescriptive	Food Service	RET	per unit	148	100%	148	0.03	0.02	11	\$19	100%	5%	12%	6	64%	0%	84.0%	76.4%	77.0%	96.8
715	Lighting_Int	Fluorescent Delamping	Biz - Prescriptive	Health	RET	per unit	161	100%	161	0.02	0.02	11	\$19	100%	5%	10%	6	43%	0%	84.0%	77.1%	77.4%	88.7
716	Lighting_Int	Fluorescent Delamping	Biz - Prescriptive	Lodging	RET	per unit	114	100%	114	0.02	0.01	11	\$19	100%	5%	32%	6	44%	0%	84.0%	73.7%	77.0%	72.3
717	Lighting_Int	Fluorescent Delamping	Biz - Prescriptive	Retail	RET	per unit	110	100%	110	0.02	0.02	11	\$19	100%	5%	35%	6	63%	0%	84.0%	73.2%	77.0%	78.1
718	Lighting_Int	Fluorescent Delamping	Biz - Prescriptive	Office	RET	per unit	81	100%	81	0.02	0.01	11	\$19	100%	5%	52%	6	55%	0%	84.0%	68.7%	77.0%	58.3
719	Lighting_Int	Fluorescent Delamping	Biz - Prescriptive	Warehouse	RET	per unit	79	100%	79	0.02	0.01	11	\$19	100%	5%	53%	6	37%	0%	84.0%	68.3%	77.0%	66.9
720	Lighting_Int	Fluorescent Delamping	Biz - Prescriptive	Other	RET	per unit	90	100%	90	0.02	0.01	11	\$19	100%	5%	47%	6	62%	0%	84.0%	70.4%	77.0%	66.3
721	Lighting_Int	Lighting Occupancy Sensor	Biz - Prescriptive	Assembly	RET	per control/fixture	422	30%	126	0.02	0.02	15	\$65	100%	20%	63%	7	90%	13%	84.0%	51.6%	70.5%	7.5
722	Lighting_Int	Lighting Occupancy Sensor	Biz - Prescriptive	Education	RET	per control/fixture	425	30%	128	0.03	0.02	15	\$65	100%	20%	63%	7	90%	13%	84.0%	51.9%	70.9%	8.6
723	Lighting_Int	Lighting Occupancy Sensor	Biz - Prescriptive	Food Sales	RET	per control/fixture	734	30%	220	0.03	0.03	15	\$65	100%	20%	63%	7	90%	13%	84.0%	67.1%	77.0%	12.2
724	Lighting_Int	Lighting Occupancy Sensor	Biz - Prescriptive	Food Service	RET	per control/fixture	769	30%	231	0.04	0.03	15	\$65	100%	20%	61%	7	90%	13%	84.0%	67.9%	77.0%	13.4
725	Lighting_Int	Lighting Occupancy Sensor	Biz - Prescriptive	Health	RET	per control/fixture	838	30%	251	0.02	0.03	15	\$65	100%	20%	58%	7	90%	13%	84.0%	69.4%	77.0%	11.9
726	Lighting_Int	Lighting Occupancy Sensor	Biz - Prescriptive	Lodging	RET	per control/fixture	594	30%	178	0.02	0.02	15	\$65	100%	20%	70%	7	90%	13%	84.0%	62.8%	77.0%	9.6
727	Lighting_Int	Lighting Occupancy Sensor	Biz - Prescriptive	Retail	RET	per control/fixture	571	30%	171	0.03	0.02	15	\$65	100%	20%	71%	7	90%	13%	84.0%	61.8%	77.0%	10.6
728	Lighting_Int	Lighting Occupancy Sensor	Biz - Prescriptive	Office	RET	per control/fixture	419	30%	126	0.02	0.01	15	\$65	100%	20%	62%	7	90%	13%	84.0%	51.4%	70.3%	7.5
729	Lighting_Int	Lighting Occupancy Sensor	Biz - Prescriptive	Warehouse	RET	per control/fixture	409	30%	123	0.03	0.01	15	\$65	100%	20%	61%	7	90%	13%	84.0%	50.3%	69.3%	8.9
730	Lighting_Int	Lighting Occupancy Sensor	Biz - Prescriptive	Other	RET	per control/fixture	466	30%	140	0.03	0.02	15	\$65	100%	20%	69%	7	90%	13%	84.0%	55.5%	74.4%	8.7
731	Lighting_Int	Lighting Daylight Sensor	Biz - Prescriptive	Assembly	RET	per control/fixture	540	28%	151	0.03	0.02	15	\$58	100%	44%	71%	7	90%	13%	84.0%	68.9%	77.0%	4.7
732	Lighting_Int	Lighting Daylight Sensor	Biz - Prescriptive	Education	RET	per control/fixture	544	28%	152	0.03	0.02	15	\$58	100%	44%	71%	7	90%	13%	84.0%	69.1%	77.0%	5.3
733	Lighting_Int	Lighting Daylight Sensor	Biz - Prescriptive	Food Sales	RET	per control/fixture	940	28%	263	0.04	0.03	15	\$58	100%	44%	50%	7	90%	13%	84.0%	76.0%	77.0%	7.6
734	Lighting_Int	Lighting Daylight Sensor	Biz - Prescriptive	Food Service	RET	per control/fixture	985	28%	276	0.04	0.04	15	\$58	100%	44%	47%	7	90%	13%	84.0%	76.4%	77.0%	8.3
735	Lighting_Int	Lighting Daylight Sensor	Biz - Prescriptive	Health	RET	per control/fixture	1,073	28%	301	0.03	0.03	15	\$58	100%	44%	43%	7	90%	13%	84.0%	77.1%	77.0%	7.4
736	Lighting_Int	Lighting Daylight Sensor	Biz - Prescriptive	Lodging	RET	per control/fixture	761	28%	213	0.03	0.02	15	\$58	100%	44%	59%	7	90%	13%	84.0%	73.7%	77.0%	6.0
737	Lighting_Int	Lighting Daylight Sensor	Biz - Prescriptive	Retail	RET	per control/fixture	731	28%	205	0.04	0.03	15	\$58	100%	44%	61%	7	90%	13%	84.0%	73.2%	77.0%	6.5
738	Lighting_Int	Lighting Daylight Sensor	Biz - Prescriptive	Office	RET	per control/fixture	537	28%	150	0.03	0.02	15	\$58	100%	44%	71%	7	90%	13%	84.0%	68.8%	77.0%	4.7
739	Lighting_Int	Lighting Daylight Sensor	Biz - Prescriptive	Warehouse	RET	per control/fixture	523	28%	147	0.04	0.02	15	\$58	100%	44%	72%	7	90%	13%	84.0%	68.4%	77.0%	5.5
740	Lighting_Int	Lighting Daylight Sensor	Biz - Prescriptive	Other	RET	per control/fixture	597	28%	167	0.03	0.02	15	\$58	100%	44%	68%	7	90%	13%	84.0%	70.5%	77.0%	5.4
741	Lighting_Int	Dual Occupancy / Daylight Sensor	Biz - Prescriptive	Assembly	RET	per control	241	38%	92	0.02	0.01	15	\$75	75%	15%	39%	7	90%	13%	69.7%	32.1%	43.4%	6.3
742	Lighting_Int	Dual Occupancy / Daylight Sensor	Biz - Prescriptive	Education	RET	per control	243	38%	92	0.02	0.01	15	\$75	100%	15%	40%	7	90%	13%	84.0%	32.4%	44.1%	7.2
743	Lighting_Int	Dual Occupancy / Daylight Sensor	Biz - Prescriptive	Food Sales	RET	per control	419	38%	159	0.02	0.02	15	\$75	100%	15%	69%	7	90%	13%	84.0%	53.0%	74.1%	10.2
744	Lighting_Int	Dual Occupancy / Daylight Sensor	Biz - Prescriptive	Food Service	RET	per control	439	38%	167	0.03	0.02	15	\$75	100%	15%	72%	7	90%	13%	84.0%	54.8%	75.8%	11.2
745	Lighting_Int	Dual Occupancy / Daylight Sensor	Biz - Prescriptive	Health	RET	per control	479	38%	182	0.02	0.02	15	\$75	100%	15%	73%	7	90%	13%	84.0%	58.0%	77.0%	10.0
746	Lighting_Int	Dual Occupancy / Daylight Sensor	Biz - Prescriptive	Lodging	RET	per control	339	38%	129	0.02	0.01	15	\$75	100%	15%	56%	7	90%	13%	84.0%	43.6%	65.6%	8.0
747	Lighting_Int	Dual Occupancy / Daylight Sensor	Biz - Prescriptive	Retail	RET	per control	326	38%	124	0.02	0.02	15	\$75	100%	15%	53%	7	90%	13%	84.0%	41.5%	63.7%	8.8
748	Lighting_Int	Dual Occupancy / Daylight Sensor	Biz - Prescriptive	Office	RET	per control	240	38%	91	0.02	0.01	15	\$75	75%	15%	39%	7	90%	13%	69.6%	32.0%	43.0%	6.3
749	Lighting_Int	Dual Occupancy / Daylight Sensor	Biz - Prescriptive	Warehouse	RET	per control	233	38%	89	0.02	0.01	15	\$75	100%	15%	38%	7	90%	13%	84.0%	31.3%	40.8%	7.5
750	Lighting_Int	Dual Occupancy / Daylight Sensor	Biz - Prescriptive	Other	RET	per control	266	38%	101	0.02	0.01	15	\$75	100%	15%	44%	7	90%	13%	84.0%	34.8%	51.3%	7.3
751	Lighting_Int	Luminaire-Level Lighting Controls	Biz - Prescriptive	Assembly	RET	per control	241	61%	147	0.03	0.02	15	\$56	100%	60%	71%	7	90%	13%	63.0%	55.3%	57.8%	3.4
752	Lighting_Int	Luminaire-Level Lighting Controls	Biz - Prescriptive	Education	RET	per control	338	61%	206	0.03	0.02	15	\$56	100%	60%	59%	7	90%	13%	63.0%	57.9%	57.8%	4.6
753	Lighting_Int	Luminaire-Level Lighting Controls	Biz - Prescriptive	Food Sales	RET	per control	419	61%	256	0.04	0.03	15	\$56	100%	60%	50%	7	90%	13%	63.0%	58.8%	57.8%	5.5
754	Lighting_Int	Luminaire-Level Lighting Controls	Biz - Prescriptive	Food Service	RET	per control	439	61%	268	0.04	0.03	15	\$56	100%	60%	47%	7	90%	13%	63.0%	59.0%	57.8%	6.0
755	Lighting_Int	Luminaire-Level Lighting Controls	Biz - Prescriptive	Health	RET	per control	479	61%	292	0.03	0.03	15	\$56	100%	60%	43%	7	90%	13%	63.0%	59.4%	57.8%	5.3
756	Lighting_Int	Luminaire-Level Lighting Controls	Biz - Prescriptive	Lodging	RET	per control	339	61%	207	0.03	0.02	15	\$56	100%	60%	59%	7	90%	13%	63.0%	57.9%	57.8%	4.3
757	Lighting_Int	Luminaire-Level Lighting Controls	Biz - Prescriptive	Retail	RET	per control	552	61%	337	0.04	0.05	15	\$56	100%	60%	34%	7	90%	13%	63.0%	59.8%	57.8%	6.6
758	Lighting_Int	Luminaire-Level Lighting Controls	Biz - Prescriptive	Office	RET	per control	363	61%	221	0.03	0.02	15	\$56	100%	60%	57%	7	90%	13%	63.0%	58.2%	57.8%	4.3
759	Lighting_Int	Luminaire-Level Lighting Controls	Biz - Prescriptive	Warehouse	RET	per control	381	61%	232	0.04	0.03	15	\$56	100%	60%	54%	7	90%	13%	63.0%	58.4%	57.8%	5.2
760	Lighting_Int	Luminaire-Level Lighting Controls	Biz - Prescriptive	Other	RET	per control	266	61%	163	0.03	0.02	15	\$56	100%	60%	68%	7	90%	13%	63.0%	56.2%	57.8%	3.9
761	Lighting_Int	Networked Lighting Control	Biz - Prescriptive	Assembly	RET	Wh saved per sq	2	35%	1	0.00	0.00	15	\$0	100%	100%	55%	7	90%	13%	63.0%	63.0%	48.7%	1.2
762	Lighting_Int	Networked Lighting Control	Biz - Prescriptive	Education	RET	Wh saved per sq	3	35%	1	0.00	0.00	15	\$1	100%	79%	55%	7	90%	13%	63.0%	56.8%	48.7%	1.6
763	Lighting_Int	Networked Lighting Control	Biz - Prescriptive	Food Sales	RET	Wh saved per sq	3	35%	1	0.00	0.00	15	\$1	100%	63%	55%	7	90%	13%	63.0%	51.6%	48.7%	1.9
764	Lighting_Int	Networked Lighting Control	Biz - Prescriptive	Food Service	RET	Wh saved per sq	4	35%	1	0.00	0.00	15	\$1	100%	61%	55%	7	90%	13%	63.0%	50.6%	48.7%	2.1
765	Lighting_Int	Networked Lighting Control	Biz - Prescriptive	Health	RET	Wh saved per sq	4	35%	1	0.00	0.00	15	\$1	100%	56%	55%	7	90%	13%	63.0%	48.9%	48.7%	1.9
766	Lighting_Int	Networked Lighting Control	Biz - Prescriptive	Lodging	RET	Wh saved per sq	3	35%	1	0.00	0.00	15	\$1	100%	78%	55%	7	90%	13%	63.0%	56.8%	48.7%	1.5
767	Lighting_Int	Networked Lighting Control	Biz - Prescriptive	Retail	RET	Wh saved per sq	5	35%	2	0.00	0.00	15	\$1	100%	48%	55%	7	90%	13%	63.0%	46.4%	48.7%	2.3
768	Lighting_Int	Networked Lighting Control	Biz - Prescriptive	Office	RET	Wh saved per sq	3	35%	1	0.00	0.00	15	\$1	100%	73%	55%	7	90%	13%	63.0%	55.0%	48.7%	1.5
769	Lighting_Int	Networked Lighting Control	Biz - Prescriptive	Warehouse	RET	Wh saved per sq	3	35%	1	0.00	0.00	15	\$1	100%	70%	55%	7	90%	13%	63.0%	53.8%	48.7%	1.8
770	Lighting_Int	Networked Lighting Control	Biz - Prescriptive	Other	RET	Wh saved per sq	2	35%	1	0.00	0.00	15	\$0	100%	100%	55%	7	90%	13%	63.0%	63.0%	48.7%	1.4
771	Misc	Non-Refrigerated Vending Machine Controls	Biz - Prescriptive	Assembly	RET	per unit	385	61%	237	0.00	0.03	5	\$233	9%	9%	15%	1	0%	2%	25.7%	24.0%	26.4%	2.5
772	Misc	Non-Refrigerated Vending Machine Controls	Biz - Prescriptive	Education	RET	per unit	385	61%	237	0.00	0.03	5	\$233	9%	9%	15%	1	0%	2%	25.7%	24.0%	26.4%	2.5
773	Misc	Non-Refrigerated Vending Machine Controls	Biz - Prescriptive	Food Sales	RET	per unit	385	61%	237	0.00	0.03	5	\$233	9%	9%	15%	1	0%	2%	25.7%	24.0%	26.4%	2.5
774	Misc	Non-Refrigerated Vending Machine Controls	Biz - Prescriptive	Food Service	RET	per unit	385	61%	237	0.00	0.03	5	\$233	9%	9%	15%	1	0%	2%	25.7%	24.0%	26.4%	2.5
775	Misc	Non-Refrigerated Vending Machine Controls	Biz - Prescriptive	Health	RET																		

Appendix C: C&I Measure Assumptions

Measure #	End-Use	Measure Name	Program	Building Type	Replacement Type (TOS=Time of Sale)	Unit	Base Annual Electric	% Elec Savings	Per Unit Elec Savings	Per Unit Summer kW	Per Unit Winter 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
783	Misc	Kitchen Exhaust Hood Demand Ventilation Control System	Biz - Custom	Food Sales	TOS	per hood CFM	8,846	50%	4,423	0.55	0.56	20	\$1,192	100%	37%	59%	2	1%	20%	63.0%	54.3%	57.8%	8.1
784	Misc	Kitchen Exhaust Hood Demand Ventilation Control System	Biz - Custom	Food Service	TOS	per hood CFM	8,846	50%	4,423	0.55	0.53	20	\$1,192	100%	37%	59%	2	2%	20%	63.0%	54.3%	57.8%	8.2
785	Misc	Kitchen Exhaust Hood Demand Ventilation Control System	Biz - Custom	Health	TOS	per hood CFM	8,846	50%	4,423	0.55	0.50	20	\$1,192	100%	37%	59%	2	2%	20%	63.0%	54.3%	57.8%	8.1
786	Misc	Kitchen Exhaust Hood Demand Ventilation Control System	Biz - Custom	Lodging	TOS	per hood CFM	8,846	50%	4,423	0.55	0.57	20	\$1,192	100%	37%	59%	2	5%	20%	63.0%	54.3%	57.8%	8.1
787	Misc	Kitchen Exhaust Hood Demand Ventilation Control System	Biz - Custom	Retail	TOS	per hood CFM	8,846	50%	4,423	0.55	0.51	20	\$1,192	100%	37%	59%	2	0%	20%	63.0%	54.3%	57.8%	8.1
788	Misc	Kitchen Exhaust Hood Demand Ventilation Control System	Biz - Custom	Office	TOS	per hood CFM	8,846	50%	4,423	0.55	0.51	20	\$1,192	100%	37%	59%	2	5%	20%	63.0%	54.3%	57.8%	8.0
789	Misc	Kitchen Exhaust Hood Demand Ventilation Control System	Biz - Custom	Warehouse	TOS	per hood CFM	8,846	50%	4,423	0.55	0.48	20	\$1,192	100%	37%	59%	2	0%	20%	63.0%	54.3%	57.8%	8.1
790	Misc	Kitchen Exhaust Hood Demand Ventilation Control System	Biz - Custom	Other	TOS	per hood CFM	8,846	50%	4,423	0.55	0.52	20	\$1,192	100%	37%	59%	2	0%	20%	63.0%	54.3%	57.8%	8.1
791	Misc	High Efficiency Hand Dryers	Biz - Custom	Assembly	TOS	per unit	2,093	83%	1,737	0.10	0.21	10	\$483	100%	36%	60%	3	1%	50%	65.0%	60.0%	60.0%	4.2
792	Misc	High Efficiency Hand Dryers	Biz - Custom	Education	TOS	per unit	2,093	83%	1,737	0.16	0.20	10	\$483	100%	36%	60%	3	1%	50%	65.0%	60.0%	60.0%	4.7
793	Misc	High Efficiency Hand Dryers	Biz - Custom	Food Sales	TOS	per unit	3,819	83%	3,170	0.28	0.40	10	\$483	100%	66%	28%	3	1%	50%	65.0%	60.5%	60.0%	4.7
794	Misc	High Efficiency Hand Dryers	Biz - Custom	Food Service	TOS	per unit	1,909	83%	1,585	0.09	0.19	10	\$483	100%	33%	64%	3	1%	50%	65.0%	60.0%	60.0%	4.2
795	Misc	High Efficiency Hand Dryers	Biz - Custom	Health	TOS	per unit	1,909	83%	1,585	0.10	0.18	10	\$483	100%	33%	64%	3	1%	50%	65.0%	60.0%	60.0%	4.3
796	Misc	High Efficiency Hand Dryers	Biz - Custom	Lodging	TOS	per unit	262	83%	217	0.04	0.03	10	\$483	4%	4%	11%	3	1%	50%	54.0%	54.0%	54.0%	6.0
797	Misc	High Efficiency Hand Dryers	Biz - Custom	Retail	TOS	per unit	1,909	83%	1,585	0.09	0.18	10	\$483	100%	33%	64%	3	1%	50%	65.0%	60.0%	60.0%	4.2
798	Misc	High Efficiency Hand Dryers	Biz - Custom	Office	TOS	per unit	262	83%	217	0.04	0.02	10	\$483	4%	4%	11%	3	1%	50%	54.0%	54.0%	54.0%	5.9
799	Misc	High Efficiency Hand Dryers	Biz - Custom	Warehouse	TOS	per unit	262	83%	217	0.04	0.02	10	\$483	4%	4%	11%	3	1%	50%	54.0%	54.0%	54.0%	5.9
800	Misc	High Efficiency Hand Dryers	Biz - Custom	Other	TOS	per unit	262	83%	217	0.10	0.03	10	\$483	4%	4%	11%	3	1%	50%	54.0%	54.0%	54.0%	9.8
801	Misc	ENERGY STAR Uninterrupted Power Supply	Biz - Custom	Assembly	RET	per unit	3,125	4%	114	0.02	0.01	15	\$59	100%	19%	63%	4	0%	0%	63.0%	38.6%	53.0%	7.7
802	Misc	ENERGY STAR Uninterrupted Power Supply	Biz - Custom	Education	RET	per unit	3,125	4%	114	0.02	0.01	15	\$59	100%	19%	63%	4	0%	0%	63.0%	38.6%	53.0%	7.7
803	Misc	ENERGY STAR Uninterrupted Power Supply	Biz - Custom	Food Sales	RET	per unit	3,125	4%	114	0.02	0.01	15	\$59	100%	19%	63%	4	0%	0%	63.0%	38.6%	53.0%	7.7
804	Misc	ENERGY STAR Uninterrupted Power Supply	Biz - Custom	Food Service	RET	per unit	3,125	4%	114	0.02	0.01	15	\$59	100%	19%	63%	4	0%	0%	63.0%	38.6%	53.0%	7.7
805	Misc	ENERGY STAR Uninterrupted Power Supply	Biz - Custom	Health	RET	per unit	3,125	4%	114	0.02	0.01	15	\$59	100%	19%	63%	4	0%	0%	63.0%	38.6%	53.0%	7.7
806	Misc	ENERGY STAR Uninterrupted Power Supply	Biz - Custom	Lodging	RET	per unit	3,125	4%	114	0.02	0.01	15	\$59	100%	19%	63%	4	0%	0%	63.0%	38.6%	53.0%	7.7
807	Misc	ENERGY STAR Uninterrupted Power Supply	Biz - Custom	Retail	RET	per unit	3,125	4%	114	0.02	0.01	15	\$59	100%	19%	63%	4	0%	0%	63.0%	38.6%	53.0%	7.7
808	Misc	ENERGY STAR Uninterrupted Power Supply	Biz - Custom	Office	RET	per unit	3,125	4%	114	0.02	0.01	15	\$59	100%	19%	63%	4	0%	0%	63.0%	38.6%	53.0%	7.7
809	Misc	ENERGY STAR Uninterrupted Power Supply	Biz - Custom	Warehouse	RET	per unit	3,125	4%	114	0.02	0.01	15	\$59	100%	19%	63%	4	0%	0%	63.0%	38.6%	53.0%	7.7
810	Misc	ENERGY STAR Uninterrupted Power Supply	Biz - Custom	Other	RET	per unit	3,125	4%	114	0.02	0.01	15	\$59	100%	19%	63%	4	0%	0%	63.0%	38.6%	53.0%	7.7
811	Misc	Miscellaneous Custom	Biz - Custom	Assembly	RET	per kWh	7	15%	1	0.00	0.00	10	\$0	100%	25%	62%	5	89%	10%	63.0%	46.7%	55.3%	5.4
812	Misc	Miscellaneous Custom	Biz - Custom	Education	RET	per kWh	7	15%	1	0.00	0.00	10	\$0	100%	25%	62%	5	92%	10%	63.0%	46.7%	55.3%	4.7
813	Misc	Miscellaneous Custom	Biz - Custom	Food Sales	RET	per kWh	7	15%	1	0.00	0.00	10	\$0	100%	25%	62%	5	98%	10%	63.0%	46.7%	55.3%	6.3
814	Misc	Miscellaneous Custom	Biz - Custom	Food Service	RET	per kWh	7	15%	1	0.00	0.00	10	\$0	100%	25%	62%	5	97%	10%	63.0%	46.7%	55.3%	6.3
815	Misc	Miscellaneous Custom	Biz - Custom	Health	RET	per kWh	7	15%	1	0.00	0.00	10	\$0	100%	25%	62%	5	96%	10%	63.0%	46.7%	55.3%	5.1
816	Misc	Miscellaneous Custom	Biz - Custom	Lodging	RET	per kWh	7	15%	1	0.00	0.00	10	\$0	100%	25%	62%	5	94%	10%	63.0%	46.7%	55.3%	4.9
817	Misc	Miscellaneous Custom	Biz - Custom	Retail	RET	per kWh	7	15%	1	0.00	0.00	10	\$0	100%	25%	62%	5	98%	10%	63.0%	46.7%	55.3%	5.7
818	Misc	Miscellaneous Custom	Biz - Custom	Office	RET	per kWh	7	15%	1	0.00	0.00	10	\$0	100%	25%	62%	5	94%	10%	63.0%	46.7%	55.3%	4.9
819	Misc	Miscellaneous Custom	Biz - Custom	Warehouse	RET	per kWh	7	15%	1	0.00	0.00	10	\$0	100%	25%	62%	5	98%	10%	63.0%	46.7%	55.3%	5.3
820	Misc	Miscellaneous Custom	Biz - Custom	Other	RET	per kWh	7	15%	1	0.00	0.00	10	\$0	100%	25%	62%	5	99%	10%	63.0%	46.7%	55.3%	5.3
821	Plug_Office	Advanced Power Strip – Tier 1 Commercial Use	Biz - Custom	Assembly	RET	per unit	188	61%	115	0.00	0.01	7	\$10	100%	100%	10%	2	18%	12%	63.0%	63.0%	59.3%	2.7
822	Plug_Office	Advanced Power Strip – Tier 1 Commercial Use	Biz - Custom	Education	RET	per unit	188	61%	115	0.00	0.01	7	\$10	100%	100%	10%	2	23%	12%	63.0%	63.0%	59.3%	2.7
823	Plug_Office	Advanced Power Strip – Tier 1 Commercial Use	Biz - Custom	Food Sales	RET	per unit	188	61%	115	0.00	0.01	7	\$10	100%	100%	10%	2	21%	12%	63.0%	63.0%	59.3%	2.7
824	Plug_Office	Advanced Power Strip – Tier 1 Commercial Use	Biz - Custom	Food Service	RET	per unit	188	61%	115	0.00	0.01	7	\$10	100%	100%	10%	2	12%	12%	63.0%	63.0%	59.3%	2.7
825	Plug_Office	Advanced Power Strip – Tier 1 Commercial Use	Biz - Custom	Health	RET	per unit	188	61%	115	0.00	0.01	7	\$10	100%	100%	10%	2	16%	12%	63.0%	63.0%	59.3%	2.7
826	Plug_Office	Advanced Power Strip – Tier 1 Commercial Use	Biz - Custom	Lodging	RET	per unit	188	61%	115	0.00	0.01	7	\$10	100%	100%	10%	2	5%	12%	63.0%	63.0%	59.3%	2.7
827	Plug_Office	Advanced Power Strip – Tier 1 Commercial Use	Biz - Custom	Retail	RET	per unit	188	61%	115	0.00	0.01	7	\$10	100%	100%	10%	2	21%	12%	63.0%	63.0%	59.3%	2.7
828	Plug_Office	Advanced Power Strip – Tier 1 Commercial Use	Biz - Custom	Office	RET	per unit	188	61%	115	0.00	0.01	7	\$10	100%	100%	10%	2	26%	12%	63.0%	63.0%	59.3%	2.7
829	Plug_Office	Advanced Power Strip – Tier 1 Commercial Use	Biz - Custom	Warehouse	RET	per unit	188	61%	115	0.00	0.01	7	\$10	100%	100%	10%	2	25%	12%	63.0%	63.0%	59.3%	2.7
830	Plug_Office	Advanced Power Strip – Tier 1 Commercial Use	Biz - Custom	Other	RET	per unit	188	61%	115	0.00	0.01	7	\$10	100%	100%	10%	2	17%	12%	63.0%	63.0%	59.3%	2.7
831	Plug_Office	Smart Socket	Biz - Custom	Assembly	RET	per unit	80	61%	48	0.00	0.01	7	\$9	100%	54%	41%	2	18%	12%	63.0%	58.9%	57.8%	2.7
832	Plug_Office	Smart Socket	Biz - Custom	Education	RET	per unit	80	61%	48	0.00	0.01	7	\$9	100%	54%	41%	2	23%	12%	63.0%	58.9%	57.8%	2.7
833	Plug_Office	Smart Socket	Biz - Custom	Food Sales	RET	per unit	80	61%	48	0.00	0.01	7	\$9	100%	54%	41%	2	21%	12%	63.0%	58.9%	57.8%	2.7
834	Plug_Office	Smart Socket	Biz - Custom	Food Service	RET	per unit	80	61%	48	0.00	0.01	7	\$9	100%	54%	41%	2	12%	12%	63.0%	58.9%	57.8%	2.7
835	Plug_Office	Smart Socket	Biz - Custom	Health	RET	per unit	80	61%	48	0.00	0.01	7	\$9	100%	54%	41%	2	16%	12%	63.0%	58.9%	57.8%	2.7
836	Plug_Office	Smart Socket	Biz - Custom	Lodging	RET	per unit	80	61%	48	0.00	0.01	7	\$9	100%	54%	41%	2	5%	12%	63.0%	58.9%	57.8%	2.7
837	Plug_Office	Smart Socket	Biz - Custom	Retail	RET	per unit	80	61%	48	0.00	0.01	7	\$9	100%	54%	41%	2	21%	12%	63.0%	58.9%	57.8%	2.7
838	Plug_Office	Smart Socket	Biz - Custom	Office	RET	per unit	80	61%	48	0.00	0.01	7	\$9	100%	54%	41%	2	26%	12%	63.0%	58.9%	57.8%	2.7
839	Plug_Office	Smart Socket	Biz - Custom	Warehouse	RET	per unit	80	61%	48	0.00	0.01	7	\$9	100%	54%	41%	2	25%	12%	63.0%	58.9%	57.8%	2.7
840	Plug_Office	Smart Socket	Biz - Custom	Other	RET	per unit	80	61%	48	0.00	0.01	7	\$9	100%	54%	41%	2	17%	12%	63.0%	58.9%	57.8%	2.7
841	Plug_Office	Energy Star Printer/Copier/Fax	Biz - Custom	Assembly	TOS	per unit	418	26%	110	0.02	0.01	6	\$0	100%	100%	100%	1	16%	95%	96.5%	96.0%	96.0%	3.7
842	Plug_Office	Energy Star Printer/Copier/Fax	Biz - Custom	Education	TOS	per unit	418	26%	110	0.01	0.01	6	\$0	100%	100%	100%	1	9%	95%	96.5%	96.0%	96.0%	3.2
843	Plug_Office	Energy Star Printer/Copier/Fax	Biz - Custom	Food Sales	TOS	per unit	418	26%	110	0.02	0.01	6	\$0	100%	100%	100%	1	12%	95%	96.5%	96.0%	96.0%	4.3
844	Plug_Office	Energy Star Printer/Copier/Fax	Biz - Custom	Food Service	TOS	per unit	418	26%	110	0.02	0.01	6	\$0	100%	100%	100%	1	24%	95%	96.5%	96.0%	96.0%	4.3
845	Plug_Office	Energy Star Printer/Copier/Fax	Biz - Custom	Health	TOS	per unit	418	26%	110	0.01	0.01	6	\$0	100%	100%	100%	1	19%	95%	96.5%	96.0%	96.0%	3.5
846	Plug_Office	Energy Star Printer/Copier/Fax	Biz - Custom	Lodging	TOS	per unit	418	26%	110	0.01	0.01	6	\$0	100%	100%	100%	1	33%	95%	96.5%	96		

Appendix C: C&I Measure Assumptions

Measure #	End-Use	Measure Name	Program	Building Type	Replacement Type (TOS=Time of Sale)	Unit	Base Annual Electric	% Elec Savings	Per Unit Elec Savings	Per Unit Summer kW	Per Unit Winter 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
854	Plug_Office	Energy Star Server	Biz - Custom	Food Service	TOS	per server	2,167	30%	650	0.13	0.08	9	\$301	100%	22%	50%	3	14%	25%	63.0%	42.5%	50.6%	5.8
855	Plug_Office	Energy Star Server	Biz - Custom	Health	TOS	per server	2,167	30%	650	0.08	0.07	9	\$301	100%	22%	50%	3	18%	25%	63.0%	42.5%	50.6%	4.8
856	Plug_Office	Energy Star Server	Biz - Custom	Lodging	TOS	per server	2,167	30%	650	0.07	0.08	9	\$301	75%	22%	50%	3	6%	25%	57.4%	42.5%	50.6%	4.6
857	Plug_Office	Energy Star Server	Biz - Custom	Retail	TOS	per server	2,167	30%	650	0.10	0.07	9	\$301	100%	22%	50%	3	24%	25%	63.0%	42.5%	50.6%	5.3
858	Plug_Office	Energy Star Server	Biz - Custom	Office	TOS	per server	2,167	30%	650	0.07	0.07	9	\$301	75%	22%	50%	3	30%	25%	57.4%	42.5%	50.6%	4.6
859	Plug_Office	Energy Star Server	Biz - Custom	Warehouse	TOS	per server	2,167	30%	650	0.09	0.07	9	\$301	100%	22%	50%	3	30%	25%	63.0%	42.5%	50.6%	5.0
860	Plug_Office	Energy Star Server	Biz - Custom	Other	TOS	per server	2,167	30%	650	0.09	0.08	9	\$301	100%	22%	50%	3	20%	25%	63.0%	42.5%	50.6%	4.9
861	Plug_Office	Server Virtualization	Biz - Custom	Assembly	RET	per server	2,167	14%	301	0.04	0.04	9	\$27	100%	100%	10%	3	21%	25%	63.0%	63.0%	59.2%	5.0
862	Plug_Office	Server Virtualization	Biz - Custom	Education	RET	per server	2,167	14%	301	0.03	0.03	9	\$27	100%	100%	10%	3	27%	25%	63.0%	63.0%	59.2%	4.3
863	Plug_Office	Server Virtualization	Biz - Custom	Food Sales	RET	per server	2,167	14%	301	0.06	0.04	9	\$27	100%	100%	10%	3	24%	25%	63.0%	63.0%	59.2%	5.9
864	Plug_Office	Server Virtualization	Biz - Custom	Food Service	RET	per server	2,167	14%	301	0.06	0.04	9	\$27	100%	100%	10%	3	14%	25%	63.0%	63.0%	59.2%	5.8
865	Plug_Office	Server Virtualization	Biz - Custom	Health	RET	per server	2,167	14%	301	0.04	0.03	9	\$27	100%	100%	10%	3	18%	25%	63.0%	63.0%	59.2%	4.8
866	Plug_Office	Server Virtualization	Biz - Custom	Lodging	RET	per server	2,167	14%	301	0.03	0.04	9	\$27	100%	100%	10%	3	6%	25%	63.0%	63.0%	59.2%	4.6
867	Plug_Office	Server Virtualization	Biz - Custom	Retail	RET	per server	2,167	14%	301	0.05	0.03	9	\$27	100%	100%	10%	3	24%	25%	63.0%	63.0%	59.2%	5.3
868	Plug_Office	Server Virtualization	Biz - Custom	Office	RET	per server	2,167	14%	301	0.03	0.03	9	\$27	100%	100%	10%	3	30%	25%	63.0%	63.0%	59.2%	4.6
869	Plug_Office	Server Virtualization	Biz - Custom	Warehouse	RET	per server	2,167	14%	301	0.04	0.03	9	\$27	100%	100%	10%	3	30%	25%	63.0%	63.0%	59.2%	5.0
870	Plug_Office	Server Virtualization	Biz - Custom	Other	RET	per server	2,167	14%	301	0.04	0.04	9	\$27	100%	100%	10%	3	20%	25%	63.0%	63.0%	59.2%	4.9
871	Plug_Office	Electrically Commutated Plug Fans in data centers	Biz - Custom	Assembly	RET	per unit	86,783	18%	15,778	2.20	1.88	15	\$480	100%	100%	10%	4	21%	25%	63.0%	63.0%	61.7%	7.1
872	Plug_Office	Electrically Commutated Plug Fans in data centers	Biz - Custom	Education	RET	per unit	86,783	18%	15,778	1.42	1.78	15	\$480	100%	100%	10%	4	27%	25%	63.0%	63.0%	61.7%	6.1
873	Plug_Office	Electrically Commutated Plug Fans in data centers	Biz - Custom	Food Sales	RET	per unit	86,783	18%	15,778	3.20	1.99	15	\$480	100%	100%	10%	4	24%	25%	63.0%	63.0%	61.7%	8.4
874	Plug_Office	Electrically Commutated Plug Fans in data centers	Biz - Custom	Food Service	RET	per unit	86,783	18%	15,778	3.15	1.88	15	\$480	100%	100%	10%	4	14%	25%	63.0%	63.0%	61.7%	8.3
875	Plug_Office	Electrically Commutated Plug Fans in data centers	Biz - Custom	Health	RET	per unit	86,783	18%	15,778	1.92	1.78	15	\$480	100%	100%	10%	4	18%	25%	63.0%	63.0%	61.7%	6.8
876	Plug_Office	Electrically Commutated Plug Fans in data centers	Biz - Custom	Lodging	RET	per unit	86,783	18%	15,778	1.70	2.04	15	\$480	100%	100%	10%	4	6%	25%	63.0%	63.0%	61.7%	6.5
877	Plug_Office	Electrically Commutated Plug Fans in data centers	Biz - Custom	Retail	RET	per unit	86,783	18%	15,778	2.53	1.82	15	\$480	100%	100%	10%	4	24%	25%	63.0%	63.0%	61.7%	7.5
878	Plug_Office	Electrically Commutated Plug Fans in data centers	Biz - Custom	Office	RET	per unit	86,783	18%	15,778	1.72	1.80	15	\$480	100%	100%	10%	4	30%	25%	63.0%	63.0%	61.7%	6.5
879	Plug_Office	Electrically Commutated Plug Fans in data centers	Biz - Custom	Warehouse	RET	per unit	86,783	18%	15,778	2.15	1.71	15	\$480	100%	100%	10%	4	30%	25%	63.0%	63.0%	61.7%	7.0
880	Plug_Office	Electrically Commutated Plug Fans in data centers	Biz - Custom	Other	RET	per unit	86,783	18%	15,778	2.11	1.86	15	\$480	100%	100%	10%	4	20%	25%	63.0%	63.0%	61.7%	7.0
881	Plug_Office	High Efficiency CRAC unit	Biz - Custom	Assembly	TOS	per ton	9,272	28%	2,596	0.30	0.31	15	\$750	100%	35%	62%	5	21%	25%	63.0%	53.2%	57.8%	6.6
882	Plug_Office	High Efficiency CRAC unit	Biz - Custom	Education	TOS	per ton	9,272	28%	2,596	0.30	0.29	15	\$750	100%	35%	62%	5	27%	25%	63.0%	53.2%	57.8%	6.6
883	Plug_Office	High Efficiency CRAC unit	Biz - Custom	Food Sales	TOS	per ton	9,272	28%	2,596	0.30	0.33	15	\$750	100%	35%	62%	5	24%	25%	63.0%	53.2%	57.8%	6.6
884	Plug_Office	High Efficiency CRAC unit	Biz - Custom	Food Service	TOS	per ton	9,272	28%	2,596	0.30	0.31	15	\$750	100%	35%	62%	5	14%	25%	63.0%	53.2%	57.8%	6.7
885	Plug_Office	High Efficiency CRAC unit	Biz - Custom	Health	TOS	per ton	9,272	28%	2,596	0.30	0.29	15	\$750	100%	35%	62%	5	18%	25%	63.0%	53.2%	57.8%	6.6
886	Plug_Office	High Efficiency CRAC unit	Biz - Custom	Lodging	TOS	per ton	9,272	28%	2,596	0.30	0.34	15	\$750	100%	35%	62%	5	6%	25%	63.0%	53.2%	57.8%	6.6
887	Plug_Office	High Efficiency CRAC unit	Biz - Custom	Retail	TOS	per ton	9,272	28%	2,596	0.30	0.30	15	\$750	100%	35%	62%	5	24%	25%	63.0%	53.2%	57.8%	6.6
888	Plug_Office	High Efficiency CRAC unit	Biz - Custom	Office	TOS	per ton	9,272	28%	2,596	0.30	0.30	15	\$750	100%	35%	62%	5	30%	25%	63.0%	53.2%	57.8%	6.6
889	Plug_Office	High Efficiency CRAC unit	Biz - Custom	Warehouse	TOS	per ton	9,272	28%	2,596	0.30	0.28	15	\$750	100%	35%	62%	5	30%	25%	63.0%	53.2%	57.8%	6.6
890	Plug_Office	High Efficiency CRAC unit	Biz - Custom	Other	TOS	per ton	9,272	28%	2,596	0.30	0.31	15	\$750	100%	35%	62%	5	20%	25%	63.0%	53.2%	57.8%	6.6
891	Plug_Office	Computer Room Air Conditioner Economizer	Biz - Custom	Assembly	RET	mbtu/hr	764	47%	358	0.05	0.04	15	\$82	100%	44%	52%	5	21%	25%	63.0%	56.6%	57.8%	7.1
892	Plug_Office	Computer Room Air Conditioner Economizer	Biz - Custom	Education	RET	mbtu/hr	764	47%	358	0.03	0.04	15	\$82	100%	44%	52%	5	27%	25%	63.0%	56.6%	57.8%	6.1
893	Plug_Office	Computer Room Air Conditioner Economizer	Biz - Custom	Food Sales	RET	mbtu/hr	764	47%	358	0.07	0.05	15	\$82	100%	44%	52%	5	24%	25%	63.0%	56.6%	57.8%	8.4
894	Plug_Office	Computer Room Air Conditioner Economizer	Biz - Custom	Food Service	RET	mbtu/hr	764	47%	358	0.07	0.04	15	\$82	100%	44%	52%	5	14%	25%	63.0%	56.6%	57.8%	8.3
895	Plug_Office	Computer Room Air Conditioner Economizer	Biz - Custom	Health	RET	mbtu/hr	764	47%	358	0.04	0.04	15	\$82	100%	44%	52%	5	18%	25%	63.0%	56.6%	57.8%	6.8
896	Plug_Office	Computer Room Air Conditioner Economizer	Biz - Custom	Lodging	RET	mbtu/hr	764	47%	358	0.04	0.05	15	\$82	100%	44%	52%	5	6%	25%	63.0%	56.6%	57.8%	6.5
897	Plug_Office	Computer Room Air Conditioner Economizer	Biz - Custom	Retail	RET	mbtu/hr	764	47%	358	0.06	0.04	15	\$82	100%	44%	52%	5	24%	25%	63.0%	56.6%	57.8%	7.5
898	Plug_Office	Computer Room Air Conditioner Economizer	Biz - Custom	Office	RET	mbtu/hr	764	47%	358	0.04	0.04	15	\$82	100%	44%	52%	5	30%	25%	63.0%	56.6%	57.8%	6.5
899	Plug_Office	Computer Room Air Conditioner Economizer	Biz - Custom	Warehouse	RET	mbtu/hr	764	47%	358	0.05	0.04	15	\$82	100%	44%	52%	5	30%	25%	63.0%	56.6%	57.8%	7.0
900	Plug_Office	Computer Room Air Conditioner Economizer	Biz - Custom	Other	RET	mbtu/hr	764	47%	358	0.05	0.04	15	\$82	100%	44%	52%	5	20%	25%	63.0%	56.6%	57.8%	7.0
901	Plug_Office	Data Center Hot/Cold Aisle Configuration	Biz - Custom	Assembly	RET	er DC w/ H/C aisle	13	8%	1	0.00	0.00	10	\$0	100%	44%	52%	7	21%	25%	63.0%	56.8%	57.8%	5.4
902	Plug_Office	Data Center Hot/Cold Aisle Configuration	Biz - Custom	Education	RET	er DC w/ H/C aisle	13	8%	1	0.00	0.00	10	\$0	100%	44%	52%	7	27%	25%	63.0%	56.8%	57.8%	4.7
903	Plug_Office	Data Center Hot/Cold Aisle Configuration	Biz - Custom	Food Sales	RET	er DC w/ H/C aisle	13	8%	1	0.00	0.00	10	\$0	100%	44%	52%	7	24%	25%	63.0%	56.8%	57.8%	6.3
904	Plug_Office	Data Center Hot/Cold Aisle Configuration	Biz - Custom	Food Service	RET	er DC w/ H/C aisle	13	8%	1	0.00	0.00	10	\$0	100%	44%	52%	7	14%	25%	63.0%	56.8%	57.8%	6.3
905	Plug_Office	Data Center Hot/Cold Aisle Configuration	Biz - Custom	Health	RET	er DC w/ H/C aisle	13	8%	1	0.00	0.00	10	\$0	100%	44%	52%	7	18%	25%	63.0%	56.8%	57.8%	5.1
906	Plug_Office	Data Center Hot/Cold Aisle Configuration	Biz - Custom	Lodging	RET	er DC w/ H/C aisle	13	8%	1	0.00	0.00	10	\$0	100%	44%	52%	7	6%	25%	63.0%	56.8%	57.8%	4.9
907	Plug_Office	Data Center Hot/Cold Aisle Configuration	Biz - Custom	Retail	RET	er DC w/ H/C aisle	13	8%	1	0.00	0.00	10	\$0	100%	44%	52%	7	24%	25%	63.0%	56.8%	57.8%	5.7
908	Plug_Office	Data Center Hot/Cold Aisle Configuration	Biz - Custom	Office	RET	er DC w/ H/C aisle	13	8%	1	0.00	0.00	10	\$0	100%	44%	52%	7	30%	25%	63.0%	56.8%	57.8%	4.9
909	Plug_Office	Data Center Hot/Cold Aisle Configuration	Biz - Custom	Warehouse	RET	er DC w/ H/C aisle	13	8%	1	0.00	0.00	10	\$0	100%	44%	52%	7	30%	25%	63.0%	56.8%	57.8%	5.3
910	Plug_Office	Data Center Hot/Cold Aisle Configuration	Biz - Custom	Other	RET	er DC w/ H/C aisle	13	8%	1	0.00	0.00	10	\$0	100%	44%	52%	7	20%	25%	63.0%	56.8%	57.8%	5.3
911	Refrigeration	Strip Curtains, Cooler	Biz - Prescriptive	Assembly	RET	per in sq/ft	0	0%	0	0.00	0.00	4	\$10	49%	49%	100%	1	0%	25%	84.0%	84.0%	84.0%	0.0
912	Refrigeration	Strip Curtains, Cooler	Biz - Prescriptive	Education	RET	per in sq/ft	0	0%	0	0.00	0.00	4	\$10	49%	49%	100%	1	13%	25%	84.0%	84.0%	84.0%	0.0
913	Refrigeration	Strip Curtains, Cooler	Biz - Prescriptive	Food Sales	RET	per in sq/ft	536	15%	80	0.01	0.01	4	\$10	100%	49%	13%	1	19%	25%	84.0%	79.9%	77.0%	4.0
914	Refrigeration	Strip Curtains, Cooler	Biz - Prescriptive	Food Service	RET	per in sq/ft	96	15%	14	0.00	0.00	4	\$10	49%	49%	17%	1	7%	25%	56.6%	56.6%	40.2%	0.7
915	Refrigeration	Strip Curtains, Cooler	Biz - Prescriptive	Health	RET	per in sq/ft	0	0%	0	0.00	0.00	4	\$10	49%	49%	100%	1	9%	25%	84.0%	84.0%	84.0%	0.0
916	Refrigeration	Strip Curtains, Cooler	Biz - Prescriptive	Lodging	RET	per in sq/ft	0	0%	0	0.00	0.00</												

Appendix C: C&I Measure Assumptions

Measure #	End-Use	Measure Name	Program	Building Type	Replacement Type (TOS=Time of Sale)	Unit	Base Annual Electric	% Elec Savings	Per Unit Elec Savings	Per Unit Summer kW	Per Unit Winter 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
925	Refrigeration	Automated Door Closer for Refrigerator	Biz - Prescriptive	Health	RET	per building	1,259,893	0%	2,399	0.62	0.27	8	\$502	100%	50%	47%	1	9%	27%	84.0%	77.3%	77.0%	5.7
926	Refrigeration	Automated Door Closer for Refrigerator	Biz - Prescriptive	Lodging	RET	per building	1,259,893	0%	2,399	0.62	0.27	8	\$502	100%	50%	47%	1	12%	27%	84.0%	77.3%	77.0%	5.7
927	Refrigeration	Automated Door Closer for Refrigerator	Biz - Prescriptive	Retail	RET	per building	1,259,893	0%	2,399	0.62	0.27	8	\$502	100%	50%	47%	1	13%	27%	84.0%	77.3%	77.0%	5.7
928	Refrigeration	Automated Door Closer for Refrigerator	Biz - Prescriptive	Office	RET	per building	1,259,893	0%	2,399	0.62	0.27	8	\$502	100%	50%	47%	1	36%	27%	84.0%	77.3%	77.0%	5.7
929	Refrigeration	Automated Door Closer for Refrigerator	Biz - Prescriptive	Warehouse	RET	per building	1,259,893	0%	2,399	0.62	0.27	8	\$502	100%	50%	47%	1	40%	27%	84.0%	77.3%	77.0%	5.7
930	Refrigeration	Automated Door Closer for Refrigerator	Biz - Prescriptive	Other	RET	per building	1,259,893	0%	2,399	0.62	0.27	8	\$502	100%	50%	47%	1	10%	27%	84.0%	77.3%	77.0%	5.7
931	Refrigeration	Strip Curtains, Freezer	Biz - Prescriptive	Assembly	RET	per in sq/ft	0	0%	0	0.00	0.00	4	\$10	49%	49%	100%	2	0%	25%	84.0%	84.0%	84.0%	0.0
932	Refrigeration	Strip Curtains, Freezer	Biz - Prescriptive	Education	RET	per in sq/ft	0	0%	0	0.00	0.00	4	\$10	49%	49%	100%	2	7%	25%	84.0%	84.0%	84.0%	0.0
933	Refrigeration	Strip Curtains, Freezer	Biz - Prescriptive	Food Sales	RET	per in sq/ft	1,473	15%	221	0.03	0.03	4	\$10	100%	49%	10%	2	10%	25%	84.0%	82.5%	81.4%	11.0
934	Refrigeration	Strip Curtains, Freezer	Biz - Prescriptive	Food Service	RET	per in sq/ft	489	15%	73	0.01	0.01	4	\$10	100%	49%	21%	2	4%	25%	84.0%	79.5%	77.0%	3.6
935	Refrigeration	Strip Curtains, Freezer	Biz - Prescriptive	Health	RET	per in sq/ft	0	0%	0	0.00	0.00	4	\$10	49%	49%	100%	2	5%	25%	84.0%	84.0%	84.0%	0.0
936	Refrigeration	Strip Curtains, Freezer	Biz - Prescriptive	Lodging	RET	per in sq/ft	0	0%	0	0.00	0.00	4	\$10	49%	49%	100%	2	6%	25%	84.0%	84.0%	84.0%	0.0
937	Refrigeration	Strip Curtains, Freezer	Biz - Prescriptive	Retail	RET	per in sq/ft	0	0%	0	0.00	0.00	4	\$10	49%	49%	100%	2	7%	25%	84.0%	84.0%	84.0%	0.0
938	Refrigeration	Strip Curtains, Freezer	Biz - Prescriptive	Office	RET	per in sq/ft	0	0%	0	0.00	0.00	4	\$10	49%	49%	100%	2	19%	25%	84.0%	84.0%	84.0%	0.0
939	Refrigeration	Strip Curtains, Freezer	Biz - Prescriptive	Warehouse	RET	per in sq/ft	0	0%	0	0.00	0.00	4	\$10	49%	49%	100%	2	21%	25%	84.0%	84.0%	84.0%	0.0
940	Refrigeration	Strip Curtains, Freezer	Biz - Prescriptive	Other	RET	per in sq/ft	144	15%	22	0.00	0.00	4	\$10	50%	49%	25%	2	5%	25%	67.2%	66.8%	57.6%	1.1
941	Refrigeration	Automated Door Closer for Freezer	Biz - Prescriptive	Assembly	RET	per building	1,259,893	1%	6,949	1.30	0.77	8	\$502	100%	50%	10%	2	0%	27%	84.0%	81.7%	79.9%	14.3
942	Refrigeration	Automated Door Closer for Freezer	Biz - Prescriptive	Education	RET	per building	1,259,893	1%	6,949	1.30	0.78	8	\$502	100%	50%	10%	2	7%	58%	84.0%	81.7%	79.9%	14.3
943	Refrigeration	Automated Door Closer for Freezer	Biz - Prescriptive	Food Sales	RET	per building	1,259,893	1%	6,949	1.30	0.82	8	\$502	100%	50%	10%	2	10%	32%	84.0%	81.7%	79.9%	14.3
944	Refrigeration	Automated Door Closer for Freezer	Biz - Prescriptive	Food Service	RET	per building	1,259,893	1%	6,949	1.30	0.75	8	\$502	100%	50%	10%	2	4%	54%	84.0%	81.7%	79.9%	14.2
945	Refrigeration	Automated Door Closer for Freezer	Biz - Prescriptive	Health	RET	per building	1,259,893	1%	6,949	1.30	0.79	8	\$502	100%	50%	10%	2	5%	27%	84.0%	81.7%	79.9%	14.3
946	Refrigeration	Automated Door Closer for Freezer	Biz - Prescriptive	Lodging	RET	per building	1,259,893	1%	6,949	1.30	0.77	8	\$502	100%	50%	10%	2	6%	27%	84.0%	81.7%	79.9%	14.3
947	Refrigeration	Automated Door Closer for Freezer	Biz - Prescriptive	Retail	RET	per building	1,259,893	1%	6,949	1.30	0.77	8	\$502	100%	50%	10%	2	7%	27%	84.0%	81.7%	79.9%	14.3
948	Refrigeration	Automated Door Closer for Freezer	Biz - Prescriptive	Office	RET	per building	1,259,893	1%	6,949	1.30	0.77	8	\$502	100%	50%	10%	2	19%	27%	84.0%	81.7%	79.9%	14.3
949	Refrigeration	Automated Door Closer for Freezer	Biz - Prescriptive	Warehouse	RET	per building	1,259,893	1%	6,949	1.30	0.77	8	\$502	100%	50%	10%	2	21%	27%	84.0%	81.7%	79.9%	14.3
950	Refrigeration	Automated Door Closer for Freezer	Biz - Prescriptive	Other	RET	per building	1,259,893	1%	6,949	1.30	0.77	8	\$502	100%	50%	10%	2	5%	27%	84.0%	81.7%	79.9%	14.3
951	Refrigeration	Electronically Commutated (EC) Walk-In Evaporator Fan Motor	Biz - Prescriptive	Assembly	RET	per motor	2,884	55%	1,586	0.18	0.18	15	\$347	100%	58%	50%	3	0%	34%	84.0%	78.1%	77.0%	5.2
952	Refrigeration	Electronically Commutated (EC) Walk-In Evaporator Fan Motor	Biz - Prescriptive	Education	RET	per motor	2,884	55%	1,586	0.18	0.18	15	\$347	100%	58%	50%	3	10%	34%	84.0%	78.1%	77.0%	5.2
953	Refrigeration	Electronically Commutated (EC) Walk-In Evaporator Fan Motor	Biz - Prescriptive	Food Sales	RET	per motor	2,884	55%	1,586	0.18	0.19	15	\$347	100%	58%	50%	3	14%	34%	84.0%	78.1%	77.0%	5.2
954	Refrigeration	Electronically Commutated (EC) Walk-In Evaporator Fan Motor	Biz - Prescriptive	Food Service	RET	per motor	2,884	55%	1,586	0.18	0.17	15	\$347	100%	58%	50%	3	6%	34%	84.0%	78.1%	77.0%	5.2
955	Refrigeration	Electronically Commutated (EC) Walk-In Evaporator Fan Motor	Biz - Prescriptive	Health	RET	per motor	2,884	55%	1,586	0.18	0.18	15	\$347	100%	58%	50%	3	7%	34%	84.0%	78.1%	77.0%	5.2
956	Refrigeration	Electronically Commutated (EC) Walk-In Evaporator Fan Motor	Biz - Prescriptive	Lodging	RET	per motor	2,884	55%	1,586	0.18	0.18	15	\$347	100%	58%	50%	3	9%	34%	84.0%	78.1%	77.0%	5.2
957	Refrigeration	Electronically Commutated (EC) Walk-In Evaporator Fan Motor	Biz - Prescriptive	Retail	RET	per motor	2,884	55%	1,586	0.18	0.18	15	\$347	100%	58%	50%	3	10%	34%	84.0%	78.1%	77.0%	5.2
958	Refrigeration	Electronically Commutated (EC) Walk-In Evaporator Fan Motor	Biz - Prescriptive	Office	RET	per motor	2,884	55%	1,586	0.18	0.18	15	\$347	100%	58%	50%	3	27%	34%	84.0%	78.1%	77.0%	5.2
959	Refrigeration	Electronically Commutated (EC) Walk-In Evaporator Fan Motor	Biz - Prescriptive	Warehouse	RET	per motor	2,884	55%	1,586	0.18	0.18	15	\$347	100%	58%	50%	3	30%	34%	84.0%	78.1%	77.0%	5.2
960	Refrigeration	Electronically Commutated (EC) Walk-In Evaporator Fan Motor	Biz - Prescriptive	Other	RET	per motor	2,884	55%	1,586	0.18	0.18	15	\$347	100%	58%	50%	3	8%	34%	84.0%	78.1%	77.0%	5.2
961	Refrigeration	Q-Sync Motor for Walk-In Evaporator Fan Motor	Biz - Custom	Assembly	RET	per motor	2,091	24%	505	0.40	0.06	10	\$96	100%	53%	42%	3	0%	2%	63.0%	58.7%	57.8%	14.7
962	Refrigeration	Q-Sync Motor for Walk-In Evaporator Fan Motor	Biz - Custom	Education	RET	per motor	2,091	24%	505	0.40	0.06	10	\$96	100%	53%	42%	3	10%	2%	63.0%	58.7%	57.8%	14.7
963	Refrigeration	Q-Sync Motor for Walk-In Evaporator Fan Motor	Biz - Custom	Food Sales	RET	per motor	2,091	24%	505	0.40	0.06	10	\$96	100%	53%	42%	3	14%	2%	63.0%	58.7%	57.8%	14.8
964	Refrigeration	Q-Sync Motor for Walk-In Evaporator Fan Motor	Biz - Custom	Food Service	RET	per motor	2,091	24%	505	0.40	0.05	10	\$96	100%	53%	42%	3	6%	2%	63.0%	58.7%	57.8%	14.7
965	Refrigeration	Q-Sync Motor for Walk-In Evaporator Fan Motor	Biz - Custom	Health	RET	per motor	2,091	24%	505	0.40	0.06	10	\$96	100%	53%	42%	3	7%	2%	63.0%	58.7%	57.8%	14.8
966	Refrigeration	Q-Sync Motor for Walk-In Evaporator Fan Motor	Biz - Custom	Lodging	RET	per motor	2,091	24%	505	0.40	0.06	10	\$96	100%	53%	42%	3	9%	2%	63.0%	58.7%	57.8%	14.7
967	Refrigeration	Q-Sync Motor for Walk-In Evaporator Fan Motor	Biz - Custom	Retail	RET	per motor	2,091	24%	505	0.40	0.06	10	\$96	100%	53%	42%	3	10%	2%	63.0%	58.7%	57.8%	14.7
968	Refrigeration	Q-Sync Motor for Walk-In Evaporator Fan Motor	Biz - Custom	Office	RET	per motor	2,091	24%	505	0.40	0.06	10	\$96	100%	53%	42%	3	27%	2%	63.0%	58.7%	57.8%	14.7
969	Refrigeration	Q-Sync Motor for Walk-In Evaporator Fan Motor	Biz - Custom	Warehouse	RET	per motor	2,091	24%	505	0.40	0.06	10	\$96	100%	53%	42%	3	30%	2%	63.0%	58.7%	57.8%	14.7
970	Refrigeration	Q-Sync Motor for Walk-In Evaporator Fan Motor	Biz - Custom	Other	RET	per motor	2,091	24%	505	0.40	0.06	10	\$96	100%	53%	42%	3	8%	2%	63.0%	58.7%	57.8%	14.7
971	Refrigeration	Evaporator Fan Motor Controls	Biz - Prescriptive	Assembly	RET	per motor	1,298	23%	293	0.03	0.03	13	\$162	100%	68%	54%	4	0%	34%	84.0%	71.9%	65.7%	1.6
972	Refrigeration	Evaporator Fan Motor Controls	Biz - Prescriptive	Education	RET	per motor	1,298	23%	293	0.03	0.03	13	\$162	100%	68%	54%	4	10%	34%	84.0%	71.9%	65.7%	1.6
973	Refrigeration	Evaporator Fan Motor Controls	Biz - Prescriptive	Food Sales	RET	per motor	1,298	23%	293	0.03	0.03	13	\$162	100%	68%	54%	4	6%	34%	84.0%	71.9%	65.7%	1.6
974	Refrigeration	Evaporator Fan Motor Controls	Biz - Prescriptive	Food Service	RET	per motor	1,298	23%	293	0.03	0.03	13	\$162	100%	68%	54%	4	7%	34%	84.0%	71.9%	65.7%	1.6
975	Refrigeration	Evaporator Fan Motor Controls	Biz - Prescriptive	Health	RET	per motor	1,298	23%	293	0.03	0.03	13	\$162	100%	68%	54%	4	9%	34%	84.0%	71.9%	65.7%	1.6
976	Refrigeration	Evaporator Fan Motor Controls	Biz - Prescriptive	Lodging	RET	per motor	1,298	23%	293	0.03	0.03	13	\$162	100%	68%	54%	4	10%	34%	84.0%	71.9%	65.7%	1.6
977	Refrigeration	Evaporator Fan Motor Controls	Biz - Prescriptive	Retail	RET	per motor	1,298	23%	293	0.03	0.03	13	\$162	100%	68%	54%	4	27%	34%	84.0%	71.9%	65.7%	1.6
978	Refrigeration	Evaporator Fan Motor Controls	Biz - Prescriptive	Office	RET	per motor	1,298	23%	293	0.03	0.03	13	\$162	100%	68%	54%	4	30%	34%	84.0%	71.9%	65.7%	1.6
979	Refrigeration	Evaporator Fan Motor Controls	Biz - Prescriptive	Warehouse	RET	per motor	1,298	23%	293	0.03	0.03	13	\$162	100%	68%	54%	4	8%	34%	84.0%	71.9%	65.7%	1.6
980	Refrigeration	Evaporator Fan Motor Controls	Biz - Custom	Other	RET	per motor	1,298	23%	293	0.03	0.03	13	\$162	100%	18%	54%	4	8%	34%	63.0%	47.2%	49.3%	6.0
981	Refrigeration	Floating Head Pressure Controls	Biz - Custom	Assembly	RET	per HP	1,228	25%	307	0.00	0.03	15	\$431	7%	7%	23%	6	0%	20%	28.4%	28.4%	30.1%	4.3
982	Refrigeration	Floating Head Pressure Controls	Biz - Custom	Education	RET	per HP	1,228	25%	307	0.00	0.03	15	\$431	7%	7%	23%	6	10%	20%	28.4%	28.4%	30.1%	4.3
983	Refrigeration	Floating Head Pressure Controls	Biz - Custom	Food Sales	RET	per HP	1,228	25%	307	0.00	0.04	15	\$431	7%	7%	23%	6	14%	20%	28.4%	28.4%	30.1%	4.4
984	Refrigeration	Floating Head Pressure Controls	Biz - Custom	Food Service	RET	per HP	1,228	25%	307	0.00	0.03	15	\$431	7%	7%	23%	6	6%	20%	28.4%	28.4%	30.1%	4.3
985	Refrigeration	Floating Head Pressure Controls	Biz - Custom	Health	RET	per HP	1,228	25%	307	0.00	0.04	15	\$431	7%	7%	23%	6	7%	20%	28.4%	28.4%		

Appendix C: C&I Measure Assumptions

Measure #	End-Use	Measure Name	Program	Building Type	Replacement Type (TOS=Time of Sale)	Unit	Base Annual Electric	% Elec Savings	Per Unit Elec Savings	Per Unit Summer kW	Per Unit Winter 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
996	Refrigeration	Door Heater Controls for Cooler	Biz - Prescriptive	Lodging	RET	per door	752	45%	338	0.02	0.04	10	\$80	100%	100%	53%	2	2%	25%	84.0%	84.0%	77.0%	1.4
997	Refrigeration	Door Heater Controls for Cooler	Biz - Prescriptive	Retail	RET	per door	752	45%	338	0.02	0.04	10	\$80	100%	100%	53%	7	23%	25%	84.0%	84.0%	77.0%	1.4
998	Refrigeration	Door Heater Controls for Cooler	Biz - Prescriptive	Office	RET	per door	752	45%	338	0.02	0.04	10	\$80	100%	100%	53%	7	5%	25%	84.0%	84.0%	77.0%	1.4
999	Refrigeration	Door Heater Controls for Cooler	Biz - Prescriptive	Warehouse	RET	per door	752	45%	338	0.02	0.04	10	\$80	100%	100%	53%	7	3%	25%	84.0%	84.0%	77.0%	1.4
1000	Refrigeration	Door Heater Controls for Cooler	Biz - Prescriptive	Other	RET	per door	752	45%	338	0.02	0.04	10	\$80	100%	100%	53%	7	9%	25%	84.0%	84.0%	77.0%	1.4
1001	Refrigeration	Zero Energy Doors for Refrigerated Cases	Biz - Custom	Assembly	RET	per door	682	100%	682	0.05	0.08	12	\$735	9%	9%	26%	7	2%	25%	36.8%	36.8%	40.0%	5.0
1002	Refrigeration	Zero Energy Doors for Refrigerated Cases	Biz - Custom	Education	RET	per door	682	100%	682	0.05	0.08	12	\$735	9%	9%	26%	7	2%	25%	36.8%	36.8%	40.0%	5.0
1003	Refrigeration	Zero Energy Doors for Refrigerated Cases	Biz - Custom	Food Sales	RET	per door	682	100%	682	0.05	0.08	12	\$735	9%	9%	26%	7	14%	25%	36.8%	36.8%	40.0%	5.1
1004	Refrigeration	Zero Energy Doors for Refrigerated Cases	Biz - Custom	Food Service	RET	per door	682	100%	682	0.05	0.07	12	\$735	9%	9%	26%	7	7%	25%	36.8%	36.8%	40.0%	5.0
1005	Refrigeration	Zero Energy Doors for Refrigerated Cases	Biz - Custom	Health	RET	per door	682	100%	682	0.05	0.08	12	\$735	9%	9%	26%	7	4%	25%	36.8%	36.8%	40.0%	5.0
1006	Refrigeration	Zero Energy Doors for Refrigerated Cases	Biz - Custom	Lodging	RET	per door	682	100%	682	0.05	0.08	12	\$735	9%	9%	26%	7	2%	25%	36.8%	36.8%	40.0%	5.0
1007	Refrigeration	Zero Energy Doors for Refrigerated Cases	Biz - Custom	Retail	RET	per door	682	100%	682	0.05	0.08	12	\$735	9%	9%	26%	7	23%	25%	36.8%	36.8%	40.0%	5.0
1008	Refrigeration	Zero Energy Doors for Refrigerated Cases	Biz - Custom	Office	RET	per door	682	100%	682	0.05	0.08	12	\$735	9%	9%	26%	7	5%	25%	36.8%	36.8%	40.0%	5.0
1009	Refrigeration	Zero Energy Doors for Refrigerated Cases	Biz - Custom	Warehouse	RET	per door	682	100%	682	0.05	0.08	12	\$735	9%	9%	26%	7	3%	25%	36.8%	36.8%	40.0%	5.0
1010	Refrigeration	Zero Energy Doors for Refrigerated Cases	Biz - Custom	Other	RET	per door	682	100%	682	0.05	0.08	12	\$735	9%	9%	26%	7	9%	25%	36.8%	36.8%	40.0%	5.0
1011	Refrigeration	Display Case Door Retrofit, Medium Temp	Biz - Custom	Assembly	RET	per linear ft	1,558	50%	779	0.11	0.09	15	\$390	100%	20%	65%	8	0%	25%	63.0%	63.0%	53.9%	7.1
1012	Refrigeration	Display Case Door Retrofit, Medium Temp	Biz - Custom	Education	RET	per linear ft	1,558	50%	779	0.11	0.09	15	\$390	100%	20%	65%	8	0%	25%	63.0%	63.0%	53.9%	7.2
1013	Refrigeration	Display Case Door Retrofit, Medium Temp	Biz - Custom	Food Sales	RET	per linear ft	1,558	50%	779	0.09	0.09	15	\$390	100%	20%	65%	8	3%	25%	63.0%	63.0%	53.9%	6.7
1014	Refrigeration	Display Case Door Retrofit, Medium Temp	Biz - Custom	Food Service	RET	per linear ft	1,558	50%	779	0.11	0.08	15	\$390	100%	20%	65%	8	0%	25%	63.0%	63.0%	53.9%	7.1
1015	Refrigeration	Display Case Door Retrofit, Medium Temp	Biz - Custom	Health	RET	per linear ft	1,558	50%	779	0.12	0.09	15	\$390	100%	20%	65%	8	0%	25%	63.0%	63.0%	53.9%	7.4
1016	Refrigeration	Display Case Door Retrofit, Medium Temp	Biz - Custom	Lodging	RET	per linear ft	1,558	50%	779	0.11	0.09	15	\$390	100%	20%	65%	8	0%	25%	63.0%	63.0%	53.9%	7.0
1017	Refrigeration	Display Case Door Retrofit, Medium Temp	Biz - Custom	Retail	RET	per linear ft	1,558	50%	779	0.11	0.09	15	\$390	100%	20%	65%	8	0%	25%	63.0%	63.0%	53.9%	7.1
1018	Refrigeration	Display Case Door Retrofit, Medium Temp	Biz - Custom	Office	RET	per linear ft	1,558	50%	779	0.11	0.09	15	\$390	100%	20%	65%	8	1%	25%	63.0%	63.0%	53.9%	7.1
1019	Refrigeration	Display Case Door Retrofit, Medium Temp	Biz - Custom	Warehouse	RET	per linear ft	1,558	50%	779	0.11	0.09	15	\$390	100%	20%	65%	8	0%	25%	63.0%	63.0%	53.9%	7.1
1020	Refrigeration	Display Case Door Retrofit, Medium Temp	Biz - Custom	Other	RET	per linear ft	1,558	50%	779	0.11	0.09	15	\$390	100%	20%	65%	8	1%	25%	63.0%	63.0%	53.9%	7.1
1021	Refrigeration	Aerofolfs for Open Display Cases	Biz - Custom	Assembly	RET	per unit	45,880	10%	4,588	0.65	0.51	10	\$312	100%	100%	10%	8	0%	27%	63.0%	63.0%	60.1%	5.4
1022	Refrigeration	Aerofolfs for Open Display Cases	Biz - Custom	Education	RET	per unit	45,880	10%	4,588	0.67	0.52	10	\$312	100%	100%	10%	8	0%	58%	70.6%	66.4%	66.4%	5.5
1023	Refrigeration	Aerofolfs for Open Display Cases	Biz - Custom	Food Sales	RET	per unit	45,880	10%	4,588	0.56	0.54	10	\$312	100%	100%	10%	8	3%	32%	63.0%	63.0%	60.1%	5.1
1024	Refrigeration	Aerofolfs for Open Display Cases	Biz - Custom	Food Service	RET	per unit	45,880	10%	4,588	0.65	0.50	10	\$312	100%	100%	10%	8	0%	54%	67.8%	63.2%	63.2%	5.4
1025	Refrigeration	Aerofolfs for Open Display Cases	Biz - Custom	Health	RET	per unit	45,880	10%	4,588	0.71	0.52	10	\$312	100%	100%	10%	8	0%	27%	63.0%	63.0%	60.1%	5.6
1026	Refrigeration	Aerofolfs for Open Display Cases	Biz - Custom	Lodging	RET	per unit	45,880	10%	4,588	0.63	0.51	10	\$312	100%	100%	10%	8	0%	27%	63.0%	63.0%	60.1%	5.3
1027	Refrigeration	Aerofolfs for Open Display Cases	Biz - Custom	Retail	RET	per unit	45,880	10%	4,588	0.65	0.51	10	\$312	100%	100%	10%	8	0%	27%	63.0%	63.0%	60.1%	5.4
1028	Refrigeration	Aerofolfs for Open Display Cases	Biz - Custom	Office	RET	per unit	45,880	10%	4,588	0.65	0.51	10	\$312	100%	100%	10%	8	1%	27%	63.0%	63.0%	60.1%	5.4
1029	Refrigeration	Aerofolfs for Open Display Cases	Biz - Custom	Warehouse	RET	per unit	45,880	10%	4,588	0.65	0.51	10	\$312	100%	100%	10%	8	0%	27%	63.0%	63.0%	60.1%	5.4
1030	Refrigeration	Aerofolfs for Open Display Cases	Biz - Custom	Other	RET	per unit	45,880	10%	4,588	0.65	0.51	10	\$312	100%	100%	10%	8	1%	27%	63.0%	63.0%	60.1%	5.4
1031	Refrigeration	Night Covers for Coolers	Biz - Prescriptive	Assembly	RET	per sq ft	1,511	9%	136	0.00	0.02	5	\$42	60%	60%	47%	8	0%	55%	75.8%	75.8%	72.8%	1.1
1032	Refrigeration	Night Covers for Coolers	Biz - Prescriptive	Education	RET	per sq ft	1,511	9%	136	0.00	0.02	5	\$42	60%	60%	47%	8	0%	55%	75.8%	75.8%	72.8%	1.1
1033	Refrigeration	Night Covers for Coolers	Biz - Prescriptive	Food Sales	RET	per sq ft	1,511	9%	136	0.00	0.02	5	\$42	60%	60%	47%	8	3%	55%	75.8%	75.8%	72.8%	1.1
1034	Refrigeration	Night Covers for Coolers	Biz - Prescriptive	Food Service	RET	per sq ft	1,511	9%	136	0.00	0.01	5	\$42	60%	60%	47%	8	0%	55%	75.8%	75.8%	72.8%	1.1
1035	Refrigeration	Night Covers for Coolers	Biz - Prescriptive	Health	RET	per sq ft	1,511	9%	136	0.00	0.02	5	\$42	60%	60%	47%	8	0%	55%	75.8%	75.8%	72.8%	1.1
1036	Refrigeration	Night Covers for Coolers	Biz - Prescriptive	Lodging	RET	per sq ft	1,511	9%	136	0.00	0.02	5	\$42	60%	60%	47%	8	0%	55%	75.8%	75.8%	72.8%	1.1
1037	Refrigeration	Night Covers for Coolers	Biz - Prescriptive	Retail	RET	per sq ft	1,511	9%	136	0.00	0.02	5	\$42	60%	60%	47%	8	0%	55%	75.8%	75.8%	72.8%	1.1
1038	Refrigeration	Night Covers for Coolers	Biz - Prescriptive	Office	RET	per sq ft	1,511	9%	136	0.00	0.02	5	\$42	60%	60%	47%	8	1%	55%	75.8%	75.8%	72.8%	1.1
1039	Refrigeration	Night Covers for Coolers	Biz - Prescriptive	Warehouse	RET	per sq ft	1,511	9%	136	0.00	0.02	5	\$42	60%	60%	47%	8	0%	55%	75.8%	75.8%	72.8%	1.1
1040	Refrigeration	Night Covers for Coolers	Biz - Prescriptive	Other	RET	per sq ft	1,511	9%	136	0.00	0.02	5	\$42	60%	60%	47%	8	1%	55%	75.8%	75.8%	72.8%	1.1
1041	Refrigeration	Door Heater Controls for Freezer	Biz - Prescriptive	Assembly	RET	per door	3,024	45%	1,361	0.07	0.15	10	\$80	100%	100%	10%	9	3%	25%	84.0%	84.0%	80.7%	5.6
1042	Refrigeration	Door Heater Controls for Freezer	Biz - Prescriptive	Education	RET	per door	3,024	45%	1,361	0.07	0.15	10	\$80	100%	100%	10%	9	0%	25%	84.0%	84.0%	80.7%	5.6
1043	Refrigeration	Door Heater Controls for Freezer	Biz - Prescriptive	Food Sales	RET	per door	3,024	45%	1,361	0.07	0.16	10	\$80	100%	100%	10%	9	31%	25%	84.0%	84.0%	80.7%	5.6
1044	Refrigeration	Door Heater Controls for Freezer	Biz - Prescriptive	Food Service	RET	per door	3,024	45%	1,361	0.07	0.15	10	\$80	100%	100%	10%	9	9%	25%	84.0%	84.0%	80.7%	5.6
1045	Refrigeration	Door Heater Controls for Freezer	Biz - Prescriptive	Health	RET	per door	3,024	45%	1,361	0.07	0.16	10	\$80	100%	100%	10%	9	1%	25%	84.0%	84.0%	80.7%	5.6
1046	Refrigeration	Door Heater Controls for Freezer	Biz - Prescriptive	Lodging	RET	per door	3,024	45%	1,361	0.07	0.15	10	\$80	100%	100%	10%	9	1%	25%	84.0%	84.0%	80.7%	5.6
1047	Refrigeration	Door Heater Controls for Freezer	Biz - Prescriptive	Retail	RET	per door	3,024	45%	1,361	0.07	0.15	10	\$80	100%	100%	10%	9	23%	25%	84.0%	84.0%	80.7%	5.6
1048	Refrigeration	Door Heater Controls for Freezer	Biz - Prescriptive	Office	RET	per door	3,024	45%	1,361	0.07	0.15	10	\$80	100%	100%	10%	9	7%	25%	84.0%	84.0%	80.7%	5.6
1049	Refrigeration	Door Heater Controls for Freezer	Biz - Prescriptive	Warehouse	RET	per door	3,024	45%	1,361	0.07	0.15	10	\$80	100%	100%	10%	9	0%	25%	84.0%	84.0%	80.7%	5.6
1050	Refrigeration	Door Heater Controls for Freezer	Biz - Prescriptive	Other	RET	per door	3,024	45%	1,361	0.07	0.15	10	\$80	100%	100%	10%	9	16%	25%	84.0%	84.0%	80.7%	5.6
1051	Refrigeration	Night Covers for Freezers	Biz - Prescriptive	Assembly	RET	per sq ft	2,349	9%	211	0.00	0.02	5	\$42	100%	60%	45%	10	0%	55%	84.0%	78.9%	77.0%	1.8
1052	Refrigeration	Night Covers for Freezers	Biz - Prescriptive	Education	RET	per sq ft	2,349	9%	211	0.00	0.02	5	\$42	100%	60%	45%	10	0%	55%	84.0%	78.9%	77.0%	1.8
1053	Refrigeration	Night Covers for Freezers	Biz - Prescriptive	Food Sales	RET	per sq ft	2,349	9%	211	0.00	0.02	5	\$42	100%	60%	45%	10	4%	55%	84.0%	78.9%	77.0%	1.8
1054	Refrigeration	Night Covers for Freezers	Biz - Prescriptive	Food Service	RET	per sq ft	2,349	9%	211	0.00	0.02	5	\$42	100%	60%	45%	10	0%	55%	84.0%	78.9%	77.0%	1.8
1055	Refrigeration	Night Covers for Freezers	Biz - Prescriptive	Health	RET	per sq ft	2,349	9%	211	0.00	0.02	5	\$42	100%	60%	45%	10	0%	55%	84.0%	78.9%	77.0%	1.8
1056	Refrigeration	Night Covers for Freezers	Biz - Prescriptive	Lodging	RET	per sq ft	2,349	9%	211	0.00	0.02	5	\$42	100%	60%	45%	10	0%	55%	84.0%	78.9%	77.0%	1.8
1057	Refrigeration	Night Covers for Freezers	Biz - Prescriptive	Retail	RET	per sq ft	2,349	9%	211	0.00	0.02	5	\$42	100%	60%	45%	10	0%	55%	84.0%</			

Appendix C: C&I Measure Assumptions

Measure #	End-Use	Measure Name	Program	Building Type	Replacement Type (TOS=Time of Sale)	Unit	Base Annual Electric	% Elec Savings	Per Unit Elec Savings	Per Unit Summer kW	Per Unit Winter 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
1067	Refrigeration	Electronically Commutated (EC) Reach-In Evaporator Fan Motor	Biz - Prescriptive	Retail	RET	per motor	2,884	55%	1,586	0.18	0.18	15	\$347	100%	58%	50%	11	23%	34%	84.0%	78.1%	77.0%	5.2
1068	Refrigeration	Electronically Commutated (EC) Reach-In Evaporator Fan Motor	Biz - Prescriptive	Office	RET	per motor	2,884	55%	1,586	0.18	0.18	15	\$347	100%	58%	50%	11	6%	34%	84.0%	78.1%	77.0%	5.2
1069	Refrigeration	Electronically Commutated (EC) Reach-In Evaporator Fan Motor	Biz - Prescriptive	Warehouse	RET	per motor	2,884	55%	1,586	0.18	0.18	15	\$347	100%	58%	50%	11	1%	34%	84.0%	78.1%	77.0%	5.2
1070	Refrigeration	Electronically Commutated (EC) Reach-In Evaporator Fan Motor	Biz - Prescriptive	Other	RET	per motor	2,884	55%	1,586	0.18	0.18	15	\$347	100%	58%	50%	11	14%	34%	84.0%	78.1%	77.0%	5.2
1071	Refrigeration	Q-Sync Motor for Reach-In Evaporator Fan Motor	Biz - Custom	Assembly	RET	per motor	2,091	24%	505	0.40	0.06	10	\$96	100%	53%	42%	11	2%	2%	63.0%	58.7%	57.8%	14.7
1072	Refrigeration	Q-Sync Motor for Reach-In Evaporator Fan Motor	Biz - Custom	Education	RET	per motor	2,091	24%	505	0.40	0.06	10	\$96	100%	53%	42%	11	1%	2%	63.0%	58.7%	57.8%	14.7
1073	Refrigeration	Q-Sync Motor for Reach-In Evaporator Fan Motor	Biz - Custom	Food Sales	RET	per motor	2,091	24%	505	0.40	0.06	10	\$96	100%	53%	42%	11	26%	2%	63.0%	58.7%	57.8%	14.8
1074	Refrigeration	Q-Sync Motor for Reach-In Evaporator Fan Motor	Biz - Custom	Food Service	RET	per motor	2,091	24%	505	0.40	0.05	10	\$96	100%	53%	42%	11	8%	2%	63.0%	58.7%	57.8%	14.7
1075	Refrigeration	Q-Sync Motor for Reach-In Evaporator Fan Motor	Biz - Custom	Health	RET	per motor	2,091	24%	505	0.40	0.06	10	\$96	100%	53%	42%	11	3%	2%	63.0%	58.7%	57.8%	14.8
1076	Refrigeration	Q-Sync Motor for Reach-In Evaporator Fan Motor	Biz - Custom	Lodging	RET	per motor	2,091	24%	505	0.40	0.06	10	\$96	100%	53%	42%	11	1%	2%	63.0%	58.7%	57.8%	14.7
1077	Refrigeration	Q-Sync Motor for Reach-In Evaporator Fan Motor	Biz - Custom	Retail	RET	per motor	2,091	24%	505	0.40	0.06	10	\$96	100%	53%	42%	11	23%	2%	63.0%	58.7%	57.8%	14.7
1078	Refrigeration	Q-Sync Motor for Reach-In Evaporator Fan Motor	Biz - Custom	Office	RET	per motor	2,091	24%	505	0.40	0.06	10	\$96	100%	53%	42%	11	6%	2%	63.0%	58.7%	57.8%	14.7
1079	Refrigeration	Q-Sync Motor for Reach-In Evaporator Fan Motor	Biz - Custom	Warehouse	RET	per motor	2,091	24%	505	0.40	0.06	10	\$96	100%	53%	42%	11	1%	2%	63.0%	58.7%	57.8%	14.7
1080	Refrigeration	Q-Sync Motor for Reach-In Evaporator Fan Motor	Biz - Custom	Other	RET	per motor	2,091	24%	505	0.40	0.06	10	\$96	100%	53%	42%	11	14%	2%	63.0%	58.7%	57.8%	14.7
1081	Refrigeration	LED Refrigerated Display Case Lighting Average 6W/LF	Biz - Custom	Assembly	TOS	per linear ft	115	74%	84	0.01	0.01	9	\$11	100%	77%	16%	12	1%	35%	63.0%	61.6%	57.8%	5.4
1082	Refrigeration	LED Refrigerated Display Case Lighting Average 6W/LF	Biz - Custom	Education	TOS	per linear ft	115	74%	84	0.01	0.01	9	\$11	100%	77%	16%	12	1%	35%	63.0%	61.6%	57.8%	5.4
1083	Refrigeration	LED Refrigerated Display Case Lighting Average 6W/LF	Biz - Custom	Food Sales	TOS	per linear ft	115	74%	84	0.01	0.01	9	\$11	100%	77%	16%	12	13%	35%	63.0%	61.6%	57.8%	5.4
1084	Refrigeration	LED Refrigerated Display Case Lighting Average 6W/LF	Biz - Custom	Food Service	TOS	per linear ft	115	74%	84	0.01	0.01	9	\$11	100%	77%	16%	12	4%	35%	63.0%	61.6%	57.8%	5.4
1085	Refrigeration	LED Refrigerated Display Case Lighting Average 6W/LF	Biz - Custom	Health	TOS	per linear ft	115	74%	84	0.01	0.01	9	\$11	100%	77%	16%	12	1%	35%	63.0%	61.6%	57.8%	5.4
1086	Refrigeration	LED Refrigerated Display Case Lighting Average 6W/LF	Biz - Custom	Lodging	TOS	per linear ft	115	74%	84	0.01	0.01	9	\$11	100%	77%	16%	12	1%	35%	63.0%	61.6%	57.8%	5.4
1087	Refrigeration	LED Refrigerated Display Case Lighting Average 6W/LF	Biz - Custom	Retail	TOS	per linear ft	115	74%	84	0.01	0.01	9	\$11	100%	77%	16%	12	11%	35%	63.0%	61.6%	57.8%	5.4
1088	Refrigeration	LED Refrigerated Display Case Lighting Average 6W/LF	Biz - Custom	Office	TOS	per linear ft	115	74%	84	0.01	0.01	9	\$11	100%	77%	16%	12	3%	35%	63.0%	61.6%	57.8%	5.4
1089	Refrigeration	LED Refrigerated Display Case Lighting Average 6W/LF	Biz - Custom	Warehouse	TOS	per linear ft	115	74%	84	0.01	0.01	9	\$11	100%	77%	16%	12	1%	35%	63.0%	61.6%	57.8%	5.4
1090	Refrigeration	LED Refrigerated Display Case Lighting Average 6W/LF	Biz - Custom	Other	TOS	per linear ft	115	74%	84	0.01	0.01	9	\$11	100%	77%	16%	12	7%	35%	63.0%	61.6%	57.8%	5.4
1091	Refrigeration	Solid/Glass ENERGY STAR Refrigerator	Biz - Prescriptive	Assembly	TOS	per unit	953	32%	301	0.03	0.03	12	\$123	100%	61%	69%	13	71%	55%	84.0%	73.2%	75.7%	2.2
1092	Refrigeration	Solid/Glass ENERGY STAR Refrigerator	Biz - Prescriptive	Education	TOS	per unit	953	32%	301	0.03	0.03	12	\$123	100%	61%	69%	13	47%	55%	84.0%	73.2%	75.7%	2.2
1093	Refrigeration	Solid/Glass ENERGY STAR Refrigerator	Biz - Prescriptive	Food Sales	TOS	per unit	953	32%	301	0.03	0.04	12	\$123	100%	61%	69%	13	9%	55%	84.0%	73.2%	75.7%	2.2
1094	Refrigeration	Solid/Glass ENERGY STAR Refrigerator	Biz - Prescriptive	Food Service	TOS	per unit	953	32%	301	0.03	0.03	12	\$123	100%	61%	69%	13	54%	55%	84.0%	73.2%	75.7%	2.2
1095	Refrigeration	Solid/Glass ENERGY STAR Refrigerator	Biz - Prescriptive	Health	TOS	per unit	953	32%	301	0.03	0.03	12	\$123	100%	61%	69%	13	58%	55%	84.0%	73.2%	75.7%	2.2
1096	Refrigeration	Solid/Glass ENERGY STAR Refrigerator	Biz - Prescriptive	Lodging	TOS	per unit	953	32%	301	0.03	0.03	12	\$123	100%	61%	69%	13	48%	55%	84.0%	73.2%	75.7%	2.2
1097	Refrigeration	Solid/Glass ENERGY STAR Refrigerator	Biz - Prescriptive	Retail	TOS	per unit	953	32%	301	0.03	0.03	12	\$123	100%	61%	69%	13	21%	55%	84.0%	73.2%	75.7%	2.2
1098	Refrigeration	Solid/Glass ENERGY STAR Refrigerator	Biz - Prescriptive	Office	TOS	per unit	953	32%	301	0.03	0.03	12	\$123	100%	61%	69%	13	14%	55%	84.0%	73.2%	75.7%	2.2
1099	Refrigeration	Solid/Glass ENERGY STAR Refrigerator	Biz - Prescriptive	Warehouse	TOS	per unit	953	32%	301	0.03	0.03	12	\$123	100%	61%	69%	13	17%	55%	84.0%	73.2%	75.7%	2.2
1100	Refrigeration	Solid/Glass ENERGY STAR Refrigerator	Biz - Prescriptive	Other	TOS	per unit	953	32%	301	0.03	0.03	12	\$123	100%	61%	69%	13	38%	55%	84.0%	73.2%	75.7%	2.2
1101	Refrigeration	Solid/Glass ENERGY STAR Freezer	Biz - Prescriptive	Assembly	TOS	per unit	2,654	20%	526	0.06	0.06	12	\$57	100%	100%	10%	14	19%	2%	84.0%	84.0%	77.9%	3.9
1102	Refrigeration	Solid/Glass ENERGY STAR Freezer	Biz - Prescriptive	Education	TOS	per unit	2,654	20%	526	0.06	0.06	12	\$57	100%	100%	10%	14	25%	2%	84.0%	84.0%	77.9%	3.9
1103	Refrigeration	Solid/Glass ENERGY STAR Freezer	Biz - Prescriptive	Food Sales	TOS	per unit	2,654	20%	526	0.06	0.06	12	\$57	100%	100%	10%	14	4%	2%	84.0%	84.0%	77.9%	3.9
1104	Refrigeration	Solid/Glass ENERGY STAR Freezer	Biz - Prescriptive	Food Service	TOS	per unit	2,654	20%	526	0.06	0.06	12	\$57	100%	100%	10%	14	13%	2%	84.0%	84.0%	77.9%	3.9
1105	Refrigeration	Solid/Glass ENERGY STAR Freezer	Biz - Prescriptive	Health	TOS	per unit	2,654	20%	526	0.06	0.06	12	\$57	100%	100%	10%	14	17%	2%	84.0%	84.0%	77.9%	3.9
1106	Refrigeration	Solid/Glass ENERGY STAR Freezer	Biz - Prescriptive	Lodging	TOS	per unit	2,654	20%	526	0.06	0.06	12	\$57	100%	100%	10%	14	24%	2%	84.0%	84.0%	77.9%	3.9
1107	Refrigeration	Solid/Glass ENERGY STAR Freezer	Biz - Prescriptive	Retail	TOS	per unit	2,654	20%	526	0.06	0.06	12	\$57	100%	100%	10%	14	8%	2%	84.0%	84.0%	77.9%	3.9
1108	Refrigeration	Solid/Glass ENERGY STAR Freezer	Biz - Prescriptive	Office	TOS	per unit	2,654	20%	526	0.06	0.06	12	\$57	100%	100%	10%	14	13%	2%	84.0%	84.0%	77.9%	3.9
1109	Refrigeration	Solid/Glass ENERGY STAR Freezer	Biz - Prescriptive	Warehouse	TOS	per unit	2,654	20%	526	0.06	0.06	12	\$57	100%	100%	10%	14	14%	2%	84.0%	84.0%	77.9%	3.9
1110	Refrigeration	Solid/Glass ENERGY STAR Freezer	Biz - Prescriptive	Other	TOS	per unit	2,654	20%	526	0.06	0.06	12	\$57	100%	100%	10%	14	13%	2%	84.0%	84.0%	77.9%	3.9
1111	Refrigeration	Commercial Ice Marker	Biz - Prescriptive	Assembly	TOS	per unit	5,551	8%	440	0.08	0.05	9	\$222	100%	68%	46%	15	4%	5%	84.0%	72.9%	64.3%	1.6
1112	Refrigeration	Commercial Ice Marker	Biz - Prescriptive	Education	TOS	per unit	5,551	8%	440	0.08	0.05	9	\$222	100%	68%	46%	15	3%	5%	84.0%	72.9%	64.3%	1.6
1113	Refrigeration	Commercial Ice Marker	Biz - Prescriptive	Food Sales	TOS	per unit	5,551	8%	440	0.08	0.05	9	\$222	100%	68%	46%	15	0%	5%	84.0%	72.9%	64.3%	1.6
1114	Refrigeration	Commercial Ice Marker	Biz - Prescriptive	Food Service	TOS	per unit	5,551	8%	440	0.08	0.05	9	\$222	100%	68%	46%	15	3%	5%	84.0%	72.9%	64.3%	1.6
1115	Refrigeration	Commercial Ice Marker	Biz - Prescriptive	Health	TOS	per unit	5,551	8%	440	0.08	0.05	9	\$222	100%	68%	46%	15	3%	5%	84.0%	72.9%	64.3%	1.6
1116	Refrigeration	Commercial Ice Marker	Biz - Prescriptive	Lodging	TOS	per unit	5,551	8%	440	0.08	0.05	9	\$222	100%	68%	46%	15	5%	5%	84.0%	72.9%	64.3%	1.6
1117	Refrigeration	Commercial Ice Marker	Biz - Prescriptive	Retail	TOS	per unit	5,551	8%	440	0.08	0.05	9	\$222	100%	68%	46%	15	1%	5%	84.0%	72.9%	64.3%	1.6
1118	Refrigeration	Commercial Ice Marker	Biz - Prescriptive	Office	TOS	per unit	5,551	8%	440	0.08	0.05	9	\$222	100%	68%	46%	15	5%	5%	84.0%	72.9%	64.3%	1.6
1119	Refrigeration	Commercial Ice Marker	Biz - Prescriptive	Warehouse	TOS	per unit	5,551	8%	440	0.08	0.05	9	\$222	100%	68%	46%	15	28%	5%	84.0%	72.9%	64.3%	1.6
1120	Refrigeration	Commercial Ice Marker	Biz - Prescriptive	Other	TOS	per unit	5,551	8%	440	0.08	0.05	9	\$222	100%	68%	46%	15	4%	5%	84.0%	72.9%	64.3%	1.6
1121	Refrigeration	ESTAR Refrigerated Vending Machine	Biz - Custom	Assembly	TOS	per unit	1,278	12%	153	0.00	0.02	14	\$500	3%	3%	10%	16	2%	21%	26.9%	26.9%	26.9%	4.2
1122	Refrigeration	ESTAR Refrigerated Vending Machine	Biz - Custom	Education	TOS	per unit	1,278	12%	153	0.00	0.02	14	\$500	3%	3%	10%	16	3%	21%	26.9%	26.9%	26.9%	4.2
1123	Refrigeration	ESTAR Refrigerated Vending Machine	Biz - Custom	Food Sales	TOS	per unit	1,278	12%	153	0.00	0.02	14	\$500	3%	3%	10%	16	0%	21%	26.9%	26.9%	26.9%	4.2
1124	Refrigeration	ESTAR Refrigerated Vending Machine	Biz - Custom	Food Service	TOS	per unit	1,278	12%	153	0.00	0.02	14	\$500	3%	3%	10%	16	0%	21%	26.9%	26.9%	26.9%	4.2
1125	Refrigeration	ESTAR Refrigerated Vending Machine	Biz - Custom	Health	TOS	per unit	1,278	12%	153	0.00	0.02	14	\$500	3%	3%	10%	16	3%	21%	26.9%	26.9%	26.9%	4.2
1126	Refrigeration	ESTAR Refrigerated Vending Machine	Biz - Custom	Lodging	TOS	per unit	1,278	12%	153	0.00	0.02	14	\$500	3%	3%	10%	16	5%	21%	26.9%	26.9%	26.9%	4.2
1127	Refrigeration	ESTAR Refrigerated Vending Machine	Biz - Custom	Retail	TOS	per unit	1,278	12%	153	0.00	0.02	14	\$500	3%	3%	10%	16	4%	21%	26.9%	26.9%	26.9%	4.2
1128	Refrigeration	ESTAR Refrigerated Vending Machine	Biz - Custom	Office																			

Appendix C: C&I Measure Assumptions

Measure #	End-Use	Measure Name	Program	Building Type	Replacement Type (TOS=Time of Sale)	Unit	Base Annual Electric	% Elec Savings	Per Unit Elec Savings	Per Unit Summer kW	Per Unit Winter 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
1138	Refrigeration	Refrigerated Vending Machine Controls	Biz - Prescriptive	Office	RET	per unit	1,478	25%	374	0.00	0.04	5	\$245	14%	14%	22%	16	10%	31%	51.7%	44.8%	44.8%	2.2
1139	Refrigeration	Refrigerated Vending Machine Controls	Biz - Prescriptive	Warehouse	RET	per unit	1,478	26%	378	0.00	0.04	5	\$245	14%	14%	22%	16	9%	31%	51.7%	44.8%	44.8%	2.3
1140	Refrigeration	Refrigerated Vending Machine Controls	Biz - Prescriptive	Other	RET	per unit	1,478	25%	370	0.00	0.04	5	\$245	14%	14%	22%	16	5%	31%	51.7%	44.8%	44.8%	2.2
1141	Refrigeration	Refrigeration - Custom	Biz - Custom	Assembly	RET	per kWh	7	15%	1	0.00	0.00	10	\$0	100%	25%	62%	17	4%	25%	63.0%	46.7%	55.3%	5.4
1142	Refrigeration	Refrigeration - Custom	Biz - Custom	Education	RET	per kWh	7	15%	1	0.00	0.00	10	\$0	100%	25%	62%	17	22%	25%	63.0%	46.7%	55.3%	5.5
1143	Refrigeration	Refrigeration - Custom	Biz - Custom	Food Sales	RET	per kWh	7	15%	1	0.00	0.00	10	\$0	100%	25%	62%	17	81%	25%	63.0%	46.7%	55.3%	5.1
1144	Refrigeration	Refrigeration - Custom	Biz - Custom	Food Service	RET	per kWh	7	15%	1	0.00	0.00	10	\$0	100%	25%	62%	17	27%	25%	63.0%	46.7%	55.3%	5.4
1145	Refrigeration	Refrigeration - Custom	Biz - Custom	Health	RET	per kWh	7	15%	1	0.00	0.00	10	\$0	100%	25%	62%	17	19%	25%	63.0%	46.7%	55.3%	5.6
1146	Refrigeration	Refrigeration - Custom	Biz - Custom	Lodging	RET	per kWh	7	15%	1	0.00	0.00	10	\$0	100%	25%	62%	17	21%	25%	63.0%	46.7%	55.3%	5.3
1147	Refrigeration	Refrigeration - Custom	Biz - Custom	Retail	RET	per kWh	7	15%	1	0.00	0.00	10	\$0	100%	25%	62%	17	65%	25%	63.0%	46.7%	55.3%	5.4
1148	Refrigeration	Refrigeration - Custom	Biz - Custom	Office	RET	per kWh	7	15%	1	0.00	0.00	10	\$0	100%	25%	62%	17	67%	25%	63.0%	46.7%	55.3%	5.4
1149	Refrigeration	Refrigeration - Custom	Biz - Custom	Warehouse	RET	per kWh	7	15%	1	0.00	0.00	10	\$0	100%	25%	62%	17	63%	25%	63.0%	46.7%	55.3%	5.4
1150	Refrigeration	Refrigeration - Custom	Biz - Custom	Other	RET	per kWh	7	15%	1	0.00	0.00	10	\$0	100%	25%	62%	17	43%	25%	63.0%	46.7%	55.3%	5.4
1151	Refrigeration	Retro-commissioning_Refrigerator Optimization	Biz - CustomRCx	Assembly	RET	per kWh	5	21%	1	0.00	0.00	5	\$0	100%	45%	50%	17	4%	15%	63.0%	57.2%	57.8%	3.2
1152	Refrigeration	Retro-commissioning_Refrigerator Optimization	Biz - CustomRCx	Education	RET	per kWh	5	21%	1	0.00	0.00	5	\$0	100%	45%	50%	17	22%	15%	63.0%	57.2%	57.8%	3.2
1153	Refrigeration	Retro-commissioning_Refrigerator Optimization	Biz - CustomRCx	Food Sales	RET	per kWh	5	21%	1	0.00	0.00	5	\$0	100%	45%	50%	17	81%	15%	63.0%	57.2%	57.8%	3.0
1154	Refrigeration	Retro-commissioning_Refrigerator Optimization	Biz - CustomRCx	Food Service	RET	per kWh	5	21%	1	0.00	0.00	5	\$0	100%	45%	50%	17	27%	15%	63.0%	57.2%	57.8%	3.2
1155	Refrigeration	Retro-commissioning_Refrigerator Optimization	Biz - CustomRCx	Health	RET	per kWh	5	21%	1	0.00	0.00	5	\$0	100%	45%	50%	17	19%	15%	63.0%	57.2%	57.8%	3.3
1156	Refrigeration	Retro-commissioning_Refrigerator Optimization	Biz - CustomRCx	Lodging	RET	per kWh	5	21%	1	0.00	0.00	5	\$0	100%	45%	50%	17	21%	15%	63.0%	57.2%	57.8%	3.2
1157	Refrigeration	Retro-commissioning_Refrigerator Optimization	Biz - CustomRCx	Retail	RET	per kWh	5	21%	1	0.00	0.00	5	\$0	100%	45%	50%	17	65%	15%	63.0%	57.2%	57.8%	3.2
1158	Refrigeration	Retro-commissioning_Refrigerator Optimization	Biz - CustomRCx	Office	RET	per kWh	5	21%	1	0.00	0.00	5	\$0	100%	45%	50%	17	67%	15%	63.0%	57.2%	57.8%	3.2
1159	Refrigeration	Retro-commissioning_Refrigerator Optimization	Biz - CustomRCx	Warehouse	RET	per kWh	5	21%	1	0.00	0.00	5	\$0	100%	45%	50%	17	63%	15%	63.0%	57.2%	57.8%	3.2
1160	Refrigeration	Retro-commissioning_Refrigerator Optimization	Biz - CustomRCx	Other	RET	per kWh	5	21%	1	0.00	0.00	5	\$0	100%	45%	50%	17	43%	15%	63.0%	57.2%	57.8%	3.2
1161	WholeBldg	Power Distribution Equipment Upgrades (Transformers)	Biz - Custom	Assembly	RET	per kVA	990	1%	6	0.00	0.00	30	\$6	75%	9%	39%	2	100%	20%	47.8%	31.3%	36.0%	11.0
1162	WholeBldg	Power Distribution Equipment Upgrades (Transformers)	Biz - Custom	Education	RET	per kVA	990	1%	6	0.00	0.00	30	\$6	100%	9%	39%	2	100%	20%	63.0%	31.3%	36.0%	12.5
1163	WholeBldg	Power Distribution Equipment Upgrades (Transformers)	Biz - Custom	Food Sales	RET	per kVA	990	1%	6	0.00	0.00	30	\$6	75%	9%	39%	2	100%	20%	47.8%	31.3%	36.0%	10.8
1164	WholeBldg	Power Distribution Equipment Upgrades (Transformers)	Biz - Custom	Food Service	RET	per kVA	990	1%	6	0.00	0.00	30	\$6	100%	9%	39%	2	100%	20%	63.0%	31.3%	36.0%	12.5
1165	WholeBldg	Power Distribution Equipment Upgrades (Transformers)	Biz - Custom	Health	RET	per kVA	990	1%	6	0.00	0.00	30	\$6	75%	9%	39%	2	100%	20%	47.8%	31.3%	36.0%	10.7
1166	WholeBldg	Power Distribution Equipment Upgrades (Transformers)	Biz - Custom	Lodging	RET	per kVA	990	1%	6	0.00	0.00	30	\$6	75%	9%	39%	2	100%	20%	47.8%	31.3%	36.0%	10.4
1167	WholeBldg	Power Distribution Equipment Upgrades (Transformers)	Biz - Custom	Retail	RET	per kVA	990	1%	6	0.00	0.00	30	\$6	100%	9%	39%	2	100%	20%	63.0%	31.3%	36.0%	12.7
1168	WholeBldg	Power Distribution Equipment Upgrades (Transformers)	Biz - Custom	Office	RET	per kVA	990	1%	6	0.00	0.00	30	\$6	75%	9%	39%	2	100%	20%	47.8%	31.3%	36.0%	10.6
1169	WholeBldg	Power Distribution Equipment Upgrades (Transformers)	Biz - Custom	Warehouse	RET	per kVA	990	1%	6	0.00	0.00	30	\$6	75%	9%	39%	2	100%	20%	47.8%	31.3%	36.0%	10.7
1170	WholeBldg	Power Distribution Equipment Upgrades (Transformers)	Biz - Custom	Other	RET	per kVA	990	1%	6	0.00	0.00	30	\$6	75%	9%	39%	2	100%	20%	47.8%	31.3%	36.0%	10.9
1171	WholeBldg	WholeBldg - Com RET	Biz - Custom	Assembly	RET	per kWh	7	15%	1	0.00	0.00	15	\$0	100%	25%	73%	1	80%	0%	63.0%	46.7%	57.8%	7.5
1172	WholeBldg	WholeBldg - Com RET	Biz - Custom	Education	RET	per kWh	7	15%	1	0.00	0.00	15	\$0	100%	25%	73%	1	80%	0%	63.0%	46.7%	57.8%	8.5
1173	WholeBldg	WholeBldg - Com RET	Biz - Custom	Food Sales	RET	per kWh	7	15%	1	0.00	0.00	15	\$0	100%	25%	73%	1	80%	0%	63.0%	46.7%	57.8%	7.4
1174	WholeBldg	WholeBldg - Com RET	Biz - Custom	Food Service	RET	per kWh	7	15%	1	0.00	0.00	15	\$0	100%	25%	73%	1	80%	0%	63.0%	46.7%	57.8%	8.5
1175	WholeBldg	WholeBldg - Com RET	Biz - Custom	Health	RET	per kWh	7	15%	1	0.00	0.00	15	\$0	100%	25%	73%	1	80%	0%	63.0%	46.7%	57.8%	7.3
1176	WholeBldg	WholeBldg - Com RET	Biz - Custom	Lodging	RET	per kWh	7	15%	1	0.00	0.00	15	\$0	100%	25%	73%	1	80%	0%	63.0%	46.7%	57.8%	7.1
1177	WholeBldg	WholeBldg - Com RET	Biz - Custom	Retail	RET	per kWh	7	15%	1	0.00	0.00	15	\$0	100%	25%	73%	1	80%	0%	63.0%	46.7%	57.8%	8.7
1178	WholeBldg	WholeBldg - Com RET	Biz - Custom	Office	RET	per kWh	7	15%	1	0.00	0.00	15	\$0	100%	25%	73%	1	80%	0%	63.0%	46.7%	57.8%	7.3
1179	WholeBldg	WholeBldg - Com RET	Biz - Custom	Warehouse	RET	per kWh	7	15%	1	0.00	0.00	15	\$0	100%	25%	73%	1	80%	0%	63.0%	46.7%	57.8%	7.3
1180	WholeBldg	WholeBldg - Com RET	Biz - Custom	Other	RET	per kWh	7	15%	1	0.00	0.00	15	\$0	100%	25%	73%	1	80%	0%	63.0%	46.7%	57.8%	7.5
1181	WholeBldg_NC	WholeBldg - Com NC	Biz - CustomNC	Assembly	NEW	per kWh	4	25%	1	0.00	0.00	15	\$0	100%	25%	73%	1	100%	60%	72.0%	68.0%	68.0%	7.5
1182	WholeBldg_NC	WholeBldg - Com NC	Biz - CustomNC	Education	NEW	per kWh	4	25%	1	0.00	0.00	15	\$0	100%	25%	73%	1	100%	60%	72.0%	68.0%	68.0%	8.5
1183	WholeBldg_NC	WholeBldg - Com NC	Biz - CustomNC	Food Sales	NEW	per kWh	4	25%	1	0.00	0.00	15	\$0	100%	25%	73%	1	100%	60%	72.0%	68.0%	68.0%	7.4
1184	WholeBldg_NC	WholeBldg - Com NC	Biz - CustomNC	Food Service	NEW	per kWh	4	25%	1	0.00	0.00	15	\$0	100%	25%	73%	1	100%	60%	72.0%	68.0%	68.0%	8.5
1185	WholeBldg_NC	WholeBldg - Com NC	Biz - CustomNC	Health	NEW	per kWh	4	25%	1	0.00	0.00	15	\$0	100%	25%	73%	1	100%	60%	72.0%	68.0%	68.0%	7.3
1186	WholeBldg_NC	WholeBldg - Com NC	Biz - CustomNC	Lodging	NEW	per kWh	4	25%	1	0.00	0.00	15	\$0	100%	25%	73%	1	100%	60%	72.0%	68.0%	68.0%	7.1
1187	WholeBldg_NC	WholeBldg - Com NC	Biz - CustomNC	Retail	NEW	per kWh	4	25%	1	0.00	0.00	15	\$0	100%	25%	73%	1	100%	60%	72.0%	68.0%	68.0%	8.7
1188	WholeBldg_NC	WholeBldg - Com NC	Biz - CustomNC	Office	NEW	per kWh	4	25%	1	0.00	0.00	15	\$0	100%	25%	73%	1	100%	60%	72.0%	68.0%	68.0%	7.3
1189	WholeBldg_NC	WholeBldg - Com NC	Biz - CustomNC	Warehouse	NEW	per kWh	4	25%	1	0.00	0.00	15	\$0	100%	25%	73%	1	100%	60%	72.0%	68.0%	68.0%	7.3
1190	WholeBldg_NC	WholeBldg - Com NC	Biz - CustomNC	Other	NEW	per kWh	4	25%	1	0.00	0.00	15	\$0	100%	25%	73%	1	100%	60%	72.0%	68.0%	68.0%	7.5
1191	WholeBldg	COM Competitions	Biz - Custom	Assembly	RET	per kWh	0	0%	1	0.00	0.00	2	\$0	100%	100%	10%	3	100%	0%	63.0%	63.0%	61.2%	1.5
1192	WholeBldg	COM Competitions	Biz - Custom	Education	RET	per kWh	0	0%	1	0.00	0.00	2	\$0	100%	100%	10%	3	100%	0%	63.0%	63.0%	61.2%	1.7
1193	WholeBldg	COM Competitions	Biz - Custom	Food Sales	RET	per kWh	0	0%	1	0.00	0.00	2	\$0	100%	100%	10%	3	100%	0%	63.0%	63.0%	61.2%	1.5
1194	WholeBldg	COM Competitions	Biz - Custom	Food Service	RET	per kWh	53	2%	1	0.00	0.00	2	\$0	100%	100%	10%	3	100%	0%	63.0%	63.0%	61.2%	1.7
1195	WholeBldg	COM Competitions	Biz - Custom	Health	RET	per kWh	0	0%	1	0.00	0.00	2	\$0	100%	100%	10%	3	100%	0%	63.0%	63.0%	61.2%	1.5
1196	WholeBldg	COM Competitions	Biz - Custom	Lodging	RET	per kWh	53	2%	1	0.00	0.00	2	\$0	100%	100%	10%	3	100%	0%	63.0%	63.0%	61.2%	1.4
1197	WholeBldg	COM Competitions	Biz - Custom	Retail	RET	per kWh	53	2%	1	0.00	0.00	2	\$0	100%	100%	10%	3	100%	0%	63.0%	63.0%	61.2%	1.7
1198	WholeBldg	COM Competitions	Biz - Custom	Office	RET	per kWh	53	2%	1	0.00	0.00	2	\$0	100%	100%	10%	3	100%	0%	63.0%	63.0%	61.2%	1.5
1199	WholeBldg	COM Competitions	Biz - Custom	Warehouse	RET	per kWh	0	0%	1	0.00	0.00	2	\$0	100%	100%	10%	3	100%	0%	63.0%	63.0%	61.2%	1.5
1200	WholeBldg	COM Competitions	Biz - Custom	Other	RET	per kWh	0	0%	1	0.00	0.00	2	\$0	100%	100%	10%	3	100%	0%	63.0%	63.0%	61.2%	1.5
1201	WholeBldg	Business Energy Reports	Biz - Custom	Assembly	RET	per kWh	0	0%	1	0.00	0.00	2	\$0	50%	50%								

Appendix C: C&I Measure Assumptions

Measure #	End-Use	Measure Name	Program	Building Type	Replacement Type (TOS=Time of Sale)	Unit	Base Annual Electric	% Elec Savings	Per Unit Elec Savings	Per Unit Summer kW	Per Unit Winter 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
1209	WholeBldg	Business Energy Reports	Biz - Custom	Warehouse	RET	per kWh	0	0%	1	0.00	0.00	2	\$0	50%	50%	32%	3	100%	0%	58.2%	58.2%	56.2%	1.5
1210	WholeBldg	Business Energy Reports	Biz - Custom	Other	RET	per kWh	313	0%	1	0.00	0.00	2	\$0	50%	50%	32%	3	100%	0%	58.2%	58.2%	56.2%	1.5
1211	WholeBldg	Building Benchmarking	Biz - Custom	Assembly	RET	per kWh	0	0%	1	0.00	0.00	2	\$0	50%	45%	29%	3	100%	0%	45.0%	57.2%	55.1%	1.5
1212	WholeBldg	Building Benchmarking	Biz - Custom	Education	RET	per kWh	83	1%	1	0.00	0.00	2	\$0	75%	45%	29%	3	100%	0%	60.4%	57.2%	55.1%	1.7
1213	WholeBldg	Building Benchmarking	Biz - Custom	Food Sales	RET	per kWh	0	0%	1	0.00	0.00	2	\$0	50%	45%	29%	3	100%	0%	45.0%	57.2%	55.1%	1.5
1214	WholeBldg	Building Benchmarking	Biz - Custom	Food Service	RET	per kWh	0	0%	1	0.00	0.00	2	\$0	75%	45%	29%	3	100%	0%	60.4%	57.2%	55.1%	1.7
1215	WholeBldg	Building Benchmarking	Biz - Custom	Health	RET	per kWh	114	1%	1	0.00	0.00	2	\$0	50%	45%	29%	3	100%	0%	45.0%	57.2%	55.1%	1.5
1216	WholeBldg	Building Benchmarking	Biz - Custom	Lodging	RET	per kWh	263	0%	1	0.00	0.00	2	\$0	50%	45%	29%	3	100%	0%	45.0%	57.2%	55.1%	1.4
1217	WholeBldg	Building Benchmarking	Biz - Custom	Retail	RET	per kWh	97	1%	1	0.00	0.00	2	\$0	75%	45%	29%	3	100%	0%	60.4%	57.2%	55.1%	1.7
1218	WholeBldg	Building Benchmarking	Biz - Custom	Office	RET	per kWh	114	1%	1	0.00	0.00	2	\$0	50%	45%	29%	3	100%	0%	45.0%	57.2%	55.1%	1.5
1219	WholeBldg	Building Benchmarking	Biz - Custom	Warehouse	RET	per kWh	0	0%	1	0.00	0.00	2	\$0	50%	45%	29%	3	100%	0%	45.0%	57.2%	55.1%	1.5
1220	WholeBldg	Building Benchmarking	Biz - Custom	Other	RET	per kWh	0	0%	1	0.00	0.00	2	\$0	50%	45%	29%	3	100%	0%	45.0%	57.2%	55.1%	1.5
1221	WholeBldg	Strategic Energy Management	Biz - CustomSEM	Assembly	RET	per kWh	0	0%	1	0.00	0.00	5	\$0	100%	37%	53%	3	100%	10%	63.0%	54.3%	56.8%	3.4
1222	WholeBldg	Strategic Energy Management	Biz - CustomSEM	Education	RET	per kWh	33	3%	1	0.00	0.00	5	\$0	100%	37%	53%	3	100%	10%	63.0%	54.3%	56.8%	3.8
1223	WholeBldg	Strategic Energy Management	Biz - CustomSEM	Food Sales	RET	per kWh	0	0%	1	0.00	0.00	5	\$0	100%	37%	53%	3	100%	10%	63.0%	54.3%	56.8%	3.3
1224	WholeBldg	Strategic Energy Management	Biz - CustomSEM	Food Service	RET	per kWh	0	0%	1	0.00	0.00	5	\$0	100%	37%	53%	3	100%	10%	63.0%	54.3%	56.8%	3.8
1225	WholeBldg	Strategic Energy Management	Biz - CustomSEM	Health	RET	per kWh	33	3%	1	0.00	0.00	5	\$0	100%	37%	53%	3	100%	10%	63.0%	54.3%	56.8%	3.3
1226	WholeBldg	Strategic Energy Management	Biz - CustomSEM	Lodging	RET	per kWh	0	0%	1	0.00	0.00	5	\$0	100%	37%	53%	3	100%	10%	63.0%	54.3%	56.8%	3.2
1227	WholeBldg	Strategic Energy Management	Biz - CustomSEM	Retail	RET	per kWh	0	0%	1	0.00	0.00	5	\$0	100%	37%	53%	3	100%	10%	63.0%	54.3%	56.8%	3.8
1228	WholeBldg	Strategic Energy Management	Biz - CustomSEM	Office	RET	per kWh	33	3%	1	0.00	0.00	5	\$0	100%	37%	53%	3	100%	10%	63.0%	54.3%	56.8%	3.3
1229	WholeBldg	Strategic Energy Management	Biz - CustomSEM	Warehouse	RET	per kWh	0	0%	1	0.00	0.00	5	\$0	100%	37%	53%	3	100%	10%	63.0%	54.3%	56.8%	3.3
1230	WholeBldg	Strategic Energy Management	Biz - CustomSEM	Other	RET	per kWh	0	0%	1	0.00	0.00	5	\$0	100%	37%	53%	3	100%	10%	63.0%	54.3%	56.8%	3.3
1231	WholeBldg	BEIMS	Biz - Custom	Assembly	RET	per kWh	0	0%	1	0.00	0.00	2	\$0	23%	23%	14%	3	100%	2%	44.3%	44.3%	41.5%	1.5
1232	WholeBldg	BEIMS	Biz - Custom	Education	RET	per kWh	43	2%	1	0.00	0.00	2	\$0	23%	23%	14%	3	100%	2%	44.3%	44.3%	41.5%	1.7
1233	WholeBldg	BEIMS	Biz - Custom	Food Sales	RET	per kWh	20	5%	1	0.00	0.00	2	\$0	23%	23%	14%	3	100%	2%	44.3%	44.3%	41.5%	1.5
1234	WholeBldg	BEIMS	Biz - Custom	Food Service	RET	per kWh	20	5%	1	0.00	0.00	2	\$0	23%	23%	14%	3	100%	2%	44.3%	44.3%	41.5%	1.7
1235	WholeBldg	BEIMS	Biz - Custom	Health	RET	per kWh	50	2%	1	0.00	0.00	2	\$0	23%	23%	14%	3	100%	2%	44.3%	44.3%	41.5%	1.5
1236	WholeBldg	BEIMS	Biz - Custom	Lodging	RET	per kWh	20	5%	1	0.00	0.00	2	\$0	23%	23%	14%	3	100%	2%	44.3%	44.3%	41.5%	1.4
1237	WholeBldg	BEIMS	Biz - Custom	Retail	RET	per kWh	20	5%	1	0.00	0.00	2	\$0	23%	23%	14%	3	100%	2%	44.3%	44.3%	41.5%	1.7
1238	WholeBldg	BEIMS	Biz - Custom	Office	RET	per kWh	29	4%	1	0.00	0.00	2	\$0	23%	23%	14%	3	100%	2%	44.3%	44.3%	41.5%	1.5
1239	WholeBldg	BEIMS	Biz - Custom	Warehouse	RET	per kWh	0	0%	1	0.00	0.00	2	\$0	23%	23%	14%	3	100%	2%	44.3%	44.3%	41.5%	1.5
1240	WholeBldg	BEIMS	Biz - Custom	Other	RET	per kWh	50	2%	1	0.00	0.00	2	\$0	23%	23%	14%	3	100%	2%	44.3%	44.3%	41.5%	1.5
1241	WholeBldg	Building Operator Certification	Biz - Custom	Assembly	RET	per 1000 sq ft	0	0%	1	0.00	0.00	3	\$0	50%	34%	32%	3	100%	2%	55.7%	63.0%	52.7%	2.2
1242	WholeBldg	Building Operator Certification	Biz - Custom	Education	RET	per 1000 sq ft	17,825	0%	45	0.01	0.00	3	\$0	100%	100%	10%	3	100%	2%	63.0%	63.0%	62.7%	2.4
1243	WholeBldg	Building Operator Certification	Biz - Custom	Food Sales	RET	per 1000 sq ft	60,523	0%	151	0.02	0.02	3	\$0	100%	100%	10%	3	100%	2%	63.0%	63.0%	62.9%	2.1
1244	WholeBldg	Building Operator Certification	Biz - Custom	Food Service	RET	per 1000 sq ft	49,444	0%	124	0.03	0.01	3	\$0	100%	100%	10%	3	100%	2%	63.0%	63.0%	62.9%	2.4
1245	WholeBldg	Building Operator Certification	Biz - Custom	Health	RET	per 1000 sq ft	27,632	0%	69	0.01	0.01	3	\$0	100%	100%	10%	3	100%	2%	63.0%	63.0%	62.8%	2.1
1246	WholeBldg	Building Operator Certification	Biz - Custom	Lodging	RET	per 1000 sq ft	14,600	0%	37	0.01	0.00	3	\$0	100%	100%	10%	3	100%	2%	63.0%	63.0%	62.7%	2.1
1247	WholeBldg	Building Operator Certification	Biz - Custom	Retail	RET	per 1000 sq ft	18,200	0%	46	0.01	0.01	3	\$0	100%	100%	10%	3	100%	2%	63.0%	63.0%	62.7%	2.5
1248	WholeBldg	Building Operator Certification	Biz - Custom	Office	RET	per 1000 sq ft	20,140	0%	50	0.01	0.01	3	\$0	100%	100%	10%	3	100%	2%	63.0%	63.0%	62.8%	2.1
1249	WholeBldg	Building Operator Certification	Biz - Custom	Warehouse	RET	per 1000 sq ft	7,272	0%	18	0.00	0.00	3	\$0	100%	100%	10%	3	100%	2%	63.0%	63.0%	62.3%	2.1
1250	WholeBldg	Building Operator Certification	Biz - Custom	Other	RET	per 1000 sq ft	13,644	0%	34	0.01	0.00	3	\$0	100%	100%	10%	3	100%	2%	63.0%	63.0%	62.6%	2.2
1251	Cooking	Advanced Cooking	Biz - Custom	Assembly	RET	per kWh	250	0%	1	0.00	0.00	12	\$14	1%	1%	10%	7	100%	2%	9.8%	9.8%	9.8%	7.9
1252	Cooking	Advanced Cooking	Biz - Custom	Education	RET	per kWh	250	0%	1	0.00	0.00	12	\$14	1%	1%	10%	7	100%	2%	9.8%	9.8%	9.8%	4.1
1253	Cooking	Advanced Cooking	Biz - Custom	Food Sales	RET	per kWh	250	0%	1	0.00	0.00	12	\$14	1%	1%	10%	7	100%	2%	9.8%	9.8%	9.8%	7.2
1254	Cooking	Advanced Cooking	Biz - Custom	Food Service	RET	per kWh	250	0%	1	0.00	0.00	12	\$14	1%	1%	10%	7	100%	2%	9.8%	9.8%	9.8%	6.3
1255	Cooking	Advanced Cooking	Biz - Custom	Health	RET	per kWh	250	0%	1	0.00	0.00	12	\$14	1%	1%	10%	7	100%	2%	9.8%	9.8%	9.8%	8.8
1256	Cooking	Advanced Cooking	Biz - Custom	Lodging	RET	per kWh	250	0%	1	0.00	0.00	12	\$14	1%	1%	10%	7	100%	2%	9.8%	9.8%	9.8%	9.0
1257	Cooking	Advanced Cooking	Biz - Custom	Retail	RET	per kWh	250	0%	1	0.00	0.00	12	\$14	1%	1%	10%	7	100%	2%	9.8%	9.8%	9.8%	8.0
1258	Cooking	Advanced Cooking	Biz - Custom	Office	RET	per kWh	250	0%	1	0.00	0.00	12	\$14	1%	1%	10%	7	100%	2%	9.8%	9.8%	9.8%	7.9
1259	Cooking	Advanced Cooking	Biz - Custom	Warehouse	RET	per kWh	250	0%	1	0.00	0.00	12	\$14	1%	1%	10%	7	100%	2%	9.8%	9.8%	9.8%	7.9
1260	Cooking	Advanced Cooking	Biz - Custom	Other	RET	per kWh	250	0%	1	0.00	0.00	12	\$14	1%	1%	10%	7	100%	2%	9.8%	9.8%	9.8%	6.9
1261	Lighting_Int	Advanced Lighting	Biz - Custom	Assembly	RET	per kWh	2	42%	1	0.00	0.00	15	\$2	4%	4%	14%	8	100%	2%	9.8%	9.8%	9.8%	6.8
1262	Lighting_Int	Advanced Lighting	Biz - Custom	Education	RET	per kWh	2	42%	1	0.00	0.00	15	\$2	4%	4%	14%	8	100%	2%	9.8%	9.8%	9.8%	6.2
1263	Lighting_Int	Advanced Lighting	Biz - Custom	Food Sales	RET	per kWh	2	42%	1	0.00	0.00	15	\$2	4%	4%	14%	8	100%	2%	9.8%	9.8%	9.8%	6.7
1264	Lighting_Int	Advanced Lighting	Biz - Custom	Food Service	RET	per kWh	2	42%	1	0.00	0.00	15	\$2	4%	4%	14%	8	100%	2%	9.8%	9.8%	9.8%	7.4
1265	Lighting_Int	Advanced Lighting	Biz - Custom	Health	RET	per kWh	2	42%	1	0.00	0.00	15	\$2	4%	4%	14%	8	100%	2%	9.8%	9.8%	9.8%	6.7
1266	Lighting_Int	Advanced Lighting	Biz - Custom	Lodging	RET	per kWh	2	42%	1	0.00	0.00	15	\$2	4%	4%	14%	8	100%	2%	9.8%	9.8%	9.8%	6.0
1267	Lighting_Int	Advanced Lighting	Biz - Custom	Retail	RET	per kWh	2	42%	1	0.00	0.00	15	\$2	4%	4%	14%	8	100%	2%	9.8%	9.8%	9.8%	7.8
1268	Lighting_Int	Advanced Lighting	Biz - Custom	Office	RET	per kWh	2	42%	1	0.00	0.00	15	\$2	4%	4%	14%	8	100%	2%	9.8%	9.8%	9.8%	6.3
1269	Lighting_Int	Advanced Lighting	Biz - Custom	Warehouse	RET	per kWh	2	42%	1	0.00	0.00	15	\$2	4%	4%	14%	8	100%	2%	9.8%	9.8%	9.8%	7.2
1270	Lighting_Int	Advanced Lighting	Biz - Custom	Other	RET	per kWh	2	42%	1	0.00	0.00	15	\$2	4%	4%	14%	8	100%	2%	9.8%	9.8%	9.8%	6.7
1271	Plug_Office	Advanced IT	Biz - Custom	Assembly	RET	per kWh	5	20%	1	0.00	0.00	4	\$0	100%	100%	10%	8	31%	2%	63.0%	63.0%	59.8%	2.7
1272	Plug_Office	Advanced IT	Biz - Custom	Education	RET	per kWh	5	20%	1	0.00	0.00	4	\$0	100%	100%	10%	8	39%	2%	63.0%	63.0%	59.8%	2.3
1273	Plug_Office	Advanced IT	Biz - Custom	Food Sales	RET	per kWh	5	20%	1	0.00	0.00	4	\$0	100%	100%	10%	8	35%	2%	63.0%	63.0%	59.8%	3.1
1274	Plug_Office	Advanced IT	Biz - Custom	Food Service	RET	per kWh	5	20%	1	0.00	0.00	4	\$0	100%	100%	10%	8	20%	2%	63.0%	63.0%	59.8%	

Appendix C: C&I Measure Assumptions

Measure #	End-Use	Measure Name	Program	Building Type	Replacement Type (TOS=Time of Sale)	Unit	Base Annual Electric	% Elec Savings	Per Unit Elec Savings	Per Unit Summer kW	Per Unit Winter 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
1280	Plug_Office	Advanced IT	Biz - Custom	Other	RET	per kWh	5	20%	1	0.00	0.00	4	\$0	100%	100%	10%	8	28%	2%	63.0%	63.0%	59.8%	2.6
1281	Ventilation	Advanced Motors	Biz - Custom	Assembly	RET	per kWh	8	12%	1	0.00	0.00	15	\$0	100%	40%	56%	4	100%	2%	63.0%	55.4%	57.8%	7.3
1282	Ventilation	Advanced Motors	Biz - Custom	Education	RET	per kWh	8	12%	1	0.00	0.00	15	\$0	100%	40%	56%	4	100%	2%	63.0%	55.4%	57.8%	8.6
1283	Ventilation	Advanced Motors	Biz - Custom	Food Sales	RET	per kWh	8	12%	1	0.00	0.00	15	\$0	100%	40%	56%	4	100%	2%	63.0%	55.4%	57.8%	4.7
1284	Ventilation	Advanced Motors	Biz - Custom	Food Service	RET	per kWh	8	12%	1	0.00	0.00	15	\$0	100%	40%	56%	4	100%	2%	63.0%	55.4%	57.8%	8.5
1285	Ventilation	Advanced Motors	Biz - Custom	Health	RET	per kWh	8	12%	1	0.00	0.00	15	\$0	100%	40%	56%	4	100%	2%	63.0%	55.4%	57.8%	8.0
1286	Ventilation	Advanced Motors	Biz - Custom	Lodging	RET	per kWh	8	12%	1	0.00	0.00	15	\$0	100%	40%	56%	4	100%	2%	63.0%	55.4%	57.8%	6.7
1287	Ventilation	Advanced Motors	Biz - Custom	Retail	RET	per kWh	8	12%	1	0.00	0.00	15	\$0	100%	40%	56%	4	100%	2%	63.0%	55.4%	57.8%	5.4
1288	Ventilation	Advanced Motors	Biz - Custom	Office	RET	per kWh	8	12%	1	0.00	0.00	15	\$0	100%	40%	56%	4	100%	2%	63.0%	55.4%	57.8%	7.5
1289	Ventilation	Advanced Motors	Biz - Custom	Warehouse	RET	per kWh	8	12%	1	0.00	0.00	15	\$0	100%	40%	56%	4	100%	2%	63.0%	55.4%	57.8%	7.7
1290	Ventilation	Advanced Motors	Biz - Custom	Other	RET	per kWh	8	12%	1	0.00	0.00	15	\$0	100%	40%	56%	4	100%	2%	63.0%	55.4%	57.8%	7.3
1291	Refrigeration	Advanced Refrigeration	Biz - Custom	Assembly	RET	per kWh	8	13%	1	0.00	0.00	20	\$34	0%	0%	10%	18	4%	2%	9.8%	9.8%	9.8%	8.4
1292	Refrigeration	Advanced Refrigeration	Biz - Custom	Education	RET	per kWh	8	13%	1	0.00	0.00	20	\$34	0%	0%	10%	18	23%	2%	9.8%	9.8%	9.8%	8.5
1293	Refrigeration	Advanced Refrigeration	Biz - Custom	Food Sales	RET	per kWh	8	13%	1	0.00	0.00	20	\$34	0%	0%	10%	18	81%	2%	9.8%	9.8%	9.8%	8.0
1294	Refrigeration	Advanced Refrigeration	Biz - Custom	Food Service	RET	per kWh	8	13%	1	0.00	0.00	20	\$34	0%	0%	10%	18	27%	2%	9.8%	9.8%	9.8%	8.4
1295	Refrigeration	Advanced Refrigeration	Biz - Custom	Health	RET	per kWh	8	13%	1	0.00	0.00	20	\$34	0%	0%	10%	18	19%	2%	9.8%	9.8%	9.8%	8.8
1296	Refrigeration	Advanced Refrigeration	Biz - Custom	Lodging	RET	per kWh	8	13%	1	0.00	0.00	20	\$34	0%	0%	10%	18	21%	2%	9.8%	9.8%	9.8%	8.3
1297	Refrigeration	Advanced Refrigeration	Biz - Custom	Retail	RET	per kWh	8	13%	1	0.00	0.00	20	\$34	0%	0%	10%	18	65%	2%	9.8%	9.8%	9.8%	8.4
1298	Refrigeration	Advanced Refrigeration	Biz - Custom	Office	RET	per kWh	8	13%	1	0.00	0.00	20	\$34	0%	0%	10%	18	67%	2%	9.8%	9.8%	9.8%	8.4
1299	Refrigeration	Advanced Refrigeration	Biz - Custom	Warehouse	RET	per kWh	8	13%	1	0.00	0.00	20	\$34	0%	0%	10%	18	63%	2%	9.8%	9.8%	9.8%	8.4
1300	Refrigeration	Advanced Refrigeration	Biz - Custom	Other	RET	per kWh	8	13%	1	0.00	0.00	20	\$34	0%	0%	10%	18	43%	2%	9.8%	9.8%	9.8%	8.4
1301	WholeBldg_HVAC	Advanced HVAC	Biz - Custom	Assembly	RET	per kWh	8	12%	1	0.00	0.00	15	\$1	100%	20%	65%	7	100%	2%	63.0%	39.8%	53.9%	7.5
1302	WholeBldg_HVAC	Advanced HVAC	Biz - Custom	Education	RET	per kWh	8	12%	1	0.00	0.00	15	\$1	100%	20%	65%	7	100%	2%	63.0%	39.8%	53.9%	8.5
1303	WholeBldg_HVAC	Advanced HVAC	Biz - Custom	Food Sales	RET	per kWh	8	12%	1	0.00	0.00	15	\$1	100%	20%	65%	7	100%	2%	63.0%	39.8%	53.9%	7.4
1304	WholeBldg_HVAC	Advanced HVAC	Biz - Custom	Food Service	RET	per kWh	8	12%	1	0.00	0.00	15	\$1	100%	20%	65%	7	100%	2%	63.0%	39.8%	53.9%	8.5
1305	WholeBldg_HVAC	Advanced HVAC	Biz - Custom	Health	RET	per kWh	8	12%	1	0.00	0.00	15	\$1	100%	20%	65%	7	100%	2%	63.0%	39.8%	53.9%	7.3
1306	WholeBldg_HVAC	Advanced HVAC	Biz - Custom	Lodging	RET	per kWh	8	12%	1	0.00	0.00	15	\$1	100%	20%	65%	7	100%	2%	63.0%	39.8%	53.9%	7.1
1307	WholeBldg_HVAC	Advanced HVAC	Biz - Custom	Retail	RET	per kWh	8	12%	1	0.00	0.00	15	\$1	100%	20%	65%	7	100%	2%	63.0%	39.8%	53.9%	8.7
1308	WholeBldg_HVAC	Advanced HVAC	Biz - Custom	Office	RET	per kWh	8	12%	1	0.00	0.00	15	\$1	100%	20%	65%	7	100%	2%	63.0%	39.8%	53.9%	7.3
1309	WholeBldg_HVAC	Advanced HVAC	Biz - Custom	Warehouse	RET	per kWh	8	12%	1	0.00	0.00	15	\$1	100%	20%	65%	7	100%	2%	63.0%	39.8%	53.9%	7.3
1310	WholeBldg_HVAC	Advanced HVAC	Biz - Custom	Other	RET	per kWh	8	12%	1	0.00	0.00	15	\$1	100%	20%	65%	7	100%	2%	63.0%	39.8%	53.9%	7.5
1311	Compressed Air	Efficient Air Compressor Equipment	Biz - Custom	Industrial	TOS	per kWh	9	11%	1	0.00	0.00	13	\$0	100%	24%	72%	1	100%	25%	63.0%	46.2%	57.6%	6.9
1312	Compressed Air	Efficient Air Compressor Controls	Biz - Custom	Industrial	RET	per kWh	15	7%	1	0.00	0.00	3	\$0	100%	81%	61%	2	100%	25%	63.0%	61.9%	60.7%	2.2
1313	HVAC	Efficient HVAC Equipment	Biz - Custom	Industrial	TOS	per kWh	8	13%	1	0.00	0.00	15	\$0	100%	52%	75%	1	100%	25%	63.0%	58.6%	60.7%	6.6
1314	HVAC	Efficient HVAC O&M	Biz - Custom	Industrial	RET	per kWh	33	3%	1	0.00	0.00	3	\$0	100%	100%	49%	2	100%	25%	63.0%	63.0%	60.7%	1.9
1315	Lighting_Int	Efficient Lighting Equipment	Biz - Prescriptive	Industrial	RET	per kWh	2	42%	1	0.00	0.00	15	\$0	100%	58%	72%	1	100%	65%	84.0%	79.3%	80.9%	7.5
1316	Lighting_Int	Efficient Lighting O&M	Biz - Custom	Industrial	RET	per kWh	33	3%	1	0.00	0.00	3	\$0	100%	100%	31%	2	100%	30%	63.0%	63.0%	60.7%	2.2
1317	Motors	Efficient MachDr Equipment	Biz - Custom	Industrial	TOS	per kWh	8	12%	1	0.00	0.00	15	\$0	100%	58%	72%	1	100%	25%	63.0%	59.6%	60.7%	4.7
1318	Motors	Efficient MachDr O&M	Biz - Custom	Industrial	RET	per kWh	33	3%	1	0.00	0.00	3	\$0	100%	100%	50%	2	100%	25%	63.0%	63.0%	60.7%	1.5
1319	Process Heat	Efficient ProcHeat Equipment	Biz - Custom	Industrial	TOS	per kWh	33	3%	1	0.00	0.00	15	\$0	100%	58%	72%	1	100%	25%	63.0%	59.5%	60.7%	7.6
1320	Process Heat	Efficient ProcHeat O&M	Biz - Custom	Industrial	RET	per kWh	33	3%	1	0.00	0.00	3	\$0	100%	100%	38%	2	100%	25%	63.0%	63.0%	60.7%	2.2
1321	Process Refrig	Efficient ProcRefrig Equipment	Biz - Custom	Industrial	TOS	per kWh	6	16%	1	0.00	0.00	15	\$0	100%	56%	73%	1	100%	25%	63.0%	59.3%	60.7%	6.8
1322	Process Refrig	Efficient ProcRefrig O&M	Biz - Custom	Industrial	RET	per kWh	33	3%	1	0.00	0.00	3	\$0	100%	95%	55%	2	100%	25%	63.0%	62.7%	60.7%	2.0
1323	Process Other	Other Process Equip	Biz - Custom	Industrial	TOS	per kWh	4	26%	1	0.00	0.00	11	\$0	100%	29%	76%	1	100%	25%	63.0%	49.7%	59.0%	6.5
1324	Process Other	Other Process O&M	Biz - Custom	Industrial	RET	per kWh	14	7%	1	0.00	0.00	11	\$0	100%	33%	84%	2	100%	25%	63.0%	52.3%	60.7%	6.5
1325	WholeBldg	Power Distribution (Transformers)	Biz - Custom	Industrial	RET	per kWh	179	1%	1	0.00	0.00	30	\$1	100%	9%	38%	1	100%	25%	63.0%	34.7%	40.0%	11.8
1326	WholeBldg	Strategic Energy Management	Biz - CustomSEM	Industrial	RET	per kWh	33	3%	1	0.00	0.00	3	\$0	100%	100%	45%	2	100%	25%	63.0%	63.0%	60.7%	2.3
1327	Water_WW	Water Supply & Wastewater treatment pumps and process efficiency	Biz - Custom	Industrial	RET	per kWh	5	19%	1	0.00	0.00	11	\$0	75%	22%	59%	1	100%	25%	57.6%	43.5%	53.4%	3.9
1328	Lighting_Int	Advanced Lighting Controls	Biz - Custom	Industrial	RET	per kWh	2	42%	1	0.00	0.00	15	\$2	50%	4%	14%	3	100%	25%	33.9%	30.9%	30.9%	11.6
1329	Compressed Air	Process Improvement - Air Compressor	Biz - Custom	Industrial	RET	per kWh	20	5%	1	0.00	0.00	15	\$1	100%	20%	64%	3	100%	25%	63.0%	40.0%	53.5%	64.3
1330	Process Heat	Process Improvement - Heat	Biz - Custom	Industrial	RET	per kWh	20	5%	1	0.00	0.00	15	\$0	100%	100%	48%	3	100%	25%	63.0%	63.0%	60.7%	64.3
1331	Process Other	Process Improvement - Other	Biz - Custom	Industrial	RET	per kWh	10	10%	1	0.00	0.00	10	\$0	100%	46%	78%	3	100%	25%	63.0%	57.3%	60.7%	25.3
1332	Process Refrig	Process Improvement - Refrigeration and Cooling	Biz - Custom	Industrial	RET	per kWh	8	13%	1	0.00	0.00	10	\$0	100%	37%	82%	3	100%	25%	63.0%	54.3%	60.7%	20.2
1333	Motors	Efficient Motor Pmp Equipment - Q1 Cost	Biz - Custom	Agriculture	TOS	per kWh	8	13%	1	0.00	0.00	15	\$0	100%	100%	10%	1	100%	25%	63.0%	63.0%	62.7%	4.7
1334	Motors	Efficient Motor Pmp Equipment - Q2 Cost	Biz - Custom	Agriculture	TOS	per kWh	8	13%	1	0.00	0.00	15	\$0	100%	100%	10%	1	100%	25%	63.0%	63.0%	62.2%	4.7
1335	Motors	Efficient Motor Pmp Equipment - Q3 Cost	Biz - Custom	Agriculture	TOS	per kWh	8	13%	1	0.00	0.00	15	\$0	100%	100%	10%	1	100%	25%	63.0%	63.0%	60.9%	4.7
1336	Motors	Efficient Motor Pmp O&M	Biz - Custom	Agriculture	RET	per kWh	33	3%	1	0.00	0.00	15	\$0	100%	100%	10%	2	100%	25%	63.0%	63.0%	58.9%	4.7
1337	Refrigeration	Efficient Refrigeration Equipment	Biz - Custom	Agriculture	TOS	per kWh	7	15%	1	0.00	0.00	15	\$0	100%	56%	38%	1	100%	25%	63.0%	59.3%	57.8%	6.8
1338	Refrigeration	Refrigeration Equipment O&M	Biz - Custom	Agriculture	RET	per kWh	33	3%	1	0.00	0.00	3	\$0	100%	94%	10%	2	100%	25%	63.0%	62.7%	58.4%	2.0
1339	Lighting_Int	Efficient Lighting	Biz - Prescriptive	Agriculture	TOS	per kWh	2	42%	1	0.00	0.00	15	\$0	100%	57%	37%	1	100%	65%	84.0%	79.3%	77.0%	7.5
1340	Lighting_Int	Grow Lighting	Biz - Custom	Agriculture	RET	per kWh	3	39%	1	0.00	0.00	15	\$0	100%	37%	59%	2	100%	50%	65.0%	60.0%	60.0%	7.5
1341	Ventilation	Efficient Ventilation	Biz - Custom	Agriculture	TOS	per kWh	2	54%	1	0.00	0.00	10	\$0	100%	31%	66%	1	100%	25%	63.0%	51.4%	57.8%	5.1
1342	WholeBldg	Efficient Dehumidification	Biz - Custom	Agriculture	TOS	per kWh	4	27%	1	0.00	0.00	10	\$0	100%	53%	42%	1	100%	25%	63.0%	58.7%	57.8%	5.1
1343	WholeBldg	Efficient HVAC	Biz - Custom	Agriculture	TOS	per kWh	8	13%	1	0.00	0.00	15	\$0	100%	53%	42%	1	100%	25%	63.0%	58.7%	57.8%	6.6

D. Demand Response Assumptions

This table below provides a list of assumptions and sources for the demand response programs evaluated in the study.

TABLE D-1: DEMAND RESPONSE ASSUMPTIONS AND SOURCES

DR Program	Assumption	Value	Source
DLC AC Switch	# of Control Units per Participant	1.06	2025 Market Research for AES
	Existing Participants - Res	36,224 one-way switches and 5,952 two-way switches in 2023	AES data response. No new participants, assumes 5% attrition per year.
	Existing Participants - C&I	100 one-way switches and 0 two-way switches; expect 600 switches end of 2026	AES data response
	Participant Annual Incentive - Res	\$20/participant-year	AES data response
	Participant Annual Incentive - C&I	\$20/participant-year	AES data response
	Annual Number of Control Hours	60 hours	Assumes 15 events, 4 hours each (year round)
	Per Participant Load Reduction - Summer - Res	0.57 kW for one-way Cannon switches; 0.55 kW for two-way L+G switches	AES 2023 Evaluation Report. Load reduction per event participant * Event participation rate = load reduction per program participant
	Per Participant Load Reduction - Winter - Res	1.13 kW	Average of studies: Puget Sound Energy 2022, BPA 2018, PGE 2016
	Per Participant Load Reduction - Summer - C&I	1.476 kW	Average of studies: Puget Sound Energy 2022, CenterPoint 2021, BPA 2021
	Per Participant Load Reduction - Winter - C&I	1.9 kW	Average of studies: Puget Sound Energy 2022, BPA 2021
	Control Equipment Useful Life	10 years	Freeman, Sullivan & Co Cost Effectiveness of CECONY Demand Response Programs 2013; PA Act 129 Order 2013

DR Program	Assumption	Value	Source
	Utility Per Unit Equipment/ Labor Cost - Res	\$230/new participant	Average of studies: Puget Sound Energy 2022, BPA 2021, Pacificorp 2023
	Utility Per Unit Equipment/ Labor Cost - C&I	\$387/new participant	Average of studies: Puget Sound Energy 2022, BPA 2021, Pacificorp 2023
	Participant Share of Equipment/Labor Cost	\$0	N/A
	One Time Incentive Towards Cost of Equipment	\$0	N/A
	O&M/Vendor Service Fees per Customer Res	0	AES data response
	O&M/Vendor Service Fees per Customer C&I	\$151.10/participant-year	AES data response
	Participation Rate MAP Res	Decreasing over time	AES data response, only budgeted to maintain existing switches. Expected to decline slowly as switches/equipment fail.
	Participation Rate RAP Res	Decreasing over time	AES data response, only budgeted to maintain existing switches. Expected to decline slowly as switches/equipment fail.
	Participation Rate MAP C&I	34.5%	2025 Market Research for AES for total C&I AC participation; divided between switches and thermostats based on research from outside studies: BPA 2018 (40%)
	Participation Rate RAP C&I	18.9%	2025 Market Research for AES for total C&I AC participation; divided between switches and thermostats based on research from outside studies: BPA 2021, Puget Sound Energy 2022 (average 10%)
	Saturation Res	89% for AC; 56% for electric heating	2025 Market Research for AES. Percentage of customers with central AC and those with electric space heating.
	Saturation C&I	52.4% for packaged system AC; 37% for electric heating	2025 Market Research for AES. Percentage of customers with packaged systems, split systems, or chillers and those with electric space heating.

DR Program	Assumption	Value	Source
DLC Thermostat	# of Control Units per Participant - Res	1.06	2025 Market Research for AES
	# of Customers With Smart Thermostats Already Installed - Res	19.80%	2025 Market Research for AES
	# of Customers With Smart Thermostats Already Installed - C&I	14.40%	2025 Market Research for AES
	Existing Participants - Res	40,134 BYOT and 1,401 free thermostats in 2025	AES data response
	Existing Participants - C&I	272 in 2024	AES data response - MC Inputs spreadsheet
	Participant Annual Incentive - Res	\$20/participant-year	https://www.aesindianacoolcents.com/#:~:text=During%20Demand%20Response%20Events%2C%20CoolCents,need%20to%20do%20a%20thing!
	Participant Annual Incentive - C&I	\$20/participant-year	Assume same as residential
	Annual Number of Control Hours	100 hours	Assumes 25 events, 4 hours each (year round)
	Per Participant Load Reduction - Summer - Res	1.04 kW	AES 2023 Evaluation Report (average of 3 thermostat types). Load reduction per event participant * Event participation rate = load reduction per program participant
	Per Participant Load Reduction - Winter - Res	1.49 kW	Used ratio of winter:summer load reduction from averages of studies (Puget Sound Energy 2022, BPA 2021, PGE 2021, NRECA 2021). Applied ratio to AES's summer load reduction
	Per Participant Load Reduction - Summer - C&I	1.949 kW	Average of studies: Xcel Energy 2022, Puget Sound Energy 2022, CenterPoint 2021, Pacificorp 2019
	Per Participant Load Reduction - Winter - C&I	2.542 kW	Average of studies: Puget Sound Energy 2022, Pacificorp 2019
	Control Equipment Useful Life	11 years	Illinois TRM v13

DR Program	Assumption	Value	Source
	Utility Per Unit Equipment/ Labor Cost	0	
	Participant Share of Equipment/Labor Cost	\$140	Cost of Ecobee thermostat minus the one-time incentive to customer
	One Time Incentive Towards Cost of Equipment	\$50	https://www.aesindianacoolcents.com/#:~:text=During%20Demand%20Response%20Events%2C%20CoolCents,need%20to%20do%20a%20thing!
	O&M/Vendor Service Fees per Customer Res	0	AES data response
	O&M/Vendor Service Fees per Customer C&I	\$40/participant-year	BPA 2021
	Participation Rate MAP Res	38% for summer; 30.8% for winter	2025 Market Research for AES. WTP question - those that responded "extremely likely" or "very likely" to participate in a DLC thermostat program. Participants were also asked how likely they would be to participate in program if there were winter events as well as summer events. 33% responded they would be "less likely" and 15% responded they would be "more likely". We applied the differential (19%) to the summer participation rate.
	Participation Rate RAP Res	20% for summer; 16.2% for winter	2025 Market Research for AES. WTP question - those that responded "extremely likely" to participate in a DLC thermostat program. This aligns closely with what we see in BPA 2021 and Pacificorp 2023. Participants were also asked how likely they would be to participate in program if there were winter events as well as summer events. 33% responded they would be "less likely" and 15% responded they would be "more likely". We applied the differential (19%) to the summer participation rate.

DR Program	Assumption	Value	Source
	Participation Rate MAP C&I	21.5% for summer; 17.4% for winter	2025 Market Research for AES for total C&I AC participation; divided between switches and thermostats based on research from outside studies: Puget Sound Energy 2022 (25%). Participants were also asked how likely they would be to participate in program if there were winter events as well as summer events. 33% responded they would be "less likely" and 15% responded they would be "more likely". We applied the differential (19%) to the summer participation rate.
	Participation Rate RAP C&I	15.1% for summer; 12.2% for winter	2025 Market Research for AES for total C&I AC participation; divided between switches and thermostats based on research from outside studies: Xcel Energy 2022 (8%). Participants were also asked how likely they would be to participate in program if there were winter events as well as summer events. 33% responded they would be "less likely" and 15% responded they would be "more likely". We applied the differential (19%) to the summer participation rate.
	Saturation Res	89% for AC; 37% for electric heating (electric furnace or heat pump); 82% have sufficient internet	2025 Market Research for AES. Percentage of customers with central AC and those with electric space heating. Sufficient internet taken from WTP survey.
	Saturation C&I	72% for AC; 37% for electric heating	2025 Market Research for AES. Percentage of customers with packaged systems, split systems, or chillers and those with electric space heating.
DLC Water	# of Control Units per Participant	1	Assumes 1 WH per participant
	Existing Participants - Res	~8000 expected in 2026	AES data response

DR Program	Assumption	Value	Source
Heater Switch	Participant Annual Incentive - Res	\$40/participant-year	AES data response
	Participant Annual Incentive - C&I	\$40/participant-year	Assume same as residential
	Annual Number of Control Hours	100 hours	Assumes 25 events, 4 hours each (year round)
	Per Participant Load Reduction - Summer - Res	0.105 kW	CenterPoint 2023 Evaluation Report
	Per Participant Load Reduction - Winter - Res	0.182 kW	AES 2023 Evaluation Report
	Per Participant Load Reduction - Summer - C&I	1.5 kW	Pacificorp 2019
	Per Participant Load Reduction - Winter - C&I	1.5 kW	Pacificorp 2019
	Control Equipment Useful Life	10 years	Freeman, Sullivan & Co Cost Effectiveness of CECONY Demand Response Programs 2013; PA Act 129 Order 2013
	Utility Per Unit Equipment/Labor Cost	\$330 for switch	Puget Sound Energy 2022, BPA 2021
	Participant Share of Equipment/Labor Cost	\$0	N/A
	One Time Incentive Towards Cost of Equipment	\$0	N/A
	O&M/Vendor Service Fees per Customer Res	\$16/participant-year	Average of studies: Pacificorp 2023, Puget Sound Energy 2022, BPA 2021
	O&M/Vendor Service Fees per Customer C&I	\$16/participant-year	Average of studies: Pacificorp 2023, Puget Sound Energy 2022, BPA 2021
	Participation Rate MAP Res	25.2%	2025 Market Research for AES for total C&I AC participation; divided between switches and grid-enabled WHs based on research from outside studies: Xcel Energy 2022 (30%)

DR Program	Assumption	Value	Source
	Participation Rate RAP Res	19.2%	2025 Market Research for AES for total C&I AC participation; divided between switches and grid-enabled WHs based on research from outside studies: Puget Sound Energy 2022, NREL 2022, BPA 2021, PGE 2016 (average of 25%)
	Participation Rate MAP C&I	25.2%	Assumes same as residential
	Participation Rate RAP C&I	19.2%	Assumes same as residential
	Saturation Res	50.80%	2025 Market Research for AES. Percentage of customers with electric water heating
	Saturation C&I	44.60%	2025 Market Research for AES. Percentage of customers with electric water heating
DLC Grid Enabled Water Heater	# of Control Units per Participant	1	Assumes 1 WH per participant
	Existing Participants	0	
	Participant Annual Incentive - Res	\$40/participant-year	Pacificorp 2023
	Participant Annual Incentive - C&I	\$40/participant-year	Assume same as residential & DLC WH switch
	Annual Number of Control Hours	100 hours	Assumes 25 events, 4 hours each (year round)
	Per Participant Load Reduction - Summer - Res	0.37 kW	Average of studies: NREL 2022, BPA 2021, Minnesota 2013, Puget Sound 2022, CenterPoint 2023, Xcel Energy 2022, Pacificorp 2023
	Per Participant Load Reduction - Winter - Res	0.63 kW	Average of studies: NREL 2022, BPA 2021, Minnesota 2013, Puget Sound 2022, Xcel Energy 2022, Pacificorp 2023
	Per Participant Load Reduction - Summer - C&I	1.5 kW	Pacificorp 2019
	Per Participant Load Reduction - Winter - C&I	1.5 kW	Pacificorp 2019

DR Program	Assumption	Value	Source
	Control Equipment Useful Life	10 years	Freeman, Sullivan & Co Cost Effectiveness of CECONY Demand Response Programs 2013; PA Act 129 Order 2013
	Utility Per Unit Equipment/ Labor Cost	\$50	Cost of communication module. Average of studies: Pacificorp 2023, Puget Sound Energy 2022, BPA 2021
	Participant Share of Equipment/Labor Cost	\$250	Assuming utility pays rebate for program participation. Costs for 50-gallon electric grid enabled water heaters range from \$500-\$800. Assumed \$650 for mid-range WH.
	One Time Incentive Towards Cost of Equipment	\$400	Xcel Energy 2022
	O&M/Vendor Service Fees per Customer Res	\$16/participant-year	Average of studies: Pacificorp 2023, Puget Sound Energy 2022, BPA 2021
	O&M/Vendor Service Fees per Customer C&I	\$16/participant-year	Average of studies: Pacificorp 2023, Puget Sound Energy 2022, BPA 2021
	Participation Rate MAP Res	16.8%	2025 Market Research for AES for total C&I AC participation; divided between switches and grid-enabled WHs based on research from outside studies: BPA 2021 (42% for all WH control)
	Participation Rate RAP Res	3.8%	2025 Market Research for AES for total C&I AC participation; divided between switches and grid-enabled WHs based on research from outside studies: Xcel Energy (23% for all WH control)
	Participation Rate MAP C&I	16.8%	Assumes same as residential
	Participation Rate RAP C&I	3.8%	Assumes same as residential
	Saturation Res	50.8% with electric WH; ; 82% have sufficient internet	2025 Market Research for AES. Percentage of customers with electric water heating. Sufficient internet taken from WTP survey.
	Saturation C&I	44.60%	2025 Market Research for AES. Percentage of customers with electric water heating

DR Program	Assumption	Value	Source
DLC Room AC Switch	# of Control Units per Participant	1.72	2025 Market Research for AES
	Existing Participants	0	
	Participant Annual Incentive	\$29 for summer only	Average of: PacifiCorp 2023, Puget Sound Energy 2022, ComEd program, SCE program (used Central AC incentive)
	Annual Number of Control Hours	60 hours	Assumes 15 events, 4 hours each (summer only)
	Per Participant Load Reduction - Summer - Res	0.213 kW	PacifiCorp 2019
	Control Equipment Useful Life	10 years	Freeman, Sullivan & Co Cost Effectiveness of CECONY Demand Response Programs 2013; PA Act 129 Order 2013
	Utility Per Unit Equipment/Labor Cost - Res	\$230/new participant	Average of studies: Puget Sound Energy 2022, BPA 2021, PacifiCorp 2023 (assumed same as Central AC)
	Participant Share of Equipment/Labor Cost	\$0	N/A
	One Time Incentive Towards Cost of Equipment	\$0	N/A
	O&M/Vendor Service Fees per Customer Res	\$17/participant-year	Average of studies: Puget Sound Energy 2022, BPA 2021, PacifiCorp 2023 (assumed same as Central AC)
	Participation Rate MAP Res	21%	Xcel Energy 2022 (based on Central AC)
	Participation Rate RAP Res	10%	PacifiCorp 2021
	Saturation Res	19.10%	2025 Market Research for AES
DLC Smart Appliances	# of Control Units per Participant	2.36	2025 Market Research for AES. Average number of smart devices in homes that have a smart device. This includes smart dishwashers, clothes washers, clothes dryers, plugs/outlets, and "other" smart devices.
	Existing Participants	0	

DR Program	Assumption	Value	Source
	Participant Annual Incentive	\$20/participant-year	Pacificorp 2023
	Annual Number of Control Hours	100 hours	Assumes 25 events, 4 hours each (year round)
	Per Participant Load Reduction - Summer - Res	0.04 kW	Pacificorp 2023
	Per Participant Load Reduction - Winter - Res	0.04 kW	Pacificorp 2023
	Control Equipment Useful Life	14 years	IL TRM v13. Life of clothes washer.
	Utility Per Unit Equipment/Labor Cost - Res	\$50	Cost of communication module. Assume same as smart WH. Average of studies: Pacificorp 2023, Puget Sound Energy 2022, BPA 2021
	Participant Share of Equipment/Labor Cost	\$0	BYOD
	One Time Incentive Towards Cost of Equipment	\$50	Assume same as smart thermostat
	O&M/Vendor Service Fees per Customer Res	\$8/participant-year	Pacificorp 2023
	Participation Rate MAP Res	20.00%	Pacificorp 2023
	Participation Rate RAP Res	5.00%	Pacificorp 2019
	Saturation Res	30.90%	2025 Market Research for AES. Percentage of homes with at least one smart device. This includes smart dishwashers, clothes washers, clothes dryers, plugs/outlets, and "other" smart devices.
DLC EVs	# of Control Units per Participant	1	Assumes 1 charger per household with EV
	Existing Participants	4 as of January 2025; expecting an additional 900 over next 3 years	AES data response
	Participant Annual Incentive	\$50/participant-year	AES data response. \$25 for summer and \$25 per winter.

DR Program	Assumption	Value	Source
	Annual Number of Control Hours	100 hours	Assumes 25 events, 4 hours each (year round)
	Per Participant Load Reduction - Summer - Res	0.227 kW	AES 2023 Evaluation Report. Average of all summer evening events.
	Per Participant Load Reduction - Winter - Res	0.445 kW	AES 2023 Evaluation Report. Average of all winter events.
	Per Participant Load Reduction - Summer - C&I	0.02 kW	Xcel Energy 2022
	Per Participant Load Reduction - Winter - C&I	0.03 kW	Xcel Energy 2022
	Control Equipment Useful Life	10 years	US DOE, Costs Associated with Non-Residential EV Supply Equipment, 2015
	Utility Per Unit Equipment/Labor Cost	0	Included in O&M/vendor fee
	Participant Share of Equipment/Labor Cost	\$750 for new purchase; \$0 for BYOD	Assumes installed cost of level 2 charger is \$1000. Must have networked Level 2 charger to participate. NYSEDA 2022 white paper found that only 10% of residential EV chargers are already networked level 2 chargers. Remainder would need to be upgraded to participate.
	One Time Incentive Towards Cost of Equipment	\$150/new participant for BYOD or \$250/new participant for AES marketplace	AES data response
	O&M/Vendor Service Fees per Customer Res	\$138/participant-year	AES data response
	O&M/Vendor Service Fees per Customer C&I	\$138/participant-year	Assume same as residential
	Participation Rate MAP Res	25%	Pacificorp 2019
	Participation Rate RAP Res	20%	BPA 2021
	Participation Rate MAP C&I	20%	Xcel Energy 2022

DR Program	Assumption	Value	Source
	Participation Rate RAP C&I	10%	GDS assumption of about 50% of MAP
	Saturation	100% of EV forecast	All EVs are eligible
EV TOU Rate	# of Control Units per Participant	1	
	Existing Participants	39 in secondary service rate; 7 in new TOU incentive - expected to grow to 900 by end of 2027	AES data response. No new participants in secondary service rate; expected to decline over time.
	Participant Annual Incentive	\$150/participant-year for secondary service rate; \$100/participant-year for TOU incentive (\$0.05/kWh)	AES data response
	Annual Number of Control Hours - TOU Incentive	5840	On-peak hours daily from 6am-10pm
	Annual Number of Control Hours - Secondary Service	3129	Peak and mid-peak hours weekdays from 10am-10pm (June-Sep) and 8am-8pm (Oct-May)
	Per Participant Load Reduction - Summer - Res	0.39 kW	Average of studies: SCE Summer TOU Program, Xcel 2022, ConEdison 2019, SDG&E 2021
	Per Participant Load Reduction - Winter - Res	0.33 kW	Average of studies: Xcel 2022, SDG&E 2021
	Per Participant Load Reduction - Summer - C&I	0.026 kW	Used ratio of DLC EV to TOU for residential and applied to C&I TOU load reduction
	Per Participant Load Reduction - Winter - C&I	0.033 kW	Used ratio of DLC EV to TOU for residential and applied to C&I TOU load reduction
	Control Equipment Useful Life	10 years	US DOE, Costs Associated with Non-Residential EV Supply Equipment, 2015

DR Program	Assumption	Value	Source
	Utility Per Unit Equipment/Labor Cost	\$0	AES data response. Included within vendor fee
	Participant Share of Equipment/Labor Cost	\$0	Assume BYOD
	One Time Incentive Towards Cost of Equipment	\$150/participant for TOU incentive; \$0 for secondary service	AES data response
	O&M/Vendor Service Fees per Customer Res	\$138/participant-year	AES data response
	O&M/Vendor Service Fees per Customer C&I	\$138/participant-year	Assume same as residential
	Participation Rate MAP Res	28%	Pacificorp 2019
	Participation Rate RAP Res	20%	Xcel Energy 2022
	Participation Rate MAP C&I	28%	Assumed same as residential
	Participation Rate RAP C&I	20%	Assumed same as residential
	Saturation	100% of EV forecast	All EVs are eligible
DLC Lighting	# of Control Units per Participant	1	
	Existing Participants	0	
	Participant Annual Incentive	\$200/kW	SCE and PG&E programs
	Annual Number of Control Hours	100 hours	Assumes 25 events, 4 hours each (year round)
	Per Participant Load Reduction - Summer - C&I	7.05% of total load	47% lighting savings (California Energy Commission 2019) * 15% lighting load of total load (US DOE/CBECS)
	Per Participant Load Reduction - Winter - C&I	7.05% of total load	47% lighting savings (California Energy Commission 2019) * 15% lighting load of total load (US DOE/CBECS)

DR Program	Assumption	Value	Source
	Control Equipment Useful Life	10 years	Freeman, Sullivan & Co Cost Effectiveness of CECONY Demand Response Programs 2013; PA Act 129 Order 2013
	Utility Per Unit Equipment/ Labor Cost	\$0	Assumes the participant already has networked lighting controls or is installing them for another purpose. If not, cost would be around \$20,000/kW and extremely not cost-effective.
	Participant Share of Equipment/Labor Cost	\$0	Assumes the participant already has networked lighting controls or is installing them for another purpose. If not, cost would be around \$20,000/kW and extremely not cost-effective.
	One Time Incentive Towards Cost of Equipment	\$0	Assumes the participant already has networked lighting controls or is installing them for another purpose. If not, cost would be around \$20,000/kW and extremely not cost-effective.
	O&M/Vendor Service Fees per Customer C&I	\$484	Used variable costs from California Demand Response Potential Study 2017.
	Participation Rate MAP C&I	46%	Assume same participation rate as Load Curtailment. No participation rates found for DLC Lighting programs.
	Participation Rate RAP C&I	35%	Assume same participation rate as Load Curtailment. No participation rates found for DLC Lighting programs.
	Saturation C&I	Around 1% currently, reaching 33% by end of the study	California Energy Commission 2019. Saturation of networked lighting controls.
TOU Rate	# of Control Units per Participant	1	
	Existing Participants	0	
	Participant Annual Incentive	\$0	N/A

DR Program	Assumption	Value	Source
	Annual Number of Control Hours	1043	Assume 4 hrs/week day, year round
	Per Participant Load Reduction - Summer - Res	8.60%	Average of studies: BPA 2021, Pacificorp 2023, PG&E 2023, Maryland Evaluation 2020, Dominion Energy 2022 Evaluation
	Per Participant Load Reduction - Winter - Res	3.60%	Average of studies: BPA 2021, Pacificorp 2023, PG&E 2023, Maryland Evaluation 2020, Dominion Energy 2022 Evaluation
	Per Participant Load Reduction - Summer - C&I	2.00%	Pacificorp 2023
	Per Participant Load Reduction - Winter - C&I	1.00%	Pacificorp 2023
	Control Equipment Useful Life	20 years	Useful life of smart meter. https://docs.cpuc.ca.gov/published/FINAL_DECISION/58362-07.htm#:~:text=The%20AMI%20system's%20useful%20life%20does%20not,is%20a%20reasonable%20forecast%20for%20the%20purposes
	Utility Per Unit Equipment/ Labor Cost	\$0	No cost to join rate
	Participant Share of Equipment/Labor Cost	\$0	No cost to join rate
	One Time Incentive Towards Cost of Equipment	\$0	No cost to join rate
	O&M/Vendor Service Fees per Customer Res	\$0	N/A, utility runs rate programs
	O&M/Vendor Service Fees per Customer C&I	\$0	N/A, utility runs rate programs
	Participation Rate MAP Res	28.7%	2025 Market Research for AES
	Participation Rate RAP Res	13.0%	2025 Market Research for AES
	Participation Rate MAP C&I	42.0%	2025 Market Research for AES

DR Program	Assumption	Value	Source
	Participation Rate RAP C&I	25.0%	2025 Market Research for AES
	Saturation Res	100%	All customers with a smart meter are eligible
	Saturation C&I	100%	All customers with a smart meter are eligible
Behavioral DR	# of Control Units per Participant	1	
	Existing Participants	0	
	Participant Annual Incentive	\$0	N/A
	Annual Number of Control Hours	30	Assumes 15 events per year, 2 hours per event
	Per Participant Load Reduction - Summer - Res	2.89%	National Grid 2019 (case studies from Consumers Energy, DTE Energy, Efficiency Vermont), Portland General Electric 2018
	Per Participant Load Reduction - Winter - Res	1.20%	Portland General Electric 2018
	Control Equipment Useful Life	20 years	Useful life of smart meter. https://docs.cpuc.ca.gov/published/FINAL_DECISION/58362-07.htm#:~:text=The%20AMI%20system's%20useful%20life%20does%20not,is%20a%20reasonable%20forecast%20for%20the%20purposes
	Utility Per Unit Equipment/Labor Cost	\$0	No cost to join program
	Participant Share of Equipment/Labor Cost	\$0	No cost to join program
	One Time Incentive Towards Cost of Equipment	\$0	No cost to join program
	O&M/Vendor Service Fees per Customer Res	\$5/participant	GDS assumption that would include cost of vendor sending messages during events.

DR Program	Assumption	Value	Source
	Marketing	\$2/new participant	GDS assumption - notification that customer is being automatically enrolled in a new program. Costs include bill inserts/emails, welcome letters, updating website, digital ads, and/or webinars.
	Participation Rate MAP Res	80%	Opt-out program, assuming AES saves 20% of remaining customers as a control group
	Participation Rate RAP Res	80%	Opt-out program, assuming AES saves 20% of remaining customers as a control group
	Saturation Res	100%	All customers with a smart meter are eligible
TES Rate	# of Control Units per Participant	1	
	Existing Participants	0	
	Participant Annual Incentive	\$500	Assumes utility pays incentive of 5% of equipment cost annually (Xcel Energy current program)
	Annual Number of Control Hours	465	Assumes 3 hours per day, 5 months of year during cooling season
	Per Participant Load Reduction - Summer - C&I	20%	Austin Energy current program - must be able to shift between 20%-50% of facility demand.
	Per Participant Load Reduction - Winter - C&I	N/A	
	Control Equipment Useful Life	20 years	Pacificorp 2019
	Utility Per Unit Equipment/Labor Cost	N/A	Assumes participant owns equipment.
	Participant Share of Equipment/Labor Cost	\$9,000	Assumes \$10,000 equipment cost (Pacificorp 2019). Costs range greatly depending on system type, size, and material used. \$10,000 is likely on the lower end.
	One Time Incentive Towards Cost of Equipment	\$1,000	Assumes utility pays for 10% of equipment cost (Xcel Energy current program)
	O&M/Vendor Service Fees per Customer C&I	\$0	Pacificorp 2019

DR Program	Assumption	Value	Source
	Participation Rate MAP C&I	2.30%	Assumes double RAP participation rate.
	Participation Rate RAP C&I	1.15%	Pacificorp 2019. This type of program is only applicable for niche customer segments.
	Saturation C&I	3.4%	2025 Market Research for AES. Percentage of customers with chillers.
Battery Storage	# of Control Units per Participant	1	
	Existing Participants	0	
	Participant Annual Incentive - Res	\$400/participant	Average of studies: Massachusetts Energy Storage Demand Reduction Evaluation 2024, Xcel Energy 2022, Pacificorp 2023
	Participant Annual Incentive - C&I	\$1500/participant	Based on incentive per kW for residential programs, for 11.25 kW C&I battery
	Annual Number of Control Hours	180	Eversource 2021, Massachusetts Energy Storage Demand Reduction Evaluation 2024
	Per Participant Load Reduction - Summer - Res	3 kW	Assumes utility could use 60% of 5kW residential battery
	Per Participant Load Reduction - Winter - Res	3 kW	Assumes utility could use 60% of 5kW residential battery
	Per Participant Load Reduction - Summer - C&I	11.25 kW	2017 SGIP Advanced Energy Storage Impact Evaluation. Peak demand reduction of 45% of rebated capacity for a 25 kW battery - Figure 4-36 of study.
	Per Participant Load Reduction - Winter - C&I	11.25 kW	2017 SGIP Advanced Energy Storage Impact Evaluation. Peak demand reduction of 45% of rebated capacity for a 25 kW battery - Figure 4-36 of study.
	Control Equipment Useful Life	10 years	Tesla Powerwall warranty
	Utility Per Unit Equipment/ Labor Cost	See below.	

DR Program	Assumption	Value	Source
	Participant Share of Equipment/Labor Cost - Res	Cost of residential battery is \$15,479 in 2027 and decreases to \$11,654 in 2045. Can assume a BYOB program where participant pays full cost and eligible pool of customers is small or could assume that utility pays for 25% of battery cost to incentivize customers to participate in program.	NREL 2024 cost forecast: https://atb.nrel.gov/electricity/2024/residential_battery_storage
	Participant Share of Equipment/Labor Cost - C&I	Cost of 25 kW C&I battery is \$230,495 in 2027 and decreases to \$173,27 in 2045. Can assume a BYOB program where participant pays full cost and eligible pool of customers is small or could assume that utility pays for 25% of battery cost to incentivize customers to participate in program.	NREL 2024 cost forecast: https://atb.nrel.gov/electricity/2024/residential_battery_storage
	One Time Incentive Towards Cost of Equipment	See above.	

DR Program	Assumption	Value	Source
	O&M/Vendor Service Fees per Customer Res	\$77/kW starting in 2027; decreases to \$58/kW in 2045	NREL 2024 cost forecast: https://atb.nrel.gov/electricity/2024/residential_battery_storage
	O&M/Vendor Service Fees per Customer C&I	\$230.50/kW starting in 2027; decreases to \$173/kW in 2045	NREL 2024 cost forecast: https://atb.nrel.gov/electricity/2024/residential_battery_storage
	Participation Rate MAP Res	60%	Pacificorp 2023
	Participation Rate RAP Res	50%	Xcel Energy 2022
	Participation Rate MAP C&I	60%	Assumes same as residential
	Participation Rate RAP C&I	50%	Assumes same as residential
	Saturation Res	12% of customers with solar	LBL Tracking The Sun Report 2024
	Saturation C&I	8% of customers with solar	LBL Tracking The Sun Report 2024
Capacity Bidding	# of Control Units per Participant	1	
	Existing Participants	0	
	Participant Annual Incentive	\$80/kW pledged/nominated per participant for year-round participation	Statewide California Capacity Bidding Evaluation 2021
	Annual Number of Control Hours	360	Assumes max of 30 hours per month, runs year-round
	Per Participant Load Reduction Dispatched - Summer - C&I	25%	Average of studies: Statewide California Capacity Bidding Evaluation 2021, Pacificorp 2019; assumes day-ahead notification
	Per Participant Load Reduction Dispatched - Winter - C&I	25%	Average of studies: Statewide California Capacity Bidding Evaluation 2021, Pacificorp 2019; assumes day-ahead notification

DR Program	Assumption	Value	Source
	Nominated capacity compared to dispatched	150% of dispatched load	Statewide California Capacity Bidding Evaluation 2021
	Control Equipment Useful Life	20 years	Useful life of smart meter. https://docs.cpuc.ca.gov/published/FINAL_DECISION/58362-07.htm#:~:text=The%20AMI%20system's%20useful%20life%20does%20not,is%20a%20reasonable%20forecast%20for%20the%20purposes
	Utility Per Unit Equipment/Labor Cost	\$0	No equipment cost
	Participant Share of Equipment/Labor Cost	\$0	No equipment cost
	One Time Incentive Towards Cost of Equipment	\$0	No equipment cost
	Admin costs	\$20/kW	Assume similar to Load Curtailment program
	O&M/Vendor Service Fees per Customer C&I	\$70/kW	Pacificorp 2019
	Participation Rate MAP C&I	46%	Assumes MAP participation rate for Load Curtailment program
	Participation Rate RAP C&I	21.5%	Pacificorp 2019
	Saturation C&I	100% of C&I customers	All C&I customers are eligible to participate.
Load Curtailment	# of Control Units per Participant	1	
	Existing Participants	0	
	Participant Annual Incentive	\$6/kW per month (currently only May-Oct, but assuming 12 mo/yr in MPS)	AES Interruptible Power Tariff https://www.aesindiana.com/sites/aesvault.com/files/2024-05/Rider-14-Interruptible-Power-45911-Effective-05-09-24.pdf

DR Program	Assumption	Value	Source
	Annual Number of Control Hours	200	AES Interruptible Power Tariff https://www.aesindiana.com/sites/aesvault.com/files/2024-05/Rider-14-Interruptible-Power-45911-Effective-05-09-24.pdf
	Minimum interruption demand	1500 kW	AES Interruptible Power Tariff https://www.aesindiana.com/sites/aesvault.com/files/2024-05/Rider-14-Interruptible-Power-45911-Effective-05-09-24.pdf
	Per Participant Load Reduction - Summer - C&I	23%	Average of studies: Pacificorp 2023, Puget Sound Energy 2022, BPA 2021, PGE 2016
	Per Participant Load Reduction - Winter - C&I	23%	Average of studies: Pacificorp 2023, Puget Sound Energy 2022, BPA 2021, PGE 2016
	Control Equipment Useful Life	20 years	Useful life of smart meter. https://docs.cpuc.ca.gov/published/FINAL_DECISION/58362-07.htm#:~:text=The%20AMI%20system's%20useful%20life%20does%20not,is%20a%20reasonable%20forecast%20for%20the%20purposes
	Utility Per Unit Equipment/Labor Cost	\$10 per new kW pledged	BPA 2021, Puget Sound Energy 2022
	Participant Share of Equipment/Labor Cost	\$0	No equipment cost
	One Time Incentive Towards Cost of Equipment	\$0	No equipment cost
	Admin costs	\$20/kW	BPA 2019, Snohomish County PUD
	O&M/Vendor Service Fees per Customer C&I	\$20/kW	BPA 2021, Puget Sound Energy 2022
	Participation Rate MAP C&I	46%	2025 Market Research for AES
	Participation Rate RAP C&I	35%	2025 Market Research for AES
	Saturation C&I	100% of large C&I customers	All large C&I customers are eligible to participate.

DR Program	Assumption	Value	Source
Peak Time Rebate	Participant Annual Incentive	\$1/kWh saved	ComEd program, Ameren IL program, Delmarva Power program
	Annual Number of Control Hours	64	Assumes 16 events per year (5 summer/winter and 3 spring/fall), 4 hours per event. MISO LMR.
	Per Participant Load Reduction - Summer - Res	14%	Pacificorp 2023, PGE 2018 Pilot Study
	Per Participant Load Reduction - Winter - Res	8%	Pacificorp 2023, PGE 2018 Pilot Study
	Control Equipment Useful Life	20 years	Useful life of smart meter. https://docs.cpuc.ca.gov/published/FINAL_DECISION/58362-07.htm#:~:text=The%20AMI%20system's%20useful%20life%20does%20not,is%20a%20reasonable%20forecast%20for%20the%20purposes
	Utility Per Unit Equipment/Labor Cost	\$0	No cost to join rate
	Participant Share of Equipment/Labor Cost	\$0	No cost to join rate
	One Time Incentive Towards Cost of Equipment	\$0	No cost to join rate
	O&M/Vendor Service Fees per Customer Res	\$0	N/A, utility runs rate programs
	Participation Rate MAP Res	20%	Duke Energy DR Study 2020
	Participation Rate RAP Res	13%	Duke Energy DR Study 2020, Pacificorp 2023
	Saturation Res	100%	All customers with a smart meter are eligible
General Program Costs (unless	Implementation	\$150,000 per new program	BPA 2021, Puget Sound Energy 2022
	Admin	\$150,000 per program	Assumes 1 full time staff, sometimes shared between similar programs

DR Program	Assumption	Value	Source
otherwise noted)	Marketing	\$50 per new participant for residential & small C&I customers; \$200 per new participant for large C&I programs (ie for Curtailment & Capacity Bidding Programs)	BPA 2021, Puget Sound Energy 2022, PacifiCorp 2019
	Evaluation	\$50,000 for each program every 2 years (so \$25,000 per year)	

E. 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.

E.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.

E.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 natural gas loads. GDS first utilized AES customer data to understand the share of end-uses that utilize natural gas. Table E-1 summarizes the share of homes currently using natural gas. The natural gas shares of end-uses were developed from market research conducted by GDS for the market potential study.

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

Housing Type / End Use	Single Family	Multifamily	Total
Existing Customer Count	320,222	153,479	473,701
Space Heating Share	57.8%	18.9%	45.2%
Water Heating	50.0%	25.2%	42.0%
Gas range or stovetop	31.2%	12.0%	25.0%
Gas oven	25.2%	12.0%	21.0%
Gas clothes dryer	9.9%	1.6%	7.2%

GDS developed baseline technology models using assumptions from the Illinois TRM V13 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 not included in the building electrification modeling due to the small proportion of customers utilizing gas clothes dryers. The resulting natural gas consumption was compared to reported natural gas sales by Citizens Energy Group in American Gas Association 2020-2023 sales data. The bottom-up measure modeling estimated a total of 21,513,164 annual MMBTU of natural gas consumption, 112 percent of the 2020-2023 average annual Citizens Energy Group sales. Variations from weather normal for those years were not explored.

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 15.2 SEER2/7.65 HSPF2 to 20 SEER2/8.5 HSPF2, and ground-source heat pumps
- ❑ Heat pump water heaters with UEFs of 3.0 and 3.5
- ❑ 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. New construction homes were assumed to be 100% feasible while existing homes were assumed to be 90% feasible. After accounting for existing home feasibility, the underlying forecast of available gas consumption for existing homes to electrify was 101% of Citizen Energy Group average sales for 2020-2023.¹

GDS analyzed the economics of 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 and operational costs created a customer-based benefit-cost ratio. The economic analysis did not consider the inclusion of federal tax credits or spending, or theoretical AES incentives. 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 theoretical program costs or incentives, or benefits to the utility or electric ratepayers due to building electrification. 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 the following, from the customer perspective:

- Air-source heat pumps were cost-effective for customers. Ground-source heat pumps (GSHP) were not cost effective for single family homes and marginally cost-effective for multi-family homes.
- Heat pump water heaters (HPWHs) were marginally not cost-effective in most cases. Higher efficiency HPWHs were marginally cost effective for single family homes. In general, HPWHs were approximately equivalent to gas water heaters, with lifecycle cost ratios hovering near 1.0.
- Induction-based cooking was not cost-effective, though electric resistance cooking did demonstrate outcomes hovering around 1.0 when compared to natural gas counterparts.
- For new residential construction, all end-uses indicated similar patterns for existing homes, though were generally more favorable.
- The cost of avoiding fixed costs for adding or maintaining natural gas meters and supply was not factored into the analysis, suggesting that avoiding fixed fees associated with natural gas *could* tip cost-effectiveness to favor electric end-uses.

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 40 percent of customers would adopt electrification over time. The medium adoption scenario assumed 20 percent would adopt electrification, and the low adoption scenario assumed 10 percent would adopt electrification. For the high scenario's HVAC and water heating technologies, the available annual equipment sales under natural replacement cycle assumptions were confirmed to always be less than 100 percent of annual available sales.

Finally, GDS compared the forecasted electrification electricity sales increase to NREL's 2018 Electrification Futures study reference case. The NREL study forecasted, at a national level, residential electrification electricity sales increases. 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 specific to AES, with comparisons to the national forecast.

¹ While the measure-level aggregation of residential gas consumption did not precisely match Citizens Energy Group natural gas consumption, the results indicate generally close alignment. Given the underlying assumptions for achievable market adoption levels, the precision of the natural gas forecast is mitigated by the range of possible market adoption rates, which have a much larger impact on the results than possible errors in the residential gas consumption estimates.

E.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 2020-2023 average 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 E-2 describes the end-use share assumptions for each of the end-uses modeled for electrification.

TABLE E-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 V13 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.² 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 5.8 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.

² Natural gas consumption data was not available by building type, necessitating analyzing the commercial sector as a whole.

- 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 impacts on gas or electricity consumption. 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 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 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 possible 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:

- Under current and forecasted retail rates, HVAC heat pumps and water heaters were not cost effective to electrify in commercial buildings.
- 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 participant 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 when making energy choices.
- Acknowledges that some commercial sector customers in the economy are choosing to electrify despite sub-economic energy 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.

The economic analysis using the customer perspective revealed several general observations. 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 limited expected market adoption of commercial building electrification absent market intervention.

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 but developed alternative diffusion curves based on

several logics. 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.

E.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, with varying equipment performance needs varying by manufacturing process needs. 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, the timing for aging process equipment to be replaced, and overall business strategies.

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, in terms of the growth in electricity sales for the industrial sector. 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 industrial electrification impacts 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 50% the growth of the high case
- A low scenario that assumes 25% the growth of the high case

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.

E.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 2046 results compared to the base forecast for 2046.

E.2.1 All Sectors

Table E-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 2045 electricity sales under the three electrification scenarios are compared to the base electrification forecast, which does not include any assumed electrification growth.

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

Scenario	2027	2030	2035	2040	2045	2046	2046 Percent Above Base Forecast
Low	7,390	14,213	43,930	84,541	121,585	139,249	1.0%
Medium	8,843	18,834	62,508	143,764	226,418	258,868	1.8%
High	11,809	28,427	101,649	277,187	473,505	514,005	3.5%

The above results for additional load due to electrification show a range of one percent to 3.5 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 1.8 percent growth above the base forecast by 2046 (identical to the Medium scenario). As a national model, the growth in total electric consumption does not necessarily mirror AES's forecast and are not illustrative of year-on-year differences between scenarios that are specific to AES. Additionally, in the BAU forecast, NREL's modeling assumes no incremental load growth due to electrification occurring for the industrial sector. While the overall load growth from the NREL study is roughly the same 1.8% growth over the 2046 base forecast and aligns with the Medium scenario, there are specific differences allocating the electrification growth by sector. Sector-level results are presented below.

E.2.2 Residential Sector

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

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

Scenario	2027	2030	2035	2040	2045	2046	2046 Percent Above Base Forecast
Low	3,581	6,692	24,850	47,691	55,049	56,198	0.9%
Medium	3,606	6,893	29,882	78,511	106,046	109,855	1.8%
High	3,619	6,997	33,087	112,995	196,907	211,528	3.5%

The above results for additional load due to residential building electrification show a range of roughly one percent to 3.5 percent above the AES 2046 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 3.9 percent growth above the base forecast by 2046. 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, dampening electrification opportunities.

E.2.3 Commercial Sector

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

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

Scenario	2027	2030	2035	2040	2045	2046	2046 Percent Above Base Forecast
Low	2,479	3,532	8,440	19,562	42,598	56,452	0.8%
Medium	2,577	3,962	11,348	30,675	72,495	95,816	1.4%
High	2,870	5,471	26,004	95,037	180,844	196,084	2.8%

The above results for additional load due to commercial building electrification show a range of slightly under one percent to 2.8 percent above the AES 2046 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 2046. 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.

E.2.4 Industrial Sector

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

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

Scenario	2027	2030	2035	2040	2045	2046	2046 Percent Above Base Forecast
Low	1,330	3,990	10,639	17,289	23,939	26,598	1.7%
Medium	2,660	7,980	21,279	34,578	47,877	53,197	3.4%
High	5,320	15,959	42,558	69,156	95,754	106,394	6.8%

The above results for additional load due to industrial sector building electrification (including processes) show a range of 1.7% to 6.8% above the AES 2046 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 load 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. While the industrial sector result indicates 2046 sector-specific load growth higher than the residential or commercial sectors, the absolute growth in possible additional electrification load is the smallest of the three sectors.

AES INDIANA



2025 Demand Side Management Market Potential Study

October 24,
2025

FINAL REPORT

The logo for AES, with the letters 'a', 'e', and 's' in a stylized, rounded font. The 'a' is blue, the 'e' is purple, and the 's' is green.

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Attachment 6-4

(Avoided Costs)

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Attachment 8-1

(Annual Generator Fuel Prices)

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The logo for 'aes' is stylized with a color gradient. The 'a' is blue, the 'e' is purple, and the 's' is green. The letters are rounded and connected.

aes Indiana

2025 IRP

Attachment 8-2

(Quanta Report)



REPORT

Portfolio Reliability Analysis and Ranking to Support 2025 IRP Process

PREPARED FOR
AES INDIANA



DATE

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VERSION HISTORY

VERSION	DATE	DESCRIPTION
1.0	October 30, 2025	Initial submission



Acronyms and Abbreviations

The acronyms and abbreviations used in this report are listed in Table 1.

Table 1. Acronyms and Abbreviations

TERM	DEFINITION
ACE	Area Control Error
AEMO	Australian Energy Market Operator
AES IPL	AES Indianapolis Power & Light
BAL	Resource and Demand Balancing
BPS	Bulk Power System
CPL	Carolina Power & Light Company (Area 340)
CSCR	Composite Short Circuit Ratio
DER	Distributed Energy Resources
DR	Demand Response
ELCC	Effective Load-carrying Capability
ESCR	Effective Short Circuit Ratio
FOS	Frequency Operating Standard
GFL	Grid-following Inverter
GFM	Grid-forming Inverter
IBR	Inverter-Based Resources
ICAP	Installed Capacity
IEEE	Institute of Electrical and Electronics Engineers
IRM	Installed Reserve Margin
IRP	Integrated Resource Plan
IPL	Indianapolis Power & Light
MMWG	Multiregional Modeling Working Group
NERC	North American Electric Reliability Corporation
PEPCO	Potomac Electric Power (Area 233)
PFR	Primary Frequency Response
POI	Point of Interconnection
RoCoF	Rate of Change of Frequency
RRS	Responsive Reserve Service
RTEP	Regional Transmission Expansion Plan
SC	Synchronous Condenser
SCR	Short Circuit Ratio
SCRIF	Short Circuit Ratio with Interaction Factors
SLD	Single-line Diagram
TARA	Transmission Adequacy & Reliability Assessment
UFLS	Under-frequency Load Shedding
WEM	Western Australia Electricity Market
WSCR	Weighted Short Circuit Ratio



EXECUTIVE SUMMARY

Quanta Technology, LLC, is pleased to submit this report on Portfolio Reliability Analysis and Ranking to Support 2025 IRP Process.

This report supports the slide deck presented, summarizing the results of Quanta Technology's reliability and energy adequacy analysis for AES Indiana. The study evaluates candidate portfolios in support of the 2025 Integrated Resource Plan (IRP) and focuses on Essential Reliability Services (ERS) including frequency response, short circuit strength, energy adequacy, and import/export capability.

Import / Export Transmission Limit Findings

Between 2027 and 2035, the AES IPL transmission network is expected to undergo significant reinforcement, with the number of tie lines increasing from 18 to 39, substantially enhancing interconnection with neighboring systems. Application of the MISO contingency package allows accurate estimation of import capability under various operating conditions.

As a result, AES IPL's import limit increases from 578 MW in 2027 to 2,193 MW in 2030, and further to 2,503 MW by 2035, reflecting progressive transmission expansion and system strengthening.

Despite this improvement, export capability remains extremely limited due to rising internal demand, primarily driven by data center growth, including new Wabash Valley Power Alliance (WVPA) loads. Even with 4,630 MW of dispatchable generation capacity, AES IPL operates close to its internal supply-demand balance, leaving little margin for exports.

This trend underscores the importance of managing local generation, load growth, and transmission constraints to maintain future reliability and operational flexibility.

Energy Adequacy Results

Energy Adequacy simulations demonstrate that, if AES IPL maintains full or partial import capability (100% or 50%), the system can reliably meet demand through 2035, even under 90/10 high load scenarios. However, when imports are restricted to 0% (i.e., islanded operation), the system becomes energy-inadequate, with neither energy adequacy nor Planning Reserve Margin (PRM) targets being met.

Key findings include:

- Under 0% import conditions, energy shortfalls occur in Portfolios 3, 4, 7, 8, 15, and 16, with Portfolio 8 (2035) being the most critical.
- Nearly all portfolios fail to meet PRM requirements for 2030 and 2035, with the most severe deficits in Portfolios 7 and 8.

These results highlight the vital role of regional interconnections in ensuring long-term system adequacy. To maintain reliability, AES IPL should:

- Preserve import flexibility by ensuring strong interconnection capability.
- Continue investment in transmission upgrades to support regional energy exchange.
- Coordinate with MISO and neighboring utilities to ensure system adequacy under both normal and constrained operating conditions.



Frequency Response Analysis

Frequency response simulations were conducted to evaluate AES IPL's inertial and primary frequency response following the sudden loss of a 525 MW generating unit (Petersburg 3) under both interconnected and islanded conditions.

Under interconnected operation, all portfolios maintained acceptable frequency stability through 2040, supported by the repowering of retired coal plants with new synchronous generation, which enhances system inertia and frequency resilience.

Under islanded emergency conditions, however, several portfolios exhibited frequency nadir drops exceeding 0.5 Hz between 2027 and 2028, surpassing Underfrequency Load Shedding (UFLS) thresholds and placing parts of the load at risk of disconnection.

A similar pattern was observed in Portfolios 4, 8, and 16, where frequency recovery became adequate—maintaining a nadir above 59.5 Hz—only after 2029 for Portfolios 4 and 16 and after 2030 for Portfolio 8.

Additional resource requirements were identified to mitigate Primary Frequency Response (PFR) deficits:

- Greatest needs occur between 2027 and 2032, with the worst-case condition in Portfolio 8.
- Secondary Frequency Regulation requirements are highest under the High Regulatory: Environmental portfolio, reflecting increased system stress under stricter operational conditions.

These results emphasize the need for fast frequency response resources, such as battery storage and synchronous support, to strengthen system resilience during islanded or low-inertia operation.

Short Circuit Strength Analysis Conclusions

Two system configurations were evaluated for short circuit strength in the High Regulatory: Environmental scenario for the year 2035: the interconnected system and the Islanded system.

In the interconnected case, all four portfolios (P5 to P8) achieved 100% integration of inverter-based resources (IBRs), demonstrating that external grid support significantly enhances short circuit strength and ensures compliance with ESCR thresholds.

In contrast, the islanded system scenario revealed limitations in portfolios P7 and P8, which had higher renewable penetration. Their pass rates dropped to 70.2% and 67.6%, respectively, due to reduced short circuit contributions from IBRs.

Portfolios P5 and P6 maintained full integration even without external support, indicating their configurations are within acceptable ESCR limits.

These findings underscore the importance of grid interconnections and the need for mitigation strategies—such as synchronous condensers or grid-forming inverters—when planning high-renewable portfolios in isolated grid conditions.



TABLE OF CONTENTS

ACRONYMS AND ABBREVIATIONS	II
1 INTRODUCTION	1
1.1 Scope of Work.....	1
2 INFORMATION, DATA SOURCES, AND METHODOLOGY	2
2.1 AES IPL Load Forecast	2
2.2 Defined Portfolios	3
2.3 Resource Profiles for Solar, Wind, Offshore Wind, and Load	7
2.3.1 Average Solar Irradiance.....	7
2.3.2 Average Wind Profiles.....	8
2.3.3 Hourly Load Profile.....	10
3 TRANSMISSION LIMIT CALCULATION	16
3.1 Methodology and Contingencies to be considered.....	16
3.2 AES IPL Import / Exports limits	17
3.2.1 Data Sources.....	17
3.2.2 Base Case Performance (N-0)	17
3.2.3 Contingency and Performance Criteria	18
3.2.4 Simulation Tools.....	18
3.3 Results and Analysis.....	18
3.3.1 Transmission Network Evolution.....	18
3.3.2 Base Case Performance (N-0)	18
3.3.3 AES IPL Import Limit for Summer 2035	18
3.3.4 Export Capability	19
3.3.5 CONCLUSIONS	20
4 ENERGY ADEQUACY ANALYSIS.....	21
4.1 Energy Adequacy assessment	21
4.2 Analyzed Reliability and Energy Adequacy Metrics.....	21
4.3 Energy Adequacy analysis - Planning Reserve Margin (PRM) Criteria	22
4.4 Energy Adequacy Resulting Metrics.....	22
4.4.1 Energy Adequacy Metrics (0% Import)	22
4.5 Energy Adequacy Resulting Metrics - Conclusions	24
5 ANALYSIS OF INERTIAL AND PRIMARY FREQUENCY RESPONSE.....	26
5.1 Considerations, Methodology, and Tools for Inertial and Primary Frequency Analysis	26
5.1.1 System Inertia, Inertial Response, and Rate of Change of Frequency Threshold Considerations	27
5.2 Equivalent Model for Frequency Response Analysis.....	31
5.2.1 Mathematical Model Definition	31



5.3	Results for Inertial and Primary Frequency.....	32
5.3.1	Results for Inertial Frequency Response	32
5.3.2	Results for Online Inertia Requirements	34
5.3.3	Results for Primary Frequency Response.....	35
5.3.4	Resource deficits for Islanded emergency condition.....	38
5.4	Conclusions from Frequency Response Metrics.....	40
6	SHORT CIRCUIT STRENGTH	42
6.1	Approach: Short Circuit Strength Study	42
6.2	Short Circuit Analysis Tool and Methodology.....	42
6.3	Generation Resource Portfolio for 2035.....	45
6.4	Resource distribution for portfolio High Regulatory: Environmental.....	47
6.5	Findings: Short Circuit Strength Study	47
6.5.1	Short-Circuit Analysis Results with Interconnected system	48
6.5.2	Short-Circuit Analysis Results with Islanded system.....	49
6.5.3	Short Circuit Analysis Conclusion	49
7	CONCLUSIONS	51
7.1	Import / Export transmission limit calculation	51
7.2	Energy Adequacy Resulting Metrics.....	51
7.3	Conclusions from Frequency Response Metrics.....	52
7.3.1	Short Circuit Analysis Conclusion	52
8	WORKS CITED	54
	APPENDIX A: ADDITIONAL PORTFOLIO RESULTS	57
8.1	Synchronous Generation and Requirements and Expected RoCoF and Online Inertia Requirements	57
8.2	Primary frequency response for Interconnected and Islanded case	73

LIST OF FIGURES

Figure 1.	Large Load Additions having three possible scenarios Low - Medium - High Data Center loads.....	2
Figure 2.	AES IPL's Load Forecast.....	2
Figure 3.	Installed Capacity (ICAP) for AES IPL area for Portfolio P3.....	4
Figure 4.	ICAP defined by AES IPL as the "Reference Case" - Portfolios P1-P4.....	5
Figure 5.	ICAP defined by AES IPL as the "High Regulatory: Environmental" - Portfolios P5-P8	5
Figure 6.	ICAP defined by AES IPL as the "Gas Infrastructure Challenges" - Portfolios P9-P12	6
Figure 7.	ICAP defined by AES IPL as the "Gas Infrastructure Challenges" - Portfolios P13-P16	7
Figure 8.	Average Solar Irradiance in 2027 (kWh/kWac).....	8
Figure 9.	Average Solar Irradiance in 2030 (kWh/kWac).....	8
Figure 10.	Average Solar Irradiance in 2035 (kWh/kWac)	8
Figure 11.	Average Onshore Wind Resources Profile in 2027.....	9
Figure 12.	Average Onshore Wind Resources Profile in 2030.....	9
Figure 13.	Average Onshore Wind Resources Profile in 2035.....	9



Figure 14. AES IPL's Average Hourly Load Profile Expected for 2027 for the "No Data Center" Case.....	10
Figure 15. AES IPL's Average Hourly Load Profile Expected for 2027 for the "Low Data Center" Case.....	10
Figure 16. AES IPL's Average Hourly Load Profile Expected for 2027 for the "Medium Data Center" Case...	11
Figure 17. AES IPL's Average Hourly Load Profile Expected for 2027 for the "High Data Center" Case.....	11
Figure 18. AES IPL's Average Hourly Load Profile Expected for 2030 for the "No Data Center" Case.....	11
Figure 19. AES IPL's Average Hourly Load Profile Expected for 2030 for the "Low Data Center" Case.....	12
Figure 20. AES IPL's Average Hourly Load Profile Expected for 2030 for the "Medium Data Center" Case...	12
Figure 21. AES IPL's Average Hourly Load Profile Expected for 2030 for the "High Data Center" Case.....	13
Figure 22. AES IPL's Average Hourly Load Profile Expected for 2035 for the "No Data Center" Case.....	13
Figure 23. AES IPL's Average Hourly Load Profile Expected for 2035 for the "Low Data Center" Case.....	13
Figure 24. AES IPL's Average Hourly Load Profile Expected for 2035 for the "Medium Data Center" Case...	14
Figure 25. AES IPL's Average Hourly Load Profile Expected for 2035 for the "High Data Center" Case.....	14
Figure 28. Frequency Trace after Loss of 2,750 MW and Initial RoCoF after the Event.....	29
Figure 29. Impact of Effective System Inertia and Contingency Size on RoCoF.....	30
Figure 30. Synchronous Generation Requirements and Expected RoCoF for Portfolio P4.....	33
Figure 31. Synchronous Generation Requirements and Expected RoCoF for Portfolio P8.....	33
Figure 32. Online Inertia Requirements for Portfolio P4 in Island Mode	34
Figure 33. Online Inertia Requirements for Portfolio P8 in Island Mode	35
Figure 34. PFR for Portfolio P4 for AES IPL interconnected with external MISO network	36
Figure 35. PFR for Portfolio P8 for AES IPL interconnected with external MISO network	36
Figure 36. PFR for Portfolio P4 for AES IPL operating in the emergency Island operation mode.....	37
Figure 37. PFR for Portfolio P8 for AES IPL operating in the emergency Island operation mode.....	37
Figure 38. PFR for Portfolio P16 for AES IPL operating in the emergency Island operation mode.....	38
Figure 39. SCR Analysis Tool Workflow	43
Figure 40. ZBus Data Overview	43
Figure 41. Synchronous Generation Requirements and Expected RoCoF and Online Inertia Requirements for Portfolio 1	57
Figure 42. Synchronous Generation Requirements and Expected RoCoF and Online Inertia Requirements for Portfolio 2	58
Figure 43. Synchronous Generation Requirements and Expected RoCoF and Online Inertia Requirements for Portfolio 3	59
Figure 44. Synchronous Generation Requirements and Expected RoCoF and Online Inertia Requirements for Portfolio 4	60
Figure 45. Synchronous Generation Requirements and Expected RoCoF and Online Inertia Requirements for Portfolio 5	61
Figure 46. Synchronous Generation Requirements and Expected RoCoF and Online Inertia Requirements for Portfolio 6	62
Figure 47. Synchronous Generation Requirements and Expected RoCoF and Online Inertia Requirements for Portfolio 7	63
Figure 48. Synchronous Generation Requirements and Expected RoCoF and Online Inertia Requirements for Portfolio 8	64
Figure 49. Synchronous Generation Requirements and Expected RoCoF and Online Inertia Requirements for Portfolio 9	65
Figure 50. Synchronous Generation Requirements and Expected RoCoF and Online Inertia Requirements for Portfolio 10	66
Figure 51. Synchronous Generation Requirements and Expected RoCoF and Online Inertia Requirements for Portfolio 11	67
Figure 52. Synchronous Generation Requirements and Expected RoCoF and Online Inertia Requirements for Portfolio 12	68

Figure 53. Synchronous Generation Requirements and Expected RoCoF and Online Inertia Requirements for Portfolio 13.....	69
Figure 54. Synchronous Generation Requirements and Expected RoCoF and Online Inertia Requirements for Portfolio 14.....	70
Figure 55. Synchronous Generation Requirements and Expected RoCoF and Online Inertia Requirements for Portfolio 15.....	71
Figure 56. Synchronous Generation Requirements and Expected RoCoF and Online Inertia Requirements for Portfolio 16.....	72
Figure 57. Primary frequency response for Interconnected and Islanded case for portfolio P1.....	73
Figure 58. Primary frequency response for Interconnected and Islanded case for portfolio P2.....	74
Figure 59. Primary frequency response for Interconnected and Islanded case for portfolio P3.....	75
Figure 60. Primary frequency response for Interconnected and Islanded case for portfolio P4.....	76
Figure 61. Primary frequency response for Interconnected and Islanded case for portfolio P5.....	77
Figure 62. Primary frequency response for Interconnected and Islanded case for portfolio P6.....	78
Figure 63. Primary frequency response for Interconnected and Islanded case for portfolio P7.....	79
Figure 64. Primary frequency response for Interconnected and Islanded case for portfolio P8.....	80
Figure 65. Primary frequency response for Interconnected and Islanded case for portfolio P9.....	81
Figure 66. Primary frequency response for Interconnected and Islanded case for portfolio P10.....	82
Figure 67. Primary frequency response for Interconnected and Islanded case for portfolio P11.....	83
Figure 68. Primary frequency response for Interconnected and Islanded case for portfolio P12.....	84
Figure 69. Primary frequency response for Interconnected and Islanded case for portfolio P13.....	85
Figure 70. Primary frequency response for Interconnected and Islanded case for portfolio P14.....	86
Figure 71. Primary frequency response for Interconnected and Islanded case for portfolio P15.....	87
Figure 72. Primary frequency response for Interconnected and Islanded case for portfolio P16.....	88

LIST OF TABLES

Table 1. Acronyms and Abbreviations.....	ii
Table 2. Identification numbers for the AES IPL -defined Portfolios.....	3
Table 3. Summary of Load Factors	15
Table 4. NERC TPL-001-5: Transmission System Planning Performance Requirements	16
Table 5. Lines loading for base case	17
Table 6. Interarea flows and summarizes import limits found for the analyzed years.	19
Table 7. Power balance in the area 216.....	19
Table 8. Analyzed Reliability and Energy Adequacy Metrics	21
Table 9. Energy Adequacy Metrics if imports to the area AES IPL are limited to 0%.	22
Table 10. Expected deficits in MW shortages having AES IPL 0% Imports.	23
Table 11. Planning Reserve Margins highlighting the violations.....	24
Table 12. Comparison of Inertial and primary frequency responses	26
Table 13. Additional energy storage capacity required to address the PFR - Islanded case.....	39
Table 14. Additional synchronous generation capacity required to address the PFR - Islanded case	39
Table 15. Additional energy storage capacity required to address the PFR - Islanded case.....	40
Table 16. Resource additions for 2035.....	46
Table 17. Resource distribution of portfolio generation	47
Table 18. Short circuit results: Interconnected system	48
Table 19. Short Circuit Results: Islanded system	49



1 Introduction

Quanta Technology will support the 2025 Integrated Resource Plan (IRP) for AES IPL. Quanta Technology focused on assessing the ability of the candidate IRP portfolios to provide sufficient ERS and to quantify any required mitigations.

1.1 Scope of Work

Key areas of investigation will include the following service categories:

1. Customize reliability metrics, scoring thresholds, and ranking methodology.
2. Collect relevant portfolio and system data and configure analysis tools.
3. Conduct ERS analysis and design mitigations, focusing on:
 - a. Import / Export analysis
 - b. Energy Adequacy
 - c. Frequency Response:
 - i. Inertial
 - ii. Primary response
 - d. Short Circuit Strength
4. Evaluate the reliability of the candidate resource portfolios



2 Information, Data Sources, and Methodology

2.1 AES IPL Load Forecast

The load forecast utilized for the models in this study was defined by AES IPL considering the possible Large Load additions in the system. The three possible scenarios defined, representing Low, Medium, and High levels of new Data Center load growth are shown in Figure 1.

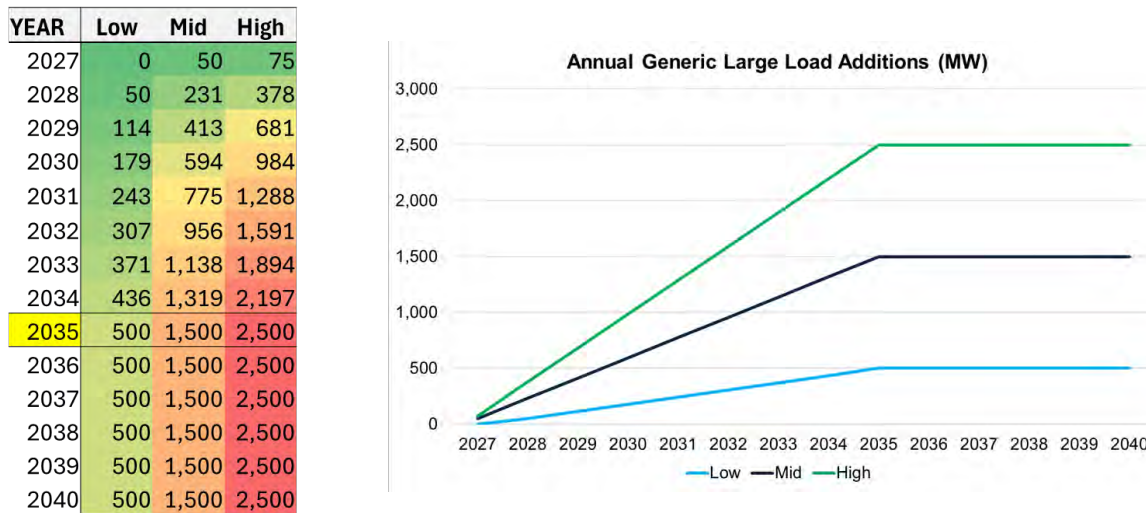


Figure 1. Large Load Additions having three possible scenarios Low - Medium - High Data Center loads

Load Forecast for the AES IPL area considering the possible Large Load additions in the system are presented in the Figure 2.

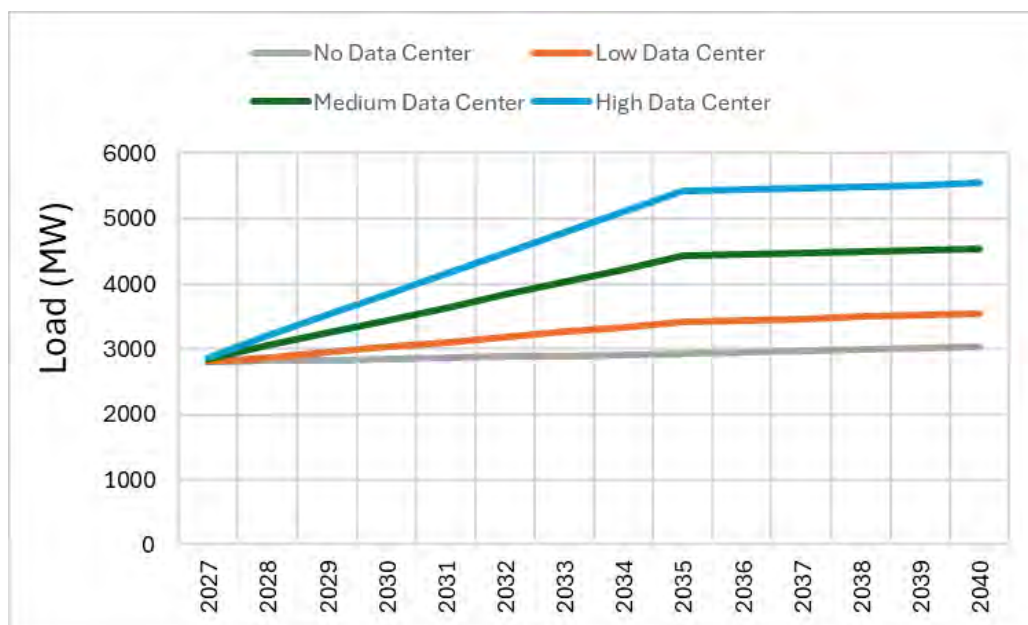


Figure 2. AES IPL's Load Forecast



2.2 Defined Portfolios

The analysis of the system’s inertial and primary frequency response, the short circuit capacities, and the energy adequacy metrics for the AES IPL area are dependent on the generation technology mix expected for the system in the coming years defined by AES IPL.

Table 2 provides the portfolio identification numbers along with the corresponding resource definitions, including expected data center load levels, existing capacity, and planned additions developed by AES IPL.

Table 2. Identification numbers for the AES IPL -defined Portfolios

#	Portfolio description
1	.1. Reference Case CX
2	.1. Mid DC CX
3	.1. Low DC CX
4	.1. High DC CX
5	.2. Gas Challenges CX
6	.2. Mid DC CX
7	.2. Low DC CX
8	.2. High DC CX
9	.3. High Enviromental CX
10	.3. Mid DC CX
11	.3. Low DC CX
12	.3. High DC CX
13	.4. Stable Markets CX
14	.4. Mid DC CX
15	.4. Low DC CX
16	.4. High DC CX

As an example of the AES IPL defined portfolios, Figure 3 presents the projected generation technology mix in terms of Installed Capacity (ICAP) through the year 2040 for the “Reference Case” – Portfolio P3, assuming a Medium level of new Data Center load growth considering the defined resource types.

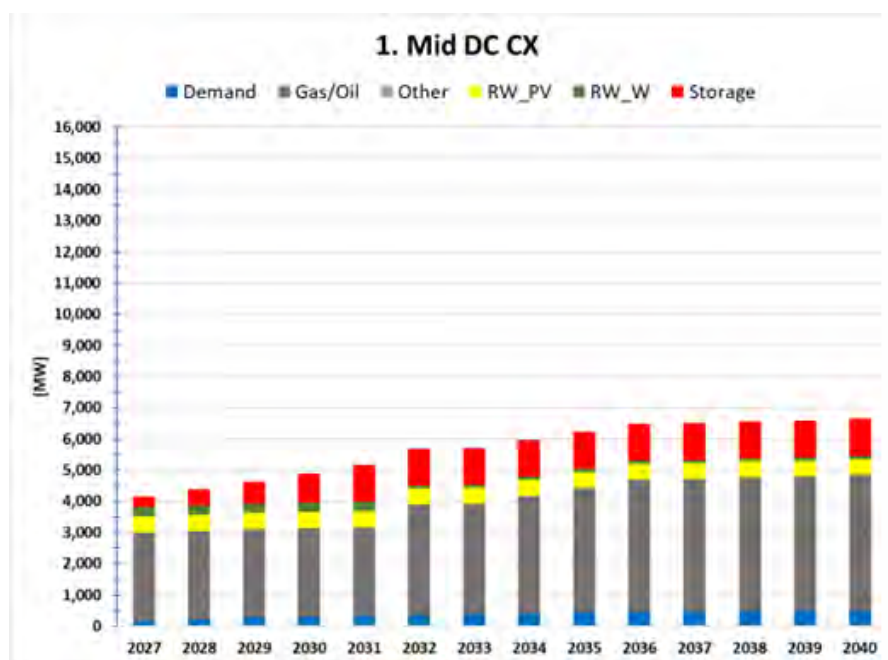


Figure 3. Installed Capacity (ICAP) for AES IPL area for Portfolio P3

Figure 4 presents the resource mix for Portfolios P1 through P5, which have been defined by AES IPL as part of the “Reference Case” scenario.

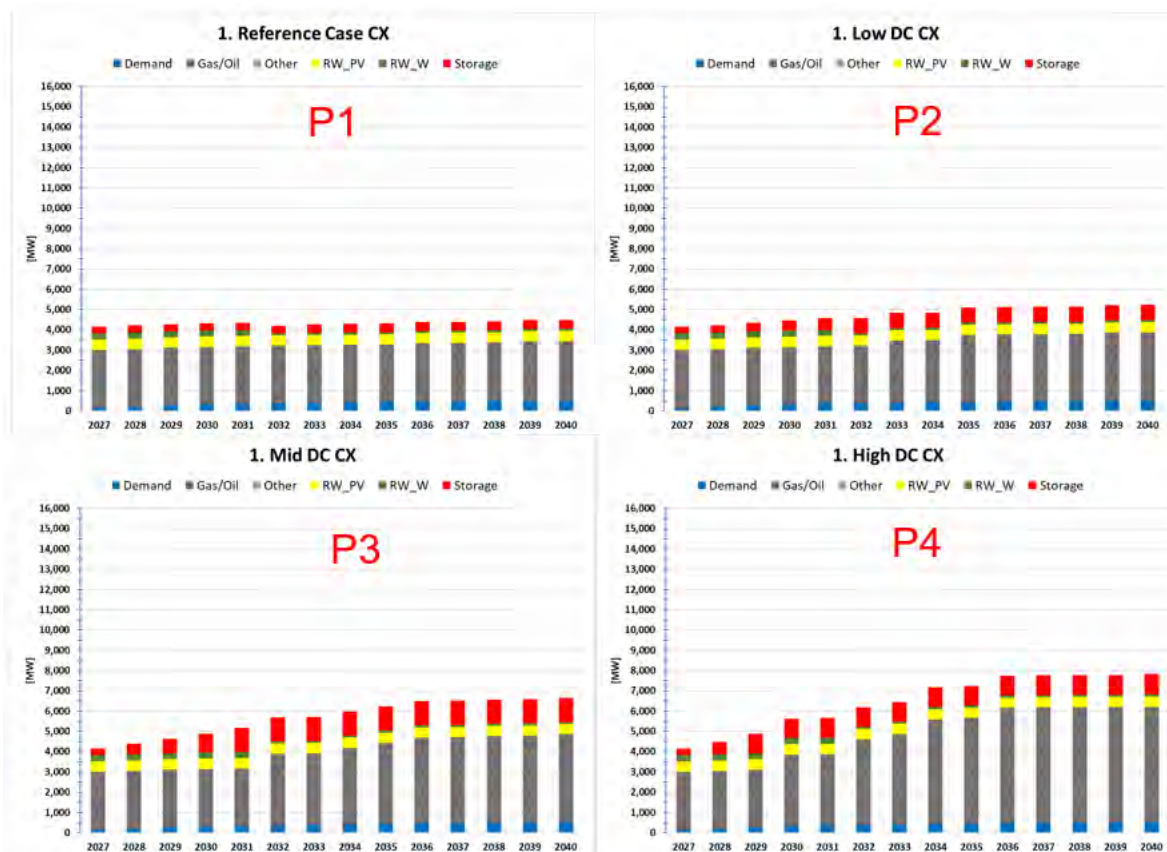




Figure 4. ICAP defined by AES IPL as the “Reference Case” - Portfolios P1-P4

Figure 5 presents the resource mix for Portfolios P5 through P8, which have been defined by AES IPL as part of the “High Regulatory: Environmental” scenario.

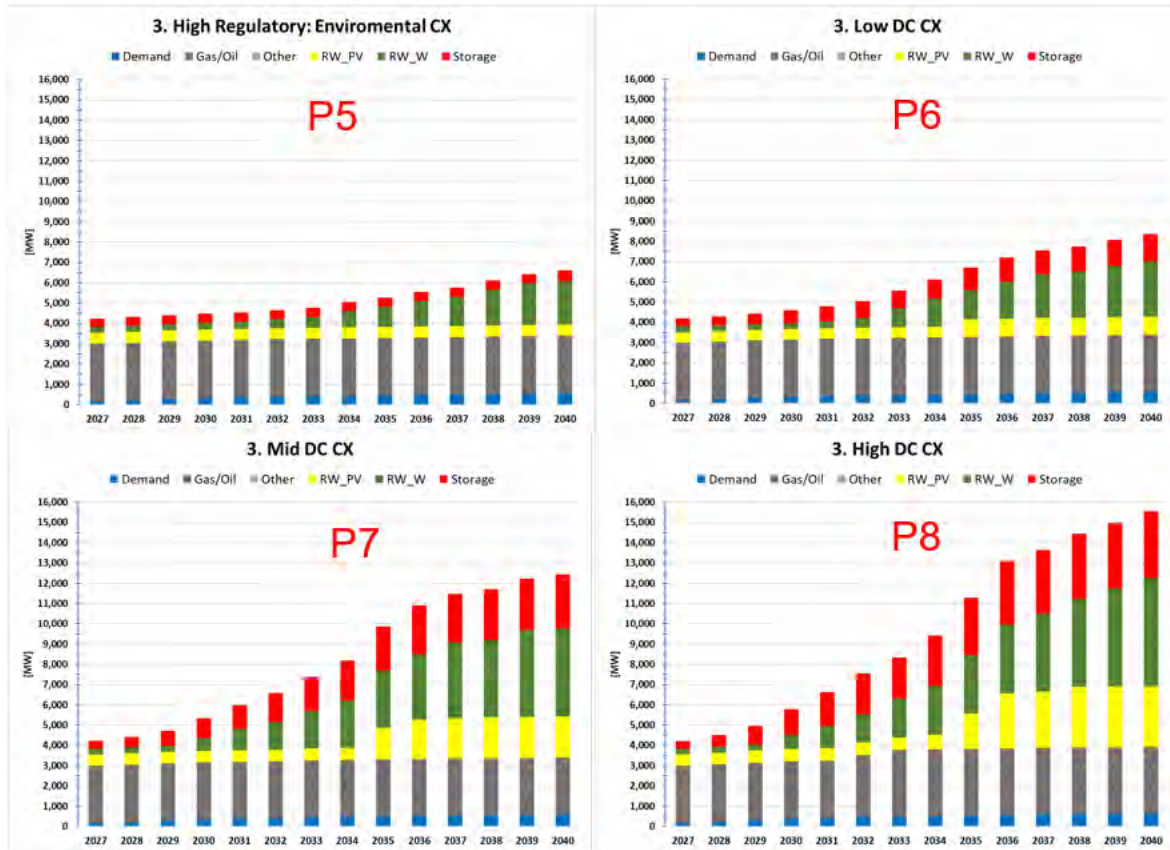


Figure 5. ICAP defined by AES IPL as the “High Regulatory: Environmental” - Portfolios P5-P8

Figure 6 presents the resource mix for Portfolios P9 through P12, which have been defined by AES IPL as part of the “Gas Infrastructure Challenges” scenario.

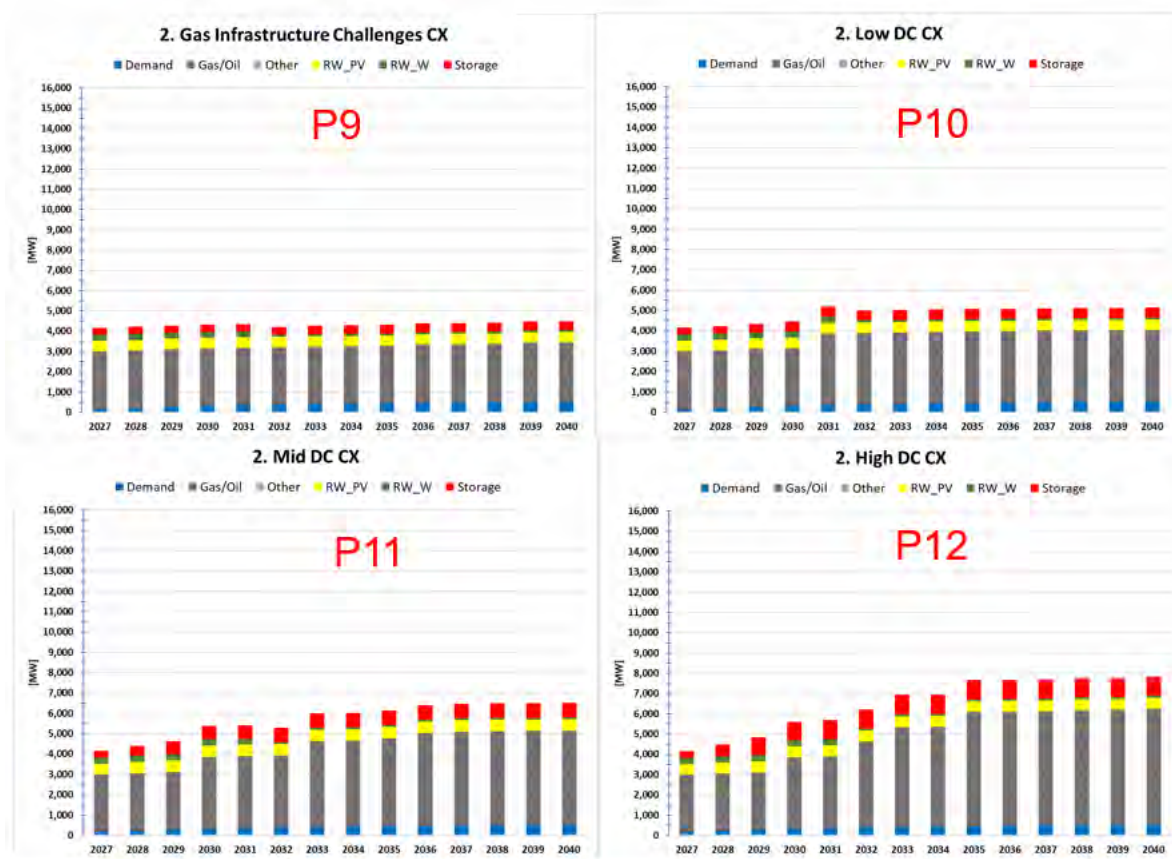


Figure 6. ICAP defined by AES IPL as the “Gas Infrastructure Challenges” - Portfolios P9-P12

Figure 7 presents the resource mix for Portfolios P13 through P16, which have been defined by AES IPL as part of the “Stable Markets” scenario.

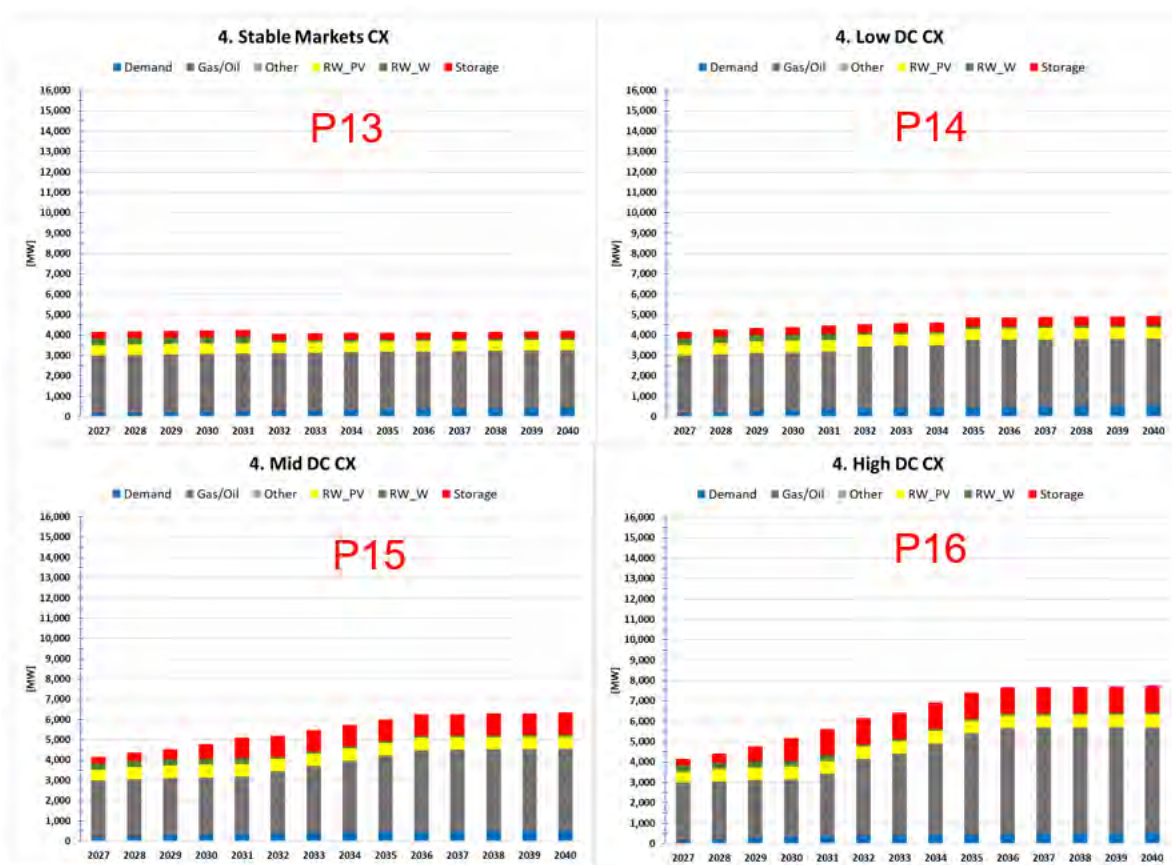


Figure 7. ICAP defined by AES IPL as the “Gas Infrastructure Challenges” - Portfolios P13-P16

2.3 Resource Profiles for Solar, Wind, Offshore Wind, and Load

AES IPL supplied hourly resource profiles for solar, wind, and load for every hour of the year. In the following sections, we will review the profile heatmaps.

2.3.1 Average Solar Irradiance

Figure 8 illustrates the average solar irradiance factors for solar resources in 2027, measured over 24 hours each day across all 12 months of the year

[illegible]

Capacity factor for the year 2027: 23.648%



Figure 8. Average Solar Irradiance in 2027 (kWh/kWac)

By analyzing Figure 8, we can observe that solar resources in 2027 achieve a 23.65% capacity factor over the course of the year.

Figure 9 shows the average solar irradiance factors for solar resources in 2030.

Avg 2030 solar profile (KWh/kWac)	Hour Ending																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																				

Capacity factor for the year 2030: 23.609%

Figure 9. Average Solar Irradiance in 2030 (kWh/kWac)

By analyzing Figure 9, we can observe that solar resources in 2030 achieve a 23.61% capacity factor over the course of the year.

Figure 10 shows the average solar irradiance factors for solar resources in 2035.

Avg 2035 solar profile (KWh/kWac)	Hour Ending																												
Month/Hr	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	Month	Daily Output. Avg	Daily Output Min	Daily Output Max	
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.18	0.31	0.37	0.42	0.41	0.40	0.37	0.28	0.08	0.01	0.00	0.00	0.00	0.00	0.00	1	2.86	1.87	4.56	
2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.08	0.24	0.40	0.49	0.54	0.55	0.52	0.45	0.36	0.18	0.03	0.00	0.00	0.00	0.00	0.00	2	3.84	2.19	5.93	
3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.08	0.25	0.44	0.53	0.60	0.64	0.64	0.61	0.57	0.48	0.33	0.09	0.01	0.00	0.00	0.00	3	5.27	3.13	7.99
4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.14	0.35	0.52	0.62	0.65	0.68	0.69	0.69	0.67	0.64	0.54	0.33	0.04	0.00	0.00	0.00	4	6.59	3.43	8.99
5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.08	0.27	0.47	0.59	0.67	0.71	0.75	0.73	0.73	0.69	0.65	0.56	0.44	0.10	0.01	0.00	0.00	5	7.44	4.85	9.53
6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.12	0.35	0.58	0.71	0.74	0.76	0.79	0.79	0.81	0.81	0.76	0.68	0.54	0.18	0.01	0.00	0.00	6	8.63	5.98	10.22
7	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.11	0.31	0.53	0.67	0.72	0.74	0.75	0.75	0.77	0.75	0.73	0.65	0.51	0.18	0.02	0.00	0.00	7	8.21	5.03	10.08
8	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.05	0.24	0.48	0.65	0.74	0.77	0.77	0.76	0.77	0.75	0.71	0.61	0.43	0.08	0.00	0.00	0.00	8	7.82	4.69	9.76
9	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.16	0.41	0.60	0.69	0.69	0.70	0.71	0.70	0.65	0.57	0.22	0.02	0.00	0.00	0.00	9	5.83	4.18	8.24	
10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.05	0.25	0.41	0.49	0.54	0.54	0.52	0.52	0.53	0.52	0.32	0.05	0.00	0.00	0.00	10	4.74	2.75	6.83	
11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.10	0.25	0.37	0.41	0.43	0.44	0.46	0.45	0.40	0.11	0.02	0.00	0.00	0.00	0.00	11	3.43	1.88	4.94	
12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.15	0.25	0.31	0.34	0.34	0.35	0.35	0.24	0.04	0.00	0.00	0.00	0.00	0.00	12	2.39	1.10	4.01	
Average all hours	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.15	0.35	0.49	0.57	0.60	0.61	0.61	0.60	0.56	0.46	0.36	0.22	0.05	0.00	0.00	0.00		5.67			
Minimum all hours	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.04	0.07	0.11	0.14	0.14	0.15	0.13	0.09	0.01	0.00	0.00	0.00	0.00	0.00	0.00		2.39			
Maximum all hours	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.17	0.48	0.75	0.88	0.94	0.98	0.99	0.96	0.96	1.00	0.95	0.93	0.74	0.30	0.03	0.00	0.00		8.63			

Capacity factor for the year 2035: 23.628%

Figure 10. Average Solar Irradiance in 2035 (kWh/kWac)

By analyzing Figure 10, it is observed that the capacity factor for solar resources in 2035 is 23.63% for the year.

2.3.2 Average Wind Profiles

Figure 11 shows the average factor for onshore wind resources profile in 2027.

[illegible]

Capacity factor for the year 2027: 27.849 %

Figure 11. Average Onshore Wind Resources Profile in 2027

Figure 11 shows that the annual capacity factor for onshore wind resources is 27.85%.

Figure 12 shows the average factor for onshore wind resources profile in 2030.

[illegible]

Capacity factor for the year 2030: 27.866 %

Figure 12. Average Onshore Wind Resources Profile in 2030

Figure 12 indicates that the annual capacity factor for onshore wind resources is 27.87% in 2030.

Figure 13 shows the average factor for onshore wind resources profile in 2035.

[illegible]

Capacity factor for the year 2035: 23.053 %

Figure 13. Average Onshore Wind Resources Profile in 2035



Figure 14 indicates that the annual capacity factor for onshore wind resources is 23.05% in 2025.

2.3.3 Hourly Load Profile

Figure 14 presents the AES IPL's average hourly load profile expected for 2027 for the "No Data Center" case.

Avg 2027 load profile (KWh/kW)	No DC Load																								Hour Ending																							
Month/Hr	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24		Month	Daily Output Avg	Daily Output Min	Daily Output Max																			
1	0.61	0.59	0.59	0.59	0.60	0.63	0.68	0.72	0.73	0.72	0.71	0.69	0.68	0.66	0.65	0.65	0.66	0.70	0.73	0.72	0.70	0.68	0.65	0.62		1	15.98	11.29	20.34																			
2	0.59	0.58	0.58	0.58	0.60	0.62	0.66	0.69	0.69	0.68	0.66	0.64	0.62	0.60	0.59	0.60	0.60	0.62	0.65	0.66	0.66	0.64	0.62	0.60		2	15.05	12.08	18.47																			
3	0.50	0.49	0.48	0.49	0.50	0.52	0.56	0.59	0.60	0.59	0.58	0.57	0.55	0.54	0.53	0.53	0.53	0.54	0.55	0.56	0.57	0.56	0.54	0.52		3	12.98	10.73	15.34																			
4	0.43	0.42	0.41	0.41	0.41	0.44	0.48	0.50	0.51	0.51	0.51	0.50	0.50	0.50	0.49	0.49	0.49	0.50	0.51	0.52	0.51	0.49	0.49	0.46		4	11.46	9.79	13.22																			
5	0.46	0.43	0.41	0.40	0.41	0.42	0.45	0.47	0.49	0.50	0.50	0.52	0.54	0.55	0.57	0.58	0.59	0.60	0.61	0.60	0.60	0.59	0.58	0.54	0.50		5	12.41	9.90	15.73																		
6	0.55	0.51	0.49	0.47	0.47	0.48	0.49	0.52	0.55	0.57	0.60	0.64	0.67	0.70	0.72	0.73	0.75	0.75	0.75	0.74	0.72	0.69	0.65	0.60		6	14.81	11.39	18.25																			
7	0.56	0.52	0.48	0.46	0.45	0.46	0.48	0.50	0.54	0.58	0.62	0.67	0.71	0.75	0.77	0.79	0.81	0.82	0.81	0.79	0.76	0.73	0.68	0.62		7	15.37	10.97	18.78																			
8	0.58	0.54	0.51	0.50	0.49	0.50	0.53	0.55	0.57	0.60	0.63	0.67	0.70	0.73	0.75	0.77	0.79	0.79	0.79	0.77	0.75	0.72	0.67	0.62		8	15.52	12.23	18.33																			
9	0.49	0.46	0.44	0.43	0.43	0.44	0.48	0.51	0.52	0.54	0.56	0.58	0.60	0.62	0.64	0.65	0.67	0.68	0.67	0.66	0.65	0.62	0.57	0.53		9	13.43	10.02	17.16																			
10	0.43	0.42	0.42	0.41	0.42	0.43	0.46	0.50	0.51	0.51	0.51	0.50	0.50	0.50	0.50	0.50	0.50	0.51	0.52	0.54	0.53	0.50	0.48	0.45		10	11.55	10.10	13.32																			
11	0.50	0.48	0.48	0.48	0.50	0.53	0.57	0.60	0.60	0.59	0.57	0.56	0.55	0.54	0.54	0.54	0.55	0.58	0.60	0.60	0.59	0.57	0.54	0.52		11	13.19	11.14	15.36																			
12	0.54	0.53	0.52	0.52	0.53	0.56	0.59	0.62	0.62	0.62	0.61	0.60	0.59	0.59	0.58	0.58	0.59	0.62	0.63	0.63	0.61	0.60	0.58	0.56		12	14.03	11.42	17.43																			
Average all hours	0.52	0.50	0.48	0.48	0.48	0.50	0.54	0.56	0.58	0.58	0.59	0.60	0.60	0.61	0.61	0.62	0.63	0.64	0.65	0.65	0.64	0.62	0.58	0.55			13.82																					
Minimum all hours	0.38	0.35	0.34	0.33	0.33	0.32	0.32	0.32	0.35	0.39	0.40	0.42	0.41	0.41	0.40	0.40	0.41	0.42	0.43	0.44	0.45	0.42	0.38				11.46																					
Maximum all hours	0.79	0.78	0.77	0.78	0.79	0.83	0.88	0.92	0.93	0.92	0.90	0.86	0.88	0.92	0.95	0.98	0.99	1.00	0.98	0.95	0.91	0.88	0.84	0.81				15.98																				
Load factor: 57.565%																																																

Load factor: 57.565%

Figure 14. AES IPL's Average Hourly Load Profile Expected for 2027 for the "No Data Center" Case

Figure 14 Indicates that the annual load factor for the year 2027 for the "No Data Center" case is 57.56%.

Figure 15 shows the AES IPL's average hourly load profile expected for 2027 for the "Low Data Center" case.

Avg 2027 load profile (KWh/kW)	Low DC Load																															
																									Hour Ending							
Month/Hr	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	Month	Daily Output Avg	Daily Output Min	Daily Output Max				
1	0.61	0.59	0.59	0.59	0.60	0.63	0.68	0.72	0.73	0.72	0.71	0.69	0.68	0.66	0.65	0.65	0.66	0.70	0.73	0.72	0.70	0.68	0.65	0.62	1	15.98	11.29	20.34				
2	0.59	0.58	0.58	0.58	0.60	0.62	0.66	0.69	0.69	0.68	0.66	0.64	0.62	0.60	0.59	0.60	0.60	0.62	0.65	0.66	0.66	0.64	0.62	0.60	2	15.05	12.08	18.47				
3	0.50	0.49	0.48	0.49	0.50	0.52	0.56	0.59	0.60	0.59	0.58	0.57	0.55	0.54	0.53	0.53	0.53	0.54	0.55	0.56	0.57	0.56	0.54	0.52	3	12.98	10.73	15.34				
4	0.43	0.42	0.41	0.41	0.41	0.44	0.48	0.50	0.51	0.51	0.51	0.50	0.50	0.49	0.49	0.49	0.49	0.50	0.50	0.51	0.52	0.51	0.49	0.46	4	11.46	9.79	13.22				
5	0.46	0.43	0.41	0.40	0.41	0.42	0.45	0.47	0.49	0.50	0.52	0.54	0.55	0.57	0.58	0.59	0.60	0.61	0.60	0.60	0.59	0.58	0.54	0.50	5	12.41	9.90	15.73				
6	0.55	0.51	0.49	0.47	0.47	0.48	0.49	0.52	0.55	0.57	0.60	0.64	0.67	0.70	0.72	0.73	0.75	0.75	0.75	0.74	0.72	0.69	0.65	0.60	6	14.81	11.39	18.25				
7	0.56	0.52	0.48	0.46	0.45	0.46	0.48	0.50	0.54	0.58	0.62	0.67	0.71	0.75	0.77	0.79	0.81	0.82	0.81	0.79	0.76	0.73	0.68	0.62	7	15.37	10.97	18.78				
8	0.58	0.54	0.51	0.50	0.49	0.50	0.53	0.55	0.57	0.60	0.63	0.67	0.70	0.73	0.75	0.77	0.79	0.79	0.79	0.77	0.75	0.72	0.67	0.62	8	15.52	12.23	18.33				
9	0.49	0.46	0.44	0.43	0.43	0.44	0.48	0.51	0.52	0.54	0.56	0.58	0.60	0.62	0.64	0.65	0.67	0.68	0.67	0.66	0.65	0.62	0.57	0.53	9	13.43	10.02	17.16				
10	0.43	0.42	0.42	0.41	0.42	0.43	0.46	0.50	0.51	0.51	0.51	0.50	0.50	0.50	0.50	0.50	0.51	0.52	0.54	0.53	0.50	0.48	0.45	10	11.55	10.10	13.32					
11	0.50	0.48	0.48	0.48	0.50	0.53	0.57	0.60	0.60	0.59	0.57	0.56	0.55	0.54	0.54	0.54	0.55	0.58	0.60	0.60	0.59	0.57	0.54	0.52	11	13.19	11.14	15.36				
12	0.54	0.53	0.52	0.52	0.53	0.56	0.59	0.62	0.62	0.62	0.61	0.60	0.59	0.59	0.58	0.58	0.59	0.62	0.63	0.63	0.61	0.60	0.58	0.56	12	14.03	11.42	17.43				
Average all hours	0.52	0.50	0.48	0.48	0.48	0.50	0.54	0.56	0.58	0.58	0.59	0.60	0.60	0.61	0.61	0.62	0.63	0.64	0.65	0.65	0.64	0.62	0.58	0.55		13.82						
Minimum all hours	0.38	0.35	0.34	0.33	0.33	0.32	0.32	0.32	0.35	0.39	0.40	0.42	0.41	0.41	0.40	0.40	0.41	0.42	0.43	0.44	0.45	0.45	0.42	0.38		11.46						
Maximum all hours	0.79	0.78	0.77	0.78	0.79	0.83	0.88	0.92	0.93	0.92	0.90	0.86	0.88	0.92	0.95	0.98	0.99	1.00	0.98	0.95	0.91	0.88	0.84	0.81		15.98						
Load factor: 57.565%																																

Load factor: 57.565%

Figure 15. AES IPL's Average Hourly Load Profile Expected for 2027 for the "Low Data Center" Case

Figure 15 indicates that the annual load factor for the year 2027 for the "Low Data Center" case is 57.56%.

Figure 16 shows the AES IPL's average hourly load profile expected for 2027 for the "Medium Data Center" case.



Avg 2027 load profile (KWh/kW)	Medium DC Load																								Hour Ending																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																		

Load factor: 57.973%

Figure 16. AES IPL's Average Hourly Load Profile Expected for 2027 for the "Medium Data Center" Case

Figure 16 indicates that the annual load factor for the year 2027 for the "Medium Data Center" case is 57.973%.

Figure 17 shows the AES IPL's average hourly load profile expected for 2027 for the "High Data Center" case.

Avg 2027 load profile (KWh/kW)	High DC Load																								Month	Daily Output, Avg	Daily Output Min	Daily Output Max
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24				
Month/Hr																												
1	0.60	0.59	0.58	0.58	0.60	0.63	0.67	0.71	0.72	0.72	0.70	0.69	0.67	0.66	0.65	0.65	0.66	0.69	0.72	0.71	0.70	0.68	0.65	0.62	1	15.85	11.20	20.17
2	0.59	0.58	0.58	0.58	0.59	0.62	0.66	0.69	0.69	0.67	0.65	0.63	0.62	0.60	0.59	0.59	0.60	0.62	0.65	0.66	0.65	0.64	0.61	0.60	2	14.93	11.98	18.32
3	0.50	0.48	0.48	0.48	0.49	0.52	0.55	0.58	0.59	0.59	0.58	0.56	0.55	0.54	0.53	0.52	0.52	0.53	0.54	0.56	0.57	0.56	0.53	0.51	3	12.88	10.64	15.21
4	0.43	0.41	0.41	0.40	0.41	0.43	0.47	0.50	0.50	0.51	0.50	0.50	0.49	0.49	0.48	0.48	0.49	0.50	0.50	0.51	0.51	0.48	0.45		4	11.36	9.71	13.11
5	0.45	0.43	0.41	0.40	0.40	0.42	0.44	0.47	0.48	0.50	0.52	0.53	0.55	0.56	0.57	0.58	0.59	0.60	0.60	0.60	0.58	0.57	0.54	0.50	5	12.31	9.82	15.60
6	0.55	0.51	0.48	0.47	0.46	0.47	0.49	0.51	0.54	0.57	0.60	0.63	0.67	0.70	0.72	0.73	0.74	0.75	0.75	0.74	0.71	0.69	0.65	0.59	6	14.73	11.34	18.15
7	0.56	0.52	0.49	0.46	0.46	0.47	0.48	0.51	0.54	0.58	0.63	0.67	0.72	0.75	0.77	0.80	0.81	0.82	0.81	0.79	0.76	0.73	0.68	0.62	7	15.44	11.08	18.83
8	0.58	0.54	0.52	0.50	0.50	0.51	0.54	0.56	0.58	0.60	0.64	0.67	0.70	0.74	0.76	0.78	0.79	0.80	0.79	0.78	0.75	0.73	0.68	0.62	8	15.67	12.40	18.45
9	0.50	0.47	0.45	0.44	0.44	0.45	0.49	0.52	0.53	0.55	0.57	0.59	0.61	0.63	0.65	0.66	0.68	0.68	0.67	0.66	0.63	0.58	0.54		9	13.67	10.29	17.37
10	0.45	0.44	0.43	0.43	0.43	0.45	0.48	0.51	0.52	0.52	0.52	0.52	0.51	0.51	0.51	0.51	0.52	0.53	0.54	0.55	0.54	0.51	0.49	0.46	10	11.89	10.45	13.64
11	0.51	0.50	0.50	0.50	0.52	0.55	0.59	0.61	0.62	0.60	0.59	0.58	0.57	0.56	0.55	0.55	0.57	0.60	0.62	0.60	0.59	0.56	0.54		11	13.58	11.56	15.75
12	0.56	0.55	0.54	0.54	0.55	0.58	0.61	0.64	0.64	0.64	0.63	0.62	0.61	0.61	0.60	0.60	0.61	0.64	0.65	0.65	0.63	0.62	0.60	0.58	12	14.50	11.91	17.87
Average all hours	0.52	0.50	0.49	0.48	0.49	0.51	0.54	0.57	0.58	0.59	0.59	0.60	0.61	0.61	0.62	0.62	0.63	0.65	0.65	0.65	0.64	0.62	0.59	0.55		13.90		
Minimum all hours	0.38	0.35	0.34	0.34	0.33	0.33	0.32	0.33	0.36	0.40	0.41	0.41	0.41	0.41	0.40	0.40	0.41	0.42	0.42	0.43	0.44	0.44	0.42	0.38		11.36		
Maximum all hours	0.78	0.77	0.77	0.77	0.79	0.82	0.87	0.91	0.92	0.91	0.89	0.86	0.88	0.92	0.95	0.98	0.99	1.00	0.98	0.95	0.91	0.88	0.83	0.81		15.85		

Load factor: 57.922%

Figure 17. AES IPL's Average Hourly Load Profile Expected for 2027 for the "High Data Center" Case

Figure 17 indicates that the annual load factor for the year 2027 for the "High Data Center" case is 57.92%.

Figure 18 shows the AES IPL's average hourly load profile expected for 2030 for the "No Data Center" case.

Avg 2030 load profile (KWh/kW)	No DC Load																											
	Hour Ending																											
Month/Hr	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	Month	Daily Output, Avg	Daily Output Min	Daily Output Max
1	0.60	0.58	0.58	0.58	0.59	0.63	0.67	0.71	0.72	0.72	0.70	0.69	0.68	0.66	0.65	0.65	0.67	0.70	0.73	0.72	0.70	0.68	0.65	0.62	1	15.88	11.20	20.37
2	0.59	0.58	0.58	0.58	0.59	0.62	0.66	0.69	0.69	0.67	0.65	0.63	0.61	0.60	0.59	0.59	0.60	0.62	0.65	0.66	0.65	0.64	0.62	0.60	2	14.94	12.11	18.49
3	0.50	0.49	0.48	0.48	0.49	0.52	0.55	0.58	0.59	0.58	0.57	0.56	0.55	0.54	0.53	0.52	0.52	0.53	0.54	0.56	0.57	0.56	0.54	0.51	3	12.84	10.23	16.53
4	0.43	0.41	0.41	0.40	0.41	0.43	0.47	0.50	0.50	0.50	0.50	0.50	0.49	0.48	0.48	0.48	0.49	0.49	0.50	0.51	0.51	0.48	0.45		4	11.31	9.61	13.01
5	0.45	0.43	0.41	0.40	0.41	0.43	0.45	0.48	0.49	0.51	0.52	0.53	0.55	0.56	0.56	0.57	0.58	0.59	0.59	0.59	0.58	0.57	0.54	0.49	5	12.28	9.84	15.77
6	0.55	0.52	0.49	0.47	0.47	0.48	0.49	0.52	0.55	0.57	0.60	0.63	0.67	0.69	0.71	0.73	0.74	0.75	0.75	0.74	0.72	0.69	0.66	0.60	6	14.78	11.39	18.28
7	0.56	0.52	0.48	0.46	0.45	0.46	0.48	0.50	0.54	0.58	0.63	0.67	0.71	0.74	0.77	0.79	0.80	0.81	0.81	0.79	0.76	0.73	0.69	0.63	7	15.37	11.20	19.15
8	0.58	0.54	0.51	0.49	0.49	0.50	0.53	0.55	0.57	0.60	0.63	0.67	0.70	0.74	0.76	0.77	0.78	0.79	0.79	0.77	0.75	0.72	0.68	0.62	8	15.53	13.12	18.70
9	0.49	0.46	0.44	0.43	0.43	0.44	0.48	0.50	0.51	0.53	0.56	0.58	0.60	0.61	0.63	0.65	0.67	0.68	0.67	0.66	0.65	0.62	0.57	0.53	9	13.40	10.05	17.47
10	0.42	0.41	0.40	0.40	0.40	0.42	0.46	0.49	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.51	0.52	0.53	0.54	0.53	0.51	0.48	0.45	10	11.46	9.69	13.31
11	0.49	0.48	0.48	0.48	0.50	0.53	0.57	0.59	0.59	0.58	0.57	0.56	0.55	0.54	0.53	0.54	0.56	0.58	0.60	0.60	0.58	0.57	0.54	0.51	11	13.11	10.38	15.62
12	0.54	0.53	0.53	0.53	0.53	0.56	0.59	0.61	0.62	0.61	0.60	0.59	0.58	0.58	0.57	0.57	0.58	0.61	0.63	0.62	0.61	0.60	0.57	0.55	12	13.93	11.22	17.43
Average all hours	0.52	0.49	0.48	0.47	0.48	0.50	0.53	0.56	0.57	0.58	0.59	0.59	0.60	0.60	0.61	0.61	0.62	0.64	0.65	0.65	0.63	0.62	0.58	0.55		13.73		
Minimum all hours	0.34	0.33	0.33	0.33	0.32	0.32	0.31	0.32	0.35	0.39	0.40	0.41	0.41	0.40	0.39	0.39	0.40	0.41	0.42	0.43	0.44	0.44	0.42	0.38		11.31		
Maximum all hours	0.79	0.78	0.78	0.78	0.80	0.83	0.88	0.91	0.93	0.92	0.89	0.86	0.89	0.93	0.95	0.98	0.99	1.00	0.98	0.96	0.93	0.90	0.84	0.82		15.88		
Load factor: 57.229%																												



Figure 19 shows the AES IPL's average hourly load profile expected for 2030 for the “Low Data Center” case.

Figure 19. AES IPL's Average Hourly Load Profile Expected for 2030 for the "Low Data Center" Case

Figure 20 shows the AES IPL's average hourly load profile expected for 2030 for the "Medium Data Center" case.

Figure 20. AES IPL's Average Hourly Load Profile Expected for 2030 for the "Medium Data Center" Case

Figure 21 shows the AES IPL's average hourly load profile expected for 2030 for the “High Data Center” case.



Avg 2030 load profile (KWh/kW)	High DC Load																																				Avg 2030 load profile (KWh/kW)							
																									Hour Ending																			
Month/Hr	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	Month	Daily Output, Avg	Daily Output Min	Daily Output Max																
1	0.65	0.64	0.63	0.63	0.64	0.67	0.71	0.74	0.75	0.74	0.73	0.72	0.71	0.70	0.69	0.69	0.70	0.73	0.75	0.74	0.73	0.71	0.69	0.66	1	16.74	13.08	20.24																
2	0.65	0.64	0.64	0.64	0.65	0.67	0.70	0.72	0.72	0.71	0.69	0.68	0.67	0.65	0.65	0.65	0.65	0.67	0.70	0.70	0.70	0.69	0.67	0.65	2	16.15	13.94	18.93																
3	0.58	0.57	0.57	0.57	0.58	0.60	0.62	0.65	0.65	0.65	0.64	0.63	0.62	0.61	0.60	0.60	0.60	0.61	0.62	0.63	0.64	0.63	0.61	0.59	3	14.67	12.63	17.55																
4	0.54	0.52	0.52	0.52	0.52	0.54	0.57	0.59	0.59	0.59	0.59	0.58	0.58	0.57	0.57	0.57	0.58	0.59	0.59	0.59	0.60	0.59	0.57	0.55	4	13.63	12.30	14.95																
5	0.56	0.54	0.53	0.52	0.52	0.54	0.56	0.58	0.59	0.60	0.61	0.62	0.63	0.64	0.65	0.65	0.66	0.67	0.67	0.66	0.66	0.65	0.62	0.59	5	14.53	12.63	17.26																
6	0.64	0.61	0.59	0.58	0.58	0.59	0.60	0.62	0.64	0.66	0.68	0.71	0.73	0.75	0.77	0.78	0.79	0.80	0.80	0.79	0.77	0.75	0.72	0.68	6	16.64	14.00	19.38																
7	0.66	0.62	0.59	0.58	0.57	0.58	0.59	0.61	0.64	0.67	0.71	0.74	0.77	0.80	0.82	0.83	0.85	0.85	0.85	0.84	0.81	0.79	0.76	0.71	7	17.26	14.00	20.21																
8	0.67	0.65	0.62	0.61	0.61	0.62	0.64	0.65	0.67	0.69	0.72	0.75	0.77	0.80	0.82	0.83	0.84	0.84	0.84	0.83	0.81	0.79	0.75	0.71	8	17.53	15.66	20.01																
9	0.61	0.59	0.58	0.57	0.57	0.58	0.60	0.62	0.63	0.65	0.67	0.68	0.70	0.71	0.73	0.74	0.75	0.76	0.76	0.75	0.74	0.71	0.68	0.64	9	16.02	13.41	19.21																
10	0.57	0.56	0.55	0.55	0.55	0.57	0.60	0.62	0.63	0.63	0.63	0.63	0.63	0.63	0.63	0.64	0.64	0.65	0.66	0.65	0.63	0.61	0.59	10	14.67	13.28	16.11																	
11	0.63	0.62	0.62	0.62	0.63	0.66	0.69	0.71	0.71	0.70	0.69	0.68	0.67	0.67	0.66	0.67	0.68	0.70	0.71	0.71	0.70	0.69	0.67	0.65	11	16.10	14.20	18.06																
12	0.67	0.67	0.66	0.66	0.67	0.69	0.71	0.73	0.73	0.73	0.72	0.72	0.71	0.70	0.70	0.70	0.71	0.73	0.74	0.74	0.73	0.72	0.70	0.68	12	16.92	14.80	19.65																
Average all hours	0.62	0.60	0.59	0.59	0.59	0.61	0.63	0.65	0.66	0.67	0.67	0.68	0.68	0.69	0.69	0.70	0.70	0.72	0.72	0.72	0.71	0.70	0.67	0.64		15.91																		
Minimum all hours	0.48	0.47	0.46	0.46	0.47	0.47	0.46	0.47	0.49	0.52	0.53	0.52	0.52	0.51	0.51	0.51	0.51	0.52	0.53	0.53	0.54	0.54	0.51	0.48		13.63																		
Maximum all hours	0.80	0.79	0.79	0.79	0.80	0.83	0.87	0.89	0.90	0.90	0.88	0.88	0.91	0.94	0.96	0.99	0.99	1.00	0.99	0.97	0.94	0.92	0.88	0.82		17.53																		
Load factor: 66.271%																																												

Load factor: 66.271%

Figure 21. AES IPL's Average Hourly Load Profile Expected for 2030 for the "High Data Center" Case

Figure 21 indicates that the annual load factor for the year 2030 for the "High Data Center" case is 66.27%.

Figure 22 shows the AES IPL's average hourly load profile expected for 2035 for the "No Data Center" case.

Avg 2035 load profile (KWh/kW)	No DC Load																								Hour Ending																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																		

Load factor: 56.905%

Figure 22. AES IPL's Average Hourly Load Profile Expected for 2035 for the "No Data Center" Case

Figure 22 indicates that the annual load factor for the year 2035 for the "No Data Center" case is 56.91%.

Figure 23 shows the AES IPL's average hourly load profile expected for 2035 for the "Low Data Center" case.

Avg 2035 load profile (KWh/kW)	Low DC Load																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																			



Figure 23 indicates that the annual load factor for the year 2035 for the “Low Data Center” case is 62.59%.

Figure 24 shows the AES IPL’s average hourly load profile expected for 2035 for the “Medium Data Center” case.

Avg 2035 load profile (KWh/kW)	Medium DC Load																								Hour Ending																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																											

Figure 24. AES IPL’s Average Hourly Load Profile Expected for 2035 for the “Medium Data Center” Case

Figure 24 indicates that the annual load factor for the year 2035 for the “Medium Data Center” case is 70.42%.

Figure 25 shows the AES IPL’s average hourly load profile expected for 2035 for the “High Data Center” case.

Avg 2035 load profile (KWh/kW)	High DC Load																								Hour Ending																			
Month/Hr	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	Month	Daily Output Avg	Daily Output Min	Daily Output Max																
1	0.74	0.73	0.73	0.73	0.74	0.76	0.78	0.81	0.81	0.81	0.80	0.79	0.78	0.78	0.77	0.77	0.78	0.80	0.82	0.81	0.81	0.79	0.77	0.76	1	18.69	16.05	21.30																
2	0.74	0.74	0.74	0.74	0.74	0.76	0.78	0.80	0.80	0.79	0.77	0.76	0.75	0.74	0.74	0.74	0.75	0.76	0.78	0.79	0.78	0.77	0.76	0.75	2	18.26	16.60	20.25																
3	0.70	0.69	0.69	0.69	0.69	0.71	0.73	0.74	0.75	0.74	0.73	0.72	0.72	0.71	0.70	0.70	0.70	0.71	0.72	0.73	0.74	0.73	0.72	0.70	3	17.16	15.59	19.17																
4	0.66	0.65	0.65	0.65	0.65	0.66	0.68	0.70	0.70	0.70	0.70	0.70	0.69	0.69	0.68	0.68	0.68	0.69	0.69	0.70	0.71	0.71	0.69	0.68	4	16.40	15.44	17.39																
5	0.68	0.67	0.66	0.65	0.66	0.67	0.68	0.70	0.70	0.71	0.71	0.72	0.72	0.73	0.73	0.74	0.74	0.75	0.75	0.75	0.75	0.75	0.73	0.71	5	17.07	15.70	19.15																
6	0.74	0.72	0.71	0.70	0.70	0.70	0.71	0.73	0.74	0.76	0.77	0.79	0.80	0.82	0.83	0.83	0.84	0.85	0.85	0.85	0.84	0.82	0.81	0.78	6	18.67	16.73	20.76																
7	0.76	0.73	0.71	0.70	0.69	0.70	0.71	0.72	0.74	0.77	0.79	0.81	0.83	0.85	0.86	0.88	0.88	0.89	0.89	0.89	0.87	0.86	0.83	0.80	7	19.18	16.78	21.40																
8	0.77	0.75	0.73	0.72	0.72	0.73	0.74	0.75	0.77	0.78	0.80	0.82	0.83	0.85	0.86	0.87	0.88	0.89	0.89	0.88	0.87	0.86	0.83	0.80	8	19.38	18.02	21.17																
9	0.73	0.71	0.70	0.69	0.69	0.70	0.72	0.73	0.73	0.75	0.76	0.77	0.78	0.79	0.80	0.81	0.82	0.82	0.82	0.82	0.82	0.80	0.77	0.75	9	18.25	16.28	20.61																
10	0.69	0.68	0.68	0.67	0.68	0.69	0.71	0.73	0.73	0.73	0.73	0.73	0.73	0.73	0.73	0.73	0.74	0.75	0.75	0.75	0.74	0.74	0.72	0.71	10	17.24	16.22	18.33																
11	0.73	0.72	0.72	0.72	0.73	0.75	0.77	0.79	0.79	0.78	0.77	0.76	0.76	0.75	0.75	0.76	0.77	0.78	0.79	0.79	0.78	0.78	0.76	0.75	11	18.26	16.51	19.75																
12	0.77	0.76	0.76	0.76	0.76	0.77	0.79	0.80	0.81	0.80	0.80	0.80	0.79	0.78	0.78	0.77	0.78	0.79	0.80	0.81	0.81	0.80	0.80	0.78	0.77	12	18.84	17.24	20.83															
Average all hours	0.73	0.71	0.71	0.70	0.70	0.72	0.73	0.75	0.76	0.76	0.76	0.76	0.76	0.76	0.77	0.77	0.77	0.78	0.79	0.80	0.80	0.79	0.78	0.77	0.74		18.12																	
Minimum all hours	0.62	0.61	0.60	0.60	0.61	0.61	0.61	0.61	0.63	0.65	0.65	0.65	0.64	0.64	0.63	0.63	0.64	0.64	0.65	0.66	0.67	0.67	0.64	0.62		16.40																		
Maximum all hours	0.86	0.85	0.85	0.85	0.86	0.88	0.90	0.92	0.93	0.93	0.91	0.92	0.94	0.96	0.97	0.99	0.99	1.00	0.99	0.98	0.97	0.95	0.92	0.89		19.38																		
Load factor:	75.486%																																											

Figure 25. AES IPL’s Average Hourly Load Profile Expected for 2035 for the “High Data Center” Case

Figure 25 indicates that the annual load factor for the year 2035 for the “High Data Center” case is 75.49%.

Figure 14 to Figure 25 indicate that AES IPL’s Energy’s peak loads occur in July and August, which along with January make the months with the highest energy demand across all cases. This pattern suggests that both summer and winter months experience significant energy consumption, likely due to increased use of cooling and heating systems, respectively.

Table 3 summarizes the AES IPL’s load factors for the three years of 2027, 2030, and 2035 for different levels of data center load.



Table 3. Summary of Load Factors

	2027	2030	2035
No Data Center	57.57%	57.23%	56.91%
Low Data Center	57.57%	59.15%	62.59%
Medium Data Center	57.97%	63.22%	70.42%
High Data Center	57.92%	66.27%	75.49%



3 Transmission Limit Calculation

AES Indiana (IPL) participates in the Midcontinent Independent System Operator (MISO) transmission network and is responsible for ensuring adequate power import and export capability to meet reliability and market needs. The Import and Export Limit Study forms part of the MISO Transmission Expansion Planning (MTEP) process and evaluates the transfer capabilities under projected load and generation conditions.

This study evaluates system performance for 2027, 2030, and 2035 scenarios using MISO-provided PSS®E and TARA models. The main objectives were to:

- Determine AES IPL's import limits under normal and contingency conditions.
- Assess export capability given internal generation and demand balance.
- Identify critical contingencies and limiting facilities.
- Support long-term planning decisions for load integration and transmission reinforcement.

3.1 Methodology and Contingencies to be considered

Considering North American Electric Reliability Corporation (NERC) TPL-001-5: Transmission System Planning Performance Requirements, the analysis was made for the contingencies defined by RTEP in Categories P1, P2, P4, P5, and P7, as described in Table 4.

Table 4. NERC TPL-001-5: Transmission System Planning Performance Requirements

CATEGORY		INITIAL CONDITION	EVENT
P0	No Contingency	Normal System	None
P1	Single Contingency	Normal System	Loss of one of the following: 1. Generator 2. Transmission circuit 3. Transformer 4. Shunt device 5. Single Pole of a DC line
P2	Single Contingency	Normal System	1. Opening of a line section without a fault 2. Bus section fault 3. Internal breaker fault (non-bus-tie breaker) 4. Internal breaker fault (bus-tie breaker)
P3	Multiple Contingency	Loss of generator unit followed by System adjustments	Loss of one of the following: 1. Generator 2. Transmission circuit 3. Transformer 4. Shunt device 5. Single pole of a DC line
P4	Multiple Contingency (Fault Plus Stuck Breaker)	Normal System	Loss of multiple elements caused by a stuck breaker 10 (non-bus-tie breaker) attempting to clear a fault on one of the following: 1. Generator 2. Transmission circuit 3. Transformer 4. Shunt device 5. Bus section 6. Loss of multiple elements caused by a stuck breaker (Bus-tie breaker) attempting to clear a fault on the associated bus
P5	Multiple Contingency (Fault Plus Relay Failure to Operate)	Normal System	Delayed fault clearing due to the failure of a non-redundant relay protecting the faulted element to operate as designed for one of the following: 1. Generator 2. Transmission circuit 3. Transformer 4. Shunt device 5. Bus Section



CATEGORY	INITIAL CONDITION	EVENT
P6 Multiple Contingency (Two Overlapping Singles)	Loss of one of the following followed by System adjustments 1. Transmission Circuit 2. Transformer 3. Shunt Device 4. Single pole of a DC line	Loss of one of the following: 1. Transmission circuit 2. Transformer 3. Shunt device 4. Single pole of a DC line
P7 Multiple Contingency (Common Structure)	Normal System	The loss of: 1. Any two adjacent (vertically or horizontally) circuits on a common structure 2. Loss of a bipolar DC line

3.2 AES IPL Import / Exports limits

3.2.1 Data Sources

Power flow and stability cases were developed using data published by MISO and AES Indiana. The Power System base case for 2035 is:

MISO25_2035_SUM__TA_Final_ScL_Pre.sav

The following datasets were used for the other target study years:

FILE NAME (Base or Reference Cases)*	Year	Case description
MISO25_2027_SUM__TA_08-25EPR_Base_Final.raw	2027	Referential Power flow for Summer 2027 updated in August 2025
MISO25_2030_SUM__TA_08-25EPR_Base_Final.raw	2030	Referential Power flow for Summer 2030 updated in August 2025
MISO25_2035_SUM__TA_08-25EPR_Base_Final.raw	2035	Referential Power flow for Summer 2035 updated in August 2035

3.2.2 Base Case Performance (N-0)

Under the N-0 (all elements in service) scenario, the system shows adequate voltage and thermal performance. Line loadings are within normal limits in 2027 and 2030. By 2035, the expanded network mitigates prior 345 kV overloads observed in earlier years.

The following table presents the line loading results for the base case (N-0) condition, in which all transmission elements are in service.

Table 5. Lines loading for base case

Voltage Level [kV]	2027		2030		2035	
	Average	Maximum	Average	Maximum	Average	Maximum
34.5	2%	11%	29%	95%	29%	95%
138	24%	57%	25%	60%	25%	59%
230	21%	21%	21%	21%	21%	21%
345	24%	56%	21%	84%	22%	78%
765					9%	12%

It can be observed that between 2027 and 2030, the 345 kV network experiences increased loading. By 2035, the integration of the new 765 kV transmission line significantly relieves congestion and reduces loading across the 345 kV system.



3.2.3 Contingency and Performance Criteria

Contingency definitions followed NERC Standard TPL-001-4/5 — Transmission System Planning Performance Requirements. These include N-1 and N-1-1 events representing credible outages of lines, transformers, or generation units. In 2035, 1,346 contingencies affecting AES IPL were evaluated to ensure compliance with reliability standards.

3.2.4 Simulation Tools

All simulations were performed using Siemens PTI PSS®E and TARA for power flow and contingency analysis. Transmission line loading, interface limits, and voltage performance were monitored under base and contingency conditions to determine limiting elements and maximum feasible transfer levels.

To find the AES IPL transmission limits for imports and exports, the Transmission Adequacy & Reliability Assessment (TARA) software tool was used. Its provider describes TARA as:

“TARA is a steady-state power flow software tool with modeling capabilities and analytical applications that extend beyond traditional power flow solutions. Using extraordinarily robust and speedy linear (DC) and non-linear (AC) power flow calculations, TARA integrates data checking, N-1/N-1-1 reliability analysis, transfer limit calculation, preventive and corrective dispatch, critical facility identification, reactive analysis, outage analysis, model building, and region-specific tools for generation deliverability and reserve requirements analysis.” [1]

3.3 Results and Analysis

3.3.1 Transmission Network Evolution

Between 2027 and 2035, significant reinforcement of the AES IPL transmission network occurs. The number of tie lines with neighboring systems increases from 18 in 2027 to 39 in 2035. Addition of 765 kV transmission corridors alleviates congestion on 345 kV facilities, enabling larger import flows and improved system robustness.

3.3.2 Base Case Performance (N-0)

Under the N-0 (all elements in service) scenario, the system shows adequate voltage and thermal performance. Line loadings are within normal limits in 2027 and 2030. By 2035, the expanded network mitigates prior 345 kV overloads observed in earlier years.

3.3.3 AES IPL Import Limit for Summer 2035

Under pre-contingency conditions for the Summer 2035 scenario, with 2,503 MW of imports into the AES IPL system from neighboring areas, the analysis identified a limiting contingency and a critical monitored element. Specifically, the 345/138 kV transformer at 16SUNNYS reaches 100% loading under post-contingency conditions. This indicates full utilization of the transformer’s thermal capacity, confirming that the operational transfer limit has been reached for the evaluated scenario.



Table 6. Interarea flows and summarizes import limits found for the analyzed years.

IPL Imports from:	2027		2030		2035	
	Imports [MW]	Tie Branches [#]	Imports [MW]	Tie Branches [#]	Imports [MW]	Tie Branches [#]
AEP	-249	3	566	3	123	5
DEI	379	13	1,976	18	2,914	27
HE	0	1	-57	3	-425	6
SIGE	-18	1	-27	1	-11	1
Total	112	18	2,458	25	2,601	39

CALCULATED IMPORT LIMIT [MW]	578	2,193	2,503

Between 2027 and 2035, the transmission network connecting AES IPL to neighboring systems undergoes significant reinforcement, with the number of tie lines increasing from 18 in 2027 to 39 for the year 2035.

When applying the MISO contingency package, we could calculate the maximum level of flows that can be scheduled into IPL.

The calculated import limit for AES IPL increases from 578 MW in 2027 to 2,193 MW in 2030 and to 2,503 MW by 2035. Including potential imports from all MISO areas.

The Export limit calculation for AES IPL it is relevant to analyze the power balance in the area 216

3.3.4 Export Capability

Next table shows the power balance in the area:

Table 7. Power balance in the area 216

LOADS [MW]	2027	2030	2035
IPL Loads (In Area 216)	3,291	3,374	3,510
Leap Load*	114	1,200	1,200
Added Data Centers**	0	1,600	1,600
Total	3,405	6,174	6,310

Notes: * The Leap load corresponds to the Wabash Valley Power Alliance (WVPA) Data Center, which is modeled within Area 216 in the MISO power flow.

** Could vary between 500 and 2,500 MW for 2035 depending on the integration strategy.

Due to rising internal demand—especially from large new loads like data centers, IPL has little to no remaining capacity to export power to neighboring areas under analyzed conditions. Scaling load down could create some room to export power to neighboring areas.

Export analysis for MISO Area 216 (AES IPL) shows minimal available export capacity. High internal demand, notably from Wabash Valley Power Alliance (WVPA) data centers, consumes most local generation. Even with 4,630 MW of dispatchable capacity, exports are negligible unless internal load is reduced. Scaling load down in simulation shows some limited ability to export to neighboring areas.



3.3.5 CONCLUSIONS

Between 2027 and 2035, the transmission network interconnecting AES IPL with neighboring systems undergoes significant reinforcement, with the number of tie lines increasing from 18 to 39. Application of the MISO contingency package enables determination of the maximum power transfer levels that can be scheduled into the IPL system under various operating conditions.

As a result of these network enhancements and resource integrations, AES IPL's import capability increases markedly—from 578 MW in 2027 to 2,193 MW in 2030, reaching 2,503 MW by 2035, considering potential transfers from all MISO areas. This steady growth reflects progressive improvements in transmission capacity and system reliability.

Despite this substantial improvement in import capability, export potential remains extremely limited. Rising internal demand—driven primarily by the addition of large loads such as data centers, including those of the Wabash Valley Power Alliance (WVPA)—consumes most available local generation. Even with 4,630 MW of dispatchable capacity, AES IPL operates close to its internal supply-demand balance, leaving little to no headroom for power exports.

Simulation results indicate that reducing internal load could create limited opportunities to export power to neighboring areas; however, such conditions are not typical under current or projected load scenarios. This trend underscores the growing importance of carefully managing local generation, demand growth, and transmission constraints in planning future resource integration and interconnection strategies to maintain system flexibility and reliability.



4 Energy Adequacy analysis

4.1 Energy Adequacy assessment

Energy Adequacy evaluates the power system's ability to meet demand across all 8,760 hours of the year, not just during peak periods. This assessment is especially critical for systems with high levels of renewables and energy storage, where energy availability may not always align with demand.

The methodology includes:

- Hourly simulations using chronological load and renewable generation profiles.
- Random shuffling of daily profiles to expose risks related to seasonal and intra-day variability.
- Optimization of storage charging and discharging patterns to ensure demand is reliably met throughout the year.
- Evaluation across multiple generation portfolios and load growth scenarios, reflecting a wide range of future system conditions.

Unlike traditional capacity assessments that focus on instantaneous peak demand, Energy Adequacy emphasizes sustained energy delivery, making it essential for planning in renewable-rich, storage-dependent systems.

4.2 Analyzed Reliability and Energy Adequacy Metrics

Table 8. Analyzed Reliability and Energy Adequacy Metrics

Metric	Definition	Explanation	Unit	Time Horizon Analyzed
LOLH	Loss of Load Hours	Expected number of hours per year when load cannot be fully served. Threshold: LOLH should be ≤ 2.4 hours per year OR 1 day in 10 years	Hours/year	Annual/Summer/Winter
EUE	Expected Unserved Energy	Total energy not served in a year Threshold: EUE should be ≤ 2.4 hours * peak (50/50 forecast)	GWh	Annual
Max MW Short	Max Power Shortage (MW)	Max MW shortage during shortage hours Threshold: Max MW Short should be $\leq 90\%$ of tie-line import limits	MW	Annual/Summer/Winter
Avg MW Short	Average Power Shortage (MW)	Average MW shortage during shortage hours	MW	Summer/Winter
min RM%	Minimum Reserve Margin	Lowest reserve margin for all analyzed hours Threshold: Summer $> 2.9\%$; Winter $> 6.2\%$	Percent (%)	Annual/Summer/Winter
LOLE (days in 10 years)	Loss of Load Expectation	Expected number of days per year during which at least one shortage event occurs * 10	Days/year	Annual
LOLP	Loss of Load Probability	Probability that system demand exceeds available supply in any given hour; LOLP = LOLH/8760	Probability (dimensionless)	Annual



4.3 Energy Adequacy analysis - Planning Reserve Margin (PRM) Criteria

According to the report "MISO's Planning Reserve Margin (PRM) for Planning Year 2025-26", the minimum required Planning Reserve Margins are defined as:

- Summer: Greater than 2.9%
- Winter: Greater than 6.2%

These thresholds serve as benchmarks to evaluate whether each portfolio provides sufficient capacity to meet expected load plus reserves, ensuring system reliability during seasonal peak conditions.

4.4 Energy Adequacy Resulting Metrics

If the AES Indiana (IPL) area maintains full tie-line availability and can import 100% or at least 50% of its transfer capability from neighboring systems, Energy Adequacy metrics show no issues in meeting future load, even under 90/10 high load forecast conditions, through 2035.

When transmission import capability is reduced to 0%, the system shows a clear dependence on external energy support, highlighting the critical role of regional imports in maintaining energy adequacy.

4.4.1 Energy Adequacy Metrics (0% Import)

Table 9 shows the Energy Adequacy Metrics where the imports to the AES IPL area are limited to 0%.

Table 9. Energy Adequacy Metrics if imports to the area AES IPL are limited to 0%.

Import 0%	1. REFERENCE CASE				3. HIGH REGULATORY: ENVIRONMENTAL				2. GAS INFRASTRUCTURE CHALLENGES				4. STABLE MARKETS			
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
LOLE (interruption days in 10 years)																
Year																
2027	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2030	-	-	4	-	-	-	2	493	-	-	-	-	-	-	4	942
2035	-	-	12	10	-	1	1,996	3,322	-	-	-	-	-	-	290	357
EUE (Expected Unserved Energy) [GWh]																
Year																
2027	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2030	-	0	0	0	-	0	0	125	-	0	-	0	-	0	0	266
2035	0	0	1	1	0	0	999	4,770	0	-	0	0	0	0	61	89
LOLP (Loss of Load Probability) [%]																
Year																
2027	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
2030	0%	0%	0%	0%	0%	0%	0%	10%	0%	0%	0%	0%	0%	0%	0%	19%
2035	0%	0%	0%	0%	0%	0%	33%	71%	0%	0%	0%	0%	0%	0%	6%	7%
LOLH (Loss of Load Hours per Year)																
Year																
2027	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2030	-	-	7	-	-	-	4	835	-	-	-	-	-	-	7	1,630
2035	-	-	14	13	-	1	2,857	6,213	-	-	-	-	-	-	503	594
LOLH (Loss of Load Hours) _Summer																
Summer																
2027	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2030	-	-	-	-	-	-	-	336	-	-	-	-	-	-	-	579
2035	-	-	8	4	-	-	914	1,819	-	-	-	-	-	-	147	173
LOLH (Loss of Load Hours) _Winter																
Winter																
2027	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2030	-	-	-	-	-	-	-	157	-	-	-	-	-	-	-	410
2035	-	-	-	-	-	-	722	1,318	-	-	-	-	-	-	80	1

It could be observed that with imports limited to 0%, energy adequacy concerns emerge in portfolios 3, 4, 7, 8, 15, and 16. The most critical shortfall is observed in portfolio 8 for the year 2035.

Table 10 presents the expected deficits in MW shortages having AES IPL 0% Imports.



Table 10. Expected deficits in MW shortages having AES IPL 0% Imports.

Import 0%	1. REFERENCE CASE				3. HIGH REGULATORY: ENVIRONMENTAL				2. GAS INFRASTRUCTURE CHALLENGES				4. STABLE MARKETS			
Import 0%	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
MW Short																
Year																
2027	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2030	-	0	140	0	-	0	103	662	-	0	-	0	-	0	137	692
2035	0	0	203	186	0	43	1,340	1,922	0	-	0	0	0	0	558	506
avg MW Short_Summer																
Summer																
2027	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2030	-	-	-	-	-	-	-	149	-	-	-	-	-	-	-	170
2035	-	-	28	9	-	-	353	787	-	-	-	-	-	-	127	148
avg MW Short_Winter																
Winter																
2027	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2030	-	-	-	-	-	-	-	117	-	-	-	-	-	-	-	133
2035	-	-	-	-	-	-	360	755	-	-	-	-	-	-	108	4
max MW Deficit_Summer																
Summer																
2027	-	-	-	0	-	-	-	0	-	-	-	0	-	-	-	0
2030	-	0	0	0	-	0	0	662	-	0	-	0	-	0	0	667
2035	0	0	174	90	0	0	1,340	1,922	0	-	0	0	0	0	558	506
max MW Deficit_Winter																
Winter																
2027	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2030	-	0	0	0	-	0	0	453	-	0	-	0	-	0	0	515
2035	-	-	0	0	-	0	1,232	1,746	-	-	-	-	-	-	307	48

When imports are restricted to 0%, several portfolios (3, 4, 7, 8, 15, and 16) show signs of energy adequacy issues. The most critical condition is observed in portfolio 8 in the year 2035.

Table 11 shows the Planning Reserve Margins highlighting the violations according to the defined MISO threshold.



Table 11. Planning Reserve Margins highlighting the violations

Import 50%	1. REFERENCE CASE				3. HIGH REGULATORY: ENVIRONMENTAL				2. GAS INFRASTRUCTURE CHALLENGES				4. STABLE MARKETS			
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
	min RM % Summer															
Summer																
2027	18%	18%	18%	17%	19%	18%	18%	17%	18%	18%	18%	17%	18%	18%	18%	17%
2030	49%	43%	27%	39%	49%	43%	28%	13%	49%	43%	54%	39%	49%	44%	28%	13%
2035	48%	46%	30%	33%	49%	31%	0%	0%	48%	54%	41%	47%	48%	46%	23%	24%
min RM % Winter																
Winter																
2027	19%	19%	19%	19%	19%	19%	19%	19%	19%	19%	19%	19%	19%	19%	19%	19%
2030	49%	45%	32%	47%	49%	45%	33%	20%	49%	45%	59%	47%	49%	45%	32%	19%
2035	48%	48%	38%	47%	50%	33%	0%	0%	48%	56%	50%	62%	48%	48%	30%	37%
Import 0%	1. REFERENCE CASE				3. HIGH REGULATORY: ENVIRONMENTAL				2. GAS INFRASTRUCTURE CHALLENGES				4. STABLE MARKETS			
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
	min RM % Summer															
Summer																
2027	7%	7%	7%	6%	7%	7%	7%	6%	7%	7%	7%	6%	7%	7%	7%	6%
2030	7%	1%	0%	0%	7%	1%	0%	-25%	7%	1%	9%	0%	7%	1%	0%	-28%
2035	2%	0%	-2%	-1%	2%	0%	-52%	-80%	2%	6%	0%	0%	2%	0%	-18%	-18%
min RM % Winter																
Winter																
2027	8%	8%	8%	8%	8%	8%	8%	8%	8%	8%	8%	8%	8%	8%	8%	8%
2030	7%	2%	0%	1%	7%	2%	0%	-14%	7%	2%	15%	1%	7%	2%	0%	-18%
2035	2%	1%	0%	0%	3%	0%	-45%	-69%	2%	9%	2%	13%	2%	1%	-8%	0%
90/10 Load Forecast	1. REFERENCE CASE				3. HIGH REGULATORY: ENVIRONMENTAL				2. GAS INFRASTRUCTURE CHALLENGES				4. STABLE MARKETS			
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
	min RM % Summer															
Summer																
2027	20%	20%	21%	20%	21%	20%	21%	20%	20%	20%	21%	20%	20%	20%	21%	20%
2030	75%	71%	58%	70%	76%	71%	59%	46%	75%	71%	82%	70%	75%	72%	59%	46%
2035	79%	78%	66%	68%	80%	66%	31%	11%	79%	85%	76%	81%	79%	79%	59%	60%
min RM % Winter																
Winter																
2027	15%	15%	16%	16%	15%	15%	16%	16%	15%	15%	16%	16%	15%	15%	16%	16%
2030	70%	66%	55%	70%	70%	66%	57%	46%	70%	66%	80%	70%	70%	66%	56%	45%
2035	73%	73%	64%	73%	74%	60%	29%	11%	73%	80%	75%	86%	73%	73%	57%	64%

When imports are limited to 0%, almost none of the portfolios meet the required Planning Reserve Margins for the years 2030 and 2035. The most critical violation occurs in portfolios 7 and 8 in the year 2035.

4.5 Energy Adequacy Resulting Metrics - Conclusions

If the AES Indiana (IPL) area maintains full tie-line availability and is able to import 100% or at least 50% of its transmission capacity from neighboring systems, Energy Adequacy metrics indicate no reliability concerns through 2035, even under 90/10 high load forecast assumptions.

However, when import capability is reduced to 0%, the system shows a clear dependency on external energy support. Under these isolated conditions, neither energy adequacy nor Planning Reserve Margin (PRM) targets are met, emphasizing the critical importance of regional interconnections for maintaining system reliability and long-term adequacy.

Key findings include:

- With 0% imports, energy shortfalls occur in portfolios 3, 4, 7, 8, 15, and 16, with portfolio 8 in 2035 representing the most critical deficiency.



- Under the same conditions, nearly all portfolios fail to meet PRM requirements for 2030 and 2035, with the most severe violations in portfolios 7 and 8 (2035).

These results highlight the essential role of regional transmission infrastructure in supporting AES IPL's ability to meet growing demand, particularly during high-stress periods or aggressive load expansion.

To maintain long-term reliability, the following actions are recommended:

- Preserve import flexibility by maintaining robust interconnection capability.
- Continue investment in transmission upgrades to enable regional energy exchange.
- Pursue strategic coordination with neighboring systems and MISO to ensure resource adequacy under both normal and constrained scenarios.



5 Analysis of Inertial and Primary Frequency Response

Frequency stability is a fundamental measure of power system reliability, reflecting the grid's ability to maintain its nominal frequency of 60 Hz following major disturbances such as generator trips or sudden load variations. This study evaluates AES Indiana's inertial and primary frequency performance across multiple resource portfolios and network configurations—both interconnected with MISO and islanded (independent operation).

The analysis supports long-term resource adequacy and reliability planning by quantifying the minimum inertia required to limit the Rate of Change of Frequency (RoCoF), the synchronous generation needed to maintain frequency nadir above Underfrequency Load Shedding (UFLS) thresholds, and the contribution of storage and regulation resources in stabilizing post-disturbance recovery.

Primary Frequency Response (PFR) is critical to maintaining grid reliability within the MISO footprint. Acting as the first line of defense, PFR automatically detects and counters local frequency deviations within fractions of a second—well before centralized controls can respond. This inherent, localized response is essential for halting frequency declines and preventing the activation of UFLS schemes. In contrast, frequency regulation operates over a longer timeframe, relying on centralized dispatch signals from MISO to restore system balance.

As large synchronous generators are retired and replaced with inverter-based resources (IBRs) such as wind, solar, and battery storage, the system's inertial response naturally declines. This reduction in rotating mass can lead to faster and deeper frequency drops following disturbances, especially in high-renewable systems with limited synchronous generation.

Furthermore, ramping, regulation, and reserves collectively define a generator's ability to respond to changing load conditions, as outlined in NERC Resource and Demand Balancing (BAL) standards. Regulation provides rapid correction of frequency deviations within seconds to minutes, while ramping and reserves support load-following capabilities over longer intervals—from several minutes to hours—ensuring sustained system balance and reliability. [2]

5.1 Considerations, Methodology, and Tools for Inertial and Primary Frequency Analysis

To analyze the stability of power systems, it is crucial to split the frequency response into inertial and primary frequency responses. The inertial response is the immediate reaction of the power system to a disturbance, such as a fault, provided by the kinetic energy stored in the rotating masses of synchronous generators and other rotating machinery. The primary frequency response is the automatic adjustment of power output by generators and other resources in response to frequency deviations, governed by the droop control settings of the generators. The table below presents a comparison of the main aspects of inertial and primary frequency responses.

Table 12. Comparison of Inertial and primary frequency responses

Aspect	Inertial Response	Primary Frequency Response
Definition	Immediate reaction to a disturbance	Automatic adjustment of power output
Purpose	Arrests initial rate of change of frequency (RoCoF)	Stabilizes frequency post-inertial response
Time Period	0-10 seconds	10-30 seconds
Analysis Focus	System's resistance to frequency changes	Effectiveness of governor controls
Key Components	Rotating masses (synchronous generators)	Governor controls, frequency-responsive resources



To analyze inertia and primary frequency for IRP portfolios, a simplified model of the AES IPL system is represented as a single bus area connected to the MISO system via an equivalent inertia. The equivalent model for frequency response analysis was constructed using a Microsoft Excel spreadsheet that models the power balance equation of a rotating machine, commonly known as the swing equation, as detailed in section 5.2. System inertia and RoCoF are the most important variables to be defined and analyzed when a primary frequency response is a concern.

ROCOF stands for Rate of Change of Frequency. It measures how quickly the system frequency changes over time, typically in Hz per second (Hz/s).

$$ROCOF = \frac{df}{dt}$$

Where:

- df is the change in frequency
- dt is the change in time

ROCOF reflects the dynamic balance between generation and load:

- A high ROCOF indicates a sudden imbalance — such as a large generator trip or load loss.
- A low ROCOF suggests a system with high inertia or stable generation-load balance.

In simple terms, ROCOF tells us how fast the frequency is deviating from its nominal value (60 Hz)

5.1.1 System Inertia, Inertial Response, and Rate of Change of Frequency Threshold Considerations

A synchronous plant with rotating inertia stores kinetic energy in its turbine-generator rotors by virtue of its rotation at 3600 RPM for a two-pole generator and 1800 RPM for a four-pole generator. A typical machine stores 2–5 seconds of kinetic energy at full power output. When the electric grid experiences a power source loss, the ensuing power imbalance draws from the stored kinetic energy in a rapid pursuit to slow down the RoCoF decline. Following a resource trip, the initial RoCoF immediately after the event is a function of the online synchronous machines' inertia and the magnitude of generation loss.

High RoCoF following a large power loss can be detrimental to the stability of the electric grid by triggering one or multiple of the phenomena listed in the following subsections.

5.1.1.1 Wind generation resources Trip Due to Reduced Synchronizing Torques

Reduced synchronizing torques in wind generating machines could become a common cause of tripping, endangering system integrity and reliability. The current fleet of synchronous machines wasn't designed with RoCoF withstand capabilities in mind, making their performance in this area uncertain. For modern wind turbines, the maximum acceptable RoCoF is typically between 4 Hz/s for 200 to 300 milliseconds. In contrast, older Type 1 and Type 2 wind turbines often have a much lower maximum permissible RoCoF of just 1 Hz/s [3].

Practically, for all wind turbine types, slower changes, such as 1 Hz/s, can be tolerated for a longer duration (in the range of one second or more).



The limitation on permissible RoCoF stems from the use of a phase-locked loop in the converter controls of Type 3 and 4 wind turbines, which can lose track of the voltage phase angle and, therefore, the power system frequency during rapid changes in power system frequency.

5.1.1.2 Under-frequency Relays Respond to Low-frequency Levels by Tripping Load

Another factor to consider when defining the RoCoF limit is the settings of the UFLS relays. In Texas, the UFLS relays will shed the first block of load when the frequency drops below 59.3 Hz and also will shed load resources providing responsive reserve service (RRS) when the frequency drops below 59.7 Hz and stalls for 25 cycles or 0.416 s. This adds another constraint on the RoCoF speed to be slow enough to take more than 0.416 s to drop from 59.7 Hz to 59.3 Hz to enable the RRS resources to respond before the first block of the load is shed. This sets a limit on RoCoF of 0.96 Hz/s.

For AES IPL, the UFLS scheme has been installed at selected distribution substations across the system to help prevent a system collapse caused by frequency decay. The underfrequency relaying has been configured to support five increments of tripping, which are at the following frequencies: 59.5 Hz, 59.3 Hz, 59.1 Hz, 58.9 Hz, and 58.7 Hz.

5.1.1.3 Speed of System Events

Another important aspect to consider is the speed of system events, which can sometimes occur faster than the protection system's ability to respond. This means that rapid changes in the system, such as sudden faults or fluctuations in power, might outpace the reaction time of the protection mechanisms in place.

5.1.1.4 System Inertia and Inverter-based Resources

As inverter-based resources (IBRs) increasingly replace synchronous rotating machines, the overall system inertia decreases. To maintain a safe rate of change of frequency (RoCoF), the power system needs a mechanism to slow it down, without drastically altering current control and protection philosophies. Synchronously rotating machines can provide this essential inertia. Alternatively, "virtual inertia" can be supplied by grid-forming inverters with rotating inertia, such as those used in wind turbines or battery storage systems. However, most solar, wind, and battery inverters are grid-following types, which cannot provide virtual inertia [4], [5], [6].

The next figure shows the RoCoF for the Electric Reliability Council of Texas (ERCOT) following the loss of 2,750 MW (2 largest units). The Figure 26 shows a drop in frequency of 0.5 Hz in 2 seconds or a RoCoF of 0.25 Hz/s. As more IBRs reduce system inertia, the RoCoF will increase. RoCoF values of 0.5 Hz–1.0 Hz/s have been established as limits in various countries.

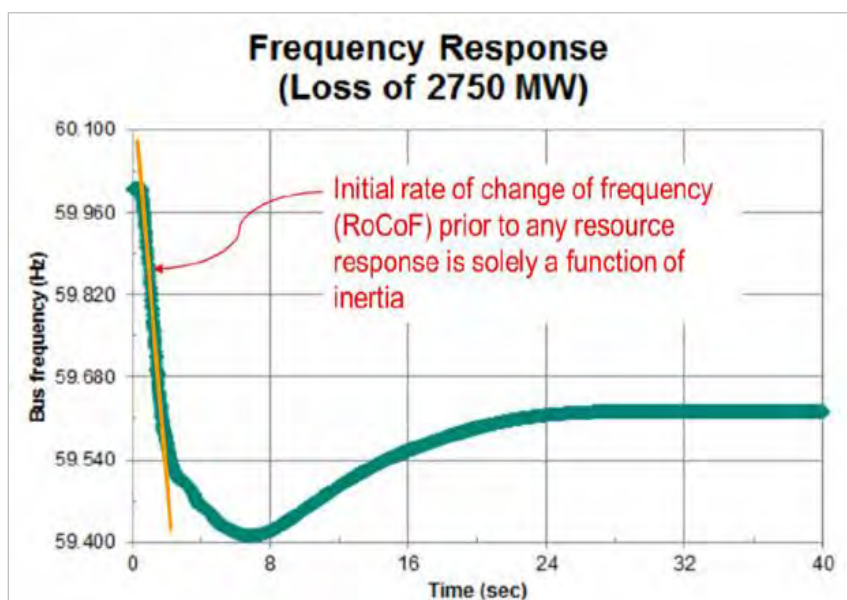


Figure 26. Frequency Trace after Loss of 2,750 MW and Initial RoCoF after the Event

5.1.1.5 More References on Acceptable Rate of Change of Frequency Thresholds

High RoCoF poses challenges to maintain system frequency within acceptable limits (i.e., avoiding load shedding or cascading events) since there is insufficient time for resources (generation or load) to respond to frequency deviations. When the electric system frequency deviates significantly from its nominal value, it can impact different types of loads: resistive loads like heaters and light bulbs may operate inefficiently or have reduced lifespans; inductive loads such as motors and transformers can overheat and suffer damage; capacitive loads like capacitor banks may fail to correct the power factor properly; electronic loads including computers and communication equipment can malfunction or be damaged; and frequency-sensitive loads like clocks can lose accuracy. Maintaining a stable frequency is crucial for the reliable operation and protection of these loads. High rates of change of frequency (RoCoF) and the resulting low frequencies are particularly concerning in regions where the instantaneous penetration of inverter-based resources (IBRs), including both distributed energy resources (DER) and bulk power system (BPS) connected IBRs, is significantly high.

Figure 27, extracted from NERC's 2020 publication titled "Fast Frequency Response Concepts and Bulk Power System Reliability Needs" [7], illustrates the impact of a contingency size on RoCoF at different system inertia levels. If the size of the largest credible contingency decreases in the future, that will positively impact RoCoF.

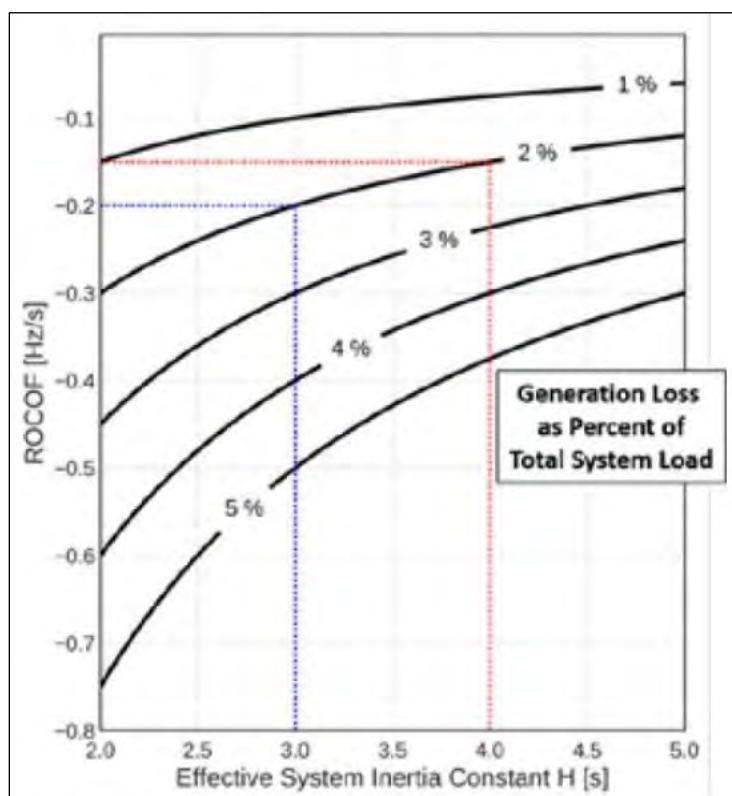


Figure 27. Impact of Effective System Inertia and Contingency Size on RoCoF

Despite its importance, there is no uniform agreement on the acceptable threshold of RoCoF. Below are some of the settings that have been adopted:

- European Network of Transmission System Operators for Electricity (ENTSO-E):** A review of global experience with high RoCoF events [8] suggests that emergency controls like UFLS may not be able to prevent blackouts if RoCoF exceeds 1 Hz/s measured over 500 ms. Another similar study [9] concluded the following:

“[...] Transients with RoCoF higher than 1 Hz/s are not manageable by system protections. This limit is related to the minimum time to measure the phenomena stably and securely and react by opening the circuit breakers of loads or generation. It seems that the current technology does not guarantee the correct operation of protection equipment in the presence of this kind of transients.” [9]
- Australia:** The Australian Energy Market Operator (AEMO) identified a need for “sufficient inertia to slow down the RoCoF and enable automatic load shedding to stabilize the island system in the first few seconds” [10]. They have since implemented restrictions on the interconnector flow to ensure its loss (the largest expected contingency) does not result in a RoCoF that exceeds 3 Hz/s. The Western Australia Electricity Market (WEM) in the Frequency Operating Standard (FOS) specifies a safe RoCoF limit of 0.25 Hz over any 500 ms period (0.5 Hz/s) for the Southwest Interconnected System (SWIS).
- Great Britain:** No operational or legislated limit for RoCoF is in place. However, the revised loss of main (LoM) requirement was for protection to be set above 1 Hz/s.
- National Grid UK:** In response to operational challenges, National Grid in the UK increased the RoCoF threshold to 1 Hz/second to mitigate false trips and enhance system stability. This adjustment helps accommodate higher penetration of renewables and reduces the risk of unintentional islanding [11].



- **Ireland and Northern Ireland (EirGrid and SONI):** A RoCoF limit is in use. This was initially 0.5 Hz/s over a 500 ms rolling window. However, this has been increased to 1 Hz/s over a 500 ms rolling window. EirGrid and SONI raised the RoCoF limit to 1 Hz/second to enable greater integration of renewable energy sources [11]. This change followed extensive studies and trials aimed at balancing supply and demand more effectively while maintaining grid stability.
- **United States:** Due to the network's vast scale and the generation mix being dominated by synchronous sources, a "high RoCoF" event is yet to occur. The largest recorded RoCoF event is -0.2 Hz/s, measured over 500 ms. This occurred in Texas after multiple generators tripped offline. IEEE 1547 specifies a RoCoF requirement for DERs (less than 20 MW). This requirement varies from 0.5 Hz/s–3 Hz/s depending on certain criteria. The averaging window that applies is 100 ms. For large generators (20 MW and larger), PRC-024-3 applies.

While NERC does not specify a strict 1 Hz/second threshold in its standards, it references the importance of maintaining RoCoF within certain limits to prevent system instability and protect grid infrastructure, aligning with the 1 Hz/second benchmark used by other grid operators globally (NERC BAL-003-1.1).

5.1.1.6 Acceptable Levels of Inertial Response and Quanta Technology's Rate of Change of Frequency Threshold Considerations

Taking into consideration the presented supporting material with theoretical background and several best practices followed by some system operators, Quanta Technology considers that for the primary frequency response analysis to be performed in AES IPL, a RoCoF lower than 1 Hz/second calculated over the first 500 ms after a large generation plant trip is a reasonable threshold for monitoring in the simplified mathematical model. Additional detailed analysis should be performed when the calculated RoCoF values reach the defined threshold.

5.2 Equivalent Model for Frequency Response Analysis

5.2.1 Mathematical Model Definition

The construction of the equivalent model for frequency response analysis is based on the power balance equation of a rotating machine, also known as the swing equation:

$$\frac{2H}{f_0} \frac{df}{dt} = \Delta P$$

Where:

H: Inertia constant (in seconds) — the ratio of stored kinetic energy at rated speed to the machine's MVA rating. It reflects how resistant the machine is to changes in speed.

f₀: Initial frequency

df/dt: Rate of change in frequency in a time period

ΔP = Loss of power resources due to contingency event
 + Variability of intermittent resources solar + wind resources at 3s–5s
 - Virtual inertial contribution from online solar + wind resources
 - Virtual inertial contribution from battery energy storage
 - Inertial response contribution from outside areas over tie-lines



The critical inertia that should be installed in the study area is taken as the maximum of:

- Inertia to limit RoCoF:

$$H = \frac{\Delta P}{2 * RoCoF Limit} f_0$$

- Inertia to avoid triggering UFLS before the responsive reserves load:

$$H = \frac{\Delta P}{2 * UFLS speed} f_0 \quad \text{where UFLS speed} = (\text{pickup frequency} - \text{trip frequency})/\text{delay}$$

The equivalent model for AES IPL incorporates all data from the PSS/E model and the AES IPL defined resource additions and retirements regarding load, including Large Data Center Facilities and generation resources. Additionally, it accounts for the anticipated integration of new resources and the planned retirements of existing resources as outlined in future portfolios. The total inertia of the system is calculated by summing the inertia of all synchronous generators, including hydro, hydro-pumped storage, nuclear, coal, gas, and oil in AES IPL system and the external MISO system. The model also considers load inertia, integrating it as part of the load damping. This calculation does not take into account inertia support from any IBRs such as photovoltaic plants, wind, offshore wind, or BESS. The updated inertia values for the generation resources were extracted from the MMWG files, considering the dynamics file “2030SUM-MISO25-IPL-Load-Model_IPL.dyr”

5.3 Results for Inertial and Primary Frequency

The inertial and primary frequency response of the AES IPL AREA to the loss of Petersburg 3 with 525 MW generator is analyzed for all defined portfolios and annually from 2027–2040. This analysis considers the resulting import capability between AES IPL and the external MISO network.

1. Where they are fully interconnected based on the calculated AES IPL import capability.

Where AES IPL operates in an emergency condition as an island.

For fully interconnected scenarios, AES IPL's load is updated annually based on the AES IPL load forecast for the area. In islanded scenarios, the served load is adjusted to balance the available generation with the AES IPL's area peak load considering in the portfolios the Large Data Center Facilities according to the defined portfolios and satisfying the required reserves.

5.3.1 Results for Inertial Frequency Response

Figure 28 illustrates the expected RoCoF for Portfolio 4, considering both scenarios: AES IPL in island mode and connected with the external MISO network. In the figure the synchronous generation requirements for the same cases are also shown.

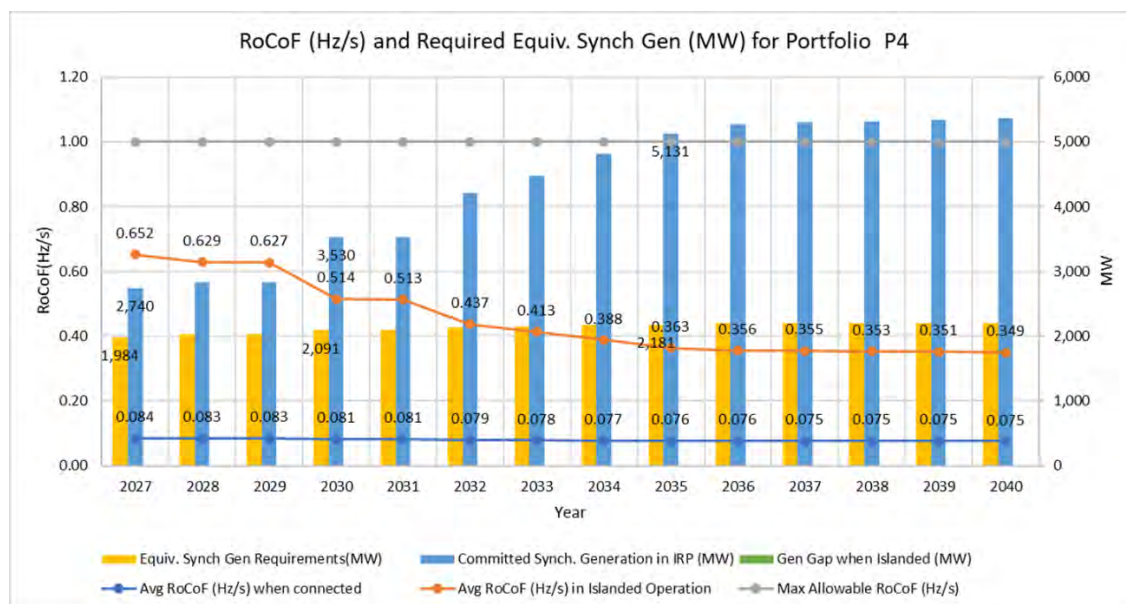


Figure 28. Synchronous Generation Requirements and Expected RoCoF for Portfolio P4

When connected with MISO, RoCoF is between 0.084 Hz/s–0.075 Hz/s, and it decreases between 0.652 Hz/s–0.349 Hz/s when AES IPL is islanded. Both values are below the acceptable threshold of 1 Hz/s. The graph also displays the dispatched synchronous generation in MW and the minimum level that must be maintained online to keep RoCoF below 1 Hz/s when AES IPL is islanded.

Figure 29. Synchronous Generation Requirements and Expected RoCoF for Portfolio P8 illustrates the expected RoCoF for Portfolio P8, considering both scenarios: AES IPL in island mode and connected with MISO.

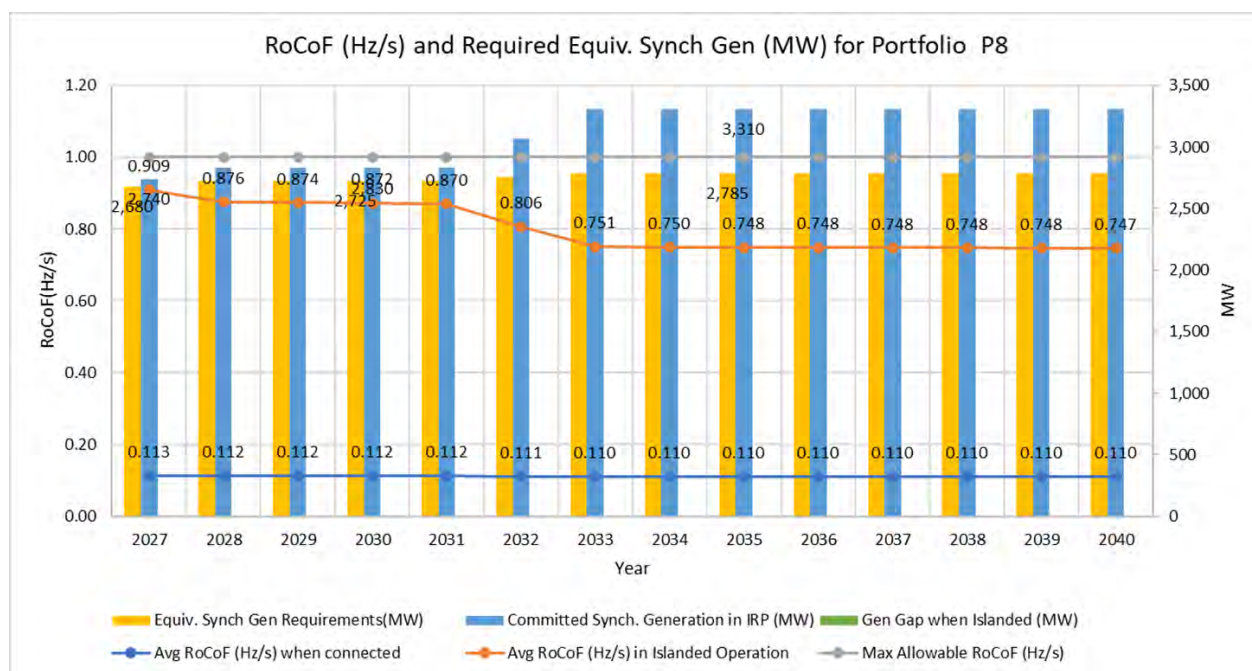


Figure 29. Synchronous Generation Requirements and Expected RoCoF for Portfolio P8



When connected with MISO, RoCoF is between 0.113 Hz/s–0.110 Hz/s, and it increases between 0.909 Hz/s–0.747 Hz/s when AES IPL is islanded. Both values are below the acceptable threshold of 1 Hz/s. The graph also displays the dispatched synchronous generation in MW and the minimum level that must be maintained online to keep RoCoF below 1 Hz/s when AES IPL is islanded.

The Synchronous Generation Requirements and Expected RoCoF for the other 14 Portfolios are presented in Appendix A.

5.3.2 Results for Online Inertia Requirements

Figure 30 displays the online dispatched inertia in MVA-s and the minimum level required to keep the RoCoF below 1 Hz/s for Portfolio P4 when the system is islanded.

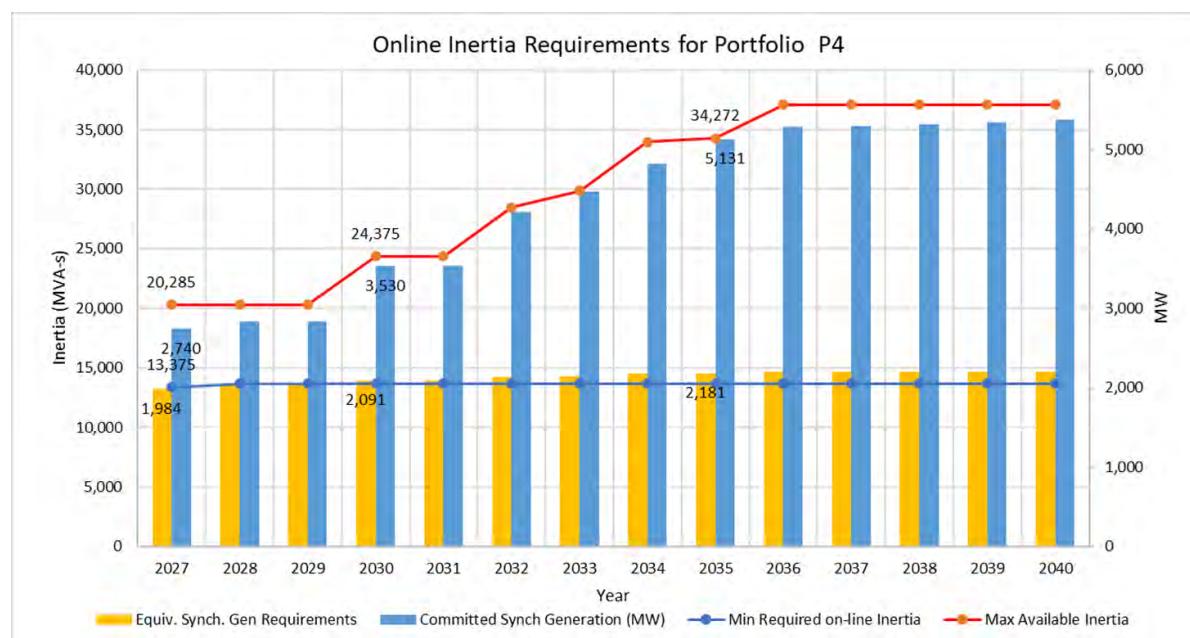


Figure 30. Online Inertia Requirements for Portfolio P4 in Island Mode

Figure 31 displays the online dispatched inertia in MVA-s and the minimum level required to keep the RoCoF below 1 Hz/s for Portfolio P8 when the system is islanded.

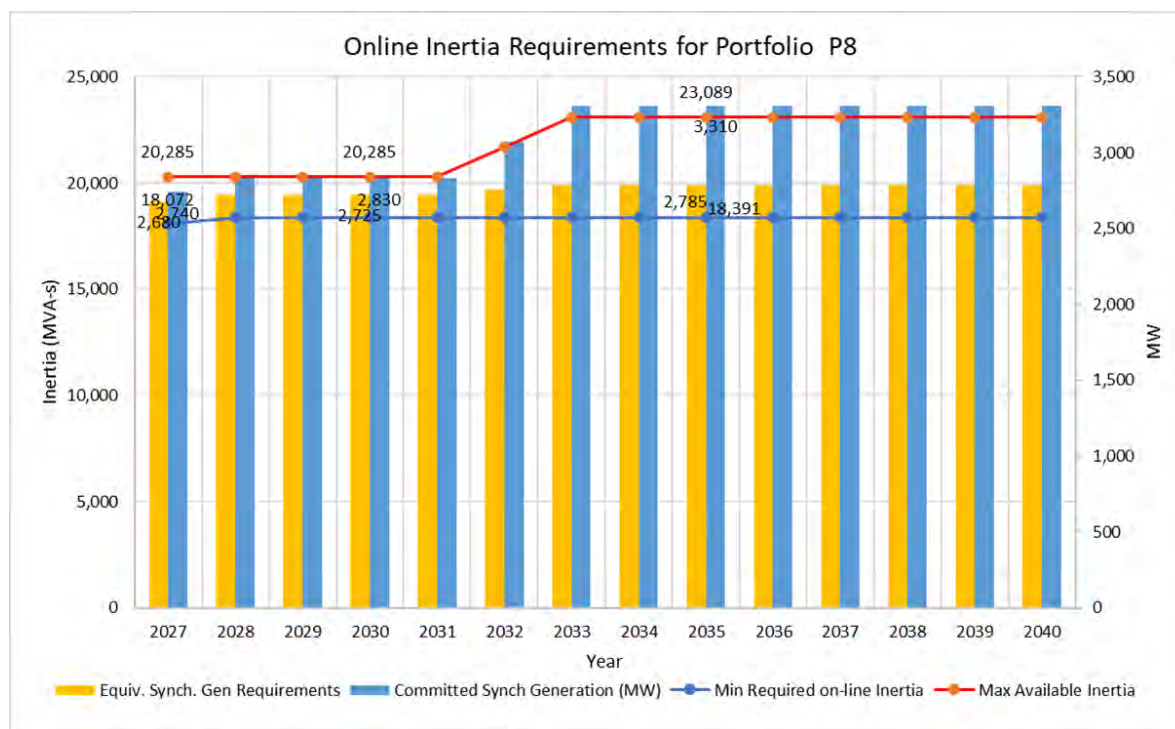


Figure 31. Online Inertia Requirements for Portfolio P8 in Island Mode

From the data in the Figure 31, it is observed that, for 2027 (for example), the minimum required inertia is 18,072 MVA-s, and the maximum available inertia is 20,285 MVA-s. On the other hand, for the Year 2035, the minimum required inertia is 18,391 MVA-s, and the maximum available inertia is 23,089 MVA-s. It is concluded that given the available generation resources, the system's inertia is adequate to maintain the RoCoF within acceptable limits, eliminating the need for additional inertial response resources.

The Online Inertia Requirements for the other 14 Portfolios are presented in Appendix A.

All portfolios maintain RoCoF below 1 Hz/s for the trip of the largest generation unit (Petersburg 3 with 525 MW) for both connected and islanded mode.

Given the available generation resources, the system's inertia is adequate to maintain the Rate of Change of Frequency (RoCoF) within acceptable limits, eliminating the need for additional inertial response resources.

In island mode for all portfolios, as long as the AES system has 2,600 MW of synchronous generation (or more than 18,000 MVA-s in Inertia), the response of the system will be adequate.

5.3.3 Results for Primary Frequency Response

The frequency impact from the trip of a large generation plant is more significant in islanded mode than in interconnected mode. Therefore, settings for the UFLS scheme must be carefully considered. In the AES IPL area, under-frequency protection has been installed at selected distribution substations to prevent system collapse due to frequency decay.

Figure 32 illustrates the expected Frequency Impact and the Required Generation for portfolio P4, considering AES IPL interconnected with the external MISO network.

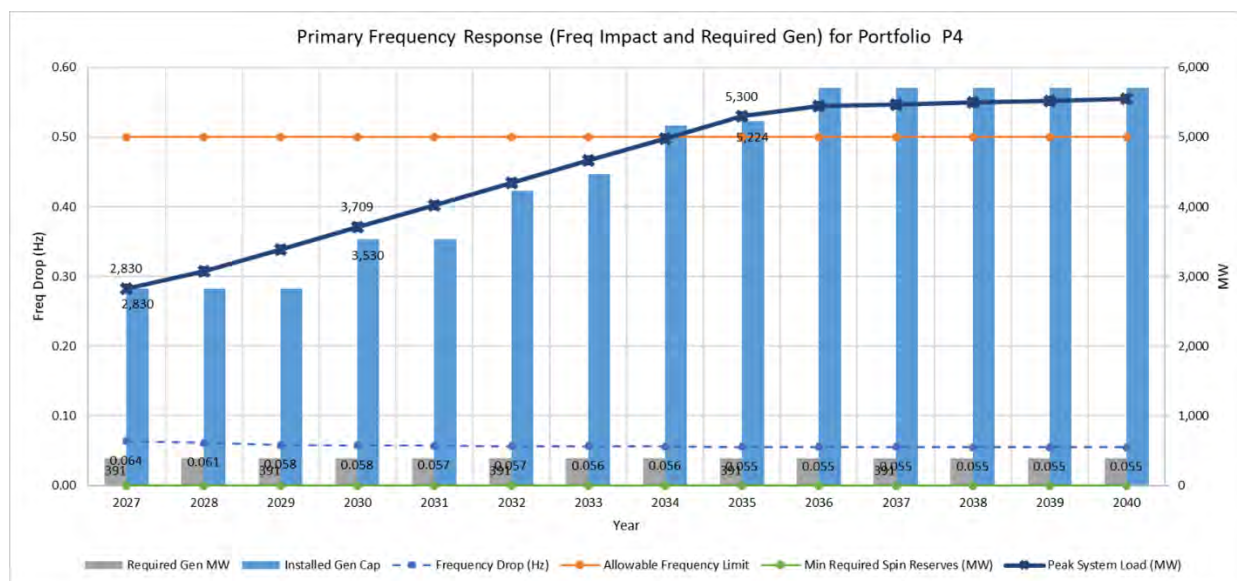


Figure 32. PFR for Portfolio P4 for AES IPL interconnected with external MISO network

From the figure could be observed that considering AES IPL interconnected with the external MISO network, the system frequency response is adequate to keep frequency Nadir above 59.5 Hz and thus avoid triggering UFLS for portfolio P4.

Figure 33 illustrates the expected Frequency Impact and the Required Generation for portfolio P8, considering AES IPL interconnected with the external MISO network.

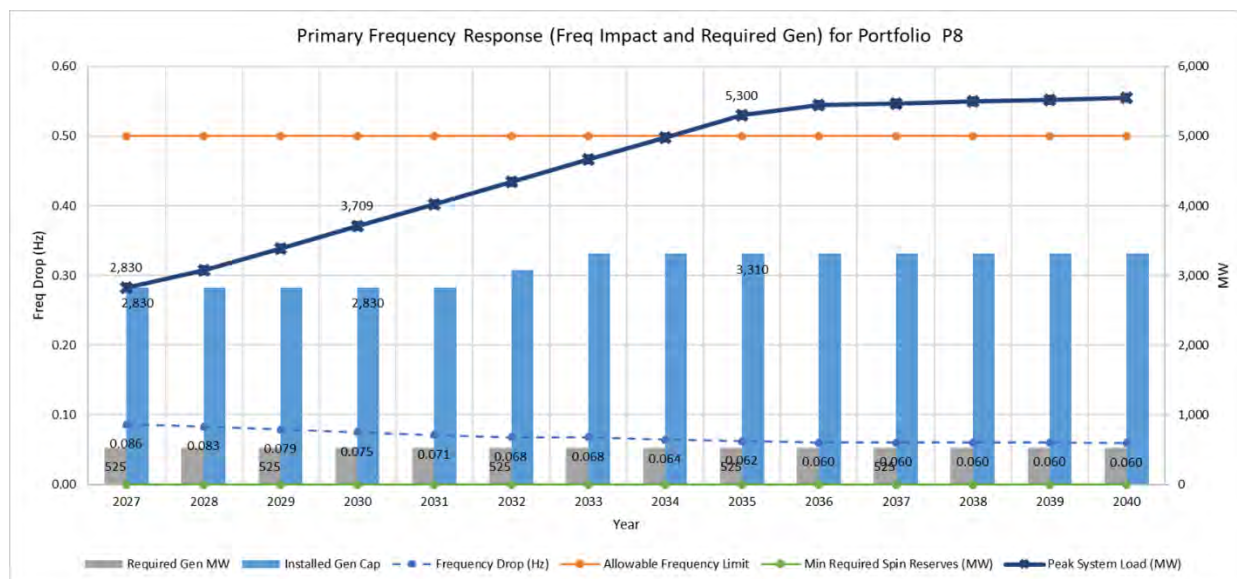


Figure 33. PFR for Portfolio P8 for AES IPL interconnected with external MISO network

Similar to portfolio P4, from the figure could be observed that considering AES IPL interconnected with the external MISO network, the system frequency response is adequate to keep frequency Nadir above 59.5 Hz and thus avoid triggering UFLS for portfolio P8.



Figure 34 illustrates the expected Frequency Impact and the Required Generation for portfolio P4, considering AES IPL operating in the emergency Island operation mode.

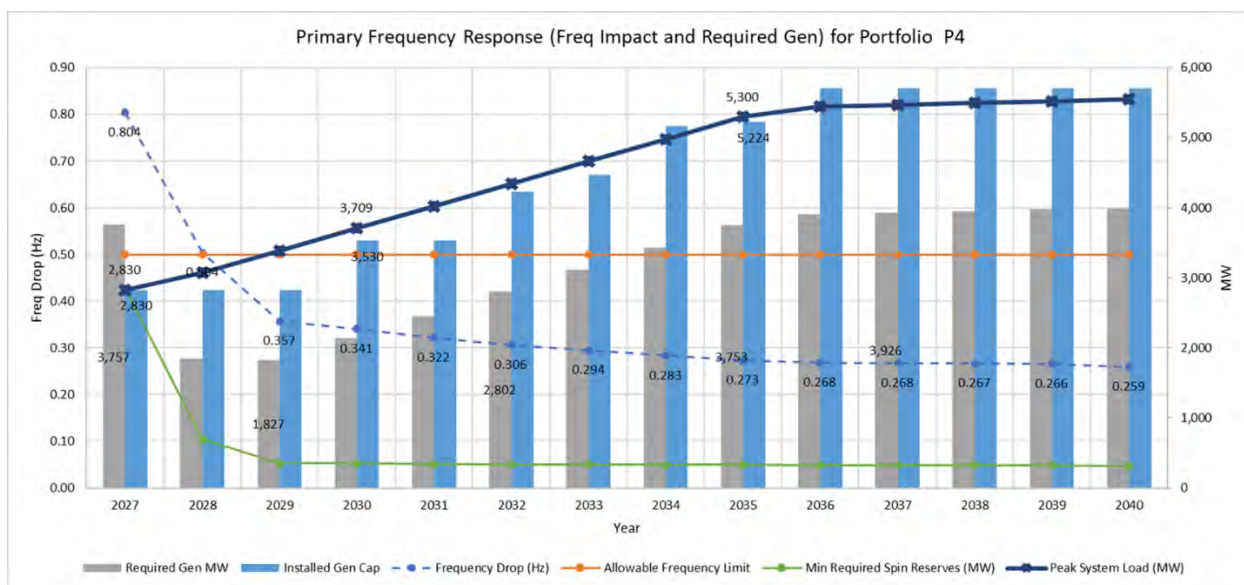


Figure 34. PFR for Portfolio P4 for AES IPL operating in the emergency Island operation mode

From the figure, it can be observed that in 2027 and 2028, the frequency drop exceeds the allowable limit of 0.5 Hz. Could be seen that for example for 2027 (0.804 Hz) exceeds the allowable limit of 0.5 Hz, surpassing the Underfrequency Load Shedding (UFLS) threshold and placing portions of the load at risk of disconnection. The system's frequency response becomes adequate to maintain the frequency nadir above 59.5 Hz—thereby avoiding UFLS activation—only after 2029.

Figure 35 illustrates the expected Frequency Impact and the Required Generation for portfolio P8, considering AES IPL operating in the emergency Island operation mode.

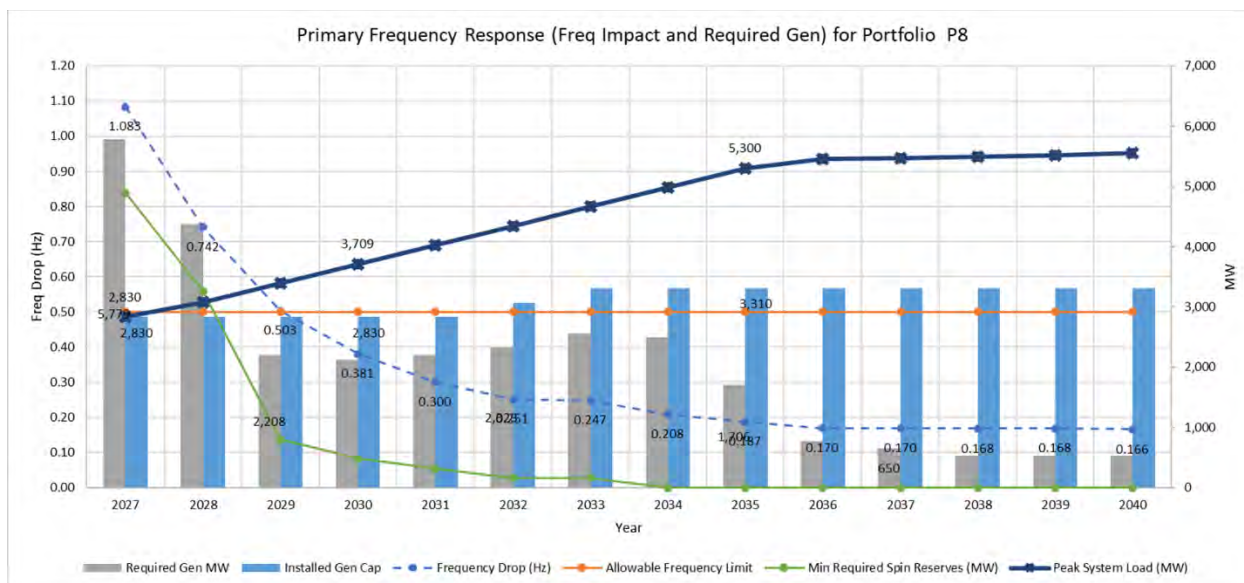


Figure 35. PFR for Portfolio P8 for AES IPL operating in the emergency Island operation mode



From the figure, it can be observed for portfolio 8 a similar condition to portfolio 4. The system's frequency response becomes adequate to maintain the frequency nadir above 59.5 Hz—thereby avoiding UFLS activation—only after 2030.

Figure 36 illustrates the expected Frequency Impact and the Required Generation for portfolio P16, considering AES IPL operating in the emergency Island operation mode.

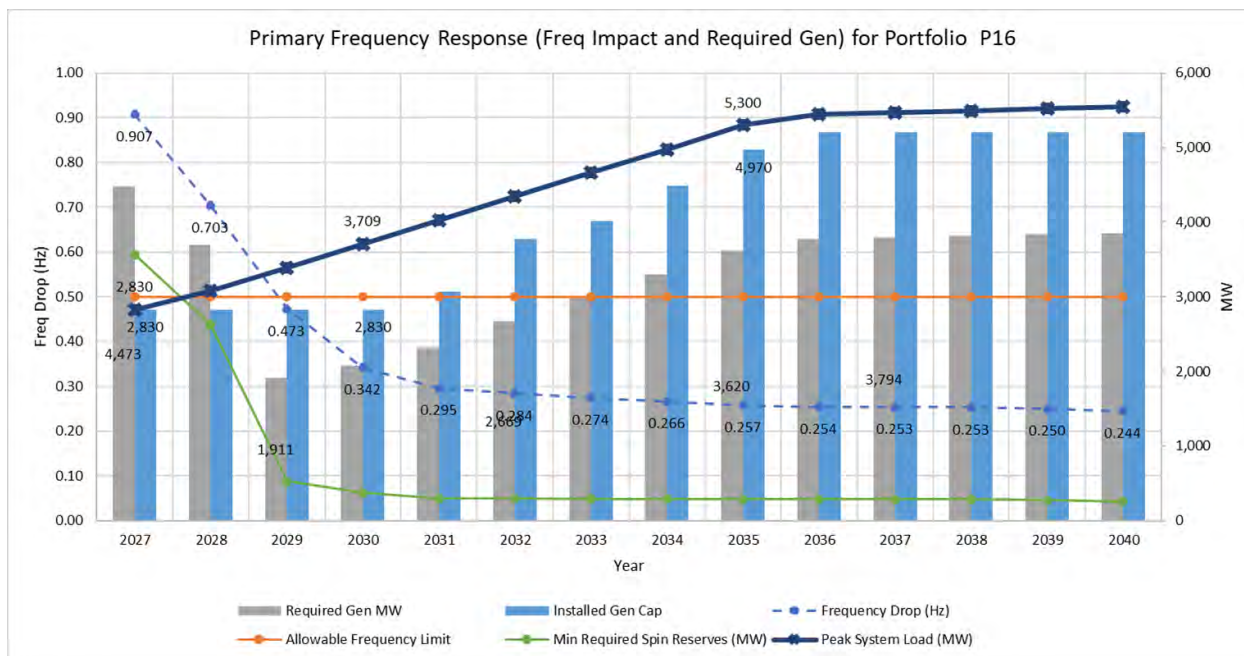


Figure 36. PFR for Portfolio P16 for AES IPL operating in the emergency Island operation mode

From the figure, it can be observed that Portfolio 16 exhibits a similar behavior to Portfolios 4 and 8. The system's frequency response becomes sufficient to maintain the frequency nadir above 59.5 Hz—thus preventing UFLS activation—only after 2029.

The Primary Frequency Response for all the Portfolios are presented in Appendix A.

5.3.4 Resource deficits for Islanded emergency condition

The Table 13 presents the additional energy storage capacity required to address the Primary Frequency Response (PFR) resource deficit across all 16 portfolios under islanded emergency operating conditions.



Table 13. Additional energy storage capacity required to address the PFR - Islanded case

Year	1. REFERENCE CASE				3. HIGH REGULATORY: ENVIRONMENTAL				2. GAS INFRASTRUCTURE CHALLENGES				4. STABLE MARKETS			
	No DC	Low DC	Mid DC	High DC	No DC	Low DC	Mid DC	High DC	No DC	Low DC	Mid DC	High DC	No DC	Low DC	Mid DC	High DC
	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10	P11	P12	P13	P14	P15	P16
2027	111	189	111	355	0	71	235	679	0	111	360	355	0	111	111	470
2028	88	0	37	7	0	2	61	411	0	82	186	47	0	63	0	303
2029	85	0	0	0	0	0	0	9	0	8	0	0	0	48	0	0
2030	82	0	0	0	0	0	0	0	0	0	0	0	0	33	0	0
2031	79	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2032	47	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2033	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2034	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2035	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2036	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2037	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2038	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2039	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2040	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Under islanded emergency conditions, a Primary Frequency Response deficit may arise. The table outlines the additional storage capacity needed to address this shortfall. These issues are most prominent between 2027 and 2032, with the worst-case scenario occurring in Portfolio 8.

The Table 13 presents the additional synchronous generation capacity required to address the Primary Frequency Response (PFR) resource deficit across all 16 portfolios under islanded emergency operating conditions.

Table 14. Additional synchronous generation capacity required to address the PFR - Islanded case

Year	1. REFERENCE CASE				3. HIGH REGULATORY: ENVIRONMENTAL				2. GAS INFRASTRUCTURE CHALLENGES				4. STABLE MARKETS			
	No DC	Low DC	Mid DC	High DC	No DC	Low DC	Mid DC	High DC	No DC	Low DC	Mid DC	High DC	No DC	Low DC	Mid DC	High DC
	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10	P11	P12	P13	P14	P15	P16
2027	111	189	111	355	0	71	235	679	0	111	360	355	0	111	111	470
2028	88	0	37	7	0	2	61	411	0	82	186	47	0	63	0	303
2029	85	0	0	0	0	0	0	9	0	8	0	0	0	48	0	0
2030	82	0	0	0	0	0	0	0	0	0	0	0	0	33	0	0
2031	79	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2032	47	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2033	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2034	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2035	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2036	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2037	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2038	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2039	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2040	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

The table summarizes the additional synchronous generation resources needed to mitigate this Primary Frequency Response shortfall. These issues are most pronounced in 2027 and 2028, with the worst-case scenario occurring in Portfolio 8.

The Table 13 presents the additional secondary frequency regulation capacity required to address the Primary Frequency Response (PFR) resource deficit across all 16 portfolios under islanded emergency operating conditions.



Table 15. Additional energy storage capacity required to address the PFR - Islanded case

Year	1. REFERENCE CASE				3. HIGH REGULATORY: ENVIRONMENTAL				2. GAS INFRASTRUCTURE CHALLENGES				4. STABLE MARKETS			
	No DC	Low DC	Mid DC	High DC	No DC	Low DC	Mid DC	High DC	No DC	Low DC	Mid DC	High DC	No DC	Low DC	Mid DC	High DC
	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10	P11	P12	P13	P14	P15	P16
2027	111	189	111	355	0	71	235	679	0	111	360	355	0	111	111	470
2028	88	0	37	7	0	2	61	411	0	82	186	47	0	63	0	303
2029	85	0	0	0	0	0	0	9	0	8	0	0	0	48	0	0
2030	82	0	0	0	0	0	0	0	0	0	0	0	0	33	0	0
2031	79	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2032	47	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2033	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2034	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2035	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2036	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2037	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2038	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2039	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2040	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

To enhance system stability, additional Secondary Frequency Regulation resources are required, as summarized in the following table. The highest requirements occur under the High Regulatory: Environmental portfolio scenario.

5.4 Conclusions from Frequency Response Metrics

To evaluate system resilience, all portfolios were simulated under a sudden generation loss of 525 MW to assess their primary frequency response under both interconnected and islanded modes.

From the inertial and primary frequency response point of view, it could be concluded that:

Under normal interconnected conditions, all portfolios maintained acceptable frequency behavior through 2040, with no violations of primary frequency response criteria. This stability is largely supported by the repowering of retired coal plants with new synchronous generation, which increases system inertia and creates headroom for remaining units to respond effectively.

Resource deficits for Islanded emergency conditions. Under islanded emergency conditions, all portfolios exhibited frequency nadir drops exceeding 0.5 Hz for multiple years, indicating deficient primary frequency response and the potential activation of Under Frequency Load Shedding (UFLS) schemes.

It can be observed that during 2027 and 2028, the system experiences frequency drops exceeding the allowable limit of 0.5 Hz—for example, in 2027, the frequency decline reaches 0.804 Hz, surpassing the Underfrequency Load Shedding (UFLS) threshold and placing portions of the load at risk of disconnection.

A similar trend is observed across Portfolios 4, 8, and 16, where the system's frequency response remains inadequate in the early years. The frequency nadir only stabilizes above 59.5 Hz, thereby preventing UFLS activation, after 2029 for Portfolios 4 and 16 and after 2030 for Portfolio 8.

Under islanded emergency conditions, the system may experience a Primary Frequency Response (PFR) deficit requiring additional resources to maintain frequency stability. Summarizing the supplemental capacity needed to address these shortfalls across storage, synchronous generation, and secondary regulation, could be concluded that:

- The largest storage and generation requirements occur between 2027 and 2032, with the worst-case scenario observed in Portfolio 8.



- To further enhance system resilience, additional Secondary Frequency Regulation resources are also required, with the highest needs identified under the High Regulatory: Environmental portfolio scenario.



6 Short Circuit Strength

6.1 Approach: Short Circuit Strength Study

“System strength” denotes the ability of the power system to maintain a healthy voltage waveform. During a disturbance, synchronous generators can provide a temporary burst of energy 10 times greater than its nominal rating. In a strong grid (with a highly dense mesh of transmission lines and synchronous generators), the voltage waveform recovers quickly after a disturbance, enhancing grid stability. In a “weak grid,” the impact of a disturbance is exacerbated, leading to potential controller instability and cascading outages” [2]:

- Short Circuit Ratio (SCR) is the ratio of the available system strength (measured in short-circuit MVA) to the MVA rating of the wind or photovoltaic plant.
- Utilities often use SCR as a guideline for integrating IBRs, with a typical requirement of $SCR \geq 5$ for stable integration.
- IBRs rely on an adequate grid strength (relative to the size of the resource) for synchronizing the power electronics.
 - In addition, IBRs do not provide significant levels of fault current [12].
- Low SCR levels raise concerns due to the risk of instability in internal plant controls.
 - Low SCR can lead to sub-synchronous behavior and control interactions among nearby power electronics devices.
 - When plants are located close together, they may interact, potentially causing oscillations. In such cases, the SCR calculation can result in overly optimistic results.
- NERC and CIGRE have published reports that suggest the use of modified measures, such as:
 - General Electric’s composite SCR.
 - ERCOT’s weighted SCR methods.
 - Short Circuit Ratio with Interaction Factors (SCRIF), also called the “Effective SCR” [13] (ESCR) for the assessment of integration risk of close-by IBRs.
- Temporal network changes such as transmission and generation maintenance outages may weaken the interconnection point SCR and thus should be studied.
- Using Quanta Technology’s analysis tool, simulations of sample systems show a limit of $ESCR \geq 3.5$ to be appropriate.

6.2 Short Circuit Analysis Tool and Methodology

The short circuit strength study starts with modeling the future resource portfolio within the transmission grid using the RTEP 2030 model.

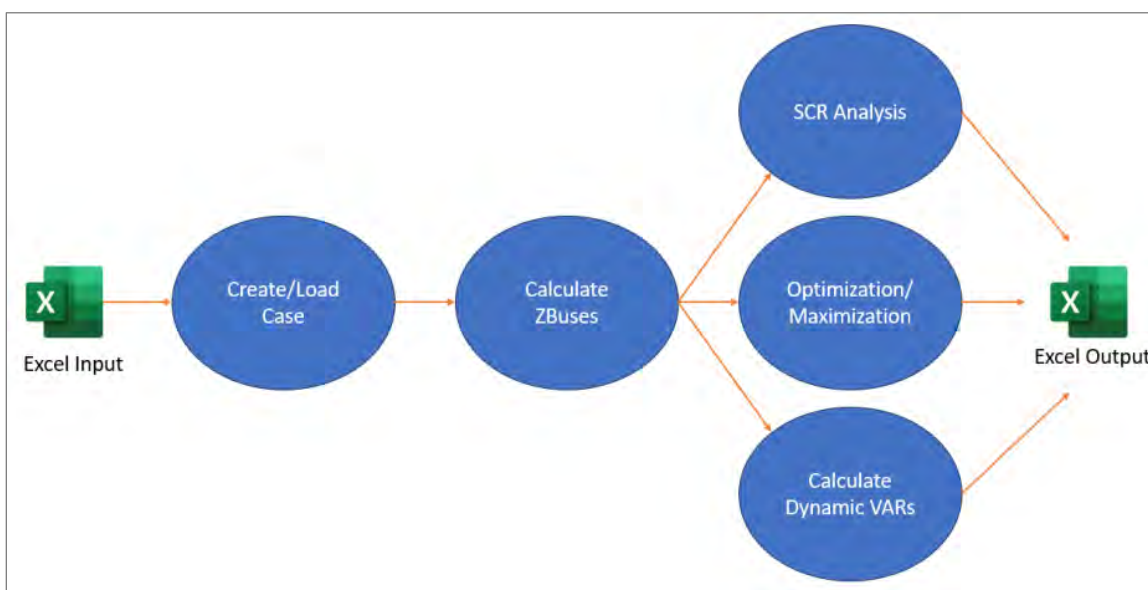


Figure 37. SCR Analysis Tool Workflow

The workflow for the SCR analysis tool is shown in Figure 37. The tool uses a Microsoft Excel file containing a reduced system model (buses, lines, transformers, and generators) as input. This file is created using the PSS/E case. The tool calculates various SCR metrics and exports the results to another Microsoft Excel file for further analysis. The workflow is detailed as follows:

- Creating study cases to store data and results for a chosen system.
- Calculating four specific SCR metrics:
 1. SCR
 2. ESCR
 3. Weighted Short Circuit Ratio (WSCR)
 4. Composite Short Circuit Ratio (CSCR)
- Calculating the Zbus matrix for different generation configurations (Zbus configuration is shown in Figure 38)

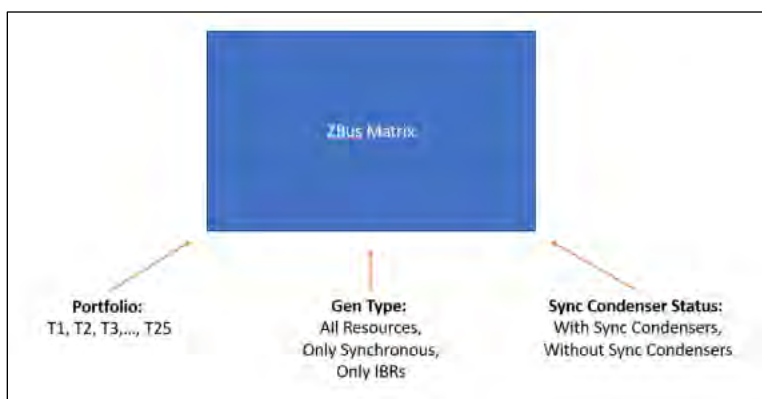


Figure 38. ZBus Data Overview

The ESCR is calculated at each inverter point of interconnection (POI) and compared to an acceptable threshold. ESCR is adopted for this study because it can account for the impact of multiple IBRs in close electrical proximity. It measures the change in voltage at one bus in response to a voltage change at another



bus. Inverter-based resource (IBR) buses that are electrically close will have a **higher Interaction Factor (IF)** compared to those that are farther apart. When multiple IBRs are clustered together, they collectively share the **grid strength and short-circuit capacity**, effectively reducing the actual grid strength below the calculated short-circuit level. **SCRIF** utilizes IBR interaction factors to assess voltage sensitivity and serves as a screening tool for potential control issues by using inverter-based resource interaction factors, as follows [12]:

$$ESCR_i = \frac{S_i}{P_i + \sum_j IF_{ji} * P_j}$$

Where:

$IF_{ji} = \frac{\Delta V_j}{\Delta V_i}$ is the interaction factor between buses i and j and is calculated using z bus.

P_i and P_j are the inverter ratings at buses i and j respectively, while S_i is the minimum short circuit MVA at bus i.

Short Circuit MVA (SCMVA) is a measure of the strength of a bus in a system. The larger SCMVA, the stronger the bus. That indicates the bus is close to large voltage sources, and thus it will take large injections of real or reactive power to change its voltage. SCMVA changes depending on grid configuration and on-line resources.

Optimizing IBR sizes at selected buses to reduce potential instability risks. When the level of IBR penetration exceeds the grid's capability, the ESCR metric will dip below acceptable thresholds. Two acceptable ESCR threshold levels are recommended:

2. 2.0 when the IBR is connected to buses with base voltage levels at or below 2 kV.
- 3.5 when the IBR is connected to voltage levels higher than 2 kV, as they will go through a transformation and thus will ensure the ESCR is similarly set as those without transformation.

The SCR Analysis Tool helps optimize IBR size reduction selectively at existing IBR locations. It does this by using a linear program to minimize the total reduction in IBR size while ensuring that the ESCR remains at or above acceptable thresholds. Additionally, the tool can identify the maximum number of IBRs that can be added across generation sites without breaching ESCR limits.

Mitigation techniques are used to improve the short circuit strength of the system. This is to determine the acceptable mitigations in one of the following forms. When the ESCR threshold is exceeded at a bus or multiple buses, the planner must mitigate the risk by one of several methods, which include but are not limited to the following:

- a) Install synchronous generation

At the time of a fault, synchronous and induction motor convertors will act as current sources and will supply short circuit current to the fault corresponding to the amount of their impedances. In turn improving ESCR ratio and the strength of the network [12].

- b) Install synchronous condensers (SC).

Synchronous condensers play a crucial role in improving short circuit strength in weak grids by providing dynamic reactive power support and enhancing fault ride-through capabilities. Unlike static reactive power compensation devices, SC are rotating machines that can supply or absorb reactive power smoothly and instantaneously. During grid faults, they can provide up to six times their rated reactive power capacity, significantly aiding voltage stability. Furthermore, their inherent rotational inertia contributes to system inertia, helping maintain frequency stability. By strategically



placing SC in weak grid areas, can improve the short circuit ratio (SCR), reduce voltage fluctuations, and ensure stable operation of connected inverter-based resources like wind and solar farms [14].

c) Equip inverters with grid-forming capability.

Grid-forming inverters (GFMs) enhance short circuit strength by operating independently of external voltage references, unlike traditional grid-following inverters. They generate their own voltage waveform and actively regulate system frequency and voltage, making them essential for improving weak grid resilience. GFMs contribute synthetic inertia and support frequency regulation by dynamically adjusting active power output in response to system disturbances. Additionally, their ability to manage fault currents without relying on a strong grid connection allows them to maintain stability in areas with low short circuit strength. When deployed strategically, GFMs help create stronger and more self-sustaining microgrids, reducing dependency on synchronous generators while supporting renewable energy integration [14].

d) Increase transmission investments.

By reconductoring lines, adding circuits, or upgrading transformers improves the short-circuit ratio (SCR) at inverter-based resource connections. Series compensation can enhance system strength by mitigating weak grid issues without requiring new transmission lines. Strengthening the grid reduces voltage instability and enhances fault ride-through capability. These upgrades support reliable inverter operation in weak grid conditions [12].

e) Reduce IBR resource size.

Reducing inverter-based resource (IBR) capacity or output can improve short-circuit ratio (SCR) and mitigate weak grid issues. Lower plant output reduces sensitivity to active and reactive power variations, enhancing grid stability [12].

The calculation of ESCR used the RTEP 2030 model with the following assumptions:

- The POI at each IBR is set to the nearest transmission bus (115 kV–500 kV) to focus only on bulk system issues and not internal plant issues.
- Solar and wind resources are equipped with grid-following inverters (GFL).
- Stand-alone battery storage systems are assumed to have grid-forming inverters and thus excluded from the analysis due to their ability to operate at low ESCR.

6.3 Generation Resource Portfolio for 2035

- Table 16 compares different generation and storage technologies across four portfolios (P5 to P8), each representing a scenario under High Regulatory: Environmental CX conditions with varying levels of data center interconnection.
- Cumulative Resources for 2035 represent the total installed capacity (in MW) of each technology type by the year 2035. This includes all existing and planned resources up to that year.
- Additions for 2035 indicate the new capacity (in MW) that is planned to be added specifically in the year 2035. These values help isolate the impact of recent expansions on grid strength and integration feasibility.
- The portfolio shown in this table High Regulatory: Environmental CX for 2035 was selected for detailed short circuit strength analysis because it includes the largest amount of renewable energy resources, particularly solar PV and wind, as well as significant battery storage additions. This high level of inverter-based resource (IBR) penetration makes it a critical scenario for evaluating grid stability and ESCR compliance under both interconnected and island conditions.



Table 16. Resource additions for 2035

Technology	Cumulative resource for 2035	Additions for 2035	Portfolio
Renewable: Solar PV	535	-	3. High Regulatory: Environmental CX (P5)
Renewable: Wind	1,000	650	
Gas/Oil: Combined Cycle	700	-	
Gas/Oil: Combustion Turbine	460	-	
Gas/Oil: Steam Turbine	1,670	-	
Storage: Battery	450	20	
Renewable: Solar PV	860	316	3. High Regulatory: Environmental Low DC CX (P6)
Renewable: Wind	1,450	1,100	
Gas/Oil: Combined Cycle	700	-	
Gas/Oil: Combustion Turbine	460	-	
Gas/Oil: Steam Turbine	1,670	-	
Storage: Battery	1,110	680	
Renewable: Solar PV	1,560	1,016	3. High Regulatory: Environmental Mid DC CX (P7)
Renewable: Wind	2,850	2,500	
Gas/oil: Combined Cycle	700	-	
Gas/Oil: Combustion Turbine	460	-	
Gas/Oil: Steam Turbine	1,670	-	
storage: Battery	2,170	1,740	
renewable: Solar PV	1,735	1,191	3. High Regulatory: Environmental High DC CX (P8)
Renewable: Wind	2,900	2,550	
Gas/oil: Combined Cycle	700	-	
Gas/oil: Combustion Turbine	940	480	
Gas/oil: Steam Turbine	1,670	-	
storage: Battery	2,810	2,380	



6.4 Resource distribution for portfolio High Regulatory: Environmental

Table 17. Resource distribution of portfolio generation

Technology	Bus Number	Bus Name	2035 (Resources in MW)			
			P5	P6	P7	P8
Solar PV	254812	PETERSBURG 2	0	105	169	198.5
	254813	PETERSBURG 3	0	105	169	198.5
	254814	PETERSBURG 4	0	105	169	198.5
	248450	07WAYNESVL	0	0	169	198.5
	248580	07MARBLE_ST	0	0	169	198.5
	248830	07RAMSY5	0	0	169	198.5
Wind	254812	PETERSBURG 2	217	220	300	350
	254813	PETERSBURG 3	217	220	300	350
	254814	PETERSBURG 4	217	220	300	350
	255100	17BABCOCK	0	100	267	250
	255101	17BURR_OAK	0	100	267	250
	255105	17HIPL	0	100	267	250
	255113	17STILLWELL	0	100	267	250
	255114	17TOWER_ROAD	0	40	267	250
CC/CT/ST	255215	17HINSHAW	0	0	267	250
	254827	16EVCT1	0	0	0	160
	254828	16EVCT2	0	0	0	160
Battery	254829	16EVST1	0	0	0	160
	249508	08DRESSR	0	85	217.5	297.5
	249529	08WHITST	0	85	217.5	297.5
	249539	08T_H_BOLTON	0	85	217.5	297.5
	254521	16FRANCS	0	85	217.5	297.5
	254523	16GUION	0	85	217.5	297.5
	254524	16HANNA	20	85	217.5	297.5
	254535	16SUNNYS	0	85	217.5	297.5
	254537	16THOMPS	0	85	217.5	297.5

Table 17 presents the bus-level distribution of various energy resources—Solar PV, Wind, Gas/Oil (CC/CT/ST), and Battery Storage—under the High Regulatory: Environmental portfolio for the year 2035. It shows how these resources are allocated across different grid locations (buses) and how their capacities vary across four sub-portfolios: P5, P6, P7, and P8, each representing increasing levels of data center interconnection. The locations listed in the table were suggested by AES IPL. Locations of future resources are not known at this time, so proxies were chosen.

6.5 Findings: Short Circuit Strength Study

In this analysis the study has been performed for year 2035 in both interconnected and islanded system, to improve short circuit strength the SCR Analysis Tool helps optimize IBR size reduction selectively at existing IBR locations. It does this by using a linear program to minimize the total reduction in IBR size while ensuring that the ESCR remains at or above acceptable thresholds. Also, adds SC at most impacted locations.



6.5.1 Short-Circuit Analysis Results with Interconnected system

Table 18. Short circuit results: Interconnected system

External areas connected to system						
	Portfolio	IBR MWs	MW Pass	MW Fail	MW Opt.	Pass %
P5	High Regulatory: Environmental CX No DC CX	1,593	1,593	0	1,593	100.0%
P6	High Regulatory: Environmental CX Low DC CX	2,359	2,359	0	2,359	100.0%
P7	High Regulatory: Environmental CX Mid DC CX	4,459	4,459	0	4,459	100.0%
P8	High Regulatory: Environmental CX High DC CX	4,684	4,684	0	4,684	100.0%

- Table 18 presents the results of short circuit strength screening for four resource portfolios P5 through P8 under the condition that the power system is interconnected with external areas. This interconnected scenario assumes that the grid can rely on neighboring systems for support, which significantly enhances its ability to maintain voltage stability and absorb inverter-based resources (IBRs) such as solar PV, wind, and battery storage. Each portfolio represents a different level of renewable energy penetration and DC interconnection complexity, ranging from no DC connections (P5) to high DC complexity (P8), all within a high regulatory and environmental compliance framework.
- The column "IBR MWs" indicates the total capacity of inverter-based resources proposed for integration in each portfolio. The "MW Pass" column shows the amount of IBR capacity that successfully meets the Effective Short Circuit Ratio (ESCR) threshold, which is a key metric for grid stability. Notably, all portfolios show a 100% pass rate, meaning that every megawatt of IBR proposed was deemed acceptable for integration. The "MW Fail" column is zero across all portfolios, confirming that no part of the proposed capacity was rejected due to short circuit strength limitations. The "MW Opt." column reflects the optimized IBR capacity that can be integrated after applying system-level optimization techniques, and in this case, it matches the total IBR capacity, indicating no need for size reduction or mitigation.
- This outcome demonstrates that when the system is interconnected with external areas, it possesses sufficient short circuit strength to support even the most aggressive renewable portfolios, including P8, which has the highest IBR capacity at 4,684 MW. The 100% pass rate across all portfolios underscores the critical role of regional grid interconnections in enabling large-scale renewable integration without compromising system stability.
- Systems with a higher proportion of synchronous generation exhibit a greater IBR pass percentage due to their contribution to short-circuit strength. Synchronous generators enhance short-circuit strength by injecting high fault currents (5–10 times their rated current) and providing inherent voltage support through reactive power, reducing system impedance and improving fault ride-through capability [15].



6.5.2 Short-Circuit Analysis Results with Islanded system

Table 19. Short Circuit Results: Islanded system

Islanded system						
	Portfolio	IBR MWs	MW Pass	MW Fail	MW Opt.	Pass %
P5	High Regulatory: Environmental CX No DC CX	1,593	1,593	0	1,593	100.0%
P6	High Regulatory: Environmental CX Low DC CX	2,359	2,359	0	2,359	100.0%
P7	High Regulatory: Environmental CX Mid DC CX	4,459	1,687	2,772	3,129	70.2%
P8	High Regulatory: Environmental CX High DC CX	4,684	1,845	2,839	3,169	67.6%

Table 19 presents the results of short circuit strength screening for four resource portfolios P5 through P8 under the condition that the power system is operating in isolation, without support from external grid connections. This scenario is critical because it tests the grid's internal ability to maintain voltage stability and absorb inverter-based resources (IBRs), such as solar PV, wind, and battery storage, without relying on neighboring systems. Each portfolio represents a different level of renewable energy penetration and DC interconnection complexity, ranging from no DC connections (P5) to high DC complexity (P8), all within a high regulatory and environmental compliance framework.

The column "IBR MWs" indicates the total capacity of inverter-based resources proposed for integration in each portfolio. The "MW Pass" column shows the amount of IBR capacity that successfully meets the Effective Short Circuit Ratio (ESCR) threshold, which is a key metric for grid stability. The "MW Fail" column reflects the portion of IBR capacity that does not meet the ESCR criteria and would require mitigation before integration. The "MW Opt." column represents the optimized IBR capacity that can be integrated after applying system-level optimization techniques to reduce instability risks. Finally, the "Pass %" column shows the percentage of IBR capacity that passes the screening, highlighting the grid's ability to support renewables in an islanded configuration.

Portfolios P5 and P6 show a 100% pass rate, indicating that the grid can fully support their respective IBR capacities even in isolation. These portfolios have lower renewable penetration. In contrast, P7 and P8 portfolios, which have significantly higher IBR capacities, face substantial limitations. P7 has a pass rate of 70.2%, with 2,772 MW failing the ESCR screening, while P8 has a pass rate of 67.6%, with 2,839 MW failing. These results demonstrate that higher levels of renewable integration place greater stress on the grid's short circuit strength when operating independently. Optimization techniques can improve integration feasibility, but mitigation measures such as installing synchronous condensers, grid-forming inverters, or enhancing transmission infrastructure may be necessary to support full IBR deployment in these scenarios.

6.5.3 Short Circuit Analysis Conclusion

- **Interconnected System Scenario**

All four portfolios- P5 to P8 achieved 100% IBR integration success when the system is interconnected with external areas. This outcome confirms that the grid, when supported by neighboring systems, maintains sufficient short circuit strength to accommodate the full scale of planned IBR additions.



- **Islanded System Scenario**

- P5 (No DC CX) and P6 (Low DC CX) portfolios successfully integrated 100% of their IBR capacities, indicating that these configurations are well within acceptable ESCR thresholds even without external support.
- P7 (Mid DC CX) and P8 (High DC CX) portfolios faced significant limitations, with only 70.2% and 67.6% of their IBR capacities passing the ESCR criteria, respectively. Notably, P7 has a lower total IBR capacity (4,459 MW) compared to P8 (4,684 MW),
- This shows that higher levels of IBR penetration place greater stress on the grid's short circuit strength, since IBRs contribute little to short circuit currents, limiting the grid's ability to support large IBR capacities under isolated conditions



7 Conclusions

7.1 Import / Export transmission limit calculation

Between 2027 and 2035, the transmission network interconnecting AES IPL with neighboring systems undergoes significant reinforcement, with the number of tie lines increasing from 18 to 39. Application of the MISO contingency package enables determination of the maximum power transfer levels that can be scheduled into the IPL system under various operating conditions.

As a result of these network enhancements and resource integrations, AES IPL's import capability increases markedly—from 578 MW in 2027 to 2,193 MW in 2030, reaching 2,503 MW by 2035, considering potential transfers from all MISO areas. This steady growth reflects progressive improvements in transmission capacity and system reliability.

Despite this substantial improvement in import capability, export potential remains extremely limited. Rising internal demand—driven primarily by the addition of large loads such as data centers, including those of the Wabash Valley Power Alliance (WVPA)—consumes most available local generation. Even with 4,630 MW of dispatchable capacity, AES IPL operates close to its internal supply-demand balance, leaving little to no headroom for power exports.

Simulation results indicate that reducing internal load could create limited opportunities to export power to neighboring areas; however, such conditions are not typical under current or projected load scenarios. This trend underscores the growing importance of carefully managing local generation, demand growth, and transmission constraints in planning future resource integration and interconnection strategies to maintain system flexibility and reliability.

7.2 Energy Adequacy Resulting Metrics

If the AES Indiana (IPL) area maintains full tie-line availability and is able to import 100% or at least 50% of its transmission capacity from neighboring systems, Energy Adequacy metrics indicate no reliability concerns through 2035, even under 90/10 high load forecast assumptions.

However, when import capability is reduced to 0%, the system shows a clear dependency on external energy support. Under these isolated conditions, neither energy adequacy nor Planning Reserve Margin (PRM) targets are met, emphasizing the critical importance of regional interconnections for maintaining system reliability and long-term adequacy.

Key findings include:

- With 0% imports, energy shortfalls occur in portfolios 3, 4, 7, 8, 15, and 16, with portfolio 8 in 2035 representing the most critical deficiency.
- Under the same conditions, nearly all portfolios fail to meet PRM requirements for 2030 and 2035, with the most severe violations in portfolios 7 and 8 (2035).

These results highlight the essential role of regional transmission infrastructure in supporting AES IPL's ability to meet growing demand, particularly during high-stress periods or aggressive load expansion.

To maintain long-term reliability, the following actions are recommended:

- Preserve import flexibility by maintaining robust interconnection capability.



- Continue investment in transmission upgrades to enable regional energy exchange.
- Pursue strategic coordination with neighboring systems and MISO to ensure resource adequacy under both normal and constrained scenarios.

7.3 Conclusions from Frequency Response Metrics

To evaluate system resilience, all portfolios were simulated under a sudden generation loss of 525 MW to assess their primary frequency response under both interconnected and islanded modes.

From the inertial and primary frequency response point of view, it could be concluded that:

Under normal interconnected conditions, all portfolios maintained acceptable frequency behavior through 2040, with no violations of primary frequency response criteria. This stability is largely supported by the repowering of retired coal plants with new synchronous generation, which increases system inertia and creates headroom for remaining units to respond effectively.

Resource deficits for Islanded emergency conditions. Under islanded emergency conditions, all portfolios exhibited frequency nadir drops exceeding 0.5 Hz for multiple years, indicating deficient primary frequency response and the potential activation of Under Frequency Load Shedding (UFLS) schemes.

It can be observed that during 2027 and 2028, the system experiences frequency drops exceeding the allowable limit of 0.5 Hz—for example, in 2027, the frequency decline reaches 0.804 Hz, surpassing the Underfrequency Load Shedding (UFLS) threshold and placing portions of the load at risk of disconnection.

A similar trend is observed across Portfolios 4, 8, and 16, where the system's frequency response remains inadequate in the early years. The frequency nadir only stabilizes above 59.5 Hz, thereby preventing UFLS activation, after 2029 for Portfolios 4 and 16 and after 2030 for Portfolio 8.

Under islanded emergency conditions, the system may experience a Primary Frequency Response (PFR) deficit requiring additional resources to maintain frequency stability. Summarizing the supplemental capacity needed to address these shortfalls across storage, synchronous generation, and secondary regulation, could be concluded that:

- The largest storage and generation requirements occur between 2027 and 2032, with the worst-case scenario observed in Portfolio 8.
- To further enhance system resilience, additional Secondary Frequency Regulation resources are also required, with the highest needs identified under the High Regulatory: Environmental portfolio scenario.

7.3.1 Short Circuit Analysis Conclusion

- **Interconnected System Scenario**

All four portfolios- P5 to P8 achieved 100% IBR integration success when the system is interconnected with external areas. This outcome confirms that the grid, when supported by neighboring systems, maintains sufficient short circuit strength to accommodate the full scale of planned IBR additions.

- **Islanded System Scenario**

- P5 (No DC CX) and P6 (Low DC CX) portfolios successfully integrated 100% of their IBR capacities, indicating that these configurations are well within acceptable ESCR thresholds even without external support.



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- This shows that higher levels of IBR penetration place greater stress on the grid's short circuit strength, since IBRs contribute little to short circuit currents, limiting the grid's ability to support large IBR capacities under isolated conditions



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[04/System%20Rate%20of%20Change%20of%20Frequency%20-](https://www.aemc.gov.au/sites/default/files/2023-04/System%20Rate%20of%20Change%20of%20Frequency%20-%20A%20GHD%20survey%20of%20international%20views_revised.pdf)
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Appendix A: Additional Portfolio Results

8.1 Synchronous Generation and Requirements and Expected RoCoF and Online Inertia Requirements

The Synchronous Generation Requirements and Expected RoCoF and Online Inertia Requirements for the 16 Portfolios are presented next:



Figure 39. Synchronous Generation Requirements and Expected RoCoF and Online Inertia Requirements for Portfolio 1



Figure 40. Synchronous Generation Requirements and Expected RoCoF and Online Inertia Requirements for Portfolio 2



Figure 41. Synchronous Generation Requirements and Expected RoCoF and Online Inertia Requirements for Portfolio 3

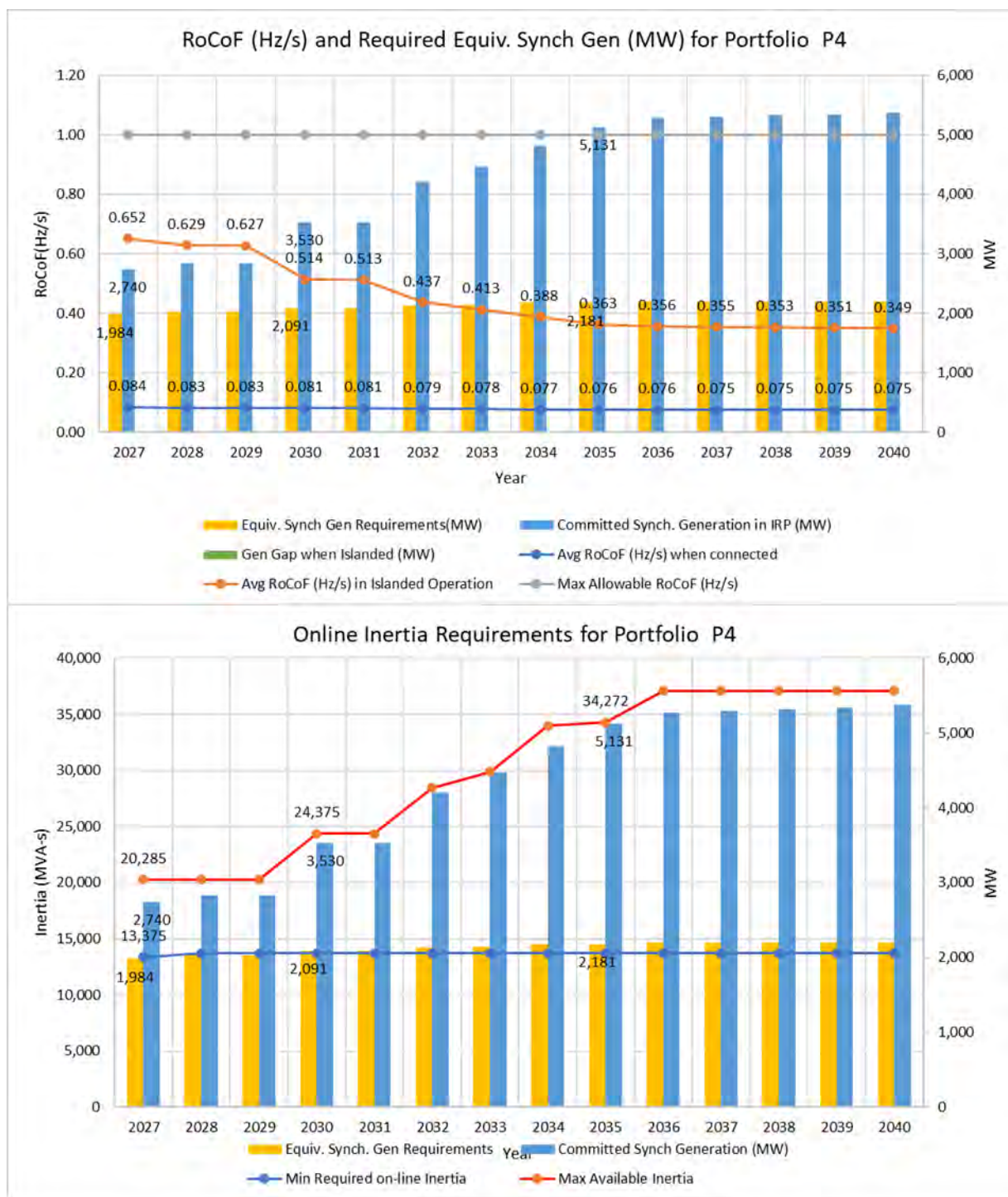


Figure 42. Synchronous Generation Requirements and Expected RoCoF and Online Inertia Requirements for Portfolio 4



Figure 43. Synchronous Generation Requirements and Expected RoCoF and Online Inertia Requirements for Portfolio 5

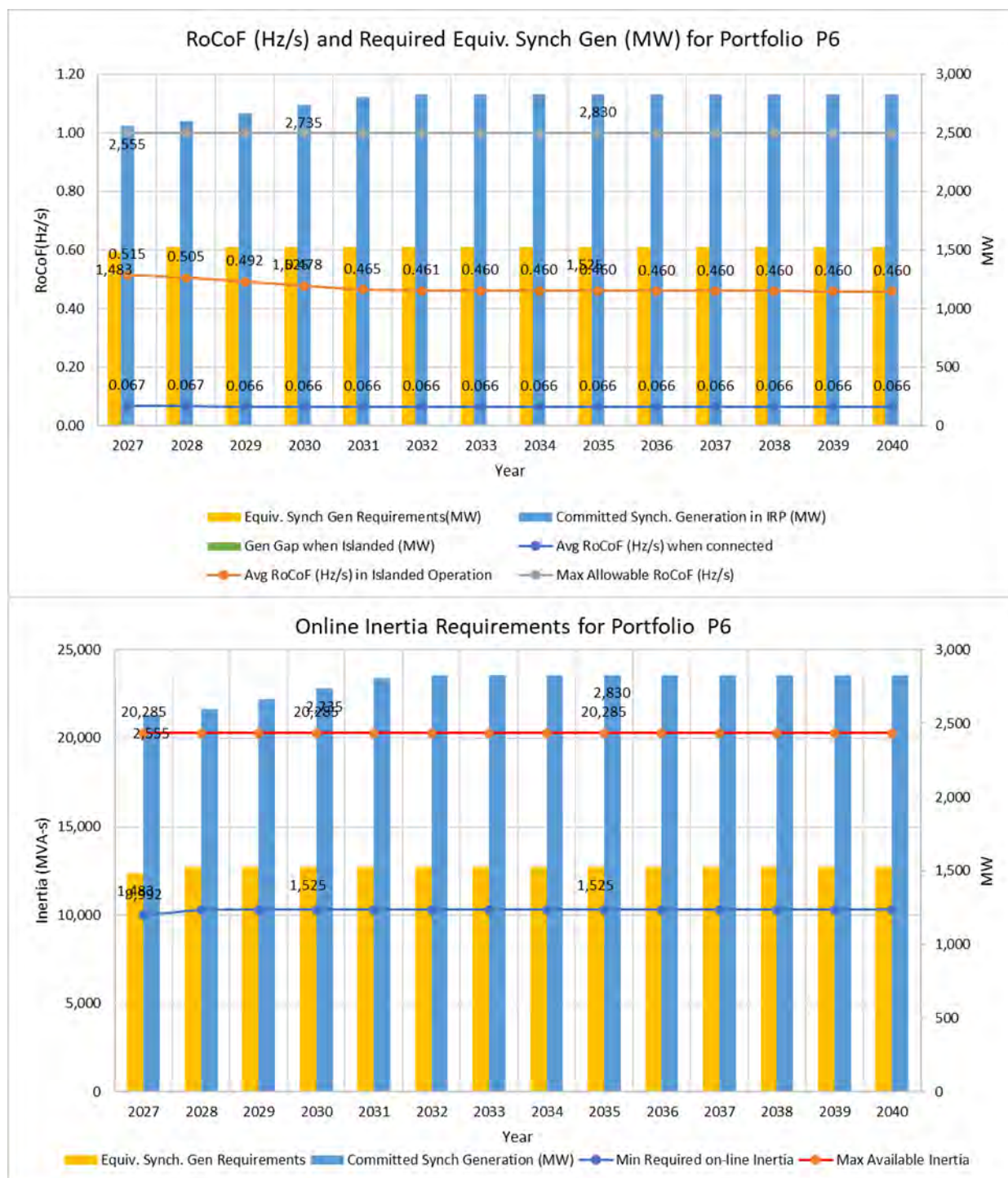


Figure 44. Synchronous Generation Requirements and Expected RoCoF and Online Inertia Requirements for Portfolio 6

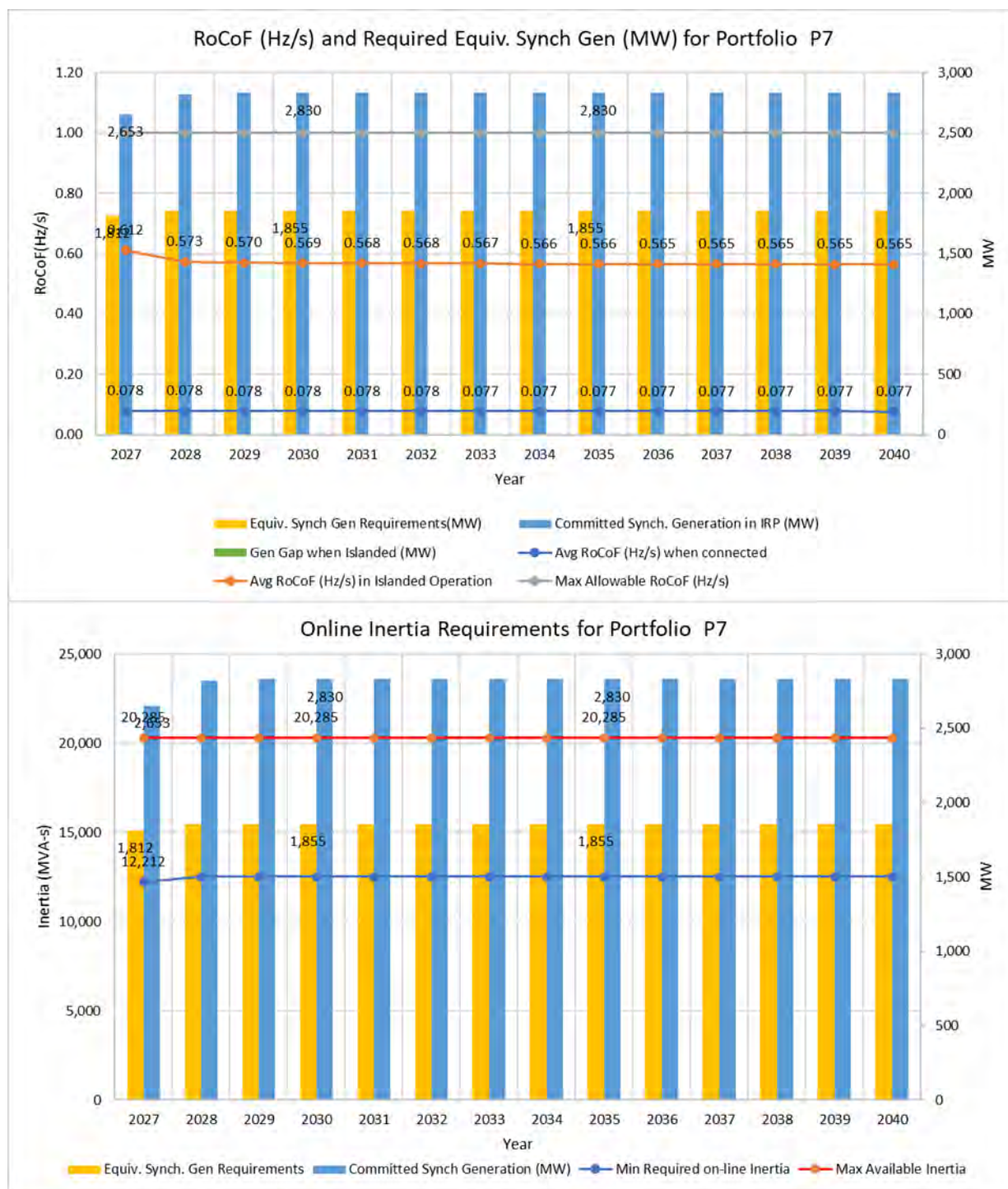


Figure 45. Synchronous Generation Requirements and Expected RoCoF and Online Inertia Requirements for Portfolio 7

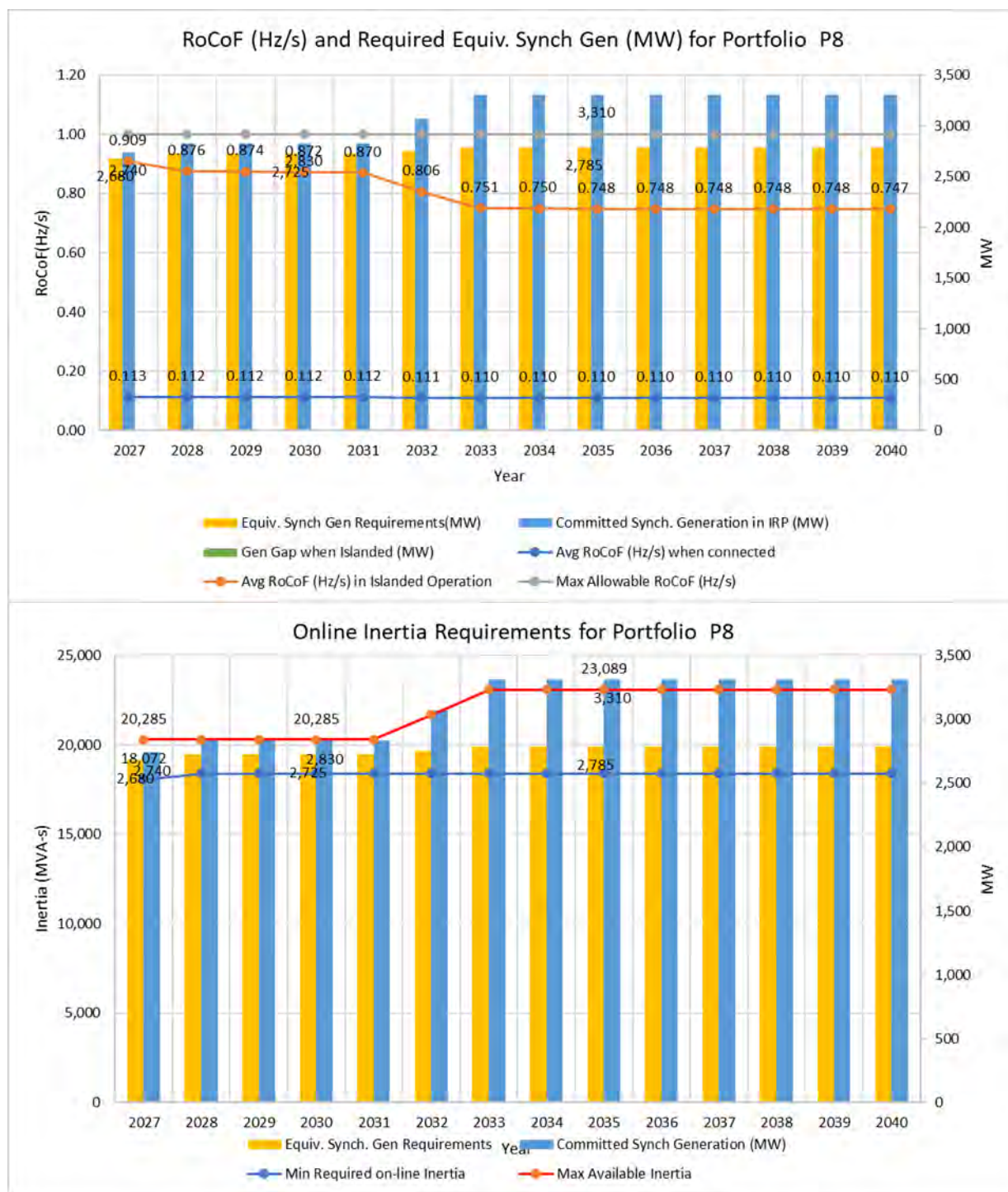


Figure 46. Synchronous Generation Requirements and Expected RoCoF and Online Inertia Requirements for Portfolio 8



Figure 47. Synchronous Generation Requirements and Expected RoCoF and Online Inertia Requirements for Portfolio 9

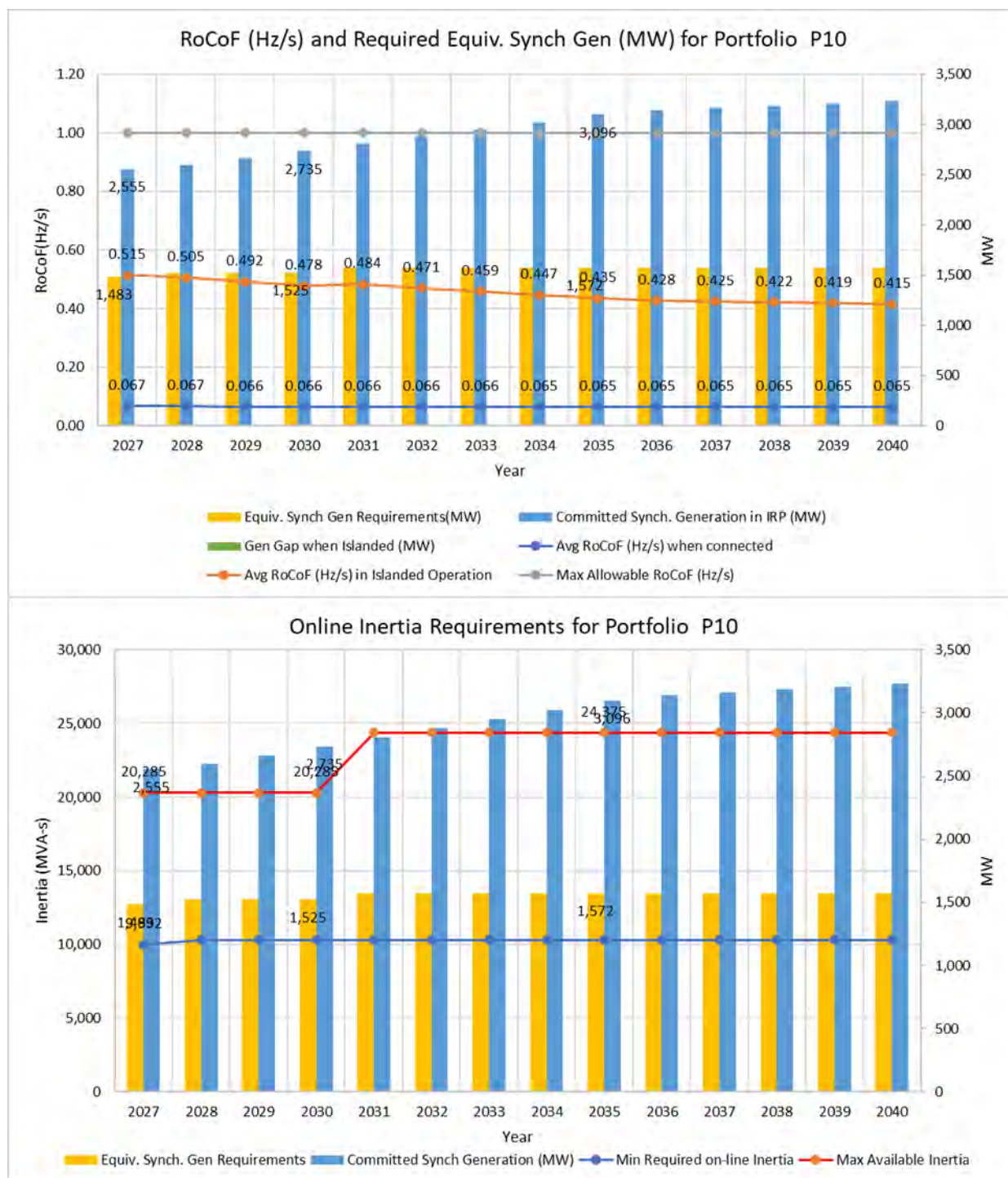


Figure 48. Synchronous Generation Requirements and Expected RoCoF and Online Inertia Requirements for Portfolio 10



Figure 49. Synchronous Generation Requirements and Expected RoCoF and Online Inertia Requirements for Portfolio 11

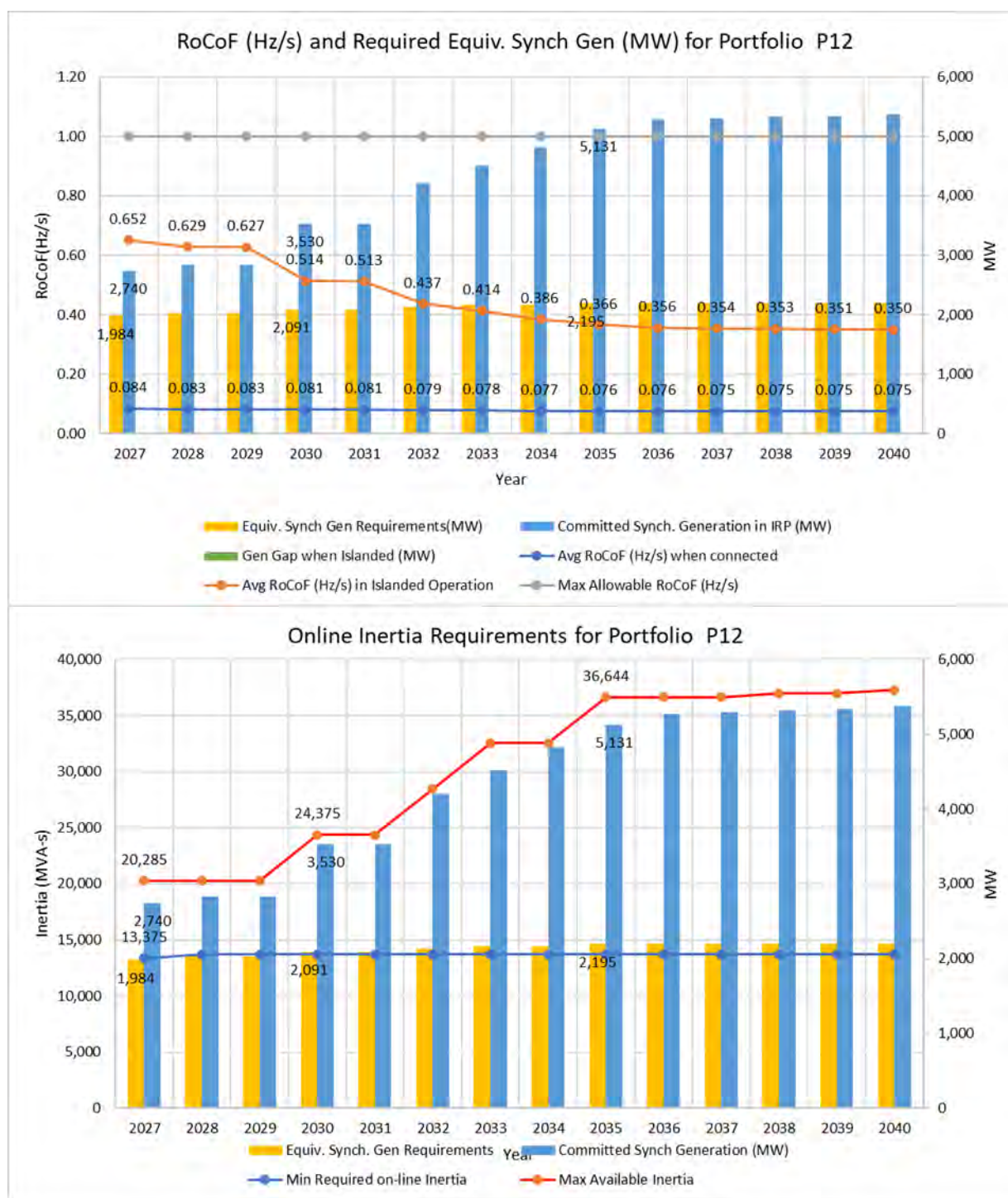


Figure 50. Synchronous Generation Requirements and Expected RoCoF and Online Inertia Requirements for Portfolio 12



Figure 51. Synchronous Generation Requirements and Expected RoCoF and Online Inertia Requirements for Portfolio 13



Figure 52. Synchronous Generation Requirements and Expected RoCoF and Online Inertia Requirements for Portfolio 14

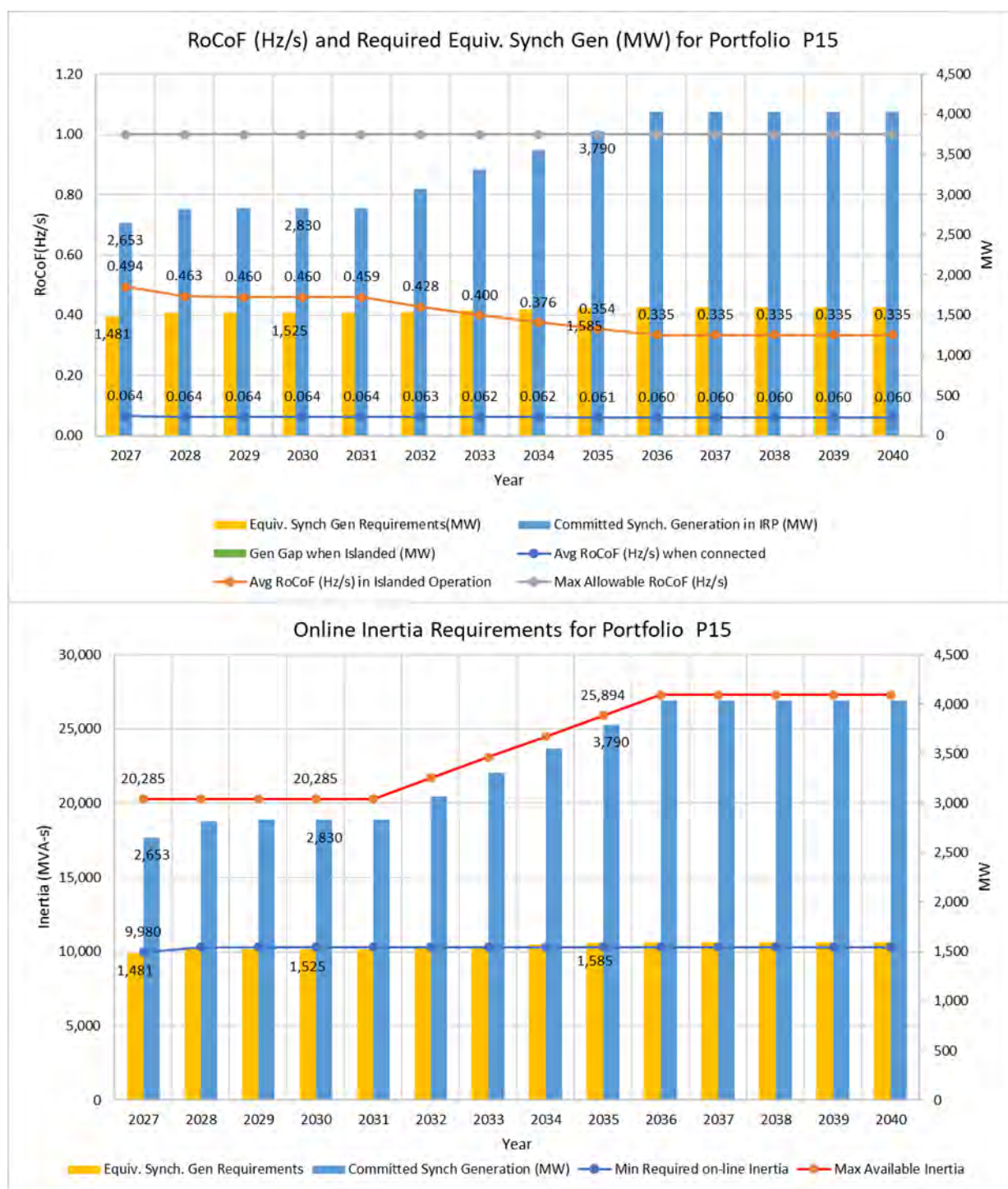


Figure 53. Synchronous Generation Requirements and Expected RoCoF and Online Inertia Requirements for Portfolio 15

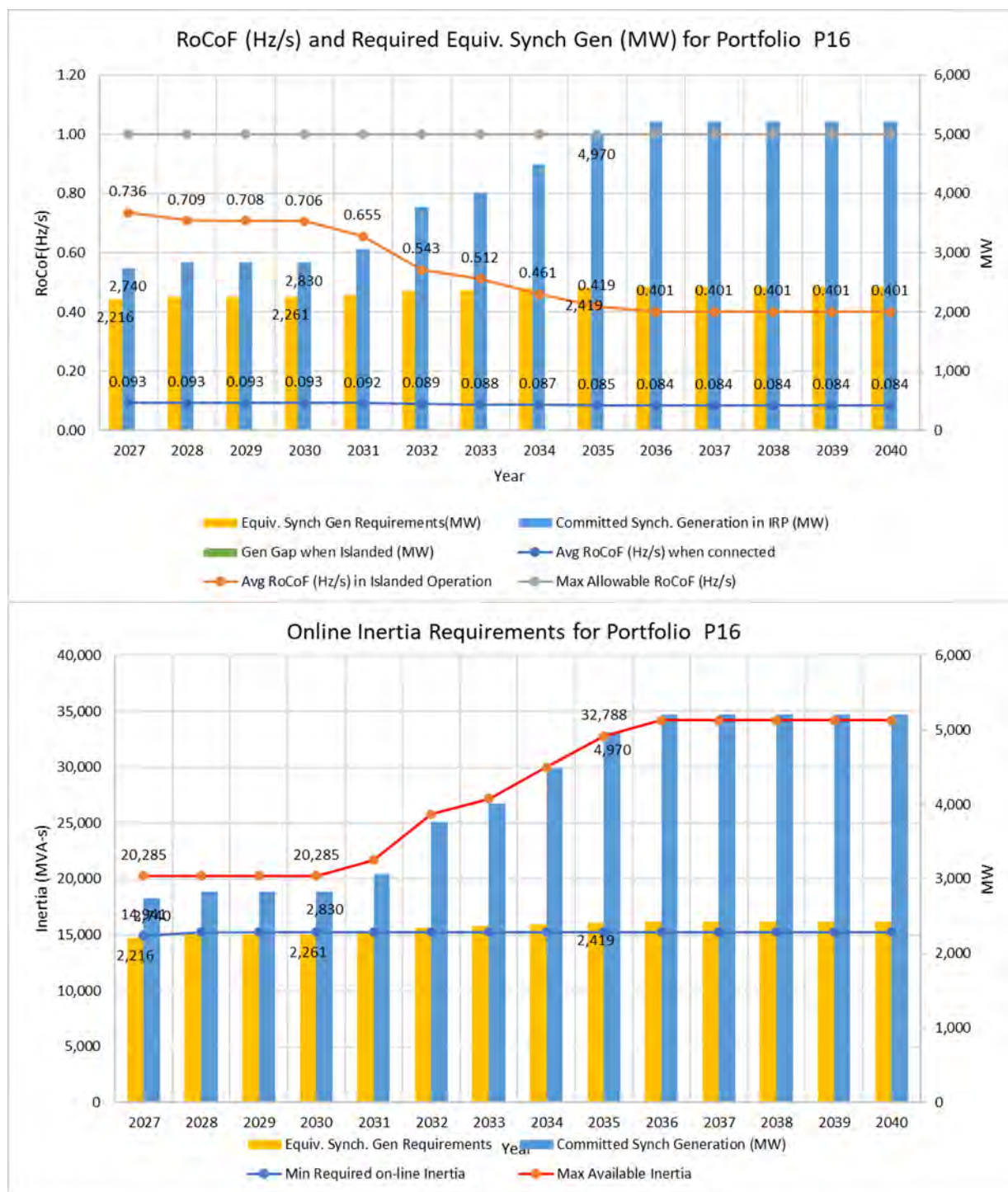


Figure 54. Synchronous Generation Requirements and Expected RoCoF and Online Inertia Requirements for Portfolio 16



8.2 Primary frequency response for Interconnected and Islanded case

The Primary frequency response for Interconnected and Islanded cases for the 16 Portfolios are presented next:

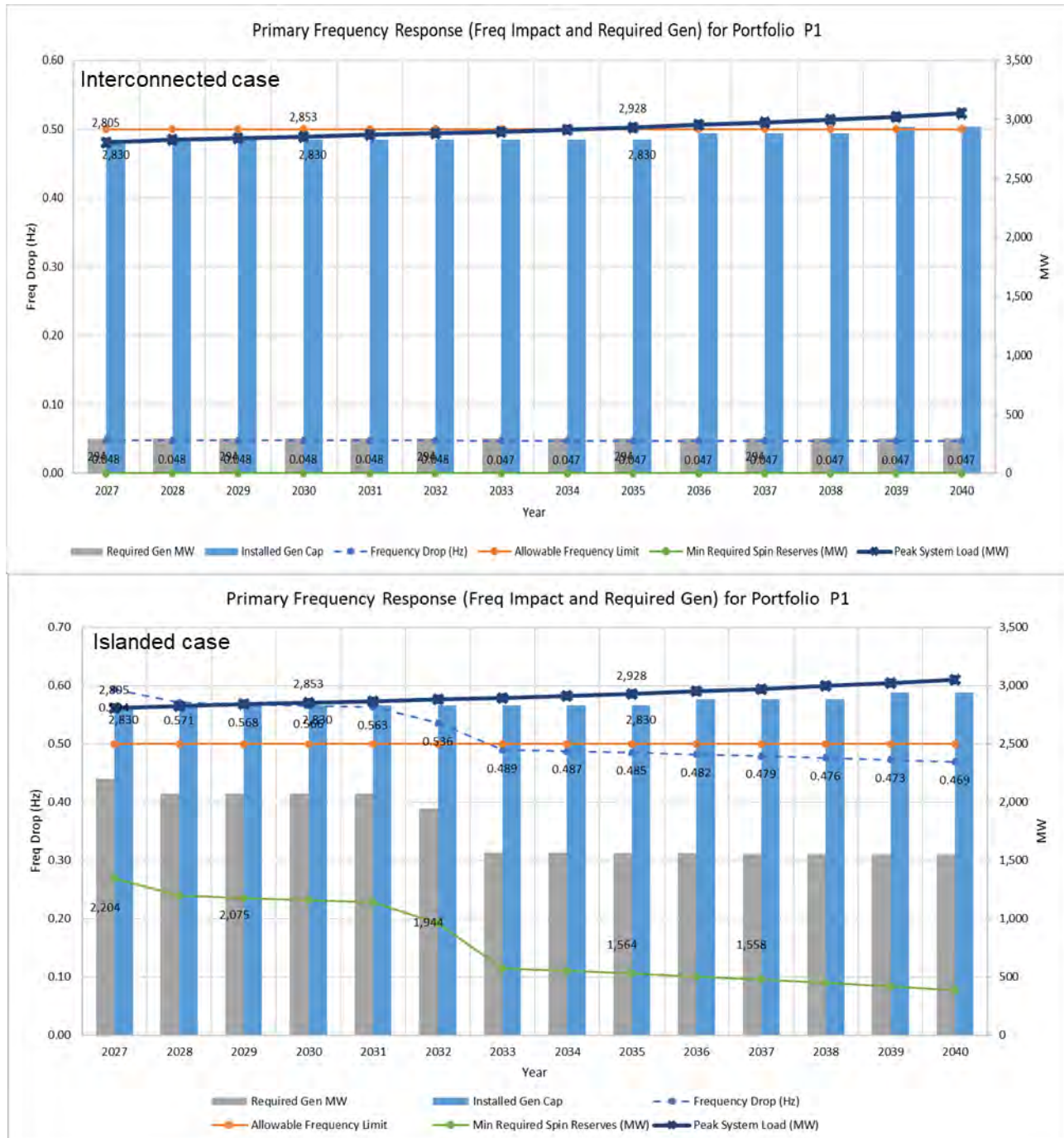


Figure 55. Primary frequency response for Interconnected and Islanded case for portfolio P1



Figure 56. Primary frequency response for Interconnected and Islanded case for portfolio P2

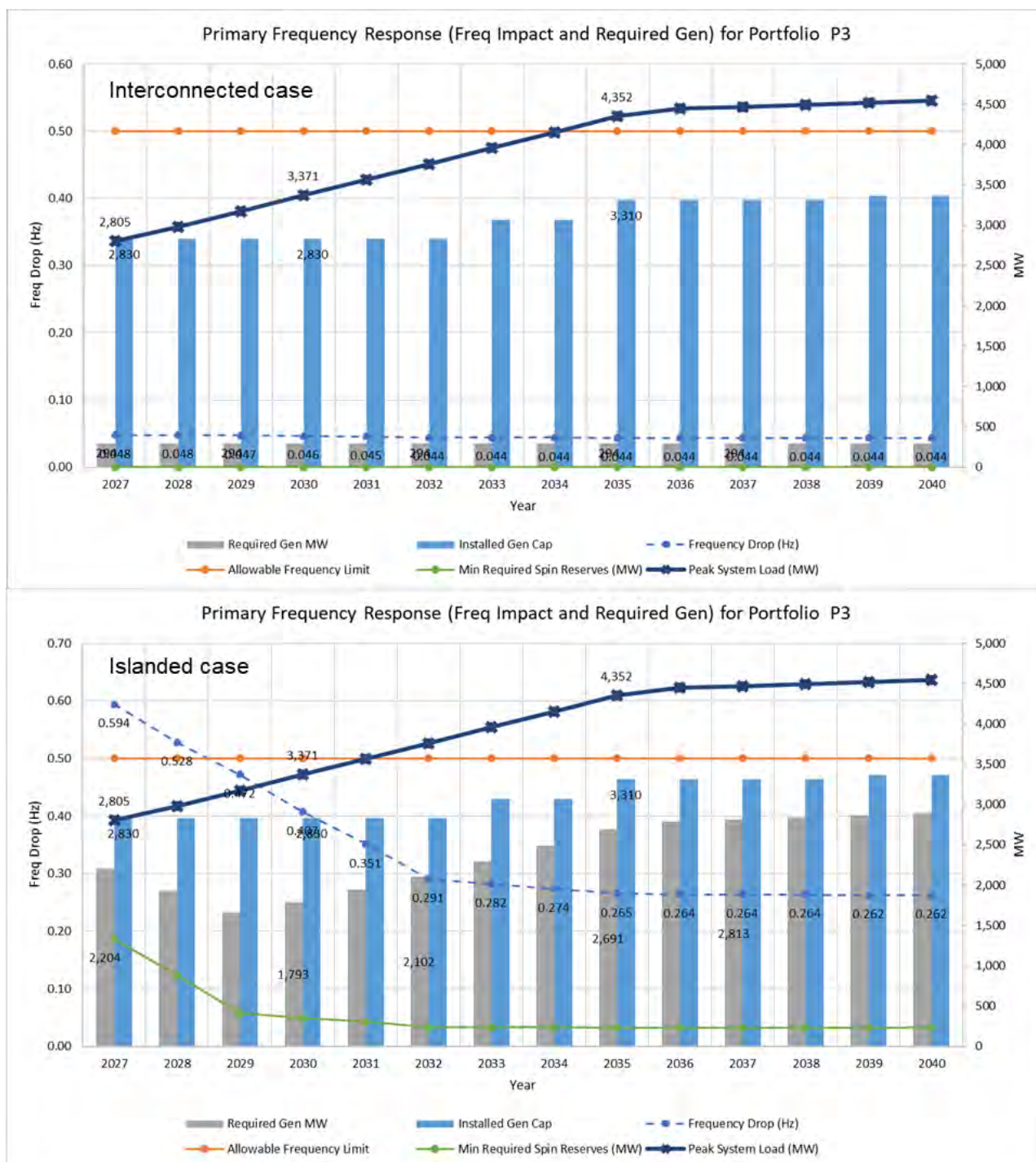


Figure 57. Primary frequency response for Interconnected and Islanded case for portfolio P3

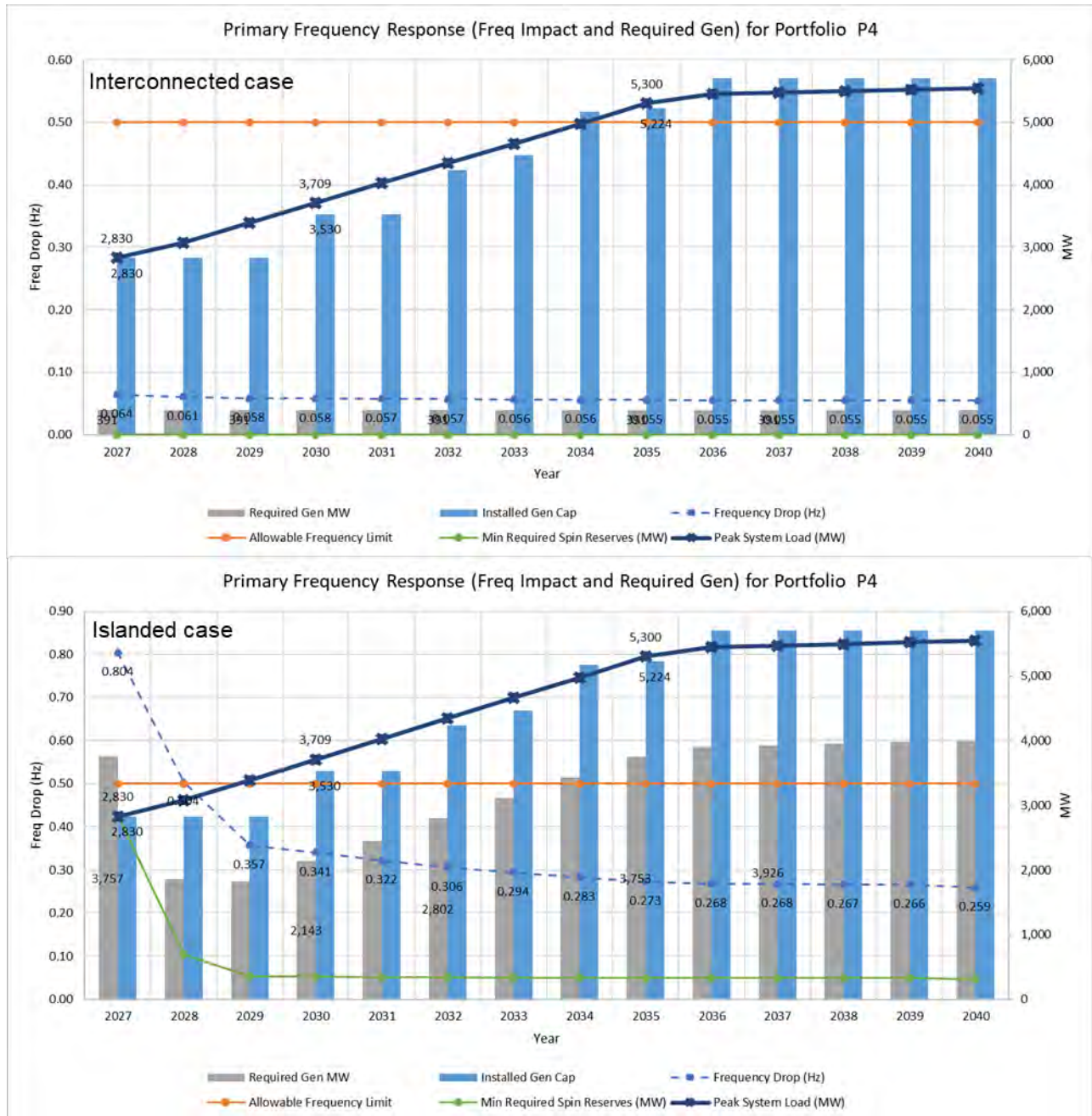


Figure 58. Primary frequency response for Interconnected and Islanded case for portfolio P4

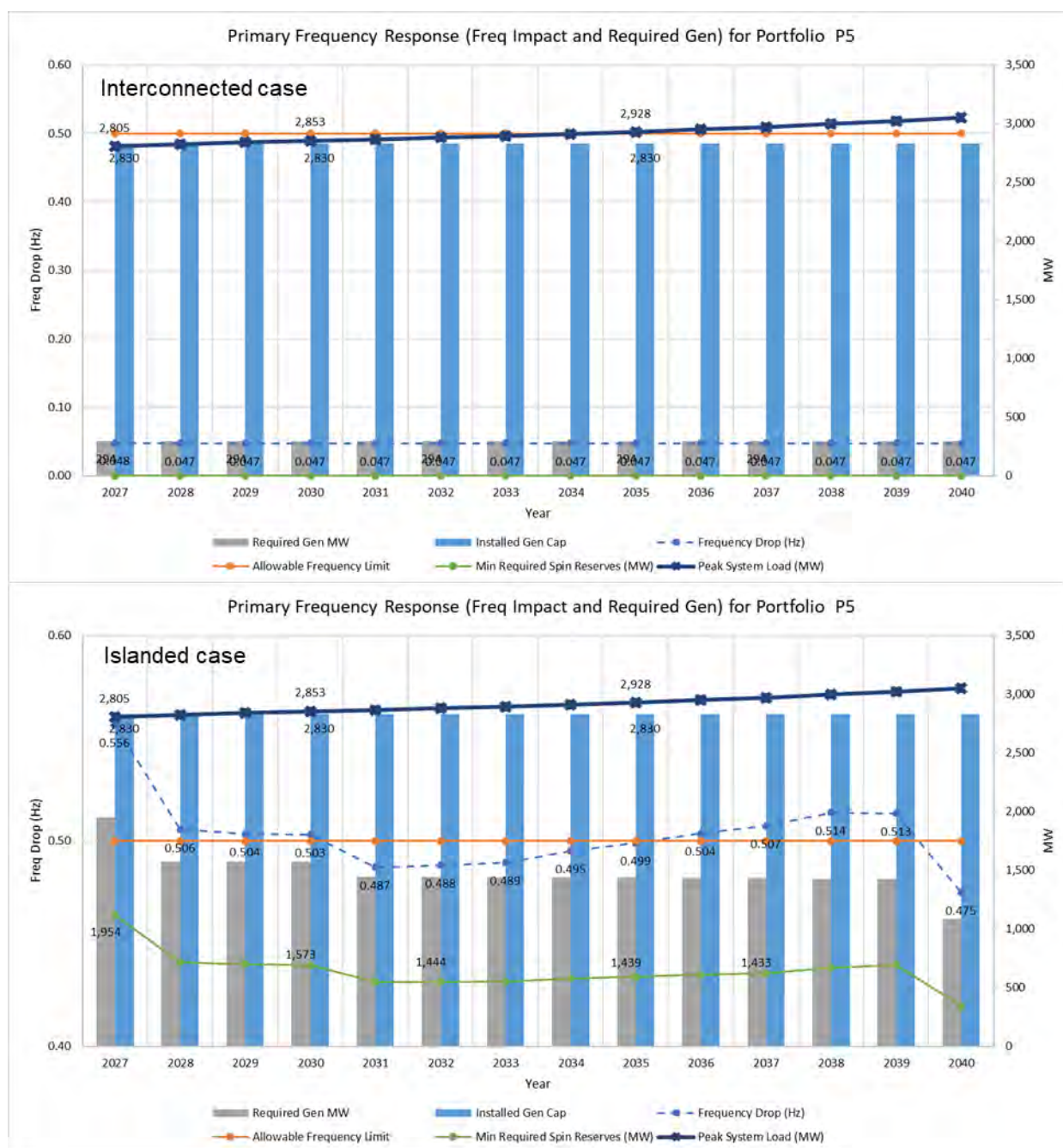


Figure 59. Primary frequency response for Interconnected and Islanded case for portfolio P5



Figure 60. Primary frequency response for Interconnected and Islanded case for portfolio P6

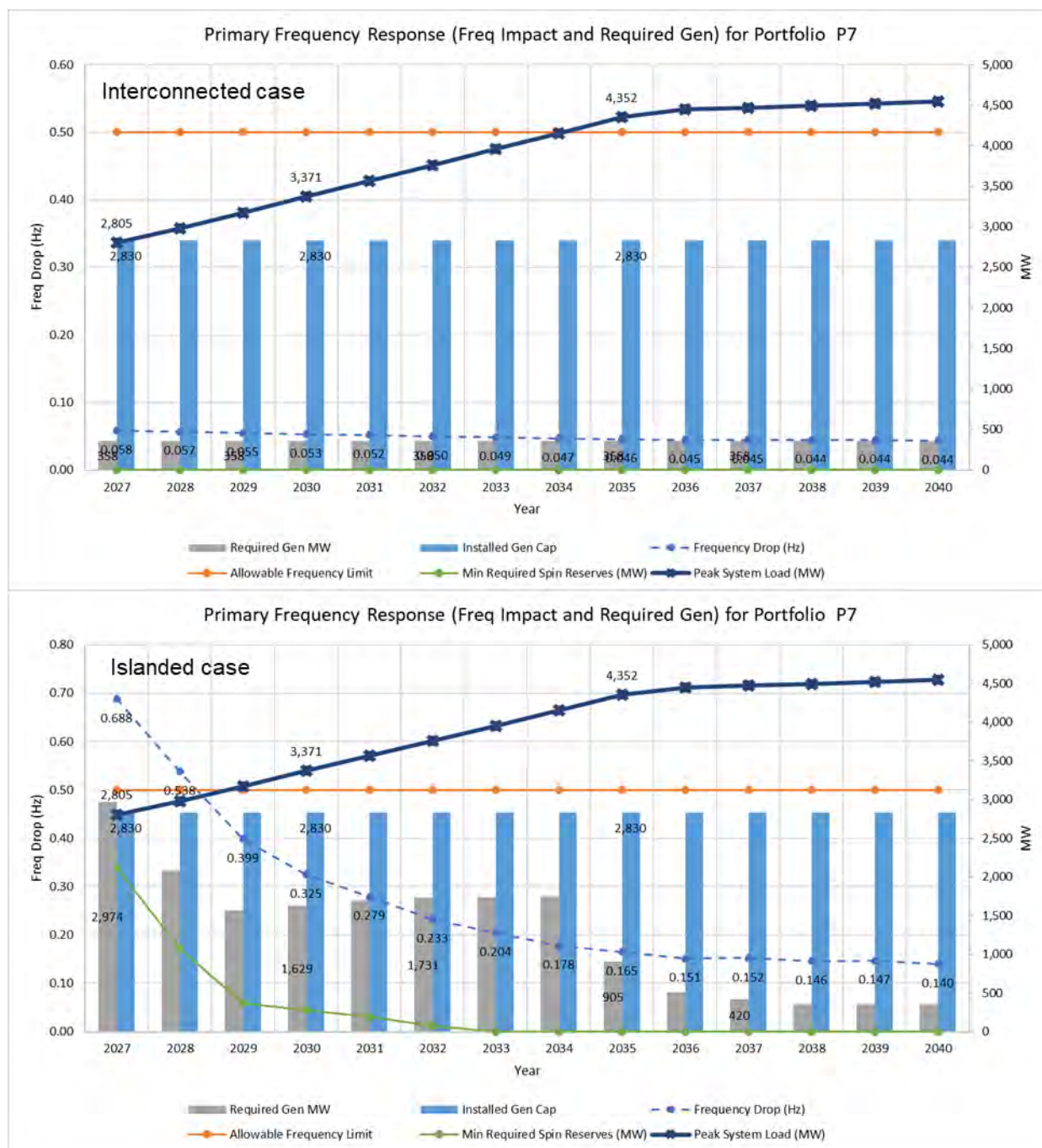


Figure 61. Primary frequency response for Interconnected and Islanded case for portfolio P7

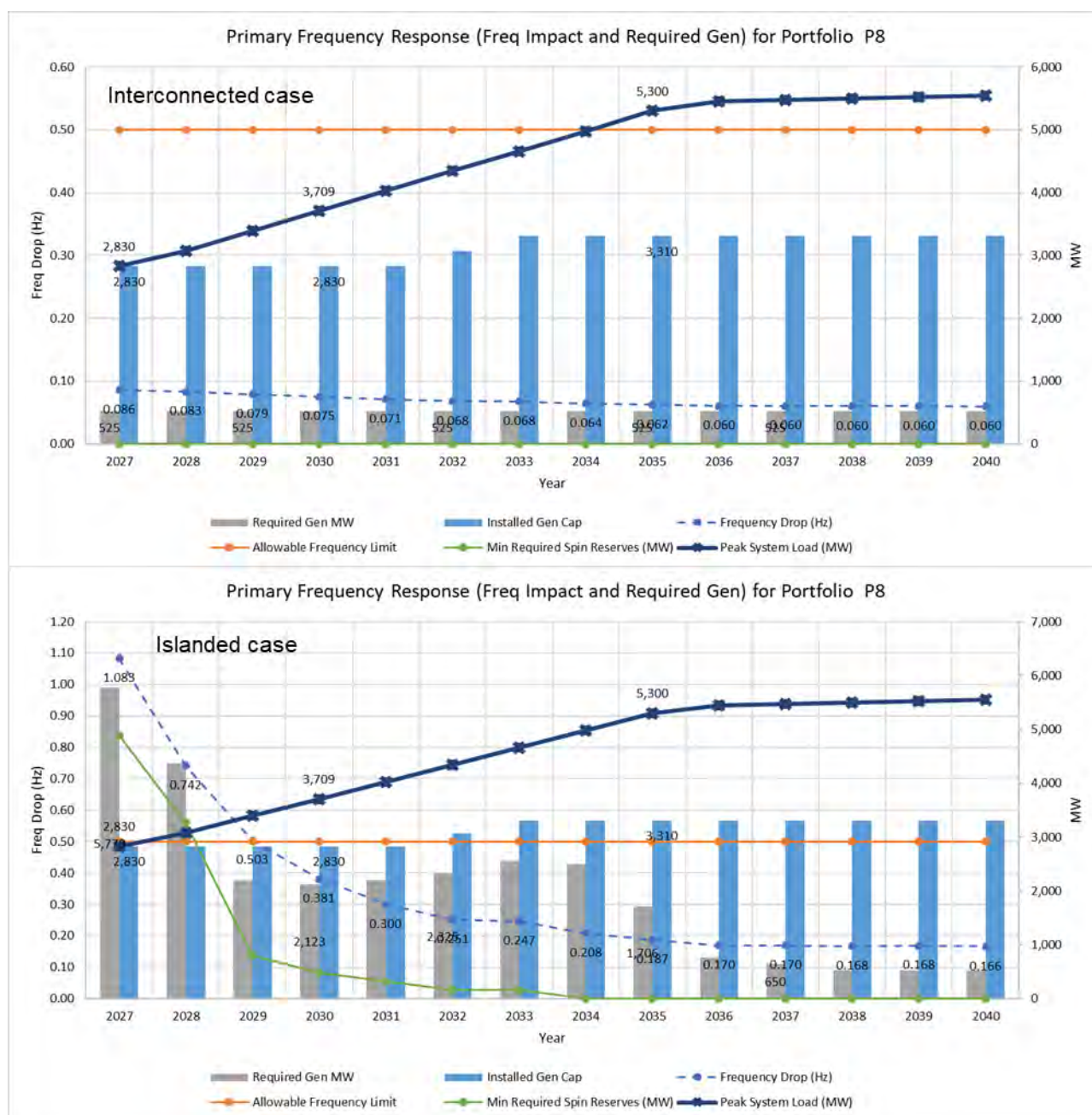


Figure 62. Primary frequency response for Interconnected and Islanded case for portfolio P8

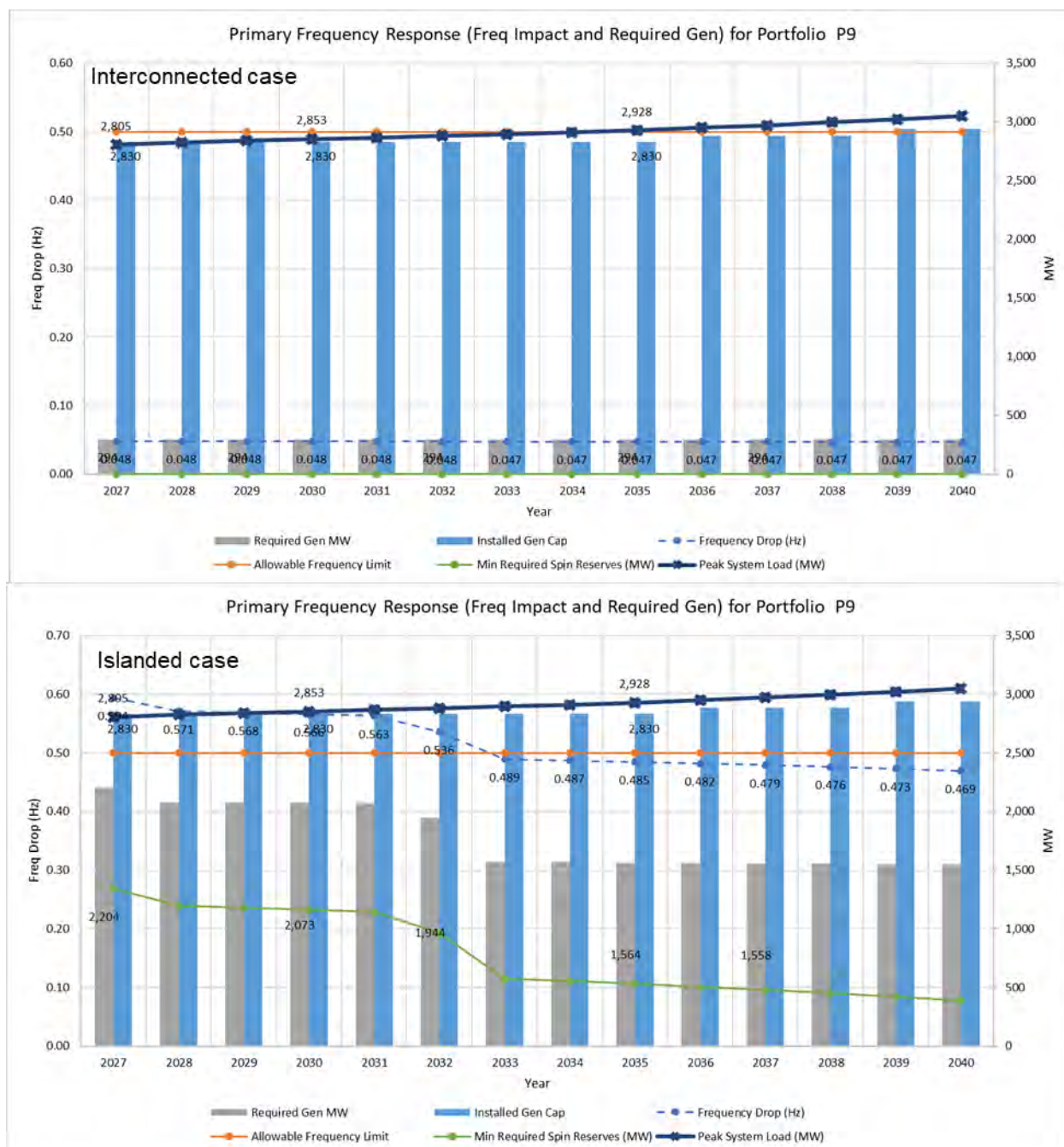


Figure 63. Primary frequency response for Interconnected and Islanded case for portfolio P9

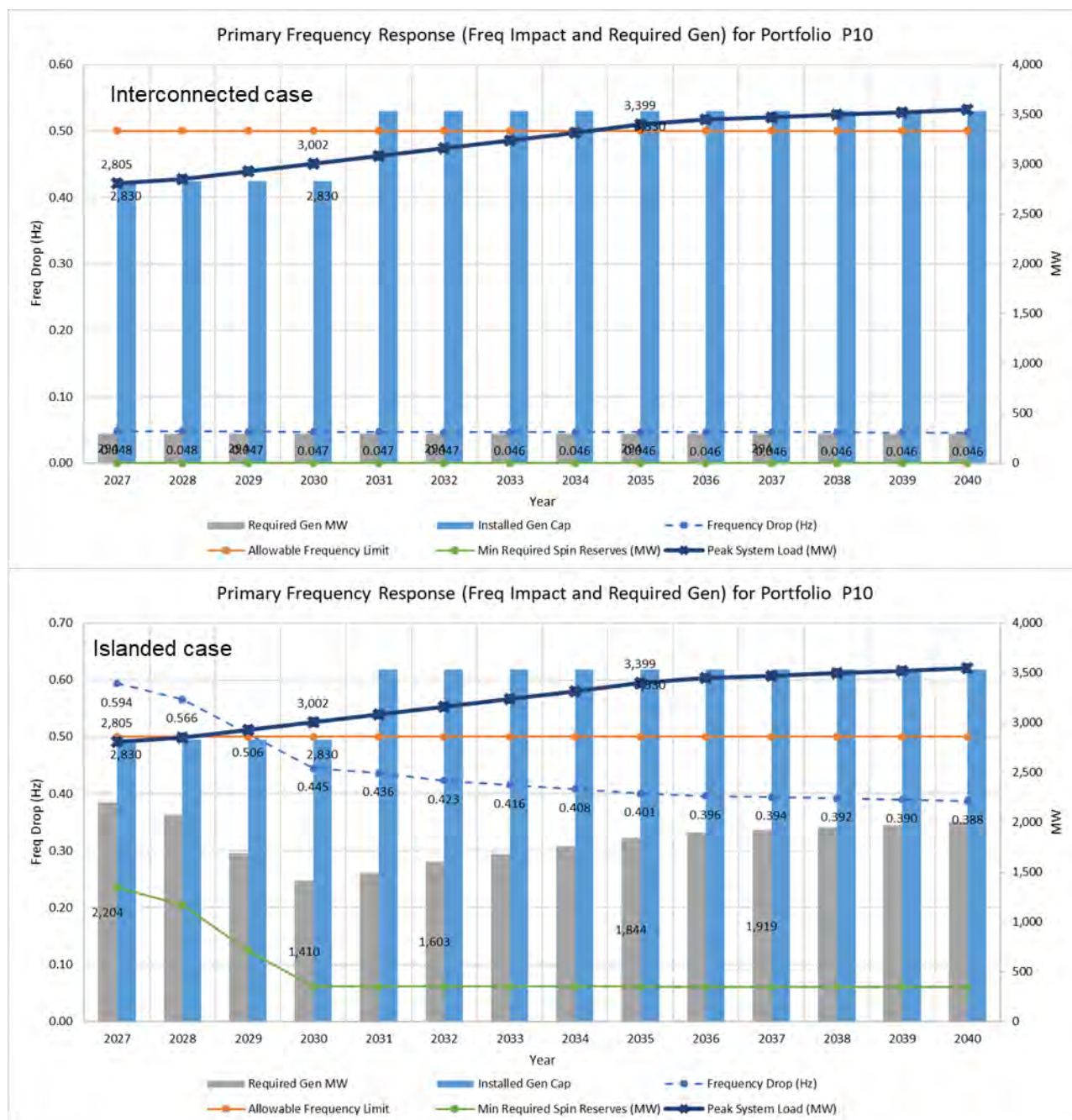


Figure 64. Primary frequency response for Interconnected and Islanded case for portfolio P10

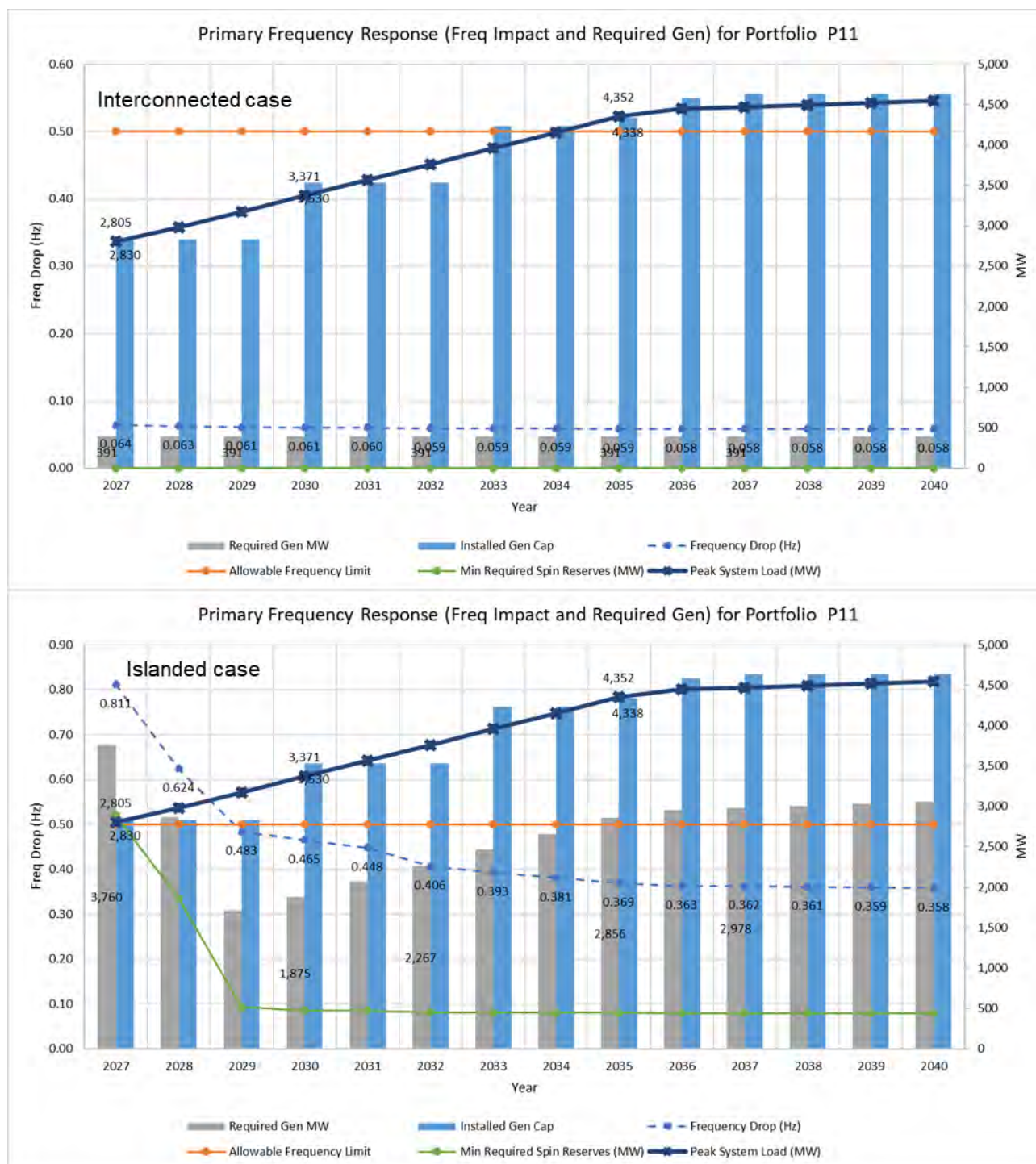


Figure 65. Primary frequency response for Interconnected and Islanded case for portfolio P11

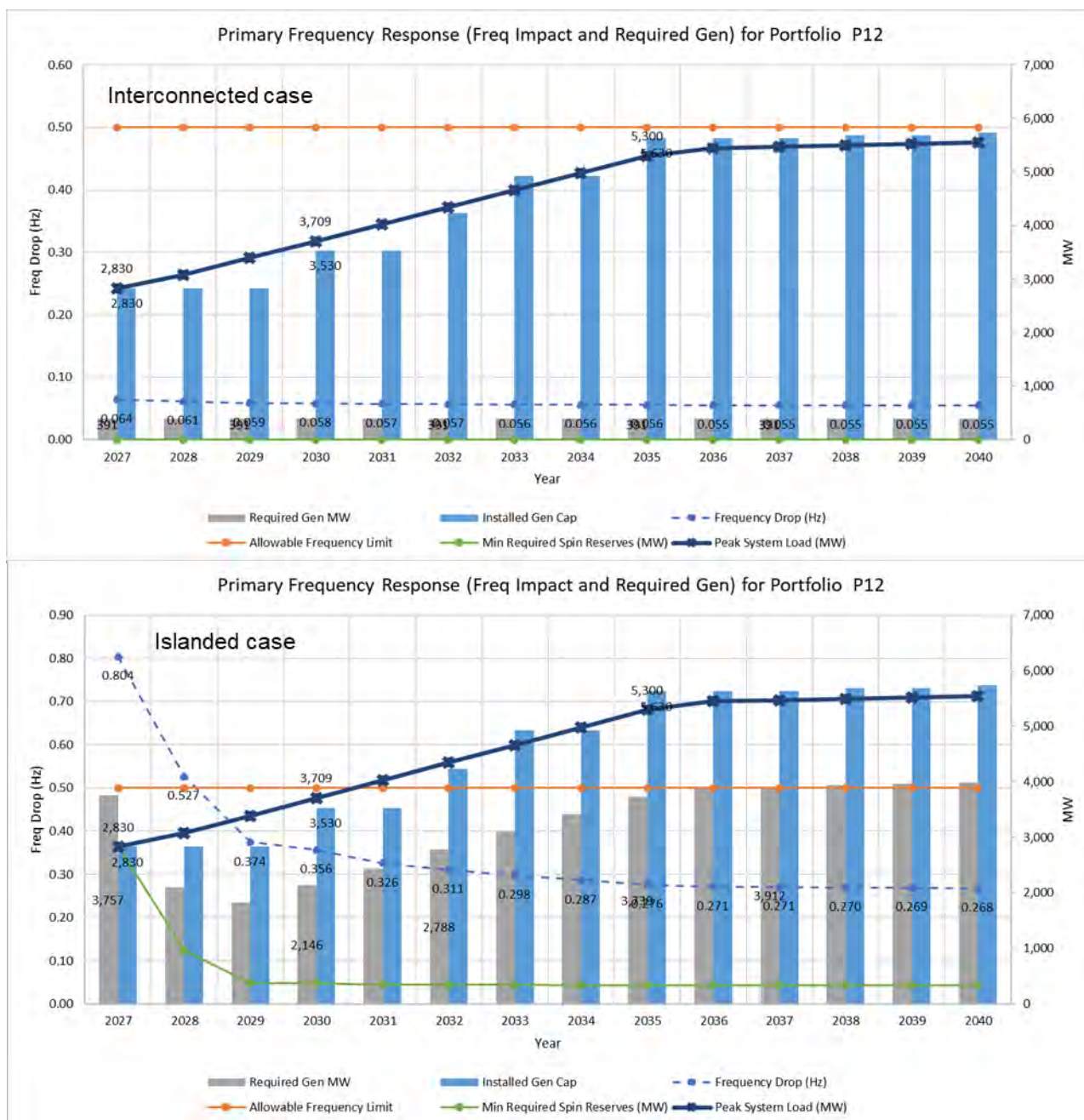


Figure 66. Primary frequency response for Interconnected and Islanded case for portfolio P12

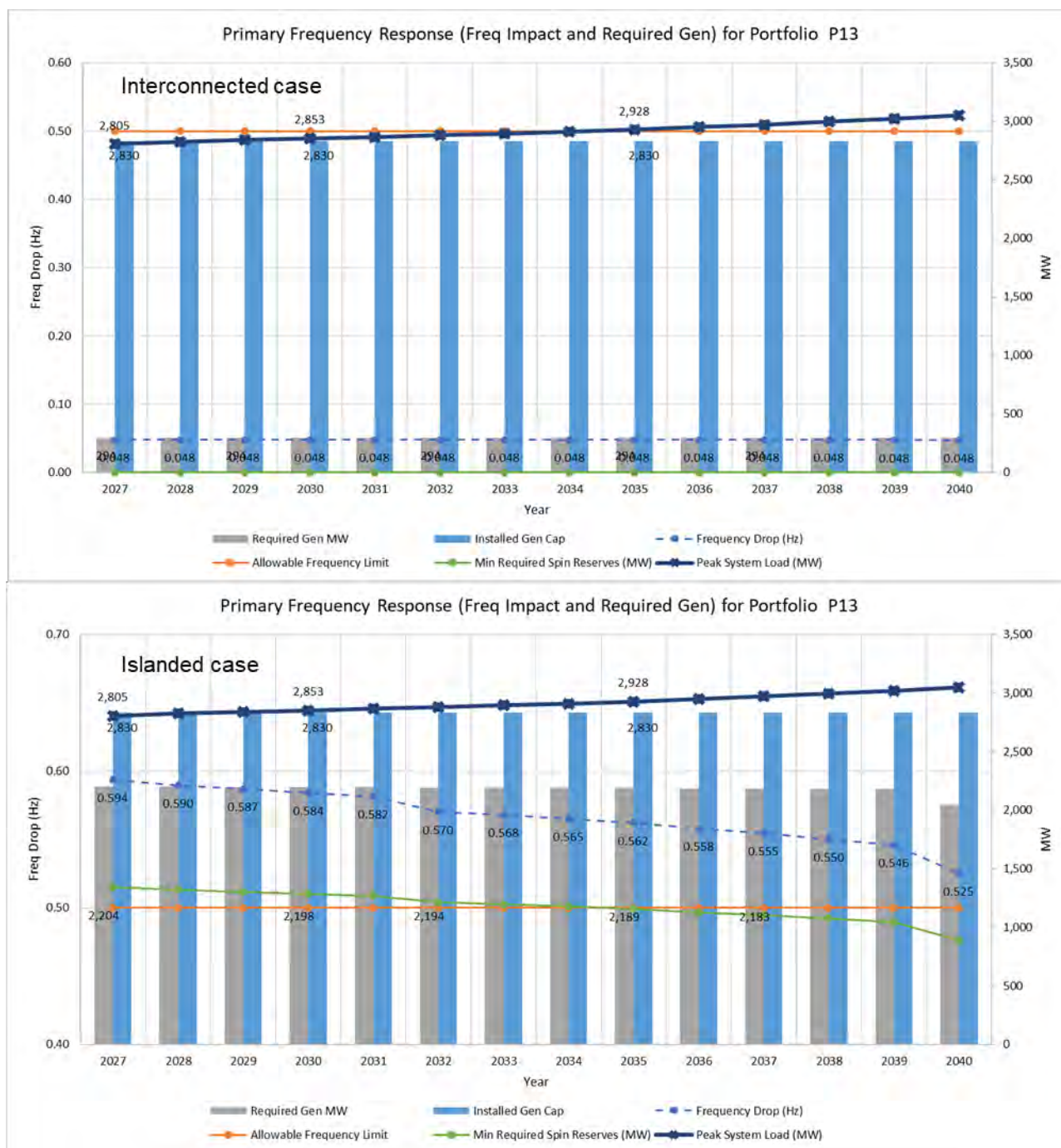


Figure 67. Primary frequency response for Interconnected and Islanded case for portfolio P13



Figure 68. Primary frequency response for Interconnected and Islanded case for portfolio P14

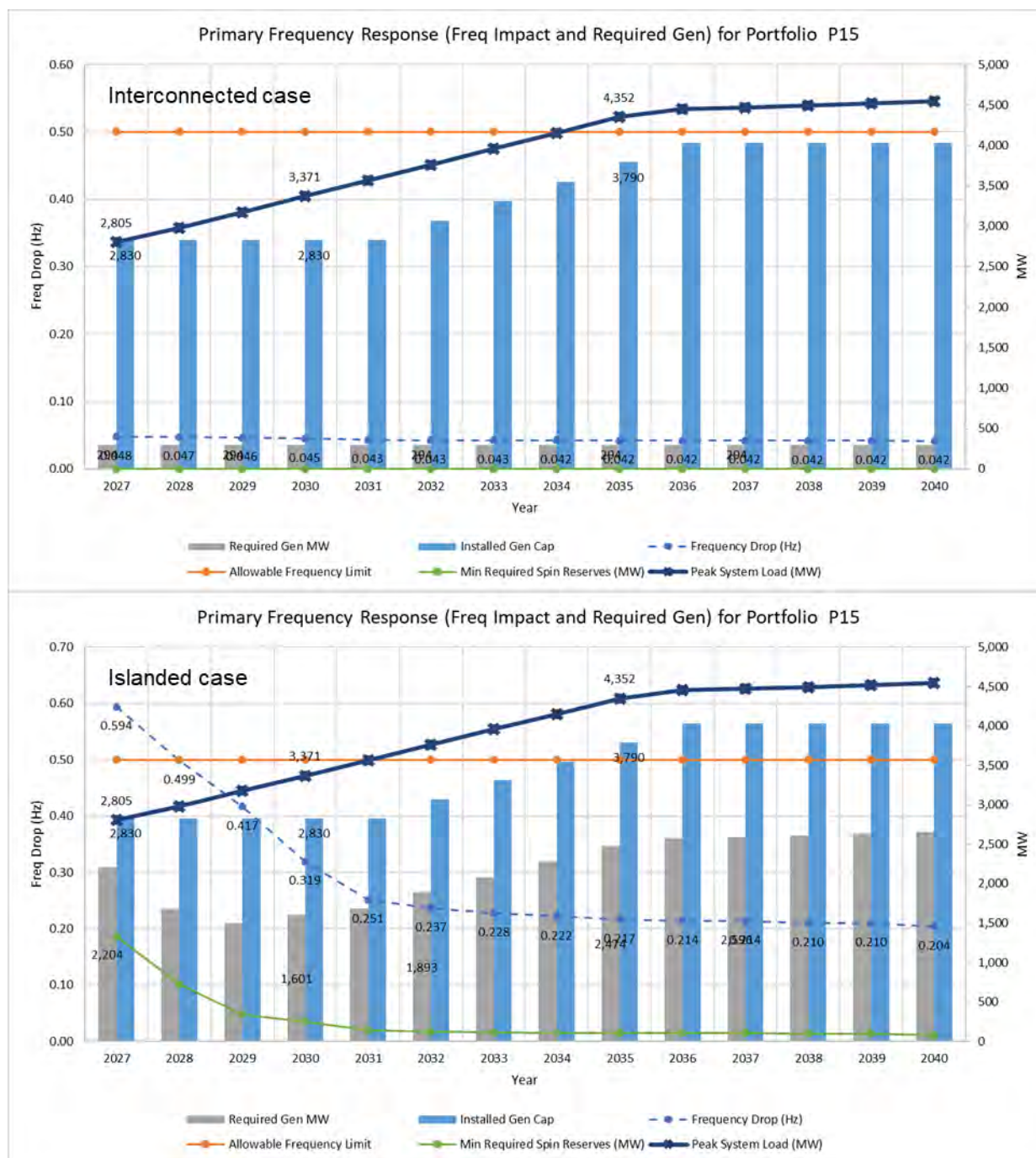


Figure 69. Primary frequency response for Interconnected and Islanded case for portfolio P15

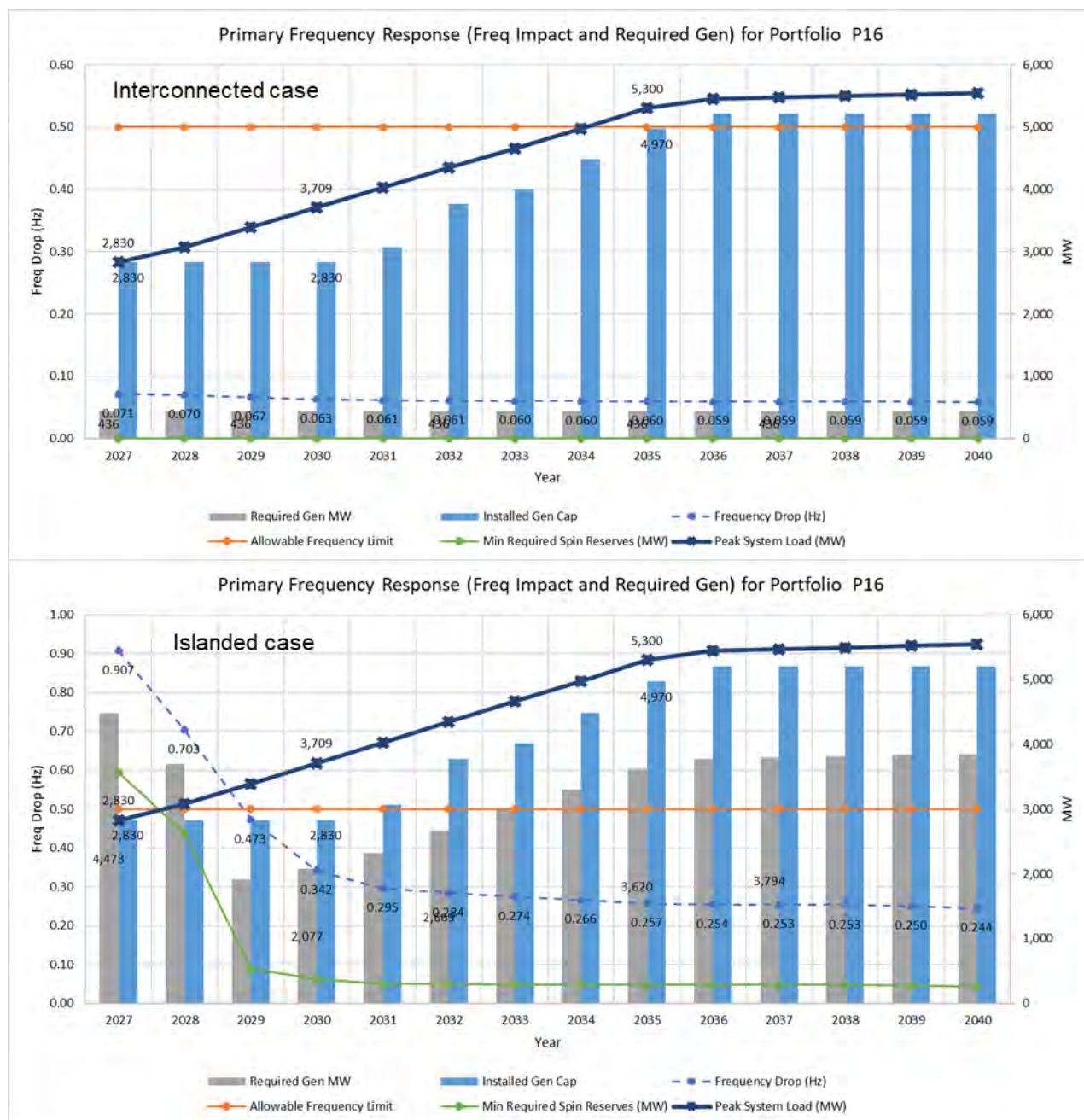


Figure 70. Primary frequency response for Interconnected and Islanded case for portfolio P16