Platte River
Power Authority

Estes Park • Fort Collins • Longmont • Loveland

Memorandum

Date: 3/4/2020

To: Platte River Power Authority Board of Directors

From: Andy Butcher, Alyssa Clemsen Roberts

Subject: **Distributed resources potential study overview**

Platte River Power Authority hired HDR, Inc. to analyze the potential of distributed energy resources (DERs) to support its 2020 integrated resources plan (IRP). The achievable DER potential was determined from a wholesale utility perspective and did not take into consideration constraints, costs or benefits related to integration of DER within the retail distribution utilities' systems.

As a result of the high level study, Platte River and the owner communities started a joint strategic planning process to more holistically evaluate and implement DER taking wholesale and retail perspectives into consideration. This strategy is expected to be completed in 2021. During this process, DER potential will be reconsidered with this broader perspective.

HDR evaluated the technical, economic and achievable potential for DERs, which includes distributed solar, energy efficiency and demand response (including distributed battery storage and control of electric vehicle charging).

The study's achievable-potential results provided inputs to Platte River's IRP. Specifically, these inputs include how DER can reduce Platte River's forecasted load growth and the associated costs of supply side resources. The study also includes the projected costs and benefits of achieving incremental levels of DER potential.

The attached study will be posted on the IRP microsite – www.prpa.org/irp – along with all other studies for the IRP. If you have any questions, please contact us.

Distributed Energy Resources Potential Study

FINAL

Prepared for:
Platte River Power Authority
2000 E Horsetooth Rd
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February 24, 2020

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Executive Summary

Platte River Power Authority (“PRPA”) retained HDR Inc. (“HDR”) to develop a Distributed Energy Resources (“DER”) potential projection for PRPA’s service territory. This study provides input to an Integrated Resource Plan (IRP) that PRPA is currently developing for 2020. This DER potential study provides a transparent and consensus-based estimate of the DER potential for the following resources: energy efficiency (“EE”), demand response (“DR”), distributed solar photovoltaic (“PV”), battery storage, and combined heat and power (“CHP”) growth in the residential, commercial, and industrial customer sectors. The DER potential of each resource has been evaluated for cost-effectiveness and achievable potential.

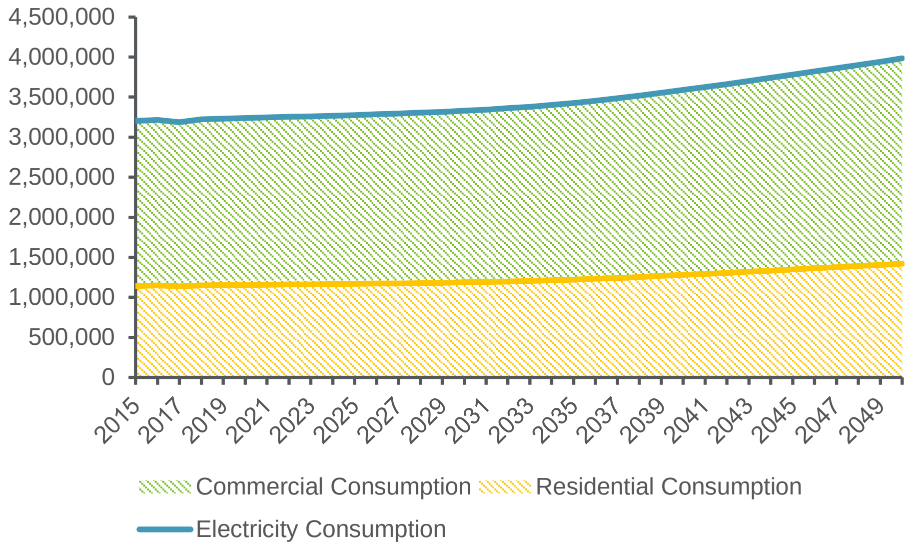
The basis of evaluation is a framework and supporting executable model that incorporates a PRPA baseline electricity load and customer forecast and characterizes the potential for distributed energy resources in comparison to several avoided cost scenarios. This study uses primary information from various sources including aggregated PRPA customer load data, aggregated customer load data from the member cities of Fort Collins, Longmont, Loveland, and Estes Park, historical PRPA and member city DER program experience, and prior PRPA DER studies.

The distributed energy resources estimates are based on existing and proven technologies and are evaluated over a 20 year study period 2021 through 2040. The approach to determine achievable DER potential included an assessment of overall technical potential of applicable customers, an assessment of economic potential via comparison against avoided costs and a total resource cost (TRC) test, and an estimate of achievable potential considering market adoption barriers and maximum participation rates. Naturally occurring conservation or energy efficiency (i.e., efficiency that is driven by codes, standards or economic decisions made by customers outside of PRPA DER programs) is already captured by the base case load forecast (i.e. such energy is outside the results of this study).

Base Load Forecast

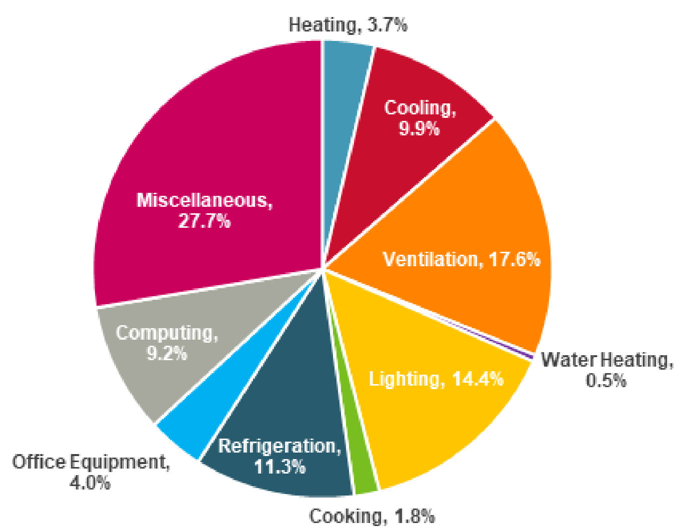
A base load customer forecast and end-use forecast was constructed from PRPA’s annual forecast by disaggregating the between Residential and Commercial & Industrial customers based on various member city’s load and customer information.
Figure ES-1-1 shows the base load forecast by customer class.

Figure ES-1-1. Electricity Consumption Forecast by Customer Class, MWh



Historically, residential customers represent around 88% of PRPA's customers, and have consumed roughly 35% of the total retail electricity sold by PRPA. Commercial & Industrial (C&I) customers represent only roughly 12% of PRPA customers, but are responsible for nearly two-thirds of total electricity consumption. The average consumption for C&I customers by end use is show in Figure ES-1-2 below.

Figure ES-1-2. End Use Consumption Shares: Commercial & Industrial, 2017



According to program information, PRPA had 12 actively funded DER programs common across the utility at the end of 2017. Within the common programs, PRPA reported a cumulative annual savings of 196,137 MWh and a cumulative 31.4 MW demand load reduction in from 2002 through 2017 in the EE programs common across PRPA. In

2017, PRPA reported 25,943 MWh of new incremental energy savings[1] and 4.06 MW of new demand reduction resulting from existing programs. The total utility funding for 2020 is expected to be about $14.1 million to accomplish planned new incremental energy savings of 34,000 MWh, or a first year measure savings cost of about $415/MWh (or a levelized cost of $44.2/MWh based on 13 year measure life and 5% discount rate).

DER Estimated Potential

The following describes the methodology and results for the estimated technical, economic, and achievable potential for EE resource, DR resources, battery storage resources and distributed solar PV resources. The technical potential is representative of a theoretical maximum possible savings that could be achieved for all measures examined, ignoring any economic or market barriers. The economic potential is a subset of technical potential which reflects only the energy or demand savings that are economically viable (i.e. a resource that generate benefits which exceed the costs over the life of the measure). The achievable potential is a subset of economic potential and defined as a realistic implementation of DER measures, factoring in market barriers and other underlying factors. In this study, achievable potential is representative of new DER potential.

DER resources reduce the demand for energy and peak load from customers. In turn, utilities are able to avoid or defer costs associated with installing new generation capacity, transmission upgrades, and avoid procuring energy from generation units on the margin. This study examines three distinct types of benefits: avoided capacity costs, avoided generation costs, and avoided carbon costs.

In this analysis, three scenarios of avoided costs are estimated to represent low, medium and high scenarios:

- The low scenario is reflective of a generation portfolio intended to reflect PRPA's existing resource mix with minimal changes. Under this scenario, the next planned asset is expected to be an aeroderivative unit.
- The medium scenario is reflective of a scenario intended to reflect PRPA's resource mix assuming coal resources are retired by 2030 and replaced with a mix of renewable resources and battery storage.
- The high scenario is reflective of a scenario intended to reflect PRPA's resource mix assuming coal resources are retired by 2030 and replaced with a mix of renewable resources and a high penetration of battery storage.

While summary results from all three avoided cost scenarios are included in this report, the medium avoided cost scenario is presented in more detail.

Energy Efficiency

Over fifty energy efficiency measures were identified and evaluated for all applicable residential and commercial & industrial customer types. Figure ES-1-3 illustrates the technical, economic, and achievable potential forecasted to 2040 for the medium avoided cost case.

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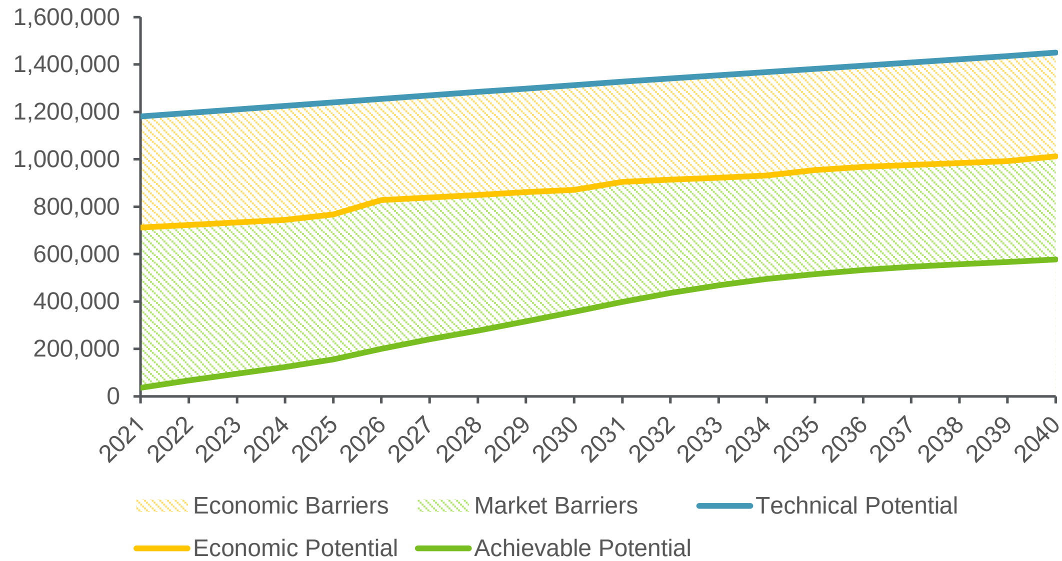
[1] New incremental energy savings are savings added in a given year and does not include prior accumulated savings or reductions from prior year savings lost at end of life.

Figure ES-1-3. Technical, Economic, and Achievable Potential for Energy Efficiency Measures, MWh, Medium Avoided Cost Scenario



This study finds that about 40% of the technical potential is achievable by 2040 for the medium avoided cost scenario. Of the achievable EE potential, one of the largest potential end-use savings category is lighting which accounts for about one-third of the projected achievable potential in 2030, given the ease of retrofitting, relatively low cost, quick payback and high consumer awareness.

The multi-year cumulative cost of the EE achievable potential including the installation cost, the utility incentive, and the utility program administration cost is shown in Table ES-1. To achieve the energy efficiency savings presented, $139.8 million would be spent by PRPA through 2030.

Table ES-1. Multi-Year Cumulative Energy Efficiency Costs, Medium Avoided Cost Scenario

Multi-Year Cumulative Costs ($000s)	2021-2025	2026-2030	2031-2035	2036-2040
Total 5-Year Costs ($000s)	$60,030	$114,100	$130,201	$123,906
Participant Cost	$11,824	$22,474	$25,646	$24,406
Utility Incentives	$35,472	$67,423	$76,937	$73,217
Utility Administrative Costs	$12,734	$24,203	$27,618	$26,283
Utility Cost Total	$48,206	$91,626	$104,555	$99,501
Average Utility Cost, per MWh*	$308	$337	$297	$269

*Average cost for the first year of installed measures.

From 2021 through 2025 the average annual utility cost (utility incentive and utility administrative cost) for the first year of installed EE measures is expected to be about $9.6 million to achieve an average 31,330 MWh incremental annual energy savings, or average first year energy savings of $308/MWh (or a levelized first year cost of $32.8/MWh based on 13 year measure life and 5% discount rate).

Demand Response

Fifteen measures were evaluated for residential, commercial, and industrial customers including programmable communicating thermostats, direct load controllers for HVAC and water heaters, residential batteries, plug-in electric vehicles, commercial lighting control, commercial-scale batteries, and distribution level system voltage reduction. The deferral capability of demand response measures (measured in kilowatts) in combination with assumptions surrounding the duration of events and an event limit per year were used to estimate the kilowatt-hours deferred. The deferral capacity (in kW) is the amount of peak load capacity that is shifted or eliminated from peak hours to off-peak hours. The deferred energy (in kWh) is a measure of the amount of energy that is shifted or eliminated from peak hours to off-peak hours.

Figure ES-1-4 and Figure ES-1-5 illustrate the technical, economic, and achievable potential of deferred energy and peak load for demand response measures forecasted to 2040 for the medium avoided cost scenario.

Figure ES-1-4. Technical, Economic, and Achievable Potential for Demand Response Measures, Deferred MWh, Medium Avoided Cost Scenario

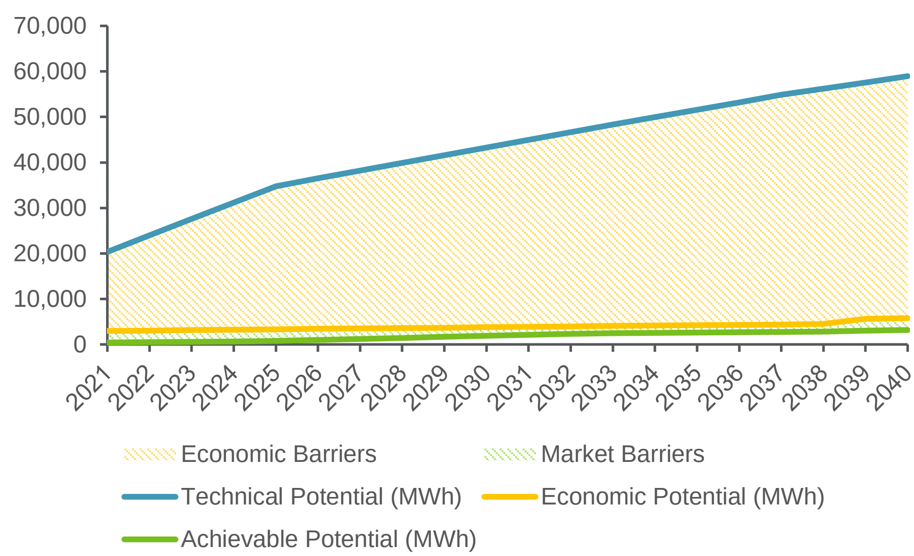
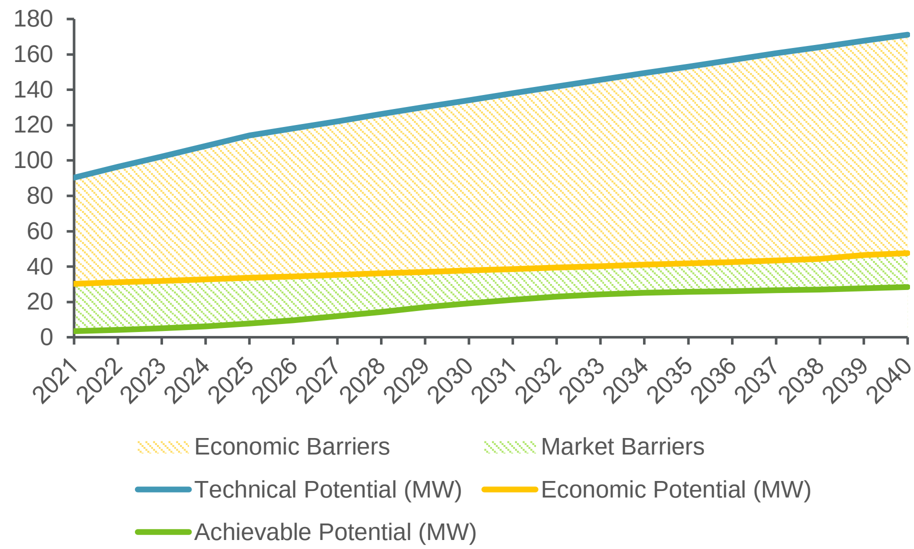


Figure ES-1-5. Technical, Economic, and Achievable Potential for Demand Response Measures, Deferred MW, Medium Avoided Cost Scenario



This study finds that about 1,900 MWh of deferred peak energy and 19 MW of deferred peak load is achievable by 2030 for the medium avoided cost scenario. This amount of deferred peak load is 3.0% of the summer peak load in 2030. Of the achievable DR potential, the largest potential end-use savings category is the HVAC control, about two-thirds of the projected achievable potential in 2030.

The multi-year cumulative cost of the demand response achievable potential including the installation cost, the utility incentive, and the utility program administration cost is shown in Table ES-2. In order to achieve this potential, PRPA would have to spend $11.8 million by 2030 for the medium avoided cost scenario.

Table ES-2. Multi-Year Cumulative Demand Response Costs, Medium Avoided Cost Scenario

Multi-Year Cumulative Costs ($000s)	2021-2025	2026-2030	2031-2035	2036-2040
HVAC	$3,839	$7,717	$7,054	$8,252
Water Heating	$289	$1,567	$1,983	$2,353
Batteries	$0	$0	$0	$336
Industrial Processes	$194	$1,056	$1,417	$1,705
Lighting	$0	$0	$0	$0
Refrigeration	$0	$0	$0	$0
Voltage Reduction	$2,280	$0	$0	$0
Total 5-Year Costs ($000s)	**$6,602**	**$10,339**	**$10,453**	**$12,646**
Participant Costs	$790	$2,035	$2,058	$2,489
Utility Incentives	$4,649	$6,106	$6,173	$7,468
Utility Administrative Costs	$1,164	$2,198	$2,222	$2,689

Multi-Year Cumulative Costs ($000s)	2021-2025	2026-2030	2031-2035	2036-2040
Utility Cost Total	**$3,471**	**$8,304**	**$8,395**	**$10,157**

From 2021 through 2025 the average annual utility cost (utility incentive and utility administrative cost) for the first year of installed DR measures is expected to be about $1.16 million to achieve an average 1.6 MW of incremental annual deferred load, or $840/kW.

Distributed Solar PV Potential

This study evaluated distributed roof mounted solar PV systems installed on residential and commercial & industrial roof tops. Based on satellite photography, geospatial data, and digital zoning data, potentially available roof space was estimated. Solar PV on parking lots was deemed to be impractical because it would require costly site-specific mounting structures to be installed and would limit the potential for repurposing into commercial businesses or other type of development. As of 2021, this study found that there is sufficient rooftop area for approximately 1,161 MWac[2] of roof mounted solar PV capacity.

The installed costs for distributed solar PV were based on actual all-in capital costs for distributed solar PV systems that Fort Collins customers built from 2013 through 2018. Two avoided cost scenarios were considered: a low case reflective of constructing a natural gas aeroderivative combustion turbine and a medium/high case reflective of the retirement of coal/fossil resources, and replacement by utility-scale solar generation. For all avoided cost scenarios, the TRC test shows no economically viable roof mounted distributed solar PV capacity across customer segments. Since no economic potential was found during the study period, there is no achievable potential during the study period. It is important to note that the TRC test evaluates the benefits from a full societal perspective including the utility and participant. Participants may find distributed solar systems cost effective by avoiding retail electricity rates, though that is not captured in a TRC test.

Combined Heat and Power

Cogeneration or Combined Heat and Power (CHP) facilities generate both electricity and thermal energy from a single source of energy. In a CHP facility, waste heat generated from the prime mover (e.g. steam boiler) is used to generate steam and hot water for heating applications, or using an absorption chiller to generate chilled water for cooling applications. CHP installations are economically feasible under certain operating and financial conditions. However, PRPA's board recently passed a resource diversification policy[3], which established a goal of a 100% non-carbon energy mix by 2030. Furthermore, three of PRPA's four owner communities have also adopted goals to achieve a 100% renewable mix by 2030. CHP facilities fueled by natural gas would not align with this policy. In conformance with this policy, and due to the challenges of

[2] MWac is capacity on alternating current basis, or the net output basis.

[3] *https://www.prpa.org/news/platte-river-board-passes-energy-policy/* - Platte River board passes energy policy, Dec 2018

acquiring relevant data from PRPA's customers, this study finds no potential for CHP. It is recommended that PRPA continue to monitor changes in biomass and CHP that could increase availability of biomass or reduce its costs.

Concluding Remarks

By 2030, it is expected that PRPA's DER plan includes a mix of new energy efficiency and demand response measures. Under the medium avoided cost scenario, the evaluated energy efficiency measures could reduce PRPA's hourly load by about 50 MW, and reduce the annual base load customer consumption by nearly 10%. Evaluated demand response measures are anticipated to provide the capability to defer 20 MW of electricity during the peak load. For PRPA to achieve the DER savings assessed in this study, $168 million in costs would be incurred by 2030 to account for utility incentives, installation costs, and program administration costs. An overview of the estimated potential of energy savings and peak load reduction is shown in the tables below.

Table ES-3. Energy Savings Results Compared to Base Load Forecast, MWh, Medium Avoided Cost Scenario

	2021	2025	2030	2035	2040
Base Load	**3,246,452**	**3,276,068**	**3,329,157**	**3,424,440**	**3,587,996**
Energy Efficiency	**36,385**	**155,883**	**356,306**	**515,652**	**577,656**
% of Base Load	*1.1%*	*4.8%*	*10.7%*	*15.1%*	*16.1%*
Demand Response Deferral	**463**	**823**	**1,925**	**2,661**	**3,206**
% of Base Load	*0.0%*	*0.0%*	*0.1%*	*0.1%*	*0.1%*
Distributed Solar	**0**	**0**	**0**	**0**	**0**
% of Base Load	*0.0%*	*0.0%*	*0.0%*	*0.0%*	*0.0%*

Table ES-4. Load Reduction Results Compared to Peak Hourly Load Forecast, MW, Medium Avoided Cost Scenario

	2021	2025	2030	2035	2040
Peak Hourly Load	**673**	**679**	**691**	**710**	**744**
Maximum Hourly Energy Efficiency Savings	**7.1**	**26.2**	**69.3**	**105**	**119**
% of Peak Load	*1.1%*	*3.9%*	*10.0%*	*14.8%*	*16.0%*
Maximum Hourly Demand Response Deferral	**3.4**	**7.7**	**19.2**	**25.5**	**28.1**
% of Peak Load	*0.6%*	*1.2%*	*3.0%*	*3.9%*	*4.1%*
Maximum Hourly Distributed Solar Savings	**0**	**0**	**0**	**0**	**0**
% of Peak Load	*0.0%*	*0.0%*	*0.0%*	*0.0%*	*0.0%*

1 Introduction

Platte River Power Authority ("PRPA") retained HDR Inc. ("HDR") to develop a Distributed Energy Resources ("DER") potential projection for PRPA's service territory. This study provides input to an Integrated Resource Plan (IRP) that PRPA is currently developing for 2020. This DER potential study provides a transparent and consensus-based estimate of the DER potential for the following resources: energy efficiency ("EE"), demand response ("DR"), distributed solar photovoltaic ("PV"), battery storage, and combined heat and power ("CHP") growth in the residential, commercial, and industrial customer sectors. The DER potential of each resource has been evaluated for cost-effectiveness and achievable potential.

HDR has leveraged public information to the extent it is practical and relevant for local conditions and collected primary data to fill gaps that are critical to the reliability of study outcomes. A significant source of local information was from the City of Fort Collins Utilities detailed customer segment data (i.e. City of Fort Collin's BERTHA database). During this study, HDR and PRPA valued the cooperation and input of the utilities staff from the City of Fort Collins, City of Longmont, and City of Loveland.

We have documented the assumptions, methods used, and results in the following sections of this report.

- Section 2 of this report describes the main sources of information and high-level assumptions;
- Section 3 describes the approach to establishing a base case load forecast and customer segmentations assumptions;
- The DER estimates reflect a range of achievable energy savings and deferred energy/capacity potential based on three supply-side avoided cost scenarios. Sections 4, 5 and 6 explain the resource estimation approach, the main avoided cost assumptions, and the estimated technical, economic, and achievable potential for energy efficiency resources, demand response resources, and distributed solar resources, respectively;
- Section 7 describes the limited potential of combined heat and power resources;
- Each energy efficiency, demand response, and distributed generation resource influences PRPA's total hourly load shape, daily. Section 8 shows the impact of these DER estimates to PRPA's forecasted hourly load shape based on the active DER measures throughout the year;
- Section 9 summarizes the study and highlights the main findings; and
- Section 10 provides references to the public information used to define the DER measures in this study.

2 Basis of Evaluation

This study uses primary information from various sources including aggregated PRPA customer load data, aggregated customer load data from the member cities of Fort Collins, Longmont, Loveland, and Estes Park, historical PRPA and member city DER program experience, and prior PRPA DER studies. Where the primary sources are not able to inform assumptions or inputs, secondary information from publicly available demand-side management studies, energy efficiency studies, and other reports such as national and regional surveys are leveraged.

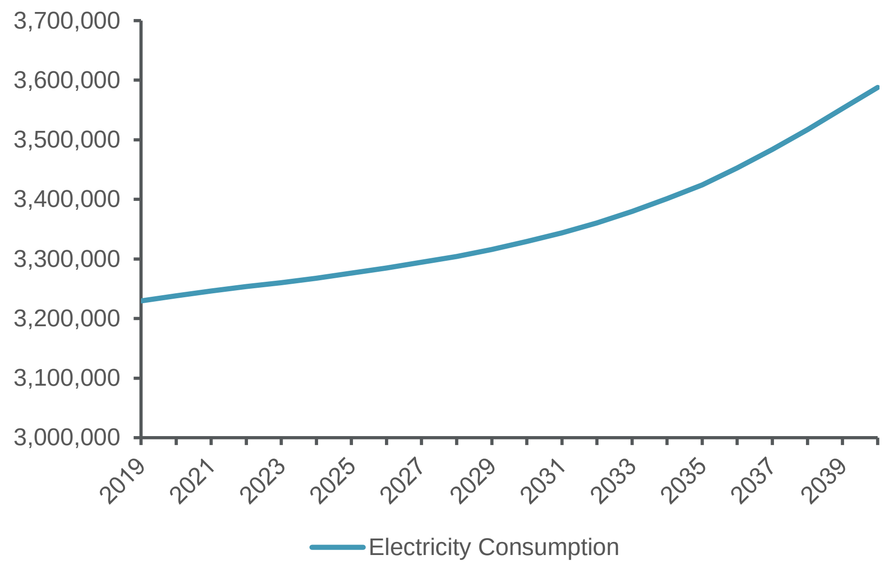
The basis of evaluation is a framework and supporting executable model that incorporates a PRPA baseline electricity load and customer forecast and characterizes the potential for distributed energy resources in comparison against several avoided cost scenarios. The baseline load forecast from 2019 through 2040 is based on the aggregated PRPA and member city customer load data and regional growth forecasts as described in more detail in section 3. The evaluation of distributed energy resource potential is split amongst energy efficiency resources (section 4), and demand response resources (section 5) including battery storage resources, distributed rooftop solar PV (section 6), and combined heat and power resources (section 7). The distributed energy resources estimates are based on several foundational principles:

- Resources are based on existing and proven technology;
- A 20 year study period starting in 2021 and ending in 2040;
- Naturally occurring conservation or energy efficiency (i.e., efficiency that is driven by codes, standards or economic decisions made by customers outside of PRPA DER programs) is already captured by the base case load forecast (i.e. such energy is outside the results of this study);
- The list of DER measures evaluated in this study are not exhaustive and, therefore, the possibility for additional energy and/or capacity savings from measures not identified is present. HDR chose to include measures within this evaluation that were deemed to have the best potential for savings based on our industry experience and judgment; and
- The approach to determine achievable potential from DER included an assessment of overall technical potential of applicable customers, an assessment of economic potential via comparison against avoided costs and a total resource cost (TRC) test (based on incremental DER costs plus administration costs), and an estimate of achievable potential considering market adoption barriers and maximum participation rates.

3 Base Case Forecast

This section describes the process of developing the segmented end-use base case forecast. Each customer segment examined is described and the energy consumption pattern is identified. PRPA provided an annual non-segmented wholesale sales forecast through 2040, shown in the figure below.

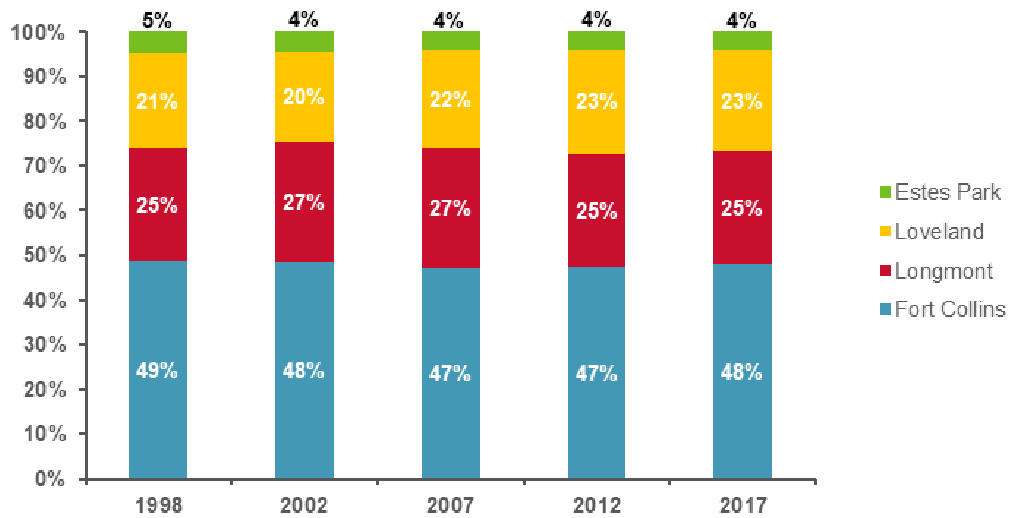
Figure 3-1. PRPA Annual Non-Segmented Base Load Forecast, MWh



Utilizing historical retail sales data, the forecast was segmented by city and customer class (Residential and Commercial & Industrial). Data provided by Fort Collins was utilized to further segment the customer classes to a lower level of granularity. 53 subcategories were established from Fort Collins' BERTHA database, resulting in 12 residential subcategories and 41 Commercial & Industrial subcategories. These subcategories were mapped to building classifications identified in the Energy Information Administration's (EIA) Residential Energy Consumption Survey (RECS) and the Commercial Building Energy Consumption Survey (CBECS). The most current CBECS was published in 2012 and the RECS has data available from 2015. These surveys provided electricity end use consumption for 10 end use categories. Given the naturally occurring energy efficiency embedded in the annual forecast provided, the EIA's 2018 AEO forecast of end use consumption was used to forecast changes in end use consumption by subcategory.

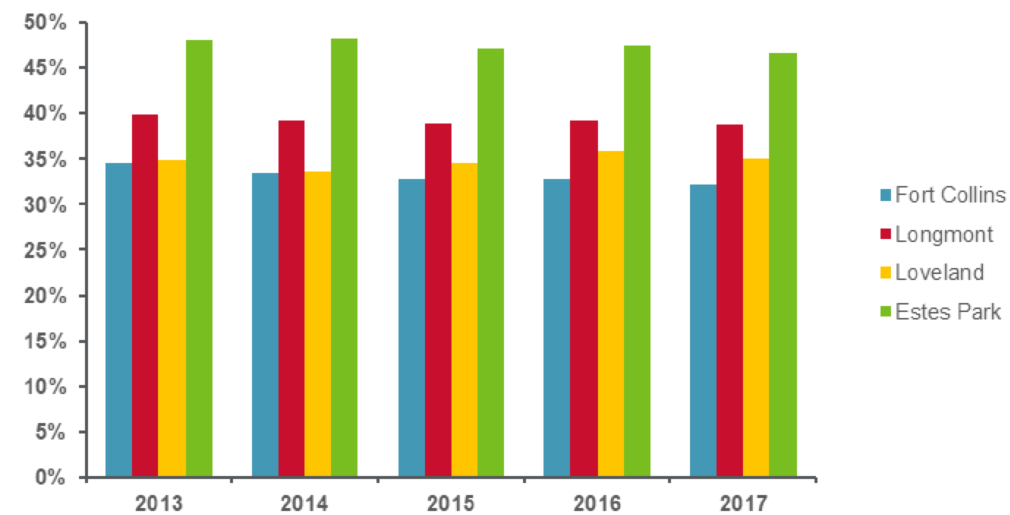
PRPA provides electricity to four cities: Fort Collins, Longmont, Loveland and Estes Park. Over time, the share of energy each municipality receives has remained fairly constant. As a result, it was assumed that the average electricity split for each of the cities over the last five years would be representative of the expected future energy distribution.

Figure 3-2. Share of Electricity Consumed by City



Additionally, the residential share in each city has remained relatively constant over the past five years. It is assumed the five year average is indicative of the future share of residential energy.

Figure 3-3. Residential Share of Electricity Consumed by City



The overall residential and commercial &industrial energy consumption for PRPA was constructed by applying the distribution of energy to each city and then applying each cities' share of energy by customer class. These values are then aggregated to create a total estimate encompassing PRPA's service region for both customer classes.

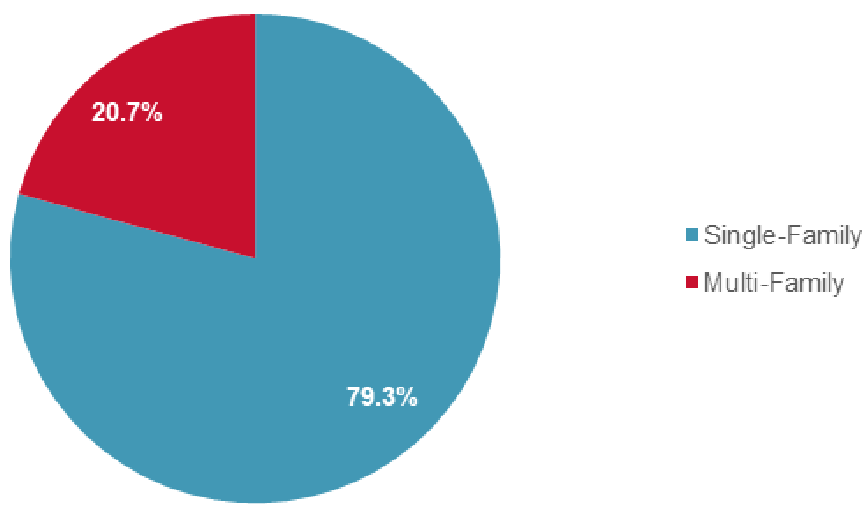
3.1 Customer Base Segmentation

The base forecast was initially split to two customer classes: Residential and Commercial & Industrial. These customer classes are further disaggregated into subcategories based on Fort Collins' BERTHA database. This section describes the subcategories used. It is assumed that the customer base in Fort Collins is representative of the entire PRPA service region.

3.1.1 Residential Customers

Historically, residential customers represent around 88% of PRPA's customers, and have consumed roughly 35% of the total retail electricity sold by PRPA. Residential customers are split between single-family and multi-family units. The energy consumption for both subcategories is shown below.

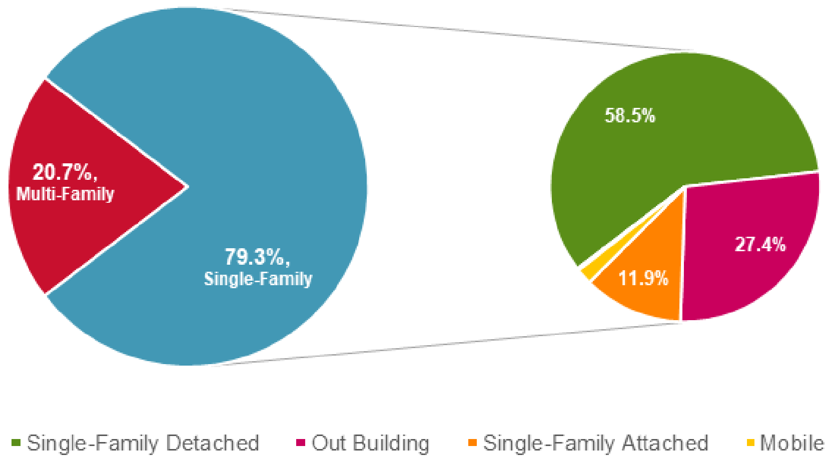
Figure 3-4. Share of Residential Subcategory Energy Consumption, 2017



Single-Family

Single-family customers are comprised of several BERTHA categories including Single-Family Attached, Single-Family Detached, Mobile, Out Buildings, Ag, and Residential. In Fort Collins, these categories comprise nearly three-quarters of the residential premises. Extrapolated to the entire PRPA service region, this translates to 101,369 customers as of 2017. On average, single-family customers use over 2,800 more kWh per customer per year than multi-family customers. Detached homes represent nearly 59% of total energy consumption in the single-family subcategory.

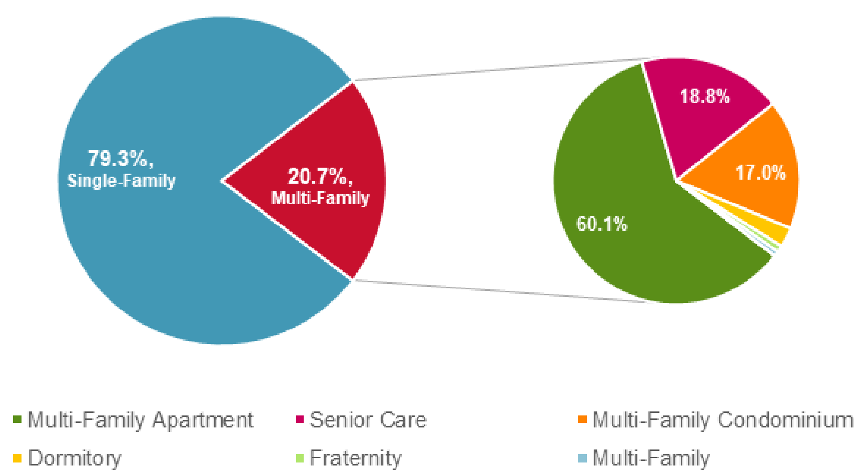
Figure 3-5. Energy Consumption Share by BERTHA Categories, Single-Family Residential, 2017



Multi-Family

Multi-family customers are comprised of the following BERTHA categories: Dormitories, Fraternities, Multi-Family, Multi-Family Apartment, Multi-Family Condominium, and Senior Care. Multi-family dwellings represent over one-quarter of premises in Fort Collins. Assuming Fort Collins is representative of PRPA's service area, the multi-family category contains 38,847 customers. The energy consumption in this subcategory is predominantly from apartment dwellings, senior care, and condominiums.

Figure 3-6. Energy Consumption Share by BERTHA Categories, Multi-Family Residential, 2017



3.1.2 Commercial & Industrial Customers

Commercial & Industrial customers represent only roughly 12% of PRPA customers, but are responsible for nearly two-thirds of total electricity consumption. Customers are classified in one of 17 subcategories based on Fort Collins' BERTHA classifications as shown in the figure and table below.

Figure 3-7. Commercial & Industrial BERTHA Energy Consumption Share by Subcategory, 2017

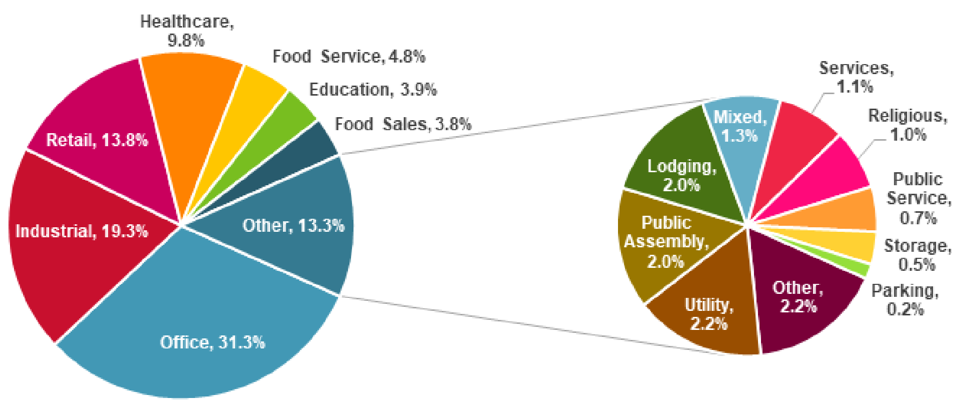


Table 3-1: Share of Energy by Commercial & Industrial Customer Sectors

Category	Description	Share of Energy
Office	Includes tech buildings, offices, and financial institutions.	31.3%
Industrial	Includes industrial buildings such as manufacturing. The BERTHA database does not offer further detail on the industries that contribute to the electricity consumption.	19.3%
Retail	Includes car dealerships, dispensaries, and malls.	13.8%
Healthcare	Includes inpatient and outpatient facilities in addition to veterinarians	9.8%
Food Service	Includes restaurants, bars, and fast food establishments.	4.8%
Education	Includes primary, secondary, post-secondary institutions and day care.	3.9%
Food Sales	Includes convenience stores, gas stations, and supermarkets.	3.8%
Other	Includes buildings which end use could not be clearly defined in BERTHA.	2.2%
Utility	No additional detail available.	2.2%
Public Assembly	Includes gyms, clubhouses, and community centers.	2.0%
Lodging	Includes hotels, motels, and boarding facilities.	2.0%
Mixed	No additional detail available.	1.3%
Services	Includes auto repair shops, car washes, personal and other services.	1.1%
Religious	No additional detail available.	1.0%
Public Service	Includes postal offices, fire halls and libraries.	0.7%
Storage	Includes warehouses and distribution centers.	0.5%

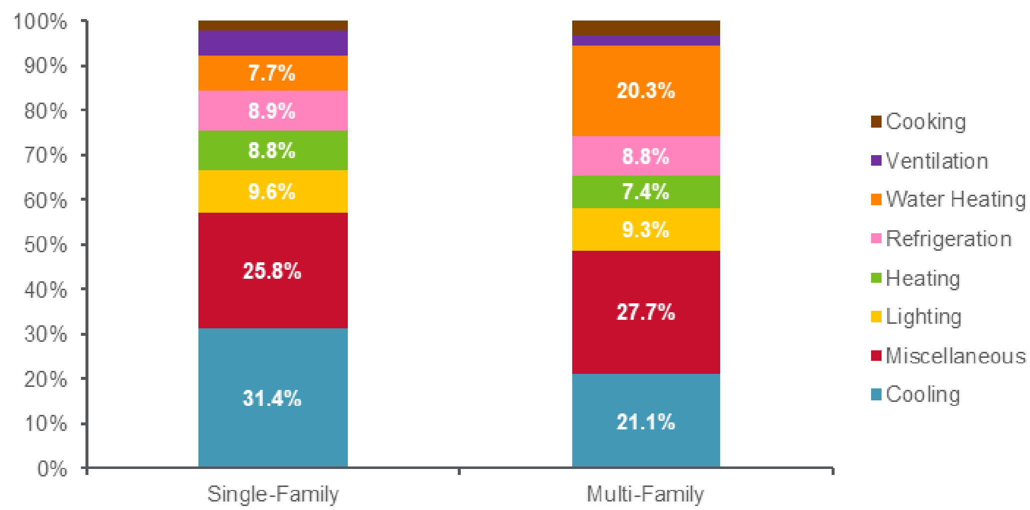
3.2 Customer Base End Use Identification

The subcategories of customers identified above were further examined to determine end use consumption. The EIA's Residential Energy Consumption Survey (RECS) and Commercial Buildings Energy Consumption Survey (CBECS) were used to establish baseline end use consumption for 2012 and 2015 respectively. Survey micro data was used to create end use consumption estimates representative of the Mountain Region, an area encompassing Idaho, Montana, Wyoming, Nevada, Utah, Colorado, Arizona and New Mexico. This was used to proxy the end use consumption in Colorado due to the absence of more local data. National forecast trends for end use consumption provided in the Annual Energy Outlook 2018 were used to forecast the regional end use consumption estimates over time. The profiles of each subcategory previously identified are examined in this section.

3.2.1 Residential Customers

Residential customers are estimated to consume more than one-quarter of electricity on cooling, the largest amount of any end use. Other major end uses are lighting, water heating and heating, which combined account for another quarter of electricity consumption by end use. Other end uses examined include ventilation, cooking, refrigeration, and miscellaneous. The miscellaneous is a catch-all category that includes appliances, plug loads, HVAC auxiliary units. The differences between single-family and multi-family end use consumption is highlighted below. The values shown in the figure below are based on the information from the 2015 RECS survey. These values are forecast to change marginally over time due to efficiency improvements and higher penetration of energy efficient equipment.

Figure 3-8. Share of Consumption by Residential End Use, 2017



Single-Family

Single-family units are estimated to consume nearly one-third of electricity for cooling, followed by a quarter on miscellaneous activities. Lighting, refrigeration and heating correspond to 27% of electricity consumption, with each end use making up around a third of the combined total. Ventilation and cooking remain as the smallest end use categories, combining for less than 10% of total electricity consumption.

Multi-Family

Multi-family units are estimated to consume over one-quarter of electricity for miscellaneous activities, followed closely by cooling and water heating. Lighting, refrigeration and heating mirror similar proportions to single-family units, while cooking and ventilation are the end uses consuming the least energy.

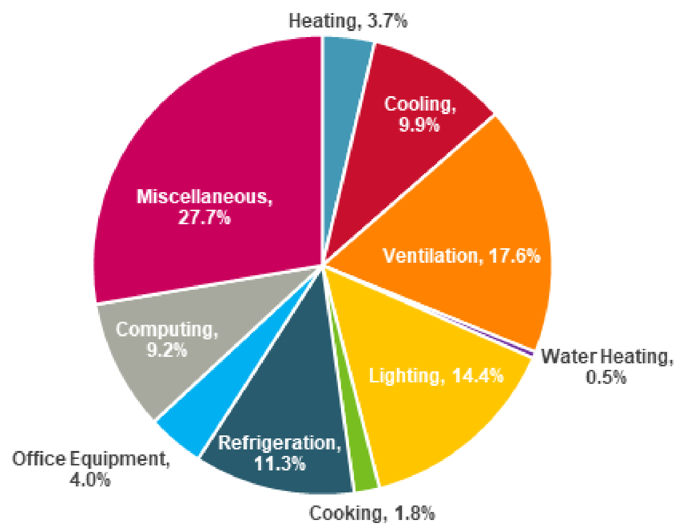
Table 3-2. Annual Average Residential Electricity Consumption per Customer by End Use in 2017, kWh

End Use	Single-Family	Multi-Family
Cooling	2,802	1,283
Miscellaneous	2,298	1,689
Lighting	857	568
Refrigeration	795	534
Heating	784	449
Water Heating	687	1,238
Ventilation	514	138
Cooking	186	195
Total Electricity Consumption	**8,924**	**6,095**

3.2.2 Commercial & Industrial Customers

Commercial & Industrial consumption is disaggregated into 10 end uses. These end uses include heating, cooling, ventilation, water heating, lighting, cooking, refrigeration, office equipment, computing, and miscellaneous. Building classifications from BERTHA were matched to one of 19 building classifications in the EIA's 2012 CBECS to generate static end use estimates for 2012. The Annual Energy Outlook 2018 (AEO 2018) was used to capture forecasted trends in end uses over time. These trends are applied to the static 2012 end use shares to estimate actual end uses for each given year. The end uses are then aggregated into the 17 subcategories presented in the Customer Base Segmentation. End uses vary drastically across different building types and are presented briefly below for each subcategory. An aggregate electricity consumption across all Commercial & Industrial subcategories is shown below. All results presented are reflective of end use estimates for 2017.

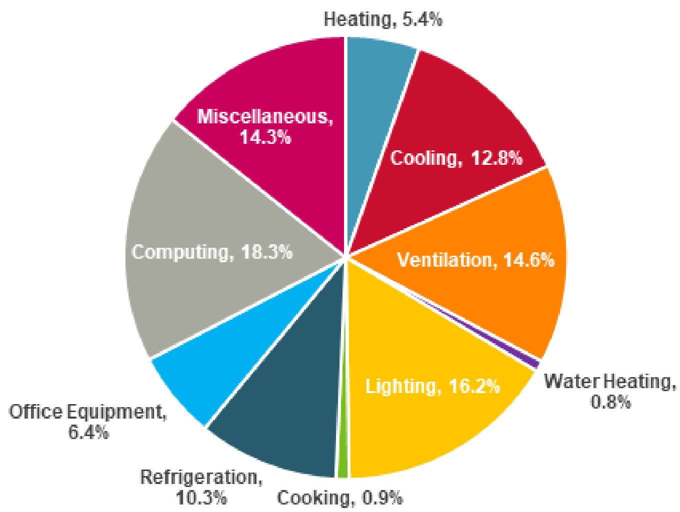
Figure 3-9. End Use Consumption Shares: Commercial & Industrial, 2017



Education

End uses in education are disaggregated across several categories, with six individual end uses exceeding 10% of total electricity consumption. Computing is the highest end use, and lighting and ventilation are the second and third highest end uses. The most inconsequential end uses for buildings classified in this subcategory are cooking and water heating.

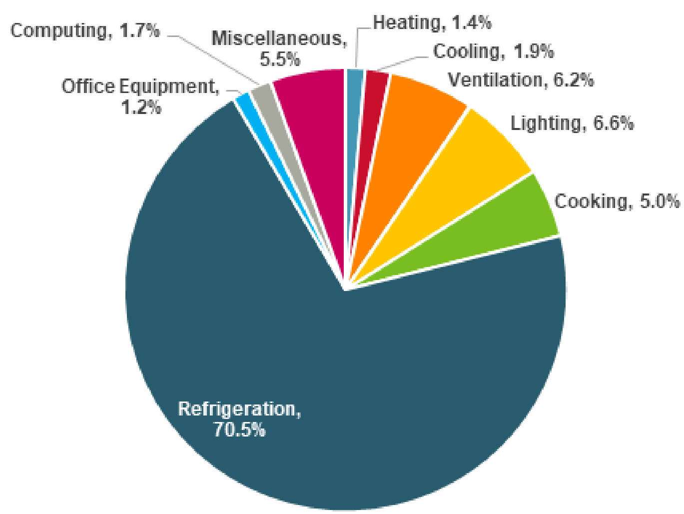
Figure 3-10. End Use Consumption Shares: Education, 2017



Food Sales

Electricity usage in food sales is primarily consumed for refrigeration with no other end use having a share greater than 7%. Lighting and ventilation are the next largest end uses in the consumption of electricity.

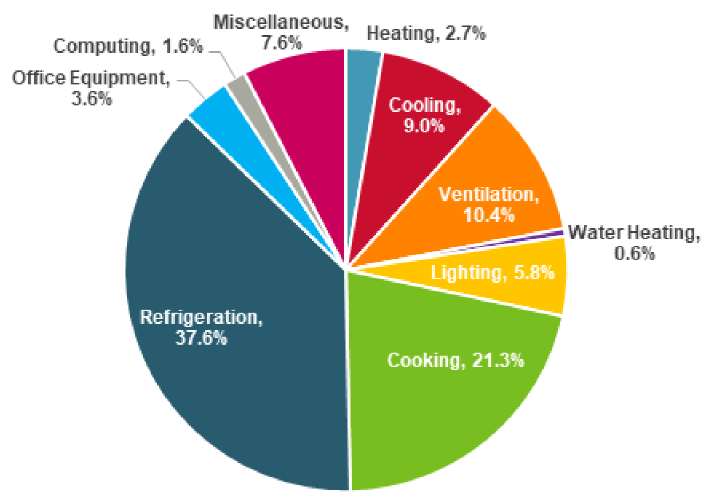
Figure 3-11. End Use Consumption Shares: Food Sales, 2017



Food Service

Food service also has refrigeration as the primary end use consumption of electricity. Combined with electricity used for cooking, the two end uses account for over half of all electricity consumed in the food service sector. Ventilation and cooling represent the next two largest end uses.

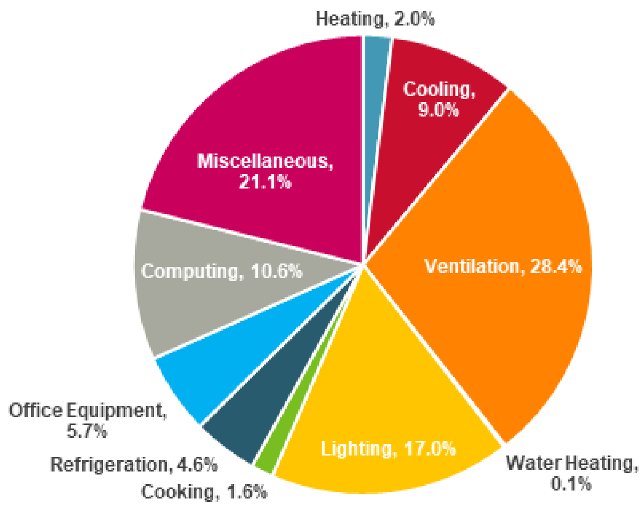
Figure 3-12. End Use Consumption Shares: Food Service, 2017



Healthcare

Health care expends the most electricity on ventilation, followed by miscellaneous uses. Lighting and computing also represent a significant amount of electricity usage, accounting for more than one-quarter of all electricity usage.

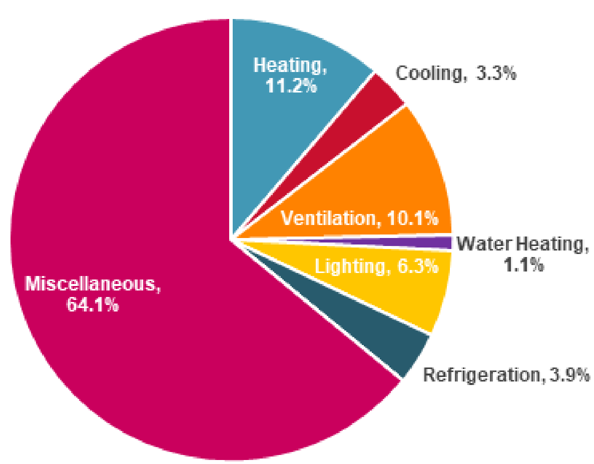
Figure 3-13. End Use Consumption Shares: Healthcare, 2017



Industrial

A vast majority of industrial energy consumption is spent on manufacturing processes, which contribute to the miscellaneous category. As a result, the miscellaneous category captures a majority of total electricity consumption in the industrial sector. Heating and ventilation are the next two largest end uses, accounting for over 20% of electricity use.

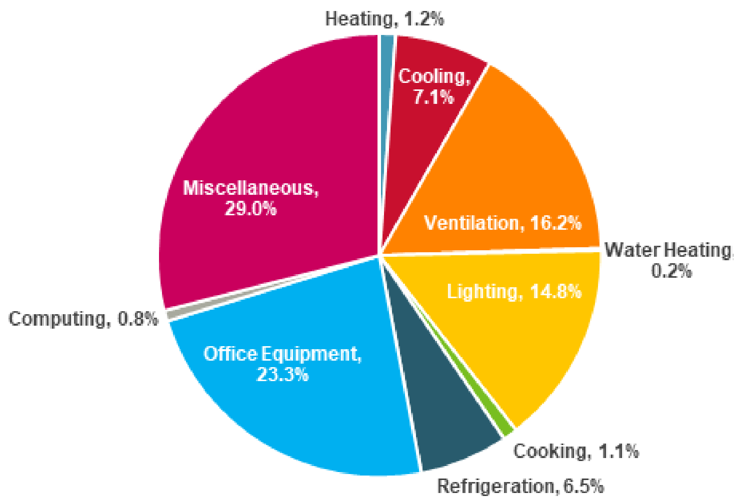
Figure 3-14. End Use Consumption Shares: Industrial, 2017



Lodging

Miscellaneous and office equipment are the two largest end uses for lodging, and contribute to over half of all electricity use. Ventilation and lighting are also categories where significant electricity is consumed.

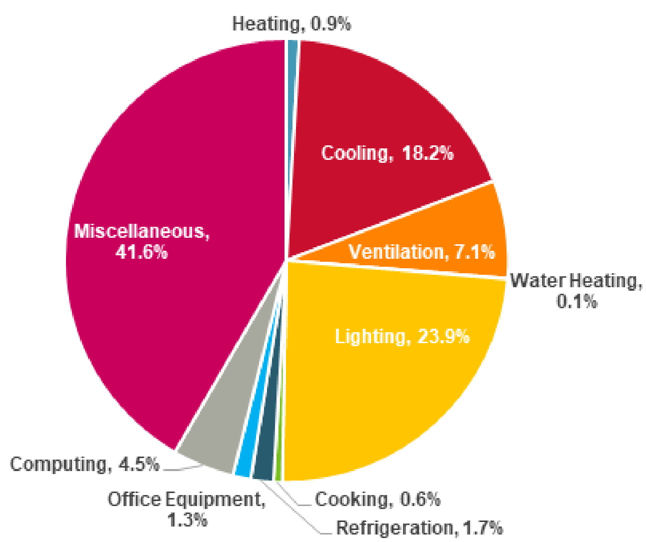
Figure 3-15. End Use Consumption Shares: Lodging, 2017



Mixed

Given the mix of buildings classified in this subcategory, the miscellaneous end use captures a significant amount of electricity consumption. Lighting is the second most electricity-intensive end use, accounting for nearly one-quarter of all electricity consumption. Cooling accounts for nearly another 20%.

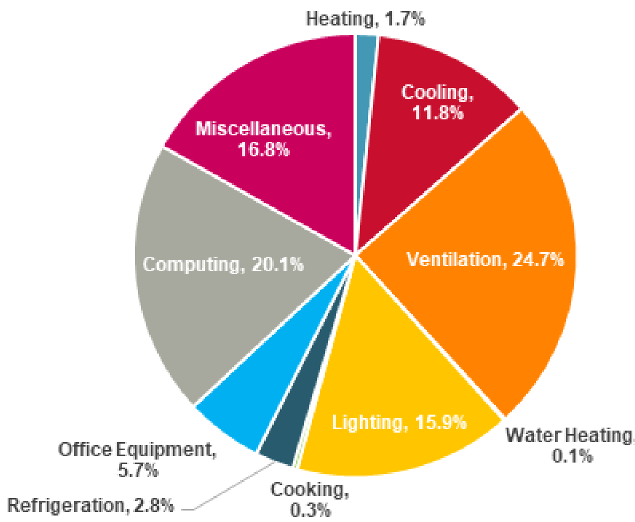
Figure 3-16. End Use Consumption Shares: Mixed, 2017



Office

The two largest end use categories for offices are ventilation and computing. Cooling, lighting, and miscellaneous are three other categories that contribute to significant electricity consumption.

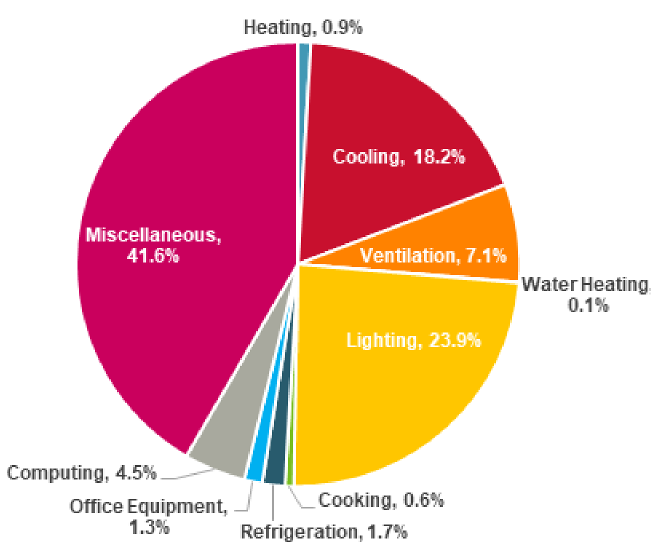
Figure 3-17. End Use Consumption Shares: Office, 2017



Parking

Parking does not have a clear match to a defined building classification in the CBECS, and as a result, it was matched to an "Other" classification in the CBECS. As a result, the end use consumption may not be an exact match of parking facilities. However, given the small electricity profile of the parking subcategory, the impact to these categories is minimal.

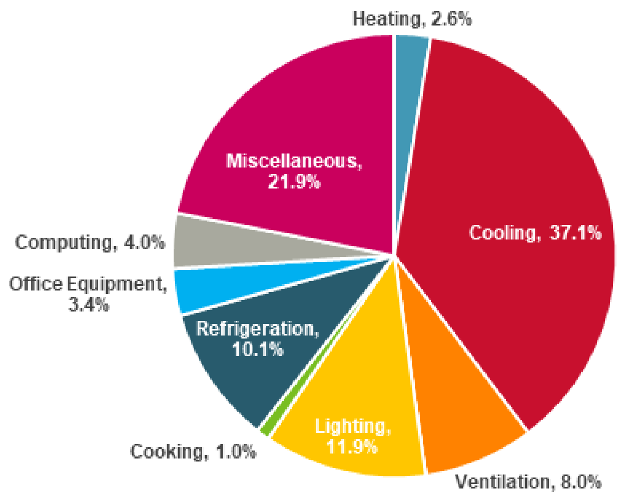
Figure 3-18. End Use Consumption Shares: Parking, 2017



Public Assembly

The public assembly subcategory expends the most electricity on cooling, accounting for 37% of total electricity consumption. Miscellaneous, lighting and refrigeration are the next largest end uses.

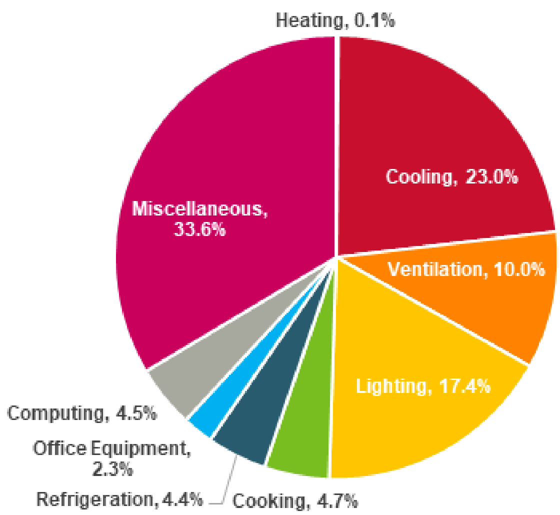
Figure 3-19. End Use Consumption Shares: Public Assembly, 2017



Public Service

Roughly one-third of electricity consumed in public service is attributed to miscellaneous end uses. Cooling, lighting and ventilation represent the next largest end use categories which combined for roughly 50% of all electricity consumed.

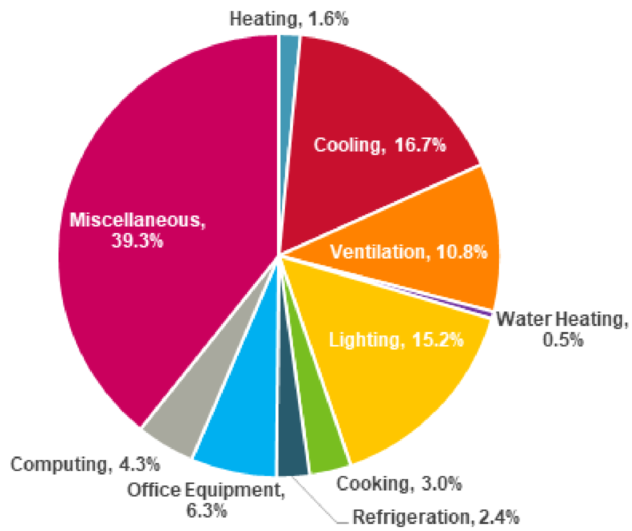
Figure 3-20. End Use Consumption Shares: Public Service, 2017



Religious

The religious subcategory also has a high percentage of electricity consumption in the miscellaneous bucket. The three other large end use categories are cooling, lighting and ventilation.

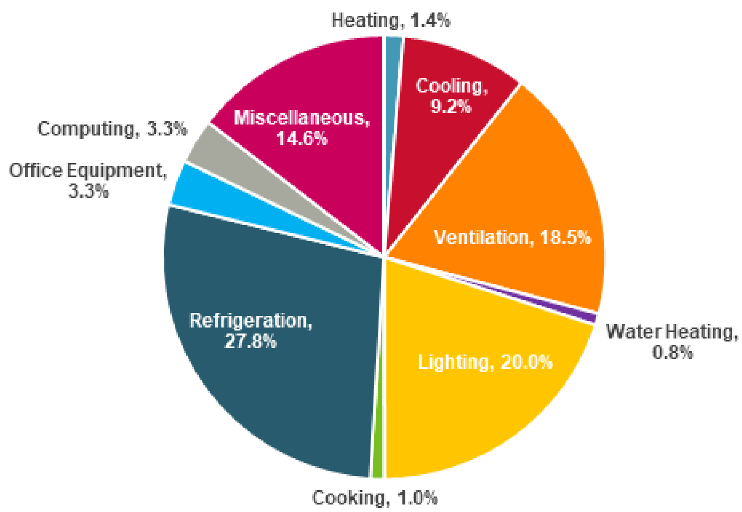
Figure 3-21. End Use Consumption Shares: Religious, 2017



Retail

Retail uses high levels of electricity consumption for refrigeration, lighting, and ventilation. These categories combine for nearly two-thirds of all electricity consumption. Miscellaneous is the only other category exceeding 10% of electricity consumption.

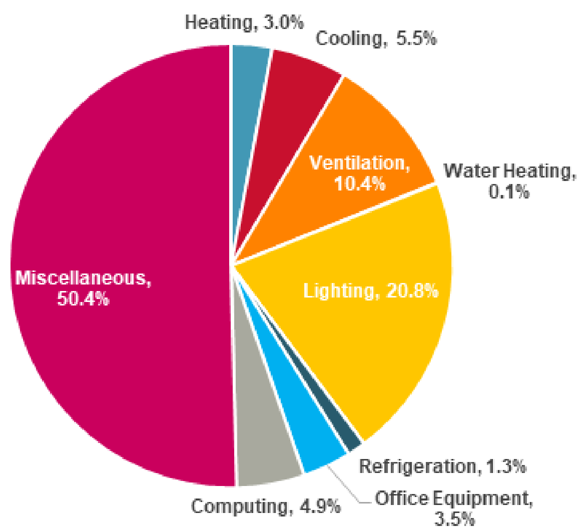
Figure 3-22. End Use Consumption Shares: Retail, 2017



Services

Nearly half of the electricity consumption for services is attributed to miscellaneous end uses. Lighting and ventilation are other significant end uses which account for 30% of electricity consumption.

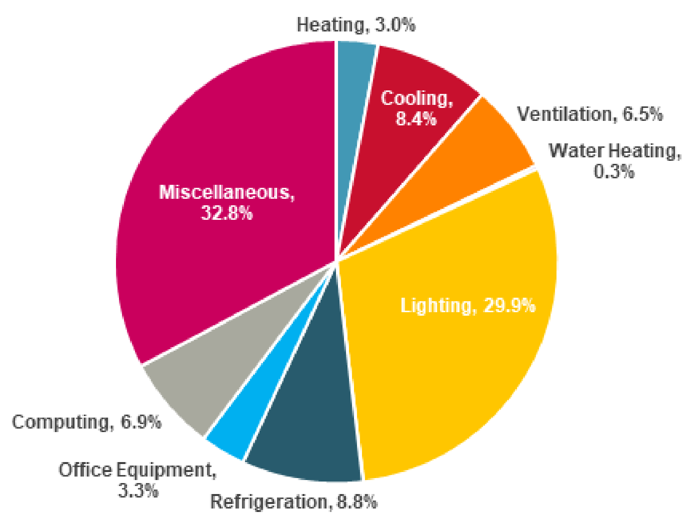
Figure 3-23. End Use Consumption Shares: Services, 2017



Storage

Two-thirds of storage electricity consumption is attributed to miscellaneous end uses and lighting. The remaining end uses each utilize less than 10% of total electricity consumed for storage.

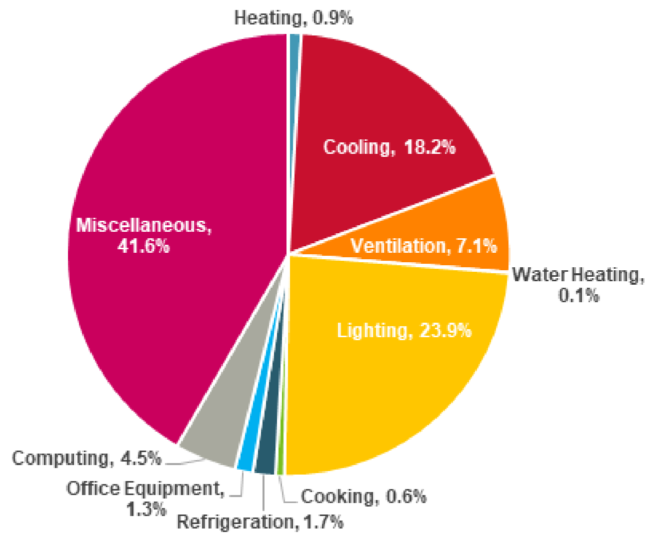
Figure 3-24. End Use Consumption Shares: Storage, 2017



Utility

The utility subcategory did not have a comparable match in the CBECS survey. As a result, it was classified as “Other” and may contain an end use profile that is not directly representative of the true end use consumption. However, only 0.3% of all electricity consumed in the Commercial & Industrial category is attributable to utilities.

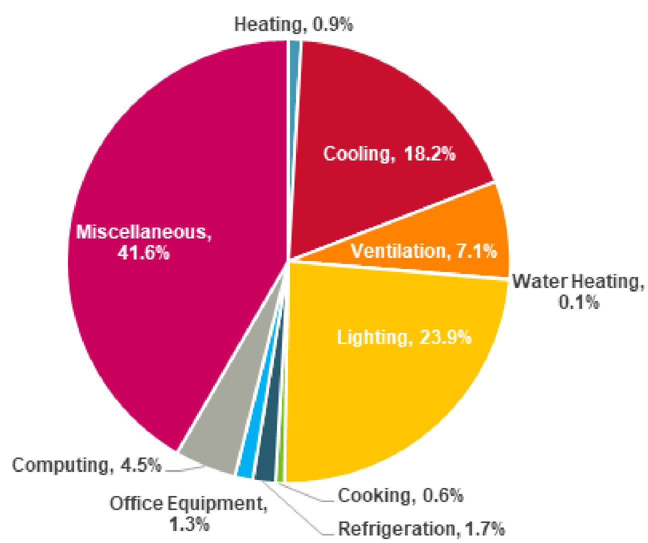
Figure 3-25. End Use Consumption Shares: Utility, 2017



Other

The other subcategory contains buildings that could not be classified in one of the 16 subcategories previously described. These buildings are also assumed to be matched to the “Other” classification in the CBECS. Given the classification of these buildings are unknown, additional accuracy for this category is not attainable.

Figure 3-26. End Use Consumption Shares: Other, 2017



3.3 Overview of Existing DER Programs

According to program information provided by PRPA, PRPA had 12 actively funded DER programs common across the utility at the end of 2017. There are additional city-specific programs that are tracked by each of the four city utilities. There are also 5 programs that are not actively funded, but still provide savings due to the remaining lifetime of previously installed EE measures.

The common DER programs with the highest reported energy savings are Efficiency Works, Business Rebates; Building Tune-Up; Efficiency Works, Consumer Products; Efficiency Works, Homes Rebates and Audits; and Midstream Lighting.

Efficiency Works, Business Rebates – This program targets commercial and industrial businesses across all municipalities and incentivizes exterior and interior lighting replacement, cooler/freezer gasket replacement, and other miscellaneous replacements. PRPA tracks the energy savings on a project specific basis in a spreadsheet. Some of the previous commercial and industrial programs (such as LightenUp and Energy Efficiency Program) have been rolled up into the Efficiency Works Business program. As of 2017, across all four cities, the Efficiency Works Business program was estimated at 152,000 MWh of cumulative energy savings.

Building Tune-Up – The Building Tune-Up program is designed to achieve cost-effective electricity, natural gas and water savings in commercial and industrial facilities through retro-commissioning (RCx). Targeted improvements are the implementation of low- or no-cost measures. In 2017, this program was estimated at about 7,200 MWh of cumulative energy savings.

Efficiency Works, Consumer Products – This program is a residential rebate-based program that provides incentives for consumers to purchase devices and appliances that contribute to energy efficiency by replacing a less efficient device with a new, more efficient device. The largest contributors to the Consumer Products programs has been the midstream lighting rebate program in which rebates are directed to lighting retailer to sell qualifying efficient consumer lighting at reduced pricing, and the Cooling Rebate Program, which provided rebates for high-efficiency air conditioners (2002-2006). In 2017, the Consumer Products programs were estimated at about 9,100 MWh of cumulative energy savings.

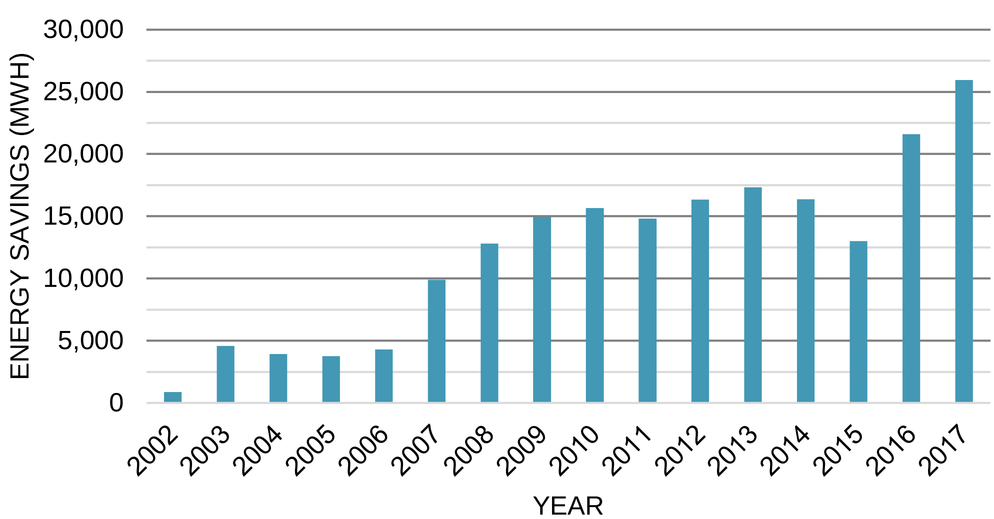
Efficiency Works, Homes Rebates and Audits – This program is a residential rebate-based program that provides energy assessments and rebates for efficiency upgrades in homes. PRPA estimated that at the end of 2017 approximately 1,900 MWh of savings (since PRPA began administering the program across the four cities in late 2014).

A recently developed demand response pilot that became operational in 2017 is one of PRPA’s first efforts in a direct load control program. It was developed as a pilot to explore how DR could be operated by PRPA to provide maximum benefits to the overall system (integrated wholesale and retail levels). The pilot made use of existing DR resources previously employed by Longmont and Fort Collins: Longmont’s distribution system voltage reduction and Fort Collins’s direct load control applied to participating customers’ air conditioners and electric water heaters. This program, subject to the power system operator needs, is in contrast to the Residential and Small Commercial Peak Partners Program, which is activated by IntelliSOURCE software during peak load times and has been place since 2014. The peak partners program is tied to load reduction of thermostats and electric water heaters. Although these two programs are not currently within the top energy saving programs, they are important time-based load reduction programs in PRPA's portfolio and have a potential for contributing to future energy savings and load reduction. In addition, PRPA has recently initiated an EV charging study that provides rebates for a limited number of Wi-Fi enabled chargers. In this pilot PRPA hopes to gain a better understanding of how and when people charge EVs in their homes, as well as how EV charging can be employed as a flexible load.

Within the common programs, PRPA reported a cumulative annual savings of 196,137 MWh and a cumulative 31.4 MW demand load reduction in from 2002 through 2017 in the EE programs common across PRPA. The active annual savings at the end of 2017 (i.e. from DER measures that have not expired) is approximately 170,000 MWh, or 5.4% of current customer sales. The active demand reduction at the end of 2017 (i.e. from active DER measures that have not expired) is approximately 30 MW, or about 4.5% of current summer peak load.

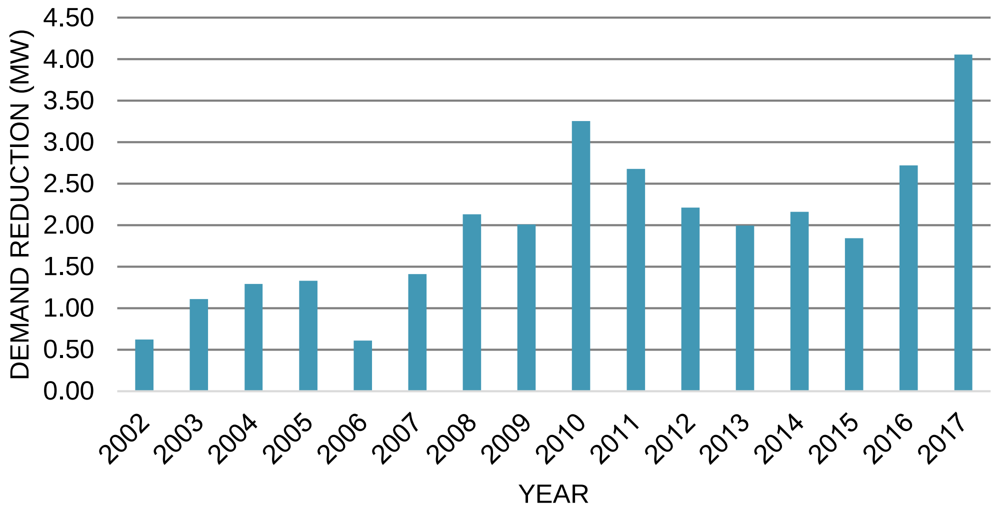
For the common programs in 2017, PRPA reported 25,943 MWh of new incremental energy savings[4] and 4.06 MW of new incremental demand reduction. New incremental energy savings have generally doubled over the last 10 years. Figure 3-27 and Figure 3-28 show the new incremental energy savings and demand reduction from 2002 through 2017.

Figure 3-27. PRPA DER Programs New Incremental Energy Savings, MWh



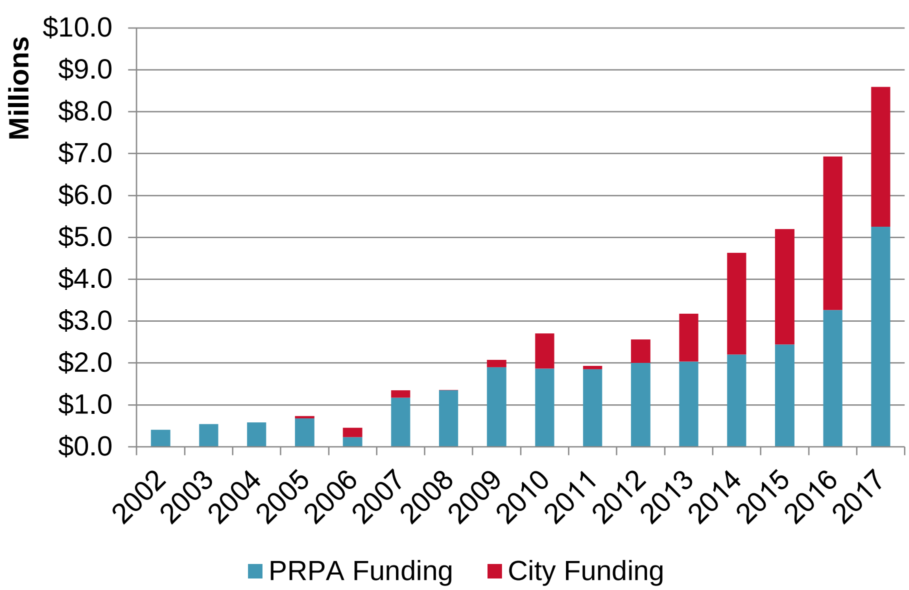
[4] New incremental energy savings are savings added in a given year and does not include prior accumulated savings or reductions from prior year savings lost at end of life.

Figure 3-28. PRPA DER Programs New Incremental Demand Reduction, MW



PRPA and the member cities have funded DER programs since 2002 as shown in the following figure. According to PRPA, the total utility funding for 2019 and 2020 is expected to be about $14.1 million to accomplish planned new incremental energy savings of 34,000 MWh, or a first year measure savings cost of about $415/MWh (or a levelized cost of $44.2/MWh based on 13 year measure life and 5% discount rate).

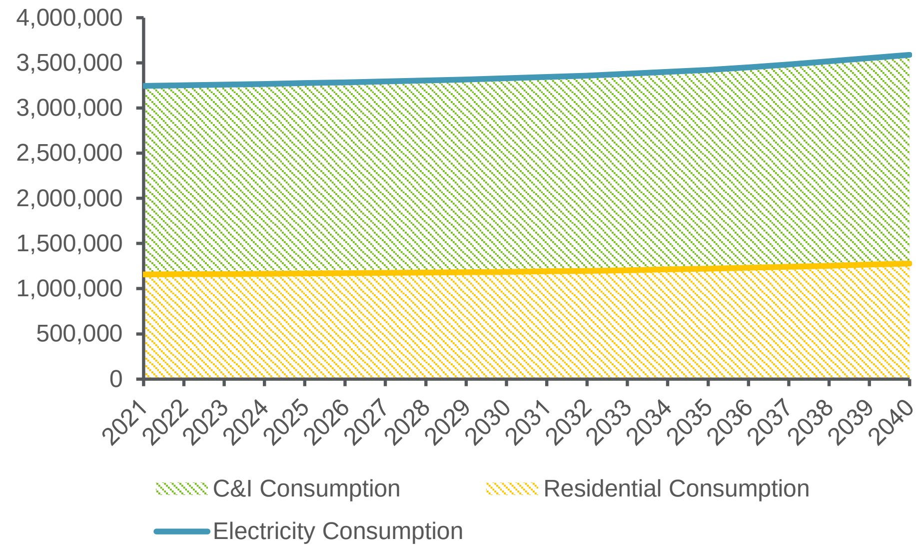
Figure 3-29. PRPA DER Programs Annual Funding



3.4 Establishment of Base Case Load Forecast

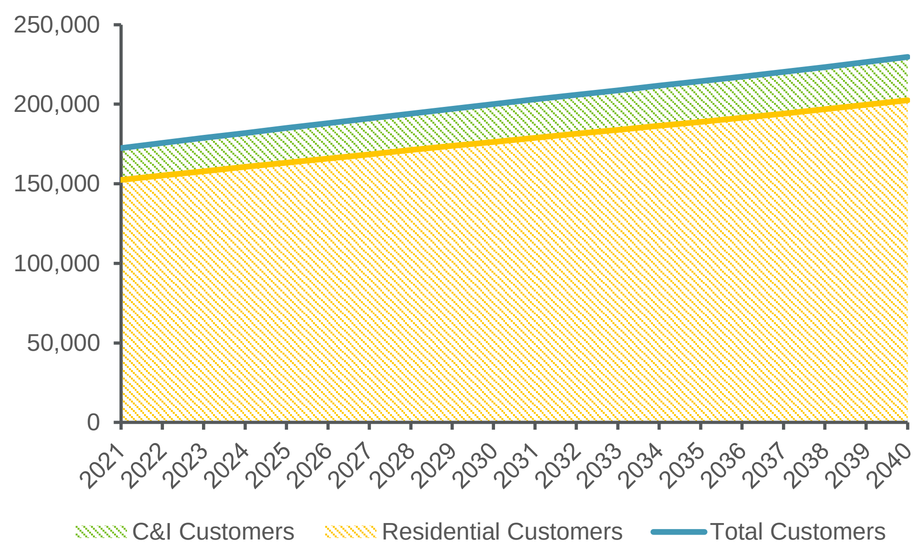
The load forecast was constructed from a top-down approach. PRPA provided an annual forecast through 2040. The first step to disaggregating the forecast was to divide the load between Residential and Commercial & Industrial customers. The share of each city's load and customer split over the last five years was applied to the annual forecast to calculate the expected electricity usage by customer class.

Figure 3-30. Electricity Consumption Forecast by Customer Class, MWh



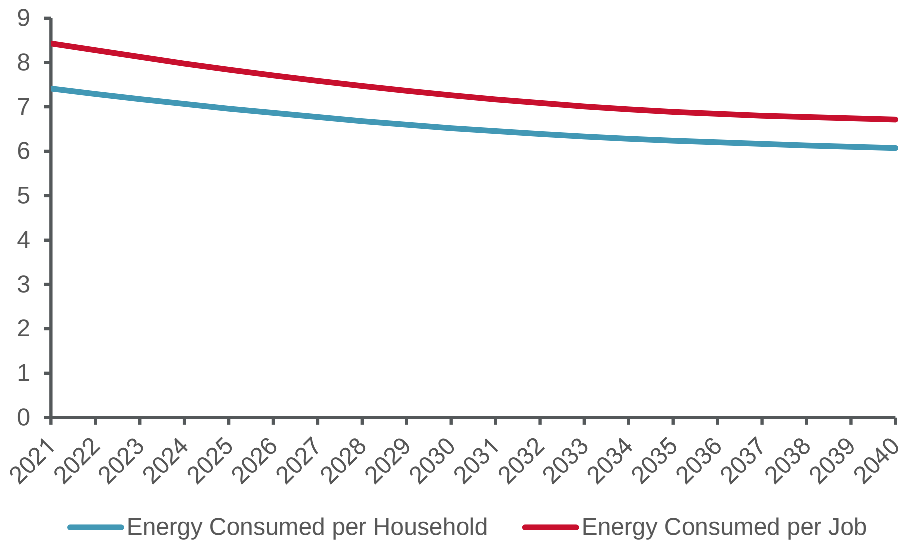
Next, the share of electricity was calculated for each subcategory based on Fort Collins' BERTHA data. The share of electricity, shown in Figure 3-2, was then applied to the electricity forecast to further disaggregate the load. Applying the end use breakouts shown in Section 3.2, the forecast is then split by end use for each subcategory.

Figure 3-31. Forecasted PRPA Customers



Over time, annual load is expected to grow an average of 0.63% per year. Customer growth within the PRPA service area is expected to grow faster than the load. On average, residential customers are anticipated to grow on average 1.59% per year, and C&I customers are anticipated to increase on average by 1.46% per year. Normalizing this load and customer growth to regional economic growth forecasts, we find that electricity consumption per household and per job is reduced over time.

Figure 3-32. Electricity Consumption per Household, Electricity Consumption per Job over Time, MWh



The decline in electricity consumption can be attributed to natural energy efficiency factors, which are embedded in the base load forecast. Natural energy efficiency describes any efficiency gains that are not attributed to specific utility programs. Three main factors are expected to drive natural energy efficiency savings: building energy codes for new construction, increasing efficiency standards for consumer appliances, and the replacement of aging appliances.

According to Colorado Department of Local Affairs[5], Larimer County, Loveland, and Longmont have adopted the 2015 IECC code for new construction. Fort Collins has recently adopted the 2018 IECC code for new construction[6]. New construction in the PRPA service area will meet at least 2015 standards (across the county and cities) and will be more energy efficient than the existing stock.

In addition, the existing stock of households have appliances that are subject to reach the end of their useful life and will need to be replaced. Newer appliances reduce the electricity consumed. Natural energy efficiency reduces the growth in the base load, and results in a decline in per capita energy consumption.

[5] Colorado Department of Local Affairs. https://www.colorado.gov/dola/colorado-energy-codes-0

[6] Codes || City of Fort Collins. https://www.fcgov.com/building/codes

4 Energy Efficiency Potential

The following section describes the methodology used to estimate technical, economic, and achievable potential for identified energy efficiency measures. Over fifty measures were identified and evaluated for all applicable categories described in Section 3.1. Each individual measure is defined by the baseline (what the measure compares against), incremental energy savings (compared to the baseline), a useful life estimate for each measure and an incremental cost (compared to the baseline) for each measure. Measures are recorded across different baselines, and are standardized to represent one household or customer. For example, the savings and cost for a smart thermostat installation are reported per thermostat, while attic insulation energy savings is evaluated per square foot. These measures are converted to savings per household for residential customers. Conversions were performed through estimates derived from the Residential Energy Consumption Survey (RECS), the Commercial Buildings Energy Consumption Survey (CBECS), City of Fort Collins customer data, PRPA experience and other distributed energy resources reports.

4.1 Energy Efficiency Measures and Assumptions

For each end-use category at least one energy efficiency measure was defined for each residential customer segment. The list of residential measures is shown in the table below. The measures included in this study are those currently available in in the market (i.e. future efficiency technologies that may be developed are not included). Further details for the EE measures are included in Appendix A.

Table 4-1. Residential Energy Efficiency Measures

EE Measure Name	Customer Segment
Heating	
Smart Thermostat installation - Electric Heating*	all residential
Smart Thermostat installation - Gas Heating*	all residential
Programmable Thermostat installation - Heating	all residential
Weatherization: Air Sealing	all residential
Weatherization: Insulation	all residential
High Efficiency Windows	all residential
Installation of ENERGY STAR® storm windows/doors	all residential
Install Heat Recovery Ventilation	all residential
Cooling	
Central Air Conditioner upgrade	all residential
Smart Thermostat installation – Cooling*	all residential
High efficiency air handler/rooftop units	Multi-family
Ventilation	
Electrically Commutated Furnace Blower Motor	all residential

EE Measure Name	Customer Segment
Water Heating	
Heat-Pump Electric storage water heater	all residential
Lighting	
LED Upgrade (interior)	all residential
LED Upgrade (exterior)	single family
Refrigeration	
ENERGY STAR® freezer	all residential
ENERGY STAR® refrigerator	all residential
Refrigerator Recycling	all residential
Miscellaneous	
ENERGY STAR® pool pumps	all residential
ENERGY STAR® dishwasher	all residential
ENERGY STAR® clothes washer	all residential
ENERGY STAR® clothes dryer	all residential
ENERGY STAR® electronics (advanced power strip)	all residential
Faucet Aerators	all residential
Low Flow Showerheads	all residential

*A smart thermostat is one physical device, but impacts both heating and cooling. Therefore, the smart thermostat measures are broken down by end-use and customer heating type. During total resource cost test, the measures were appropriately combined to evaluate the economic viability as a whole.

For each end-use category at least one energy efficiency measure was defined for each commercial & industrial customer segment. The list of commercial & industrial measures is shown in the table below.

Table 4-2. Commercial & Industrial Energy Efficiency Measures

EE Measure Name	Customer Segment
Heating	
Smart Thermostat installation – Heating*	All Commercial Categories
Cooling	
Air-cooled Chiller upgrade	All Commercial Categories
Water-cooled Chiller upgrade	Healthcare, Industrial, and Office Categories
Evaporative pre-cooling installation on air-cooled condenser	Retail, Education, Healthcare, Industrial, Office, and Utility
High efficiency air handler/rooftop units	All Commercial Categories
Advanced RTU Controller (ARC) retrofit	All Commercial Categories
Smart Thermostat installation – Cooling*	All Commercial Categories

EE Measure Name	Customer Segment
Ventilation	
Electrically Commutated Motor-Variable Air Volume	All Commercial Categories
NEMA Super Premium Motors	Education, Healthcare, Industrial, Office, Utility
Lighting	
LED Screw-in Upgrade from CFL (interior)	All Commercial & Industrial Categories
LED Linear Upgrade from T8/T12 (interior)	All Commercial & Industrial Categories
LED High-bay Fixtures (interior)	Industrial
LED Upgrade (exterior)	All Commercial Categories
LED Screw-in Upgrade (exterior)	Industrial
LED Area Lighting Upgrade (exterior)	Industrial
LED Linear Lighting Upgrade (exterior)	Industrial
Smart Lighting controllers / Occupancy sensors	All Commercial Categories
Smart Lighting controllers / Daylight sensors	All Commercial Categories
Cooking	
Electric Combination Ovens	Food Sales, Food Service, and Healthcare Categories
Electric exhaust hood	Food Sales, Food Service, and Healthcare Categories
Refrigeration	
Refrigerator Floating-Head Pressure Controls	Food Sales and Food Service Categories
Refrigerator/Freezer gaskets	Food Sales and Food Service Categories
Office Equipment and Computing	
Advanced power strips	All Commercial & Industrial Categories
Miscellaneous	
Energy Assessment Retro-commissioning	All Commercial & Industrial Categories
Energy Management System with Data Analysis	All Commercial & Industrial Categories

*A smart thermostat is one physical device, but impacts both heating and cooling. Therefore, the smart thermostat measures are broken down by end-use and customer heating type. During total resource cost test, the measures were appropriately combined to evaluate the economic viability as a whole.

Additional assumptions included in the energy efficiency analysis are shown in Table 4-3. These general assumptions include the discount rate and decomposition rates. The discount rate is used to represent the time value of money, and converts future costs and benefits to equivalent present value terms used in the determination of economic potential.

Decomposition rates are adjustments made to the stock of existing customers to reflect changes to the count of customers as a result of demolition, vacancy, or other reasons not associated with new construction. Based on the projection of PRPA's customer base, decomposition rates adjust the split between new and existing customers.

Table 4-3. General Assumptions

Variable	Unit	Value	Source
Discount Rate	%	5%	PRPA Assumption
Single Family Household Decomposition Rate	%	0.3%	EIA National Energy Modeling System, Residential Demand Module.
Multi-Family Household Decomposition Rate	%	0.5%	EIA National Energy Modeling System, Residential Demand Module.
Commercial Decomposition Rate	%	2.81%	Bureau of Labor Statistics, Business Employment Dynamics, 5 year average for establishment deaths in Colorado.

4.2 Technical Potential

The technical potential is the maximum possible savings available ignoring any economic or market barriers. Technical potential is representative of a theoretical maximum savings that could be achieved for all measures examined. In order to estimate the technical potential, specific factors were developed for each energy efficiency measure, unique to each customer segment. These factors were primarily derived from the RECS and CBECS surveys, though local input from PRPA was used where applicable. The five factors generated were:

- **Technology Factor** represents the percentage of the population that has the technology (e.g. percentage of households with a thermostat);
- **Electrical Factor** represents the percentage of the population that uses electricity for an end use, conditional on having that technology (e.g. percentage of households with a thermostat that are heated by electricity);
- **Saturation Factor** is the multiplication of the technology and electrical factor. It represents the percentage of the total population that is the target market for the energy efficiency measure;
- **Remaining Factor** represents the percentage of the population that has not yet adopted energy efficiency measures (e.g. percentage of households that have not yet adopted an energy efficient thermostat); and
- **Applicability Factor** represents the percentage of qualifying households able to adopt the measure. The applicability factor is assumed to be 100% for all EE measures except in instances where two measures cannot be simultaneously installed. For instance, residential customers are assumed to install either smart thermostats or programmable thermostats, but both cannot be installed and realize the sum of annual energy savings from the two measures.

To assess technical potential for each measure, the aforementioned assumptions or factors are applied to PRPA's customer base. Forecasting PRPA's future customers was performed by looking at historical trends between population and customers. Larimer County's historical population and jobs were compared against PRPA's historical customers to derive a long run relationship in growth between the two. These trends were applied to the economic forecast for Larimer County, which contained population and employment values, to estimate the total number of residential and commercial & industrial customers.[7] Customers were split to segments based on Fort Collins customer split from 2017. Customers were categorized as either new or existing in the forecast. All new construction becomes part of the existing stock in the next year, and it is assumed that each year, a small fraction of the existing stock is removed. New households are given different factors than existing households to capture technological advancements or changes since the existing stock was constructed.

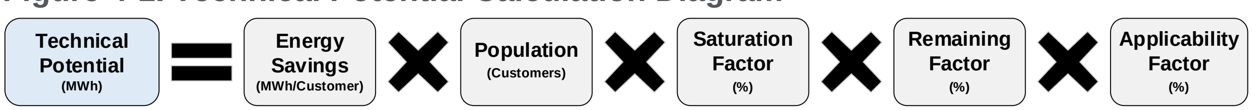
According to the Building Codes Assistance Project[8], Colorado does not have a statewide building code. Instead, Colorado is a home rule state whereby the relevant jurisdictions have adopted specific energy codes.

Since most of the households within the PRPA customer base have adopted at least a 2015 code standard so that new construction will meet at least 2015 standards (across the county and cities), we assume that there will not be a significant amount of building envelope energy efficiency that can be gained from new construction. Therefore, the remaining factor (defined above) for residential new construction building improvements will be assumed to be zero (or minimal).

Regarding appliances, some defined efficiency measures replace existing appliances with ENERGY STAR® rated appliances, but those ENERGY STAR® appliances may not be required by the building code standards (e.g. washers, dryers, refrigerators) and will remain potential for incentivizing energy efficiency for new construction. Therefore, for most appliance-related measures, the new construction remaining factor will be the same as that of the existing building stock.

For each measure, technical potential was calculated using the formula shown below.

Figure 4-1. Technical Potential Calculation Diagram



The technical potential represents the energy savings that could be achieved immediately for all existing stock and any energy savings from immediately replacing or reinstalling measures at the end of the measure's useful life. New stock is assumed to achieve the technical potential once construction has been completed. These

[7] Three of the four communities in PRPA service area fall in Larimer County and combined for nearly three-quarters of the entire county's population. Longmont is located in Boulder County, though it represents only a small portion of Boulder County's population. Larimer County was determined to be better representative of the PRPA customer base and was selected to represent the entire service area.
[8] Building Codes Assistance Project. State Code Status: Colorado. http://bcapcodes.org/code-status/state/colorado/

assumptions allow for the derivation of the maximum possible potential in any given year, regardless of any economic or market barriers.

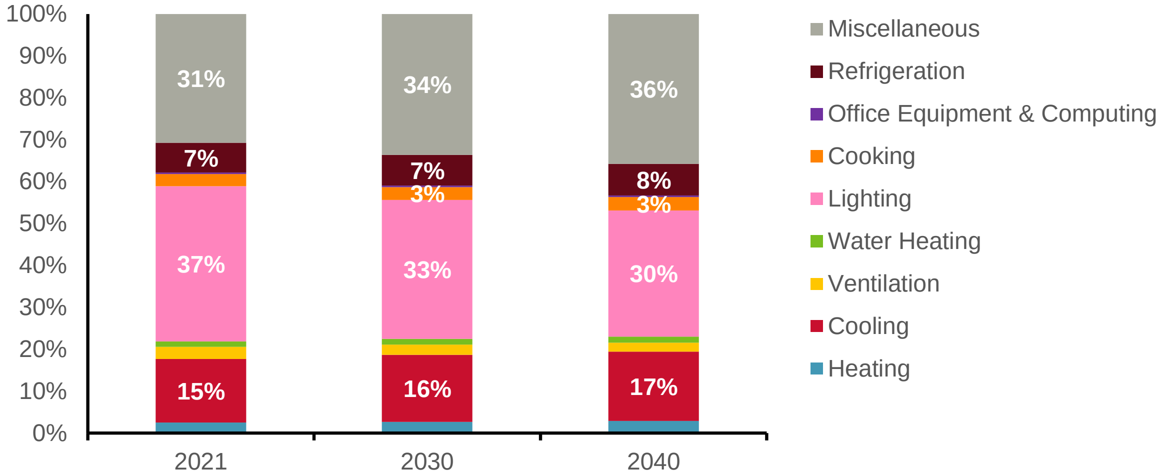
The cumulative energy savings are shown below by end use. Lighting measures and commercial energy assessment retro-commissioning and commercial energy management systems (both included in the miscellaneous category) represent some of the largest opportunities for technical potential. Together, these three measures account for 64% percent of the technical potential in 2040.

Table 4-4. Technical Potential Energy Efficiency Savings by End Use, MWh

Technical Potential	2021	2025	2030	2035	2040
Heating	29,905	32,310	35,437	38,592	42,105
Cooling	178,715	192,422	209,184	224,819	240,042
Ventilation	33,929	33,102	32,209	31,425	30,744
Water Heating	16,009	17,151	18,531	19,851	21,281
Lighting	437,265	435,517	435,002	435,191	436,379
Cooking	33,850	36,496	39,741	42,749	45,594
Office Equipment & Computing	4,396	4,740	5,161	5,552	5,921
Refrigeration	83,923	89,596	96,546	102,993	109,144
Miscellaneous	363,277	398,594	441,360	480,959	518,920
Total Technical Potential	**1,181,269**	**1,239,928**	**1,313,173**	**1,382,130**	**1,450,130**
% of Base Load Forecast	**36%**	**38%**	**39%**	**40%**	**40%**
Base Load Forecast	**3,246,452**	**3,276,068**	**3,329,157**	**3,424,440**	**3,587,996**

The figure below displays the distribution of technical potential by end use.

Figure 4-2. Technical Potential Energy Efficiency Savings by End Use



Over the study period, the technical potential does not grow significantly. As modeled, the base load forecast growth exceeds the growth of technical potential. This lower growth for technical potential is because it is assumed that new construction will be more energy efficient than the existing stock, and, therefore, some efficiency measures will not apply. The technical potential only considers current existing energy efficiency technologies and does not speculate on potential of future technologies.

4.3 Economic Potential

The economic potential is a subset of technical potential which reflects only the energy savings that are economically viable. Economic viability is defined as a set of EE measures that generate benefits which exceed the costs over the life of the measures while accounting for the time value of money. In other words, the energy savings from a set of EE measures that cost less to administer, install, and operate over the measures' life compared to an alternative generation resource will be determined to be economically viable.

4.3.1 Economic Benefits

Energy efficiency measures reduces the demand for energy from customers. In turn, utilities are able to avoid or defer costs associated with installing new generation capacity, transmission upgrades, and avoid procuring energy from generation units on the margin. This study examines three distinct types of benefits: avoided capacity costs, avoided generation costs, and avoided carbon costs. The avoided capacity costs capture the levelized fixed costs of installing a new generation unit. The avoided generation costs capture the levelized variable costs of generating or procuring energy. The avoided carbon costs capture the benefits of avoiding regulatory costs of carbon emissions from the generation of electricity. Forecasted avoided carbon costs were gathered from PRPA's 2018 Q4 Power Supply Plan (PSP) data.

In this analysis, three scenarios of avoided costs are estimated to represent low, medium and high scenarios.

1. The low scenario is intended to reflect PRPA's resource mix with minimal changes. In this case, EE avoids capacity costs tied to the cost of constructing an aeroderivative (AERO) combustion turbine generation asset. An AERO power plant is assumed to provide the necessary electric capacity as the customer load grows. In this scenario, EE is assumed to avoid energy costs determined by forecasted energy market prices for the region.
2. The medium scenario is intended to reflect PRPA's resource mix assuming coal/fossil resources are retired by 2030 and replaced with a mix of renewable resources and battery storage. In this case, EE avoids capacity costs tied to the cost of constructing batteries. The storage is assumed to provide the necessary electric capacity as existing generators are retired and the customer load grows. In this scenario, EE is assumed to avoid energy costs determined by forecasted energy market prices for the region.
3. The high scenario is intended to reflect PRPA's resource mix assuming coal resources are retired by 2030 and replaced with a mix of renewable resources and a high penetration of battery storage. In this case, EE avoided capacity costs determined by lithium ion batteries. Avoided energy costs are based a mix of wind and solar costs.

Table 4-5. Avoided Cost Scenario Assumptions for Energy Efficiency

Scenario	Avoided Cost ($/MWh)	Notes
Low	$59.38	Base case, avoided capacity from a 83MW aeroderivative engine (LM6000) power plant and avoided generation from energy market rates, blended cost on energy basis
Medium	$67.47	Avoided capacity from battery storage and avoided generation from a blend of wind and solar power plants; blended cost on energy basis
High	$76.62	This scenario reflects a blend of wind and solar power plants for avoided generation and battery storage for avoided capacity, blended cost on energy basis

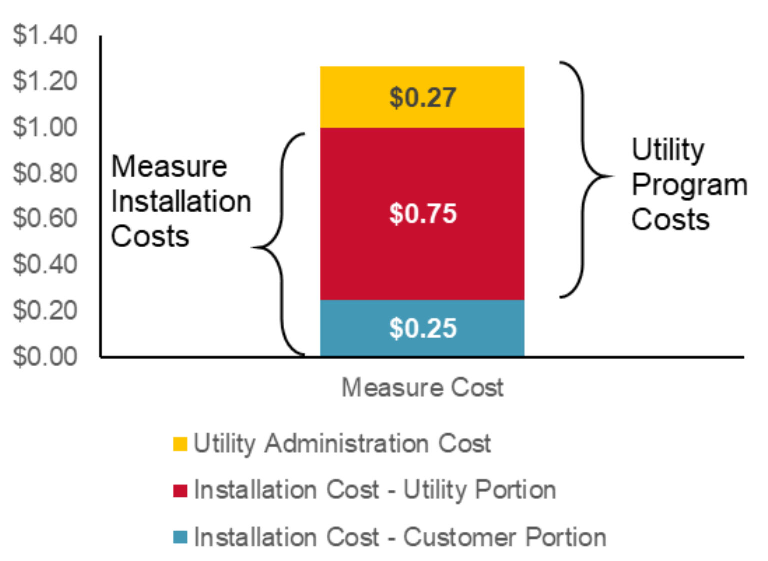
For these three scenarios, the avoided costs are capturing the benefits of delaying or not installing additional generation infrastructure (avoided capacity costs) and the benefits of not producing carbon from gas-fired units (avoided carbon costs). Based on current market conditions, estimates were gathered for the cost of generation for the different cases. The cost of carbon was gathered from PRPA's 2018 Q4 PSP data. The avoided capacity costs are assumed to begin accruing immediately, and the avoided carbon costs will begin accruing in 2025.

4.3.2 Economic Costs

Implementing energy efficiency measures results in costs borne by either the customer or the utility (or both). These costs include installation and technology costs, ongoing operations and maintenance costs, and program and administrative costs. This study utilizes the incremental cost of implementing energy efficiency measures. The incremental cost captures the cost of installing an energy efficient measure above and beyond the cost of installing a baseline measure (i.e., a less efficient or non-energy efficient measure). The evaluated costs are designed to capture the societal cost incurred, whether borne by the utility or participants, and as a result, excludes any transfers between the utility and participant (program incentives). Incremental installation costs were derived from publicly available sources.

In addition to a measure's installation cost, the total implementation cost also includes administrative costs that are borne by the utility. Program incentives make up the other portion of costs borne by the utility and PRPA has historically targeted incentivizing 50% of the measure installation cost. Based on PRPA's historical DER program funding, administrative costs were designated in this study as 35% of total utility costs (or an additional 27% above the measure installation cost). Furthermore, based on PRPA guidance, this study enlarges the utility program incentives to 75% of a measure's installation cost. The higher utility incentive share is designed to expand customer participation in EE programs beyond existing levels, to reach the achievable potential shown in the study. See below for a table showing the costs that make up the total EE measure implementation cost of a representative measure.

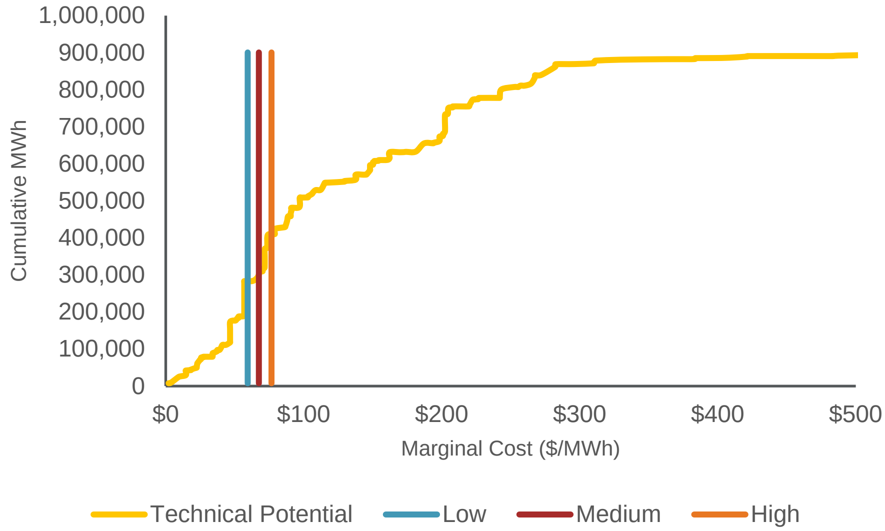
Figure 4-3. EE Measure Implementation Cost



Note: The above costs are representative of a measure installation cost of one dollar.

Each measure's implementation costs were levelized and ranked to develop a cost curve. The cost curve below indicates the amount of technical potential attainable in MWh at any given avoided cost ($/MWh). The low, medium, and high avoided costs for this study are benchmarked on the graph as a reference.

Figure 4-4. Cost Curve of EE Measures Examined, 2019



4.3.3 Portfolio Development

An energy efficiency portfolio is defined as a series of energy efficiency measures that are bundled together and evaluated as a combined package. The benefit to evaluating on a portfolio basis instead of a measure by measure basis is that the average cost of the portfolio is compared against the avoided cost. More expensive measures can be included in a portfolio because they are offset by the lower cost measures. Therefore, a portfolio can realize more cost-effective savings than when comparing costs on a measure by measure basis.

Table 4-6 shows the results of EE portfolio development in five metrics: the levelized marginal cost, the levelized average cost, the levelized first year cost, the avoided cost, and the benefit-cost ratio. The levelized marginal cost represents the cost of the most expensive measure included in the portfolio. The levelized average cost represents the utility portion[9] of the average cost per MWh (on a net present value basis) for all measures included in a portfolio from 2021 through 2033 (a 13-year lifecycle[10]). For comparison, the levelized first year cost is also shown in the table. The levelized first year cost is the utility portion of only the first year costs and savings levelized over a 13-year lifecycle. Over time, the average cost per MWh will rise as more expensive measures are installed, which results in the levelized average cost being greater than the levelized first year cost. Further discussion on installation of measures is found in Section 4.4.

The levelized average portfolio cost is compared to the avoided costs (described in section 4.3.1) to determine the resulting benefit-cost ratio for each portfolio. Portfolios were developed to ensure the benefit-cost ratio would have a value greater than 1,

[9] The utility portion includes the utility program costs, i.e., the utility administrative costs and the utility incentive portion of the measure costs.

[10] The 13-year lifecycle represents the average measure life of the EE measures considered in this study.

meaning for every dollar invested in EE measures, at least one dollar in benefits would be realized.

Table 4-6. Marginal and Average Cost of EE Portfolios

	Low	Medium	High
Levelized Marginal Cost ($/MWh)	**$75.00**	**$103.50**	**$131.00**
Levelized Average Cost ($/MWh)	**$54.69**	**$67.68**	**$76.44**
Levelized First Year Cost ($/MWh)	**$31.50**	**$36.60**	**$44.95**
Avoided Cost ($/MWh)	**$59.38**	**$67.47**	**$76.62**
Benefit-Cost Ratio	**1.09**	**1.00**	**1.00**

4.3.4 Total Resource Cost Test

The benefits and costs of each measure are compared through a total resource cost ("TRC") test, which calculates a benefit-cost ratio (present value of discounted benefits / present value of discounted costs). The TRC test evaluates whether an alternative (i.e. a portfolio of energy efficient measures) is more cost effective than the baseline (i.e. baseline measures).

In this analysis, the cost curve was used to construct portfolios containing energy efficiency measures for each scenario. In cases where the total resource cost test is greater than 1 (i.e., discounted benefits exceed costs) the portfolio is determined to be economically viable. It is important to note that the TRC test is designed for evaluating cost effectiveness from a societal perspective (utility and participants), regardless of how costs or benefits are distributed.

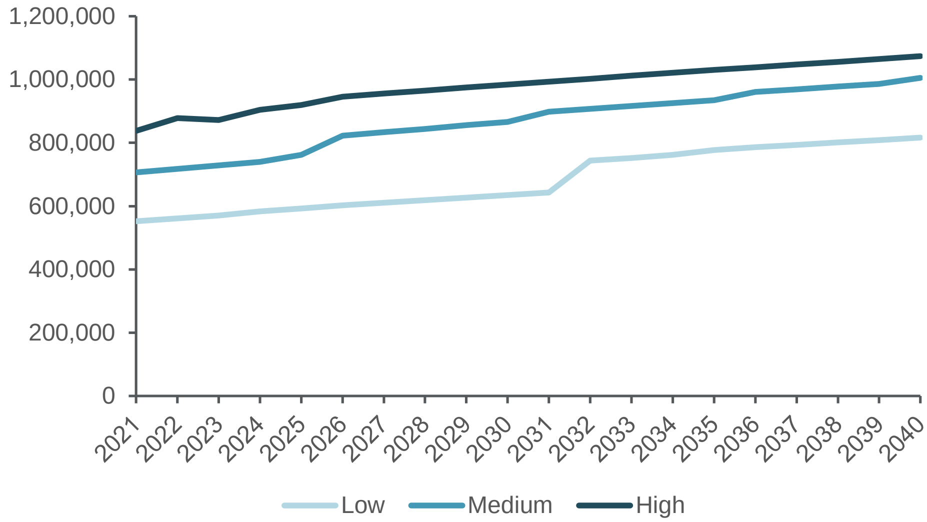
4.3.5 Economic Potential Results

The economic potential was calculated for each of the scenarios described in section 4.3.1. Scenarios with higher avoided costs will have larger economic potential, as seen in Figure 4-5. Several discontinuities can be seen over time in each scenario. These occur when the total resource cost (TRC) for a more expansive portfolio reaches or exceeds a value of 1 only after 2021. Portfolios can produce a different TRC value over time due to either a change in benefits or a change in costs in measures that are contained within a portfolio. In each year, the total resource cost test evaluates the benefits and costs over the portfolio life. For example, a portfolio evaluated in 2021 with a life of 10 years will capture all costs and benefits between 2021 and 2030. However, the same portfolio evaluated in 2030 will capture all costs and benefits between 2030 and 2039. Over time, the avoided carbon costs are projected to increase, resulting in larger benefits in future years. In addition, the cost of some energy efficiency measures are also projected to decrease over time. As technologies become more prevalent, the installation cost is expected to decrease. Price trends were generated from the EIA's Updated Buildings Sector Appliance and Equipment Costs and Efficiency Report[11] for applicable measures and these trends were applied to the estimated 2017 incremental costs to forecast future costs. As a result, increasing benefits and decreasing costs allow the TRC value for

[11] Energy Information Administration. "Updated Buildings Sector Appliance and Equipment Costs and Efficiency," June 2018. https://www.eia.gov/analysis/studies/buildings/equipcosts/.

portfolios to increase over time and incorporate additional energy efficiency measures later in the study period.

Figure 4-5. Economic Potential for Energy Efficiency Measures by Scenario



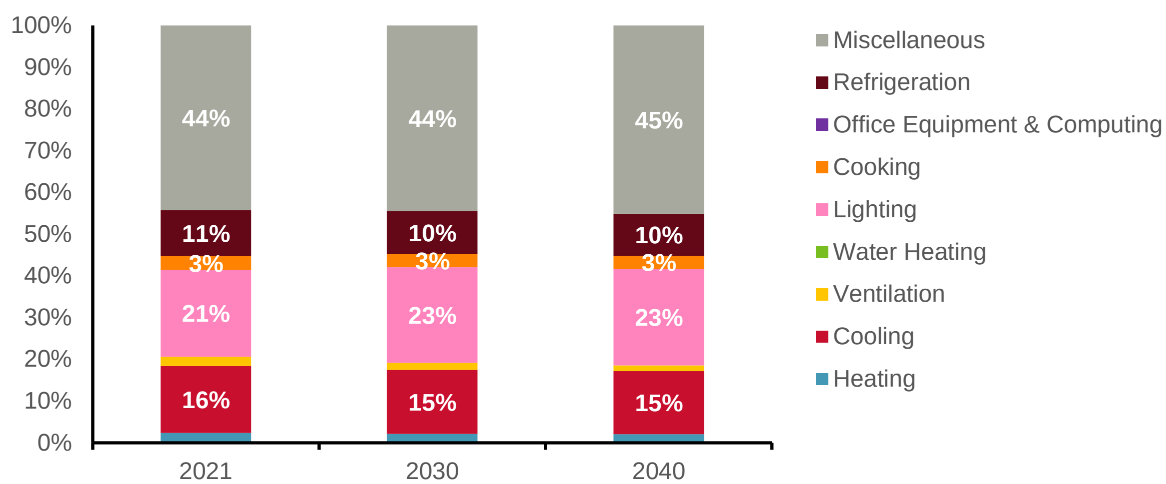
Similar to the technical potential, when a more expansive portfolio becomes economically viable, it is assumed that all existing customers immediately adopt the marginal, or highest cost, measure(s) and new customers will adopt the measure(s) once construction is completed. All customers will replace measures immediately following the end of a measure's useful life, to once again represent a theoretical level of potential that is economically viable. Table 4-7 displays the economic potential for the medium avoided cost case.

Table 4-7. Economic Potential Energy Efficiency Savings by End Use, MWh, Medium Avoided Cost Scenario

Economic Potential	2021	2025	2030	2035	2040
Heating	16,564	17,345	18,291	19,183	20,113
Cooling	114,141	122,979	133,803	143,867	153,525
Ventilation	15,850	15,268	14,677	14,189	13,799
Water Heating	0	0	0	0	0
Lighting	148,100	155,813	199,698	229,053	234,473
Cooking	23,358	25,183	27,423	29,498	31,461
Office Equipment & Computing	0	0	0	0	0
Refrigeration	78,698	83,998	90,497	96,514	102,198
Miscellaneous	315,003	346,867	387,212	422,947	456,739
Total Economic Potential	**711,714**	**767,452**	**871,600**	**955,252**	**1,012,309**
% of Base Load Forecast	**22%**	**23%**	**26%**	**28%**	**28%**
Base Load Forecast	**3,246,452**	**3,276,068**	**3,329,157**	**3,424,440**	**3,587,996**

The figure below displays the distribution of economic potential by end use. By 2040, the miscellaneous category contains almost half of the economic potential, and lighting accounts for one-fifth of all economic potential.

Figure 4-6. Economic Potential Energy Efficiency Savings by End Use, Medium Avoided Cost Scenario



4.4 Achievable Potential

The achievable potential is defined as a realistic implementation of energy efficiency measures, factoring in market barriers and other underlying factors. In this study, achievable potential is representative of new energy efficiency potential. The achievable potential estimates the existing enrollment in programs in any given year. First, the eligible customers are calculated by applying the saturation, remaining and applicability factors to the population forecast for each customer segment for measures that are economically viable.

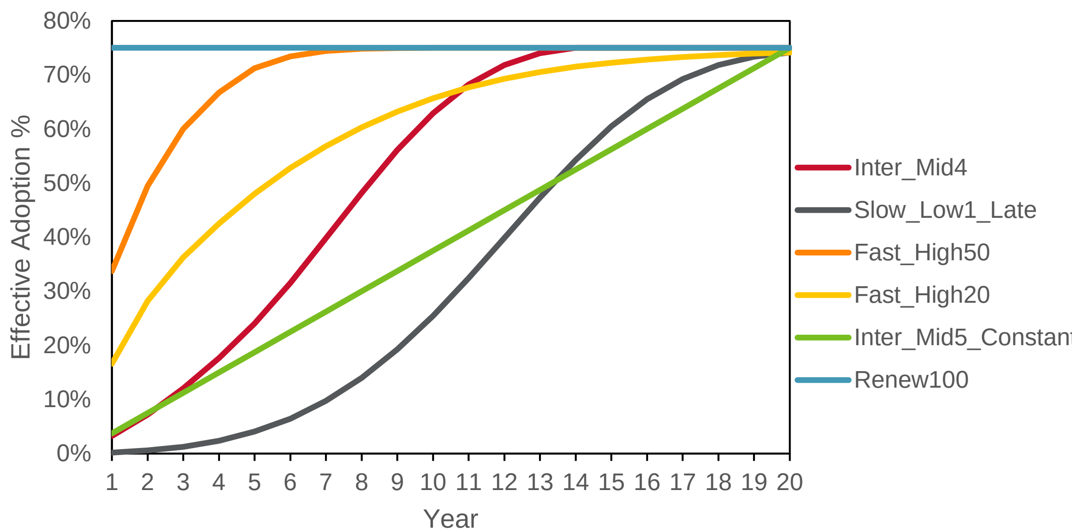
Total cumulative customers are estimated as a function of eligible customers, ramp rates, and a measure's useful life. Two sets of ramp rates are used in this analysis: base ramp rates and renewal ramp rates. Base ramp rates are used to capture the rate at which eligible customers install energy efficient measures, while renewal ramp rates are used to capture the rate at which existing customers reinstall measures after the measure life expires.

Ramp rate assumptions are based on evidence found in existing studies and shown in Figure 4-7.[12] These are applied to the eligible customers to estimate the number of new installations in a given year. The ramp rates are applied independently for each energy efficiency measure to reflect the varying degrees of penetration and maturity. The new

[12] Northwest Power and Conservation Council, "Seventh Power Plan," February 2016. https://www.nwcouncil.org/reports/seventh-power-plan

installations are estimated as difference between the current year and previous year. New participants no longer realize achievable potential savings after the end of the useful life of the measure. At this point, the renewal ramp rates are applied to allow participants to reinstall the measure and generate achievable potential savings. These ramp rates are generally more aggressive than the base ramp rates to reflect the assumption that customers are more likely to replace energy efficiency measures after burnout than initially installing a new energy efficiency measure. After savings expires from new participants, additional savings are not recognized until reinstallation occurs. In some measures, such as lighting and thermostats, it is assumed that all customers immediately reinstall an efficiency measure after burnout.

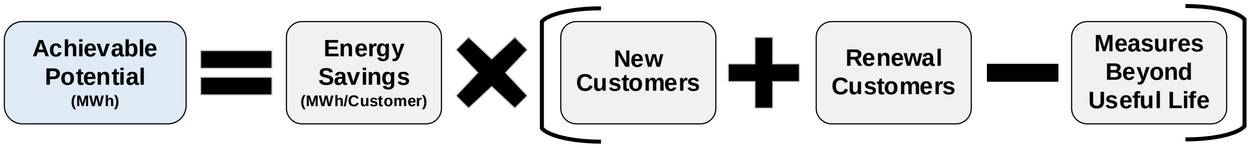
Figure 4-7. Customer Adoption Ramp Rates Used for Achievable Potential



Based on the literature, programs are unable to capture full penetration for measures. Reasons such as budget constraints, customer awareness, and other less quantifiable factors prevent programs from achieving 100% implementation. Several studies estimate that maximum penetration energy efficiency programs can achieve is between 60% and 80%, contingent on the incentives offered. In this analysis, it is assumed the maximum cumulative achievable potential in any given energy efficiency measure is 75%, and the utility incentive offered is 75% of incremental program cost.

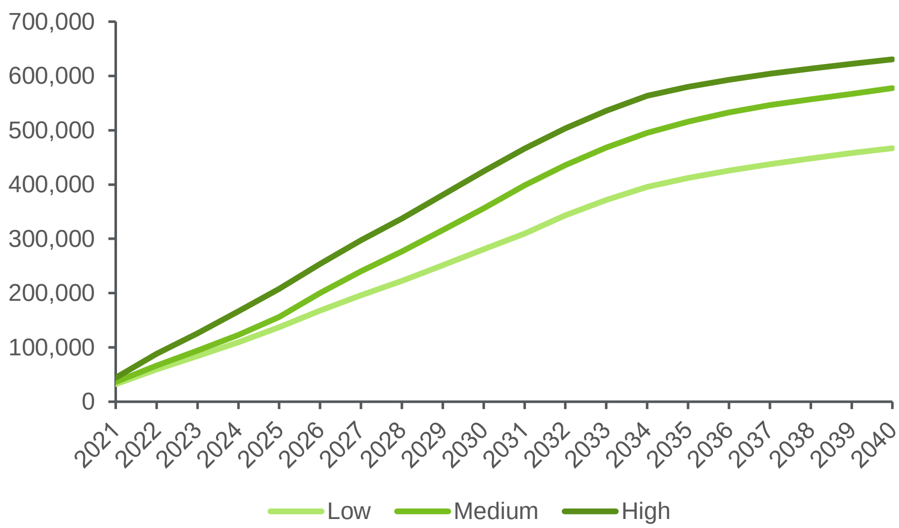
In any given year, the cumulative total of customers is equal to the number of new installations, existing installations, plus any renewal installations less any expiring customer installations. The cumulative achievable potential savings are then calculated by the multiplying the savings per customer by the cumulative number of customers in any given year.

Figure 4-8. Achievable Potential Calculation Diagram



The cumulative achievable potential results for energy efficiency are shown below for the three avoided cost scenarios. Cumulative achievable potential is the accumulation of energy efficiency measures activating in 2021; all following years include the energy efficiency from active EE measures. Achievable potential ranges between 466,685 MWh and 630,683 MWh by 2040.

Figure 4-9. Cumulative Achievable Potential for Energy Efficiency Measures, MWh



The achievable potential is broken out by end use in the table shown below. Lighting efficiency measures are expected to account for the majority of the immediate achievable potential given the ease of retrofitting, relatively low cost, quick payback and high consumer awareness. Over the study period, savings in other categories is expected to ramp up, though lighting still continues to represent a significant portion of all achievable potential. The results shown in Table 4-8 are based on the achievable potential from the medium avoided cost scenario.

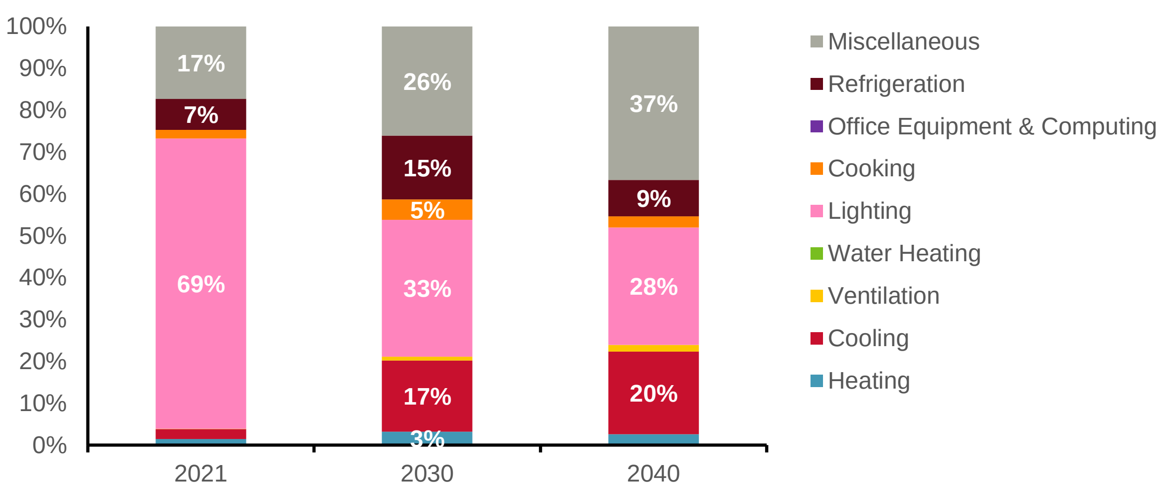
Table 4-8. Achievable Potential Energy Efficiency Savings by End Use, MWh, Medium Avoided Cost Scenario

Achievable Potential	2021	2025	2030	2035	2040
Heating	534	4,175	11,512	14,398	15,145
Cooling	873	12,508	60,566	100,659	114,240
Ventilation	28	565	3,371	7,638	8,992
Water Heating	0	0	0	0	0
Lighting	25,214	72,884	116,404	146,510	162,148
Cooking	753	6,062	17,260	19,080	15,297

Office Equipment & Computing	0	0	0	0	0
Refrigeration	2,687	20,543	54,266	63,884	50,192
Miscellaneous	6,296	39,146	92,927	163,482	211,641
Total Achievable Potential	**36,385**	**155,883**	**356,306**	**515,652**	**577,656**
% of Base Load Forecast	**1.1%**	**4.8%**	**10.7%**	**15.1%**	**16.1%**
Base Load Forecast	**3,246,452**	**3,276,068**	**3,329,157**	**3,424,440**	**3,587,996**

The figure below displays the achievable potential by end use. Lighting accounts for the majority of achievable potential in the first few years, though its share of potential decreases as measures associated with other end uses become more prevalent.

Figure 4-10. Achievable Potential Energy Efficiency Savings by End Use, Medium Avoided Cost Scenario



The incremental achievable potential, the new energy savings added in a given year from newly installed EE measures, is broken out by end use in the table shown below. An important trend to note about the incremental savings is that some of the end use savings is not a smooth trend during the analysis period. For example, the incremental savings for lighting end use category starts high in 2021, trends down by 2025, and then increases again in 2030. Part of the uneven savings is that as customers adopt lighting measures in a given year there are less remaining eligible customers for the following years (see the ramp rates in Figure 4-7). Another reason for the uneven savings is that by 2030 additional lighting measures become economically viable and, therefore, additional energy savings accumulates and the downward trend reverses for a time until the number of remaining eligible customers again decreases by 2040.

Table 4-9. Incremental Achievable Potential Energy Efficiency Savings by End Use, MWh, Medium Avoided Cost Scenario

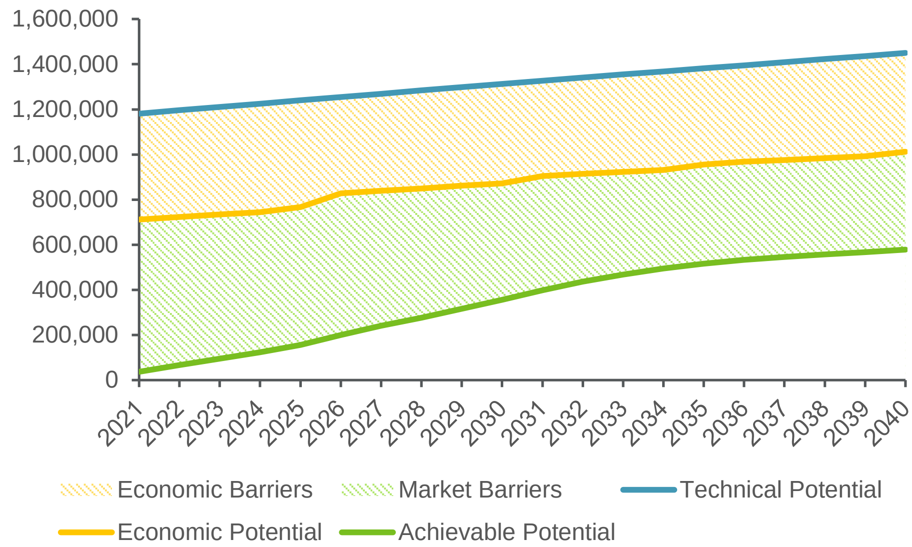
Achievable Potential	2021	2025	2030	2035	2040
Heating	534	1,147	1,884	1,502	1,915
Cooling	873	5,001	11,881	6,667	3,731
Ventilation	28	231	796	718	116
Water Heating	0	0	0	0	0
Lighting	25,214	9,604	21,552	27,907	22,078
Cooking	753	1,696	2,113	740	1,744
Office Equipment & Computing	0	0	0	0	0
Refrigeration	2,687	5,857	7,200	1,635	3,023
Miscellaneous	6,296	10,037	22,224	36,257	43,475
Total Incremental Achievable Potential	**36,385**	**33,573**	**67,649**	**75,426**	**76,082**
% of Base Load Forecast	**1.1%**	**1.0%**	**2.0%**	**2.2%**	**2.1%**
Base Load Forecast	**3,246,452**	**3,276,068**	**3,329,157**	**3,424,440**	**3,587,996**

Further examples of uneven achievable energy savings can be found within the results of this study due to modeling limitations. Because the measures in this study are either economically viable or not economically viable on an annual basis, the estimated savings from one year to the next can increase or decrease significantly. Another modeling limitation is that all installations from a specific measure were assumed to have equal measure life and, therefore, all energy savings from the first year would become retired savings all in the same year. Adoption ramp rate and life of a measure will vary in real life and, therefore, PRPA would likely observe smoother trends in achievable potential energy savings compared to the results of this study.

4.5 Energy Efficiency Potential Summary

Figure 4-11 illustrates the technical, economic, and achievable potential forecasted to 2040 for the medium avoided cost case. The total resource cost test eliminates any technical potential which is not economically viable, shown through the area labeled “Economic Barriers”. Market barriers, such as marketing, awareness, and customer behavior prevent the economic potential from being realized. The achievable potential is a subset of the economic potential, capturing customers that are anticipated to implement energy efficiency measures.

Figure 4-11. Technical, Economic, and Achievable Potential for Energy Efficiency Measures, MWh, Medium Avoided Cost Scenario



We find that 40% of the technical potential is achievable by 2040 for the medium avoided cost scenario. Of the achievable EE potential, the most significant end use energy savings from 2021 through 2030 are the LED lighting measures as shown in Figure 4-12. Beyond 2030, energy assessment retrocommissioning and energy management system measures represent the majority of achievable potential. Starting in 2021 most of the measures in the lighting category are economical and are modeled with a fast adoption ramp rate. The second most significant amount of energy savings is in the miscellaneous category, which comprises mostly of installing residential ENERGY STAR® appliances and commercial & industrial retro-commissioning and energy management systems. Overall, the estimated EE energy savings is about 14% residential and 86% commercial & industrial.

Figure 4-12. Achievable Potential Breakdown by End-Use Category, MWh, Medium Avoided Cost Scenario

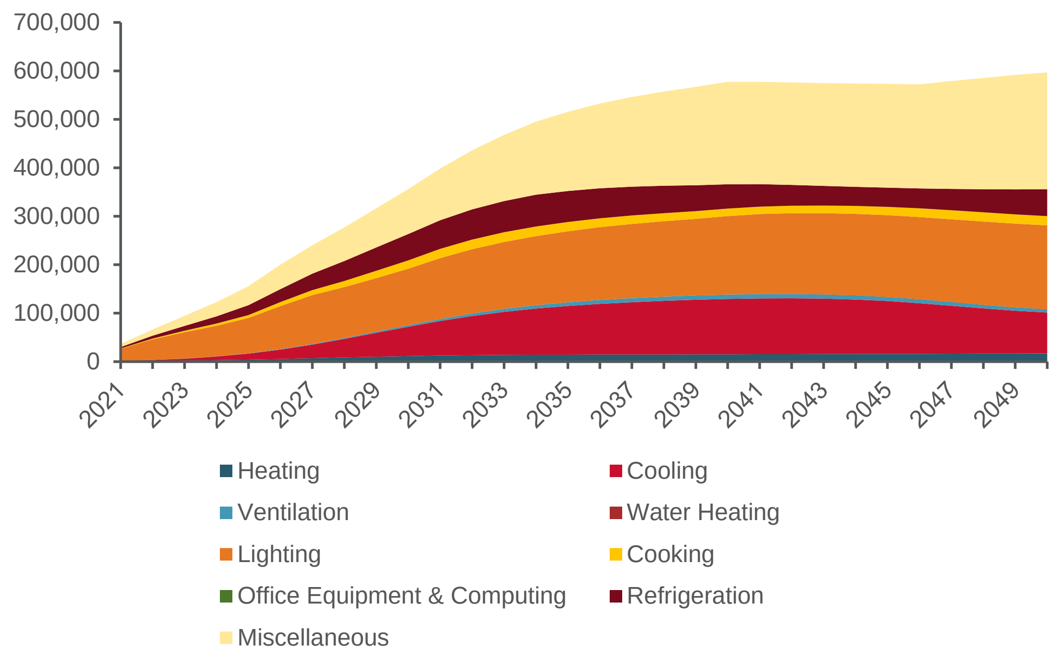


Table 4-10. Energy Efficiency Savings Summary, Medium Avoided Cost Scenario

	Technical Potential		Economic Potential			Achievable Potential		
Year	***MWh***	***% of Load Forecast***	***MWh***	***% of Load Forecast***	***% of Technical Potential***	***MWh***	***% of Load Forecast***	***% of Technical Potential***
2021	1,181,269	36.4%	711,714	21.9%	60.2%	36,385	1.1%	3.1%
2025	1,239,928	37.8%	767,452	23.4%	61.9%	155,883	4.8%	12.6%
2030	1,313,173	39.4%	871,600	26.2%	66.4%	356,306	10.7%	27.1%
2035	1,382,130	40.4%	955,252	27.9%	69.1%	515,652	15.1%	37.3%
2040	1,450,130	40.4%	1,012,309	28.2%	69.8%	577,656	16.1%	39.8%

The multi-year cumulative cost of the EE achievable potential including the installation cost, the utility incentive, and the utility program administration cost is shown in Table 4-11. To achieve the energy efficiency savings presented, $139.8 million would be spent by PRPA through 2030, and an additional $204.1 million will have to be spent between 2031 and 2040 for the medium avoided cost scenario. Costs fluctuate between five year increments due to the timing of when measures become economically viable, the adoption ramp rates used to estimate achievable potential, and the timing of opportunities for customers to renew measures after exceeding the useful life.

From 2021 through 2025 the average annual utility cost (utility incentive and utility administrative cost) for the first year of installed measures is expected to be about $9.6 million to achieve an average 31,330 MWh incremental annual energy savings, or $308/MWh (or a levelized first year cost of $32.8/MWh based on 13 year measure life and 5% discount rate). In comparison to PRPA's current 2020 budget (described in section 3.3, PRPA is expecting to spend of $14.1 million in 2020 on DER programs to save 34,000 MWh, or $415/MWh (or a levelized cost of $44.2/MWh based on 13 year measure life and 5% discount rate). While PRPA's budget plan is higher than the savings and costs observed in the modeled EE estimates, it is important to note that the EE results described in this report are based on a least cost portfolio and do not include EE savings that result in a portfolio that has a levelized average utility cost above the avoided cost. In other words, only least cost EE savings are accumulated to achieve a given portfolio savings. This contrasts with PRPA and its owner communities' existing EE programs which were designed with goals in addition to cost effectiveness, including customer service and equity among communities and customer classes. The resulting energy savings estimates from 2021 through 2025 present PRPA with a goal to strive towards for their DER programs.

Table 4-11. Multi-year Cumulative Energy Efficiency Costs, Medium Avoided Cost Scenario

Multi-Year Cumulative Costs ($000s)	2021-2025	2026-2030	2031-2035	2036-2040
Heating	$4,447	$7,907	$7,684	$8,529
Cooling	$8,329	$31,043	$29,110	$15,671
Ventilation	$374	$2,014	$3,376	$1,475
Water Heating	$0	$0	$0	$0
Lighting	$24,262	$28,058	$38,119	$37,392
Cooking	$1,056	$1,950	$959	$989
Office Equipment & Computing	$0	$0	$0	$0
Refrigeration	$11,705	$21,441	$9,348	$5,337
Miscellaneous	$9,858	$21,686	$41,603	$54,513
Total 5-Year Costs ($000s)	**$60,030**	**$114,100**	**$130,201**	**$123,906**
Participant Cost	$11,824	$22,474	$25,646	$24,406
Utility Incentives	$35,472	$67,423	$76,937	$73,217
Utility Administrative Costs	$12,734	$24,203	$27,618	$26,283
Utility Cost Total	**$48,206**	**$91,626**	**$104,555**	**$99,501**
Average Utility Cost, per MWh*	$308	$337	$297	$269

*Average cost for the first year of installed measures.

5 Demand Response Potential

This section covers demand response and battery energy storage and describes the methodology used to estimate technical, economic, and achievable potential for identified demand response measures. Research was performed to identify fifteen measures which were evaluated for residential, commercial, and industrial customers. For each measure, assumptions were developed for the energy offset, useful life and incremental cost. The deferral capability of demand response measures (measured in kilowatts) in combination with assumptions surrounding the duration of events and an event limit per year were used to estimate the kilowatt-hours deferred. The deferral capacity (in kW) is the amount of peak load capacity that is shifted or eliminated from peak hours to off-peak hours. The deferred energy (in kWh) is a measure of the amount of energy that is shifted or eliminated from peak hours to off-peak hours. Additional assumptions were made to determine if any of the measures eliminated energy consumption instead of just deferring it. For the majority of measures, it was assumed that the energy consumption would be deferred and not be eliminated.[13] Supporting information was derived from the Residential Energy Consumption Survey (RECS), the Commercial Buildings Energy Consumption Survey (CBECS), PRPA pilot programs and other distributed energy resources reports.

5.1 Demand Response Assumptions

The various demand response measures as well as the respective assumptions for evaluation are listed below. Further details for the DR measures are included in Appendix B.

Table 5-1. Demand Response Measures

DR Measure Name	Customer Segment	Average Event Duration (hours)	Estimated Events per Year
Residential			
HVAC Programmable Communicating Thermostat (PCTs)	All Residential	3	24
HVAC DLC	All Residential	3	24
Water Heater DLC	All Residential	3	48
Battery and Plug-in Hybrid Vehicles DLC - Charging Interruption during peak hours	All Residential	4	260
BESS (5kW) Automated Demand Response	Single Family	4	260
BESS (5 -10 kW) Automated Demand Response	Multi-Family	4	260

[13] For example, direct load control on an air conditioner might defer peak load and energy usage until a later time because such customer intends to meet their cooling needs eventually. However, a commercial lighting dimming control defers and eliminates peak load and energy usage because such customer's illumination needs are still met during such control.

DR Measure Name	Customer Segment	Average Event Duration (hours)	Estimated Events per Year
Commercial / Industrial			
HVAC Automated Demand Response	Commercial / Industrial	3	24
HVAC DLC and PCTs	Commercial / Industrial	3	24
50kW BESS Automated Demand Response	Commercial / Industrial	2	260
150kW BESS Automated Demand Response	Commercial / Industrial	2	260
Industrial Process - Automated Demand Response	Industrial	3	48
Industrial Process - Manual Demand Response	Industrial	3	48
Lighting - Luminaire, Zonal, and Standard Control Options	Commercial / Industrial	3	48
Refrigerated Warehouse - Automated Demand Response	Industrial	3	48
Other			
Voltage Reduction	System	4	36

In addition to the measures, general assumptions used in the demand response analysis are listed in Table 5-2.

Table 5-2. General Assumptions

Variable	Unit	Value	Source
Discount Rate	%	5%	PRPA Assumption
Single Family Household Decomposition Rate	%	0.3%	EIA National Energy Modeling System, Residential Demand Module.
Multi-Family Household Decomposition Rate	%	0.5%	EIA National Energy Modeling System, Residential Demand Module.
Commercial Decomposition Rate	%	2.81%	Bureau of Labor Statistics, Business Employment Dynamics, 5 year average for establishment deaths in Colorado.

5.2 Battery Energy Storage

Battery Energy Storage Systems (BESS) offer customers the ability to minimize energy consumption from the electric utility during periods of peak electric rates and thereby offset the utility's load demand during such periods. Customers that install BESS can recharge the system during utility off-peak periods.

This study considered BESS for residential customers at 5kW capacity and multifamily residential at 10kW both with 4 hour storage capacity. Commercial & industrial customer BESS resources were sized at 50kW and 150kW both with 2 hour storage capacity.

Cost estimates for BESS used in this study were estimated based on data gathered from the 2025 California Demand Response Potential Study[14] by the Lawrence Berkeley National Labs as well as vendor product information from Tesla.[15] Energy and demand offset for each BESS and associated storage capacity was estimated assuming a certain number of events where PRPA discharges the BESS during that time period. A maximum of 260 events per year were assumed based on one event for each weekday (i.e. 5 days per week). Although the same TRC test approach was applied to BESS resources, retail customers may choose to install BESS resources outside of any utility funded programs. Such BESS resources installed outside of the PRPA programs are not included in the estimates in this study.

A 10 year useful life was assumed for BESS. During the useful life of the BESS systems, batteries are subject to a degradation in efficiency. It was assumed that the BESS round trip efficiency would degrade by 10% after the tenth year, a reduction from 90% to 80%. To maintain the same amount of discharge energy after degradation in efficiency, additional electricity is required to charge the battery.

Although BESS systems have been installed in the electricity market for both utility-scale and retail applications over the last 10 years, the specific charge/discharge practices and cost effectiveness depends on many factors including location, electricity rate structure and utility capability. Coupled with being a relatively new market entrant, there is uncertainty in the technical capability of BESS systems as a demand response resource. Given the above uncertainty, this study has considered a conservative estimate for BESS technical potential to be limited to a small fraction of new residential and commercial construction.

5.2.1 Electric Vehicles

Plugin Hybrid Electric Vehicles and Battery Electric Vehicles (together known as EV) were also considered for this study. Based on discussions with PRPA, the current 2019 estimate of EV is about 2,000 vehicles and this is projected to increase to between 20,000 and 40,000 vehicles by 2030. This trend is generally consistent with a study published by Xcel Energy[16] for their service territory in Colorado. According to the Xcel Energy study, the average annual energy use per EV is about 2,663 kWh and the incremental monthly demand is estimated at 1.31 kW per EV (assuming level 2 charging station).

In general, EV owners are usually aware of any peak and off-peak time-of-use (TOU) electric rates and charge their vehicles accordingly. However, at this early stage in the EV market penetration there is uncertainty in how much TOU rates affect charging behavior. Additionally, there are very few charging stations at the workplaces, so most of the energy and demand associated with EV occurs during utility off-peak hours. As a

[14] 2025 California Demand Response Potential Study – Charting California's Demand Response Future: Final Report on Phase 2 Results. LBNL-2001113. March 2017. https://drrc.lbl.gov/publications/2025-california-demand-response

[15] https://www.energysage.com/solar/solar-energy-storage/tesla-powerwall-home-battery/

[16] Xcel Energy. Electric Vehicle Charging Station – Pilot Evaluation Report. May 2015.

result, there may be limited opportunity to use demand response to curtail EV loads during peak periods. EVs were assumed to have a 10 year operating life and from a DR standpoint charging interruption events were assumed as a result of PRPA request. A maximum of 260 charge interruption events were assumed based on one event for each weekday (i.e. 5 days per week). Under the total resource cost test, the results showed that the EV measure was not an economically viable DR measure at this time. According to PRPA, they plan to further investigate the timing and other factors that impact EV charging in the near term to be better positioned to evaluate its cost effectiveness.

5.3 Technical Potential

The technical potential for demand response is defined identically to the definition provided in Section 4. Technical potential is a theoretical maximum possible energy able to be offset through demand response programs, ignoring any economic or market barriers. Estimating the technical potential required developing factors for each demand response measure. These factors were primarily derived from the RECS and CBECS surveys and PRPA pilot programs, where applicable. The five factors generated were:

- **Technology Factor** represents the percentage of the population that has the technology (e.g. percentage of households with a thermostat);
- **Electrical Factor** represents the percentage of the population that uses electricity for an end use, conditional on having that technology (e.g. percentage of households with a thermostat that are heated by electricity);
- **Saturation Factor** is the multiplication of the technology and electrical factor. It represents the percentage of the total population that is the target market for demand response measures;
- **Remaining Factor** represents the percentage of the population that has not yet adopted demand response measures (e.g. percentage of households that have not yet adopted a programmable communicating thermostat); and
- **Applicability Factor** represents the percentage of qualifying population able to adopt the measure. The applicability factor is assumed to be 100% for all measures except in instances where two measures cannot be simultaneously installed. For instance, households would not install both a programmable communicating thermostat and a direct load control HVAC system.

These factors are used to evaluate technical potential for each of new and existing customers to account for differences in building code between newly constructed units and older units part of the existing stock. However, unlike energy efficiency measures, it is not assumed that new customers have units built with demand response capable measures. In addition, the installed capacity is scaled to determine the avoided generation capacity due to limits on the duration of demand response events. For example, demand response measures totaling 1 MW of installed capacity with a three hour limit can only offer 500 kW of avoided generation capacity for six hours. The study assumes a six hour peak period and all installed capacity is scaled based on the ratio of event duration and peak period to determine the deferred generation capacity, as shown in the figure below. Figure 5-2 shows the calculation of deferred energy, based on the number of DR events called per year.

Figure 5-1. Deferred Generation Capacity for Demand Response Measures, MW

Deferred Capacity (MW/customer) = Installed Capacity (MW/Customer) × [Event Duration (hours) ÷ Peak Period (hrs)]

Figure 5-2: Deferred Energy for Demand Response Measures, MWh

Deferred Energy (MWh/customer) = Deferred Capacity (MW/customer) × Events per Year (#) × Event Duration (hours)

Technical potential is calculated using the formula shown below. Unlike energy efficiency measures, demand response measures allow PRPA to shift electricity from peak hours to off-peak hours to avoid installing new generation units to augment capacity. The deferred energy from demand response measures is measured in both megawatts and megawatt-hours.

Figure 5-3. Technical Potential for Demand Response Measures, MW

Technical Potential (MW) = Deferred Capacity (MW/customer) × Population (Customers) × Saturation Factor (%) × Remaining Factor (%) × Applicability Factor (%)

Figure 5-4. Technical Potential for Demand Response Measures, MWh

Technical Potential (MWh) = Deferred Energy (MWh/Customer) × Population (Customers) × Saturation Factor (%) × Remaining Factor (%) × Applicability Factor (%)

The technical potential calculations assume that all existing stock immediately applies the measures and new stock will apply demand response measures once construction is completed. For all units, once a measure reaches the end of its useful life, it is assumed to be immediately replaced.

The cumulative demand response technical potential is shown below. Table 5-3 provides estimates of the theoretical maximum install capacity for demand response measures, while Table 5-4 measures the kilowatt-hours able to be deferred based on limitations to the frequency and duration of demand response events.

Batteries provide the greatest technical potential for demand response and represent about 90 percent of the total technical potential in deferred energy (MWh) and a third of potential when measured in MW of capacity deferred.

Table 5-3. Technical Potential for Demand Response Measures, Deferred MW

Technical Potential	2021	2025	2030	2035	2040
HVAC	49	53	58	62	67
Water Heating	4	4	5	6	7
Batteries	4	8	12	16	19
EVs	10	21	25	30	34
Industrial Processes	5	6	7	8	9
Lighting	16	20	24	28	32
Refrigeration	0	0	0	0	0
Voltage Reduction	3	3	3	3	3
Total Technical Potential	**90**	**114**	**134**	**153**	**171**
% of Peak Load	**13%**	**17%**	**19%**	**22%**	**23%**
Peak Load	**673**	**679**	**691**	**710**	**744**

Table 5-4. Technical Potential for Demand Response Measures, Deferred MWh

Technical Potential	2021	2025	2030	2035	2040
HVAC	3,533	3,813	4,152	4,475	4,820
Water Heating	508	624	765	901	1,048
Batteries	2,643	4,640	7,009	9,204	11,360
EVs	10,301	21,632	26,514	31,396	35,391
Industrial Processes	657	796	963	1,116	1,259
Lighting	2,291	2,828	3,463	4,040	4,571
Refrigeration	7	7	8	9	9
Voltage Reduction	424	427	434	447	468
Total Technical Potential	**20,363**	**34,767**	**43,308**	**51,588**	**58,925**
% of Base Load Forecast	**0.6%**	**1.1%**	**1.3%**	**1.5%**	**1.6%**
Base Load Forecast	**3,246,452**	**3,276,068**	**3,329,157**	**3,424,440**	**3,587,996**

5.4 Economic Potential

The economic potential for demand response is defined identically to the definition provided in Section 4.3. Benefits and costs are discounted and compared through a total resource cost (TRC) test. When the total resource benefit-cost ratio exceeds a value of one, this indicates a measure is economically viable as the discounted benefits outweigh the costs.

Three scenarios of avoided costs are estimated to represent low, medium and high scenarios. Each of these cases includes an avoided capacity cost and an avoided energy cost. The avoided energy cost, measured in $/MWh, captures the variable costs associated with generating electricity including variable operations and maintenance costs and fuel costs. The avoided capacity cost, measured in $/kW-yr, captures the capital costs and fixed operations and maintenance costs.

1. For the low case, the avoided cost is intended to reflect PRPA's resource mix with minimal changes. In this case, DR avoids capacity costs tied to the cost of constructing an aeroderivative (AERO) combustion turbine generation asset. An AERO power plant is assumed to provide the necessary electric capacity as the customer load grows. In this scenario, DR is assumed to avoid energy costs determined by forecasted energy market prices for the region.
2. The medium scenario is intended to reflect PRPA's resource mix assuming coal/fossil resources are retired by 2030 and replaced with a mix of renewable resources and battery storage. In this case, DR avoids capacity costs tied to the cost of constructing batteries. The storage is assumed to provide the necessary electric capacity as existing generators are retired and the customer load grows. In this scenario, DR is assumed to avoid energy costs based on solar and wind PPAs procured.
3. The high scenario is intended to reflect PRPA's resource mix assuming coal resources are retired by 2030 and replaced with a mix of renewable resources and battery storage. In this case, DR avoided capacity costs determined by lithium ion batteries. Avoided energy costs are based a mix of wind and solar PPAs. Appendix C contains more detail regarding the avoided cost assumptions.

Table 5-5. Avoided Cost Scenario Assumptions

Avoided Cost Scenario	Avoided Energy Cost ($/kW-yr)	Avoided Capacity Cost ($/MWh)
Low	$37.77	$113.60
Medium	$40.00	$144.35
High	$40.00	$192.47

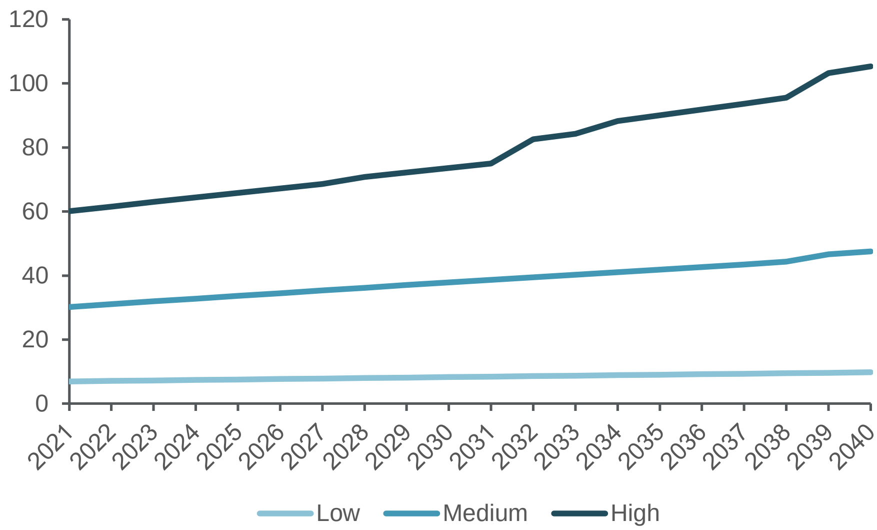
For these cases, the avoided costs are being split between avoided energy and avoided capacity costs. The avoided capacity cost, measured in dollars per kilowatt-year ($/kW-yr), captures the fixed costs on the new generation unit. The avoided energy cost captures the variable costs including variable operations and maintenance costs and fuel costs for the new generation unit, measured in dollars per megawatt-hour ($/MWh). Given that energy is assumed to be deferred to off-peak hours, it is assumed that there are no benefits generated from avoiding carbon costs. The avoided capacity costs are assumed to begin accruing immediately.

Cases with higher avoided costs will have larger economic potential, as seen in Figure 5-5. Several discontinuities can be seen in the medium and high scenarios, these occur when the total resource cost for a measure reaches or exceeds a value of 1 only after 2019. As discussed in section 4.3, the total resource cost can produce different values over time because some measures diminish in cost over time. As technologies become more prevalent, the installation cost is expected to decrease. The National

Renewable Energy Laboratory's Annual Technology Baseline[17] was used to estimate price trends for batteries and solar panels.

Depending upon the avoided cost scenario, the economic potential for demand response varies between 10 and 105 MW by 2040, corresponding to between 1,236 and 18,954 MWh of deferred energy. There is a large variation between the low and high scenarios because of the large variation in avoided costs. HVAC accounts for 40-50% of the demand response technical potential. The benefits of other demand response measures are constrained by the frequency and duration of when the utility can call events.

Figure 5-5. Economic Potential for Demand Response Measures, MW



The cumulative economic potential is shown in the table below for the medium scenario. Similar to the technical potential, the economic potential is a theoretical estimate of the maximum deferred energy possible. This theoretical maximum assumes all customers will immediately adopt the measure once it become economically viable and that all customers will immediately replace measures at end of measure life. Limitations on the frequency and duration of events for demand response measures limit the economic feasibility of most measures. However, it is assumed that batteries would be operated each weekday during peak hours.

Table 5-6. Economic Potential for Demand Response Measures, Deferred MW, Medium Avoided Cost Scenario

Economic Potential	2021	2025	2030	2035	2040
HVAC	19	21	23	25	27
Water Heating	4	4	5	6	7
Batteries	0	0	0	0	2
EVs	0	0	0	0	0

[17] National Renewable Energy Laboratory. "Annual Technology Baseline 2018," July 2018. https://atb.nrel.gov/.

Industrial Processes	5	6	7	8	9
Lighting	0	0	0	0	0
Refrigeration	0	0	0	0	0
Voltage Reduction	3	3	3	3	3
Total Economic Potential	**30**	**34**	**38**	**42**	**48**
% of Peak Load	**4%**	**5%**	**5%**	**6%**	**6%**
Peak Load	**673**	**679**	**691**	**710**	**744**

Table 5-7. Economic Potential for Demand Response Measures, Deferred MWh, Medium Avoided Cost Scenario

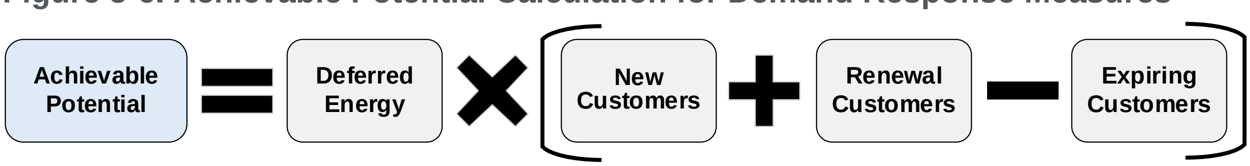
Economic Potential	2021	2025	2030	2035	2040
HVAC	1,382	1,501	1,644	1,781	1,928
Water Heating	508	624	765	901	1,048
Batteries	0	0	0	0	1,077
EVs	0	0	0	0	0
Industrial Processes	657	796	963	1,116	1,259
Lighting	0	0	0	0	0
Refrigeration	0	0	0	0	0
Voltage Reduction	424	427	434	447	468
Total Economic Potential	**2,970**	**3,348**	**3,807**	**4,246**	**5,778**
% of Base Load Forecast	**0.1%**	**0.1%**	**0.1%**	**0.1%**	**0.2%**
Base Load Forecast	**3,246,452**	**3,276,068**	**3,329,157**	**3,424,440**	**3,587,996**

5.5 Achievable Potential

The achievable potential for demand response uses the same methodology provided in Section 4.4.

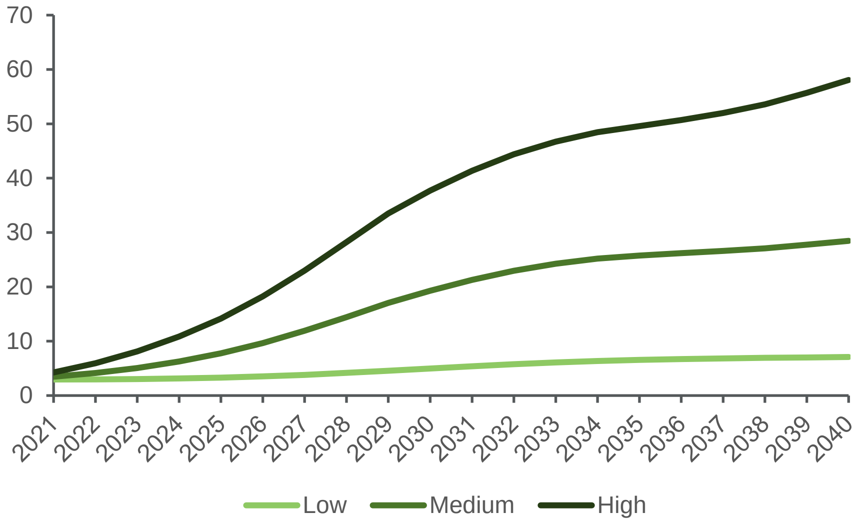
In any given year, the cumulative total customers is equal to the number of new installations plus any renewals, less any expiring customers, as shown in the figure below. The total cumulative customers is multiplied by the deferred energy to estimate the achievable potential.

Figure 5-6. Achievable Potential Calculation for Demand Response Measures



The achievable potential results are shown before for the three avoided cost scenarios.

Figure 5-7. Achievable Potential for Demand Response Measures, MW



The achievable potential is shown by category below for the medium scenario. Given most measures are not economically viable, the achievable potential is limited.

Table 5-8. Achievable Potential for Demand Response Measures, MW, Medium Avoided Cost Scenario

Achievable Potential	2021	2025	2030	2035	2040
HVAC	0.5	4.1	12	15	15
Water Heating	0	0.3	2.0	3.6	4.2
Batteries	0	0	0	0	0.4
EVs	0	0	0	0	0
Industrial Processes	0	0.4	2.5	4.5	5.3
Lighting	0	0	0	0	0
Refrigeration	0	0	0	0	0
Voltage Reduction	2.9	3.0	3.0	3.1	3.3
Total Achievable Potential	**3.5**	**7.8**	**19**	**26**	**28**
% of Peak Load	**1%**	**1%**	**3%**	**4%**	**4%**
Peak Load	**673**	**679**	**691**	**710**	**744**

Table 5-9. Achievable Potential for Demand Response Measures, MWh, Medium Avoided Cost Scenario

Achievable Potential	2021	2025	2030	2035	2040
HVAC	36	294	851	1,047	1,103
Water Heating	2	44	283	514	602
Batteries	0	0	0	0	263
EVs	0	0	0	0	0
Industrial Processes	2	57	356	653	769
Lighting	0	0	0	0	0
Refrigeration	0	0	0	0	0
Voltage Reduction	424	427	434	447	468
Total Achievable Potential	**463**	**823**	**1,925**	**2,661**	**3,206**
% of Base Load Forecast	**0.0%**	**0.0%**	**0.1%**	**0.1%**	**0.1%**
Base Load Forecast	**3,246,452**	**3,276,068**	**3,329,157**	**3,424,440**	**3,587,996**

5.6 Demand Response Potential Summary

Figure 5-8 and Figure 5-9 illustrate the technical, economic, and achievable potential of deferred energy and peak load for demand response measures forecasted to 2040 for the medium avoided cost scenario. The total resource cost test eliminated any technical potential which was found to not be economically viable, shown through the area labeled "Economic Barriers." Market barriers, such as marketing, awareness, and customer behavior prevent the economic potential from being realized. Instead, the achievable potential is a subset of the economic potential, capturing customers that are anticipated to install demand response measures.

Figure 5-8. Technical, Economic, and Achievable Potential for Demand Response Measures, Deferred MWh, Medium Avoided Cost Scenario

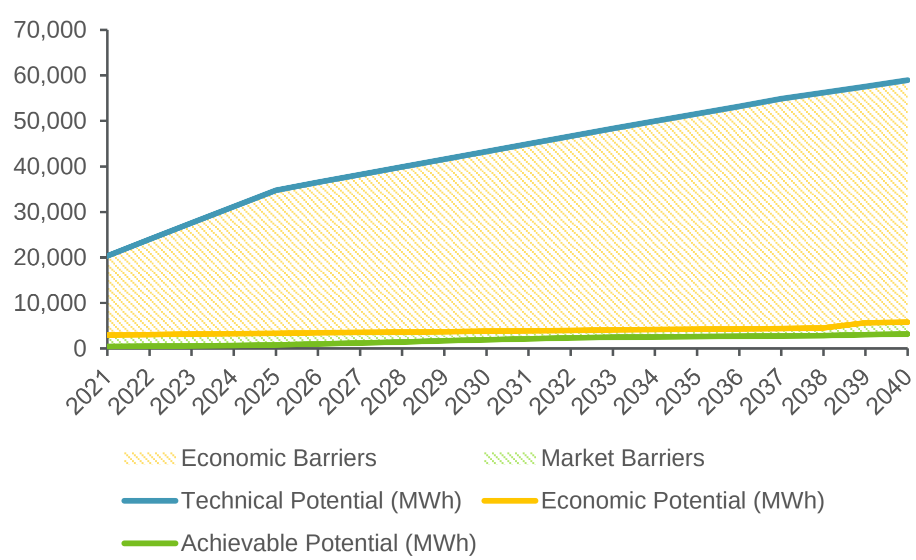
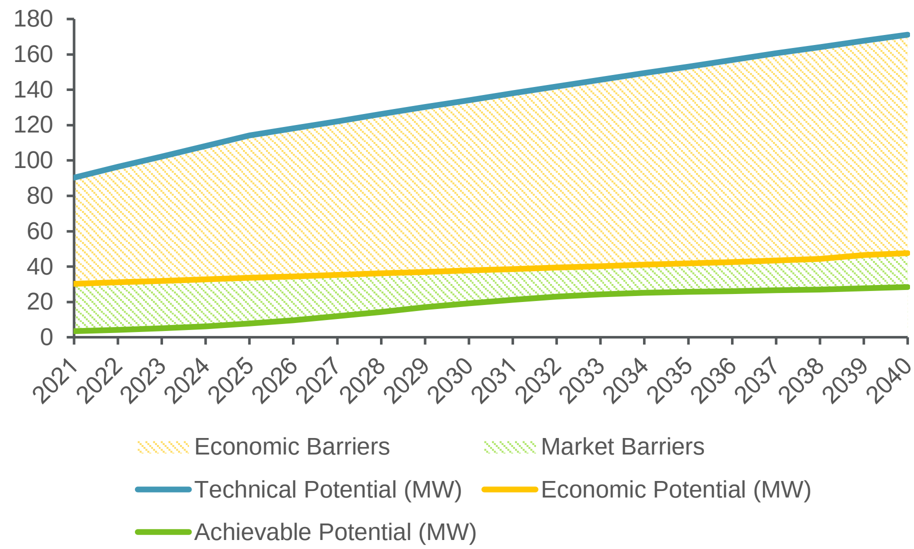


Figure 5-9. Technical, Economic, and Achievable Potential for Demand Response Measures, Deferred MW, Medium Avoided Cost Scenario



Unlike energy efficiency measures which reduce the base load, demand response measures are designed to flatten peak energy consumption by deferring energy consumption to before or after peak hours.

Table 5-10. Demand Response Summary, Medium Avoided Cost Scenario

	Technical Potential		Economic Potential			Achievable Potential		
Year	***Deferred MWh***	***% of Load Forecast***	***Deferred MWh***	***% of Load Forecast***	***% of Technical Potential***	***Deferred MWh***	***% of Load Forecast***	***% of Technical Potential***
2021	20,363	0.6%	2,970	0.09%	14.6%	463	0.01%	2.3%
2025	34,767	1.1%	3,348	0.10%	9.6%	823	0.03%	2.4%
2030	43,308	1.3%	3,807	0.11%	8.8%	1,925	0.06%	4.4%
2035	51,588	1.5%	4,246	0.12%	8.2%	2,661	0.08%	5.2%
2040	58,925	1.6%	5,778	0.16%	9.8%	3,206	0.09%	5.4%
Year	***Deferred MW***	***% of Summer Peak Load***	***Deferred MW***	***% of Summer Peak Load***	**% of Technical Potential**	***Deferred MW***	***% of Summer Peak Load***	**% of Technical Potential**
2021	90	13.4%	30	4.5%	33.4%	3	0.6%	3.8%
2025	114	16.8%	34	5.0%	29.5%	8	1.2%	6.8%
2030	134	19.4%	38	5.5%	28.2%	19	3.0%	14.4%
2035	153	21.6%	42	5.9%	27.3%	26	3.9%	16.8%
2040	171	23.0%	48	6.4%	27.8%	28	4.1%	16.6%

The technical potential to defer electricity consumption to off-peak hours is relatively small compared to the overall load for the measures examined. Limitations on the frequency and duration of demand response limit the current economic viability of measures. Future technological changes could result in greater economic potential for demand response measures as costs may decrease and automated or connected technologies may improve.

The multi-year cumulative cost of the demand response achievable potential including the installation cost, the utility incentive, and the utility program administration cost is shown in Table 5-11.In order to achieve this potential, PRPA would have to spend $11.8 million by 2030, and an additional $18.5 million between 2031 and 2040.

Table 5-11. Multi-Year Cumulative Demand Response Costs, Medium Avoided Cost Scenario

Multi-Year Cumulative Costs ($000s)	2021-2025	2026-2030	2031-2035	2036-2040
HVAC	$3,839	$7,717	$7,053	$8,252
Water Heating	$289	$1,567	$1,983	$2,353
Batteries	$0	$0	$0	$336
EVs	$0	$0	$0	$0
Industrial Processes	$194	$1,056	$1,417	$1,705
Lighting	$0	$0	$0	$0
Refrigeration	$0	$0	$0	$0
Voltage Reduction	$2,280	$0	$0	$0
Total 5-Year Costs ($000s)	**$6,602**	**$10,339**	**$10,452**	**$12,645**
Participant Costs	$790	$2,036	$2,059	$2,491
Utility Incentives	$4,649	$6,109	$6,176	$7,472
Utility Administrative Costs	$1,164	$2,193	$2,217	$2,682
Utility Cost Total	**$3,471**	**$8,302**	**$8,394**	**$10,155**

6 Distributed Solar Photovoltaic

Technical potential for a technology is the maximum amount of energy use that could be generated by that technology if all limiting constraints such as interconnection or use ability, cost competitiveness were ignored in the evaluation process. In the evaluation of distributed roof mounted solar photovoltaic (PV) systems for technical potential, HDR estimated maximum production based upon this assumption.

Satellite and geospatial data was referenced to determine the approximate area of rooftop space in the residential, commercial and industrial categories for distributed roof mounted solar. Digital zoning data was obtained for Fort Collins, Loveland, and Longmont in public databases and evaluated against building outlines obtained from Microsoft[18]. Roof areas were determined by joining and evaluating the two databases together. Roof area in Estes Park, which did not have zoning information readily available, was estimated based on an average breakdown of the other three cities. Parking structures and parking lots were not considered to be useable area. Solar PV on parking lots was deemed to be impractical because it would require costly site-specific mounting structures to be installed and would limit the potential for repurposing into commercial businesses or other type of development. Solar PV on parking garages would also require costly site-specific mounting structures to be installed and were therefore excluded from the potentially available space.

In all cases, it was assumed that approximately 80% of potentially available space could be utilized for solar system installations as useable rooftop area. Also, residential solar installations are impacted heavily by roof orientation, tree shading, and shading from other obstructions, so the technically feasible area was estimated to be 20% of the useable rooftop area. This 20% feasibility factor brings the average residential installation to be about 5.5 kW and is similar to the current average residential solar installation within the four cities. For customers that are technically able to install roof mounted solar, the commercial & industrial installations are assumed to be fixed-tilt panels that require row spacing thereby reducing the technically feasible solar area to be 75% of the usable rooftop area.

Furthermore, the technical applicability factor of installing solar panels (i.e. the percentage of customers whose rooftop is capable of such an installation due to roof orientation and type) is assumed to be 75% of single-family homes, 10% of multi-family homes, and 80% of commercial & industrial customers. Therefore, the technically feasible solar panel area is calculated as follows:

Solar Panel Array Area = Total Roof Area (sq. m) x Usable Roof Factor (%) x Feasibility Factor (%) x Customer Applicability Factor (%)

Example: *Solar Panel Array Area = Total Roof Area (sq. m) x 80% x 20% x 75%*

The following estimation of nameplate capacity available was determined via NREL PV Watts guidance for the following:

[18] https://github.com/Microsoft/USBuildingFootprints/. Licensed by Microsoft under Open Data Commons Open Database License.

*Size = Array Area (sq. m) x 1 KW/Sq. m x 15% Efficiency***[19]

Data from PRPA and municipal customers was also reviewed for existing system installations to determine the level of solar penetration by customer type. Other than in locations where there was a municipally owned solar facility – such as the Foothills Solar Project – and commercial solar projects encouraged by the Fort Collins Solar Power Purchase Program -- the majority of solar installed to date is with residential customers. As of the end of 2017, installed solar capacity across all four cities is 13,785 kW (AC basis) including 5,481 MWac residential solar, 5,251 kWac commercial solar, and the 3,000 kWac Foothills Solar Project.

Estimated solar technical potential and existing installed solar capacity is provided in the following tables. The average solar capacity factor (a measure of the annual energy delivered at the meter, divided by the rated AC capacity) is 18.8% for northern Colorado.

Table 6-1. Technically Feasible Solar Potential and Existing Solar Power*

		Potential Solar PV			Existing Solar PV	
Customer Type	**Useable Rooftop Area (square meters)**	**Technically Feasible Rooftop Area (square meters)**	**Technical Potential Capacity (kWac)**	**Technical Potential Annual Production (MWh)**	**Existing Installed Capacity thru 2017 (kWac)**	**Existing Annual Production 2017 (MWh)**
Residential	30,358,000	3,356,500	447,025	737,118	5,481	9,039
Commercial	6,601,300	3,960,800	525,643	866,755	5,250	8,658
Industrial	1,793,800	1,076,300	142,033	234,205	0	0
Other					3,053	5,035
Totals	**38,753,100**	**8,393,600**	**1,114,701**	**1,838,078**	**13,784**	**22,732**

*The technically feasible annual potential including existing installed capacity as of the end of 2017.

The average roof mounted solar project size per PRPA customer based on the above technically feasible potential is 5.4 kWac (6.3 kWdc) for residential, 34.5 kWac (40.6 kWdc) for commercial, and 640 kWac (757 kWdc) for industrial.

Solar PV cost benchmarks for all-in capital costs of various sizes and types of solar facilities is periodically assessed by NREL in publicly available reports. However, PRPA provided actual all-in capital costs for distributed solar PV systems that Fort Collins customers built from 2013 through 2018. This local customer cost data shows a decreasing cost trend since 2013, which is consistent with the larger solar industry. The following costs shown in Table 6-2 are based on the 2018 costs for installed systems by size and type in the PRPA service area. Furthermore, the analysis accounts for a reduction in solar capital costs based on NREL's Annual Technology Baseline[20] projection: an annual decrease by 4.3% to 5% until 2030 (depending on size) and an

[19] Efficiency from standard panel efficiency per NREL PV Watts Technical Manual
[20] 2018 ATB Cost and Performance Summary. https://atb.nrel.gov/electricity/2018/summary.html

annual decrease of 0.8% to 1.3% (depending on size) from 2030 through 2050. Further details for the distributed solar measures are included in Appendix B.

Table 6-2. Solar Technology Capital and O&M Costs

Cost Type	Customer Type	Size (kW)	Type	Cost Benchmark*
All-in Capital	Residential	3-10 kW	Roof Mount	$3,250/kWdc ($3,824/kWac)
All-in Capital	Commercial	10 -100 kW	Roof Mount	$2,600/kWdc ($3,060/kWac)
All-in Capital	Commercial & Industrial	500-1,000 kW	Roof Mount	$2,000/kWdc ($2,350/kWac)
Operation & Maintenance	All Types	All Sizes	Roof Mount	$20/kW-yr

*The starting cost benchmark for this study is the 2018 installed cost and is decreased for future years by projected solar PV cost reductions from NREL's Annual Technology Baseline averaging 4.3% to 5% per year.

6.1 Technical Potential

Based on the average roof mounted solar project size, the technical potential is estimated through the study period. The technical potential for solar rooftop across the study period (2021-2040) is shown in Table 6-3. Given the above assumptions on Technically Feasible Rooftop Area, there is sufficient rooftop area to install approximately 1,161 MWac capacity in 2021 and supply up to 59% of the Base Load Forecast energy usage. The capability of the distribution system to interconnect the estimated amount of technical potential was not evaluated in this study.

Table 6-3. Technical Potential Distributed Solar through 2040 by Customer Segment

Technical Potential	2021	2025	2030	2035	2040
Installed Capacity (MW)	***1,161***	***1,247***	***1,354***	***1,454***	***1,554***
Residential	465	498	538	577	618
Commercial	547	589	642	690	736
Industrial	148	159	173	187	199
Annual Production (MWh)	***1,912,050***	***2,056,269***	***2,232,174***	***2,397,140***	***2,561,901***
Residential	767,066	821,787	887,928	951,137	1,019,670
Commercial	901,414	971,873	1,058,287	1,138,398	1,214,156
Industrial	243,570	262,609	285,958	307,605	328,075
% of Base Load Forecast	*59%*	*63%*	*67%*	*70%*	*71%*

6.2 Economic Potential

The economic potential is a subset of technical potential which reflects the distributed energy that is economically viable. This is defined as measures that generate benefits which exceed the costs.

In this analysis, three ranges of avoided costs are estimated to represent a low, medium and high case.

The low scenario is an avoided cost value that compares the distributed solar measure to constructing a natural gas aeroderivative combustion turbine (AERO). Under the low scenario, it is assumed that the AERO power plant provides the necessary electric capacity as existing generators are retired and the customer load grows. The avoided cost is determined as a blended energy and capacity cost that accounts for capital and fixed O&M of the comparison AERO plant, and the 20-year average market energy price. For the determination of avoided capacity cost and avoided fixed O&M, PRPA provided its estimate that avoided capacity equals 30% of solar nameplate AC capacity. This is based on the estimated reliable capacity of solar late in the day when PRPA's peak loads typically occur.

The medium and high scenario is intended to reflect PRPA's resource mix assuming the retirement of coal resources by 2030 and replacement with renewable generation, including utility-scale wind and solar. As a result, the distributed solar measure is compared to the cost of constructing a utility-scale solar PV resource. The avoided cost of utility-scale solar is determined as a blended energy and capacity cost that accounts for capital, fixed O&M, transmission losses, and distribution losses. In addition, it was assumed that the utility-scale solar will be located close to interconnection points along PRPA's existing transmission system, not requiring any added cost for transmission wheeling. The resulting avoided cost of $34.46/MWh is still lower than cost of distributed solar causing an unfavorable TRC test result and no economically viable distributed solar for the medium or high scenario.

Table 6-4. Avoided Cost Scenario Assumptions for Distributed Solar

Scenario	Avoided Cost ($/MWh)	Notes
Low	$61.94	Avoided capacity from a 83MW AERO power plant and market energy prices, blended cost on energy basis
Medium	$34.46	Avoided generation and capacity from utility-scale solar PV
High	$34.46	Same assumptions as the medium avoided cost scenario.

Using the above costs for roof mounted solar and the TRC test (as described in section 5.4), the economic potential distributed solar capacity was evaluated for the three avoided cost scenarios. For all avoided cost scenarios, the TRC test shows no economically viable roof mounted distributed solar PV capacity across customer segments.

It is important to note that the distributed solar analysis has limitations. Distributed solar is analyzed for an average customer in the residential and commercial & industrial sector and is unable to account for economies of scale for systems larger or smaller than the defined average. In addition, the TRC test evaluates the benefits from a full societal perspective including the utility and participant. Participants may find distributed solar systems cost effective by avoiding retail electricity rates, though that is not captured in a TRC test. Since no economic potential was found during the study period, there is no achievable potential during the study period.

7 Combined Heat and Power

Cogeneration or Combined Heat and Power (CHP) facilities generate both electricity and thermal energy from a single source of energy. In a CHP facility, waste heat generated from the prime mover (e.g. engines / turbines) is used to generate steam and hot water for heating applications, or using an absorption chiller generate chilled water for cooling applications. CHP systems are typically installed in industrial, commercial facilities that have energy intensive operations and associated high annual costs. Other customers that benefit from CHP are healthcare and educational facilitates that operate in a large campus settings. In addition to energy cost optimization, CHP offers a level of supply redundancy to the grid. If CHP facilities are equipped with the necessary electrical systems, these facilities offer the ability to operate in an “islanded” mode when the utility grid is unavailable such as during adverse weather conditions.

CHP installations are economically feasible under certain operating and financial conditions. One of the key requirements is the high annual operating hours (close to base load) and high utilization of generated thermal energy from the CHP plant. Additionally, the ideal time to run comparative economic scenarios (against business as usual case) for competitiveness is when existing aging infrastructure (boilers or chillers etc.) is ready for replacement and there is an imminent need for upgrade and new capital expenses are earmarked. While CHP may provide long term economic benefits, project owners are faced with relatively higher capital costs (relative to boilers and chillers) and may not have the capability to finance.

While CHP offers the potential to optimize energy costs, combustion technologies that use natural gas or other fossil fuel results in greenhouse gas emissions (albeit significantly lower than electric-only power plants) which may not align with stakeholder interests. CHP plants operate in parallel with owner’s needs and the local electric utility requirements. Such projects will require the owner to complete an electrical interconnection application and adhere to the requirements of the local utility as it relates to metering and safety. Also, securing an air emission permit for a CHP plant is more complex in comparison to a typical boiler installation. These activities require careful planning and in addition to higher initial costs, typically extend the project schedule by several months compared to a typical boiler installation.

PRPA’s board recently passed a resource diversification policy[21], which established a goal of a 100% non-carbon energy mix by 2030. Furthermore, three of PRPA’s four owner communities have also adopted goals to achieve a 100% renewable mix by 2030. CHP facilities fueled by natural gas would not align with these policies and goals. Use of biomass may reduce or eliminate net greenhouse gas emissions. However, as described in PRPA’s 2020 Generation Technology Review, available biomass sources are limited and costly. Due to these concerns, and due to the challenges of acquiring relevant data from PRPA’s customers, this study finds no potential for CHP at this time. It is

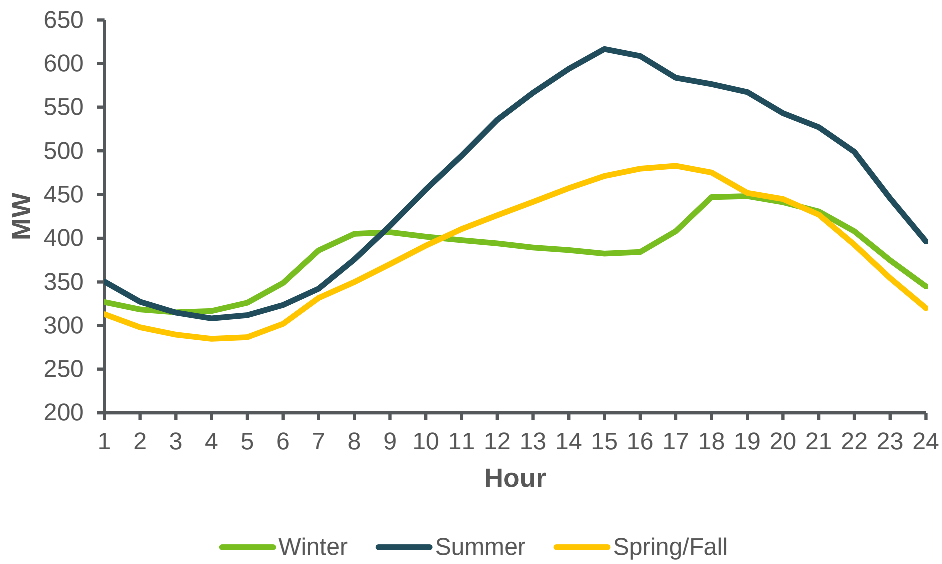
[21] *https://www.prpa.org/news/platte-river-board-passes-energy-policy/* - Platte River board passes energy policy, Dec 2018

recommended that PRPA continue to monitor changes in biomass and CHP that could increase availability of biomass or reduce its costs.

8 Determination of Potential

This section expands on the achievable potential results presented in sections 4.4 and 5.4 to the impact on PRPA's Base Case hourly loads. Results were modeled to show the impacts against three representative days for each five year interval during the study period 2021-2040. The representative days include one summer day, one winter day and one spring or fall day. The forecasted PRPA load profiles on these days are used to determine peak hours and DER contribution to the load curtailment. The Base Case hourly load curves for the representative days in 2030 are shown in the figure below.

Figure 8-1. Representative Hourly Load Curves for 2030 Base Case Forecast



8.1 Energy Efficiency Potential

The following section describes the hourly modeling for the energy efficiency measures. Each energy efficiency measure is assumed to save energy per year, as shown in Appendix A. Further assumptions were made about the number of hours per year a measure is actively saving energy based on three representative days to determine the average savings per hour for each measure. The three representative days are composed of one summer day, one winter day, and one spring or fall day.

Each of these days assumed to be representative of activity for a certain number of months. The winter day was assumed to be representative of 3 months (i.e., December, January, and February); the summer day was assumed to be representative of 3 months (i.e., June, July, and August); the spring or fall day was assumed to be representative of 6 months (i.e., March, April, May, September, October, November). For each of these days, considerations were made on which hours of the day these measures would be active. For example, it was assumed that residential exterior LED lights would be active during evening and overnight hours, but these lights would not be active during the daytime hours.

Considerations were also made to determine whether any measures would experience seasonality. For example, exterior lighting is assumed to be active irrespective of the season. However, air conditioning upgrades are assumed to only be active in the summer. Combined, these assumptions determine the average number of hours an energy efficiency measure is active in a given year.

The annual savings per hour in conjunction with the hourly schedules for measures and the achievable potential ramp rates provides the basis for estimating the impact to the base load. Results are generated to characterize the potential curtailment from energy efficiency measures at five year intervals. As provided in the table below, savings can on average reduce the base load by as much as 39.2 MW by 2030, increasing to 61.2 MW by 2040.

Table 8-1. Energy Efficiency Hourly MW Impact, Winter Extract, Medium Avoided Cost Scenario

Hour	2021 Base Load	2021 EE Curtailment	2030 Base Load	2030 EE Curtailment	2040 Base Load	2040 EE Curtailment
1	326.9	3.4	335.2	25.2	361.3	39.5
2	318.4	3.4	326.5	25.2	351.9	39.5
3	315.3	3.4	323.3	25.2	348.4	39.5
4	316.6	3.4	324.6	25.2	349.9	39.5
5	326.0	3.4	334.3	25.2	360.3	39.5
6	348.9	3.9	357.8	37.2	385.6	54.0
7	386.2	3.6	396.1	36.0	426.8	52.7
8	405.2	5.0	415.5	43.4	447.8	68.4
9	406.7	5.0	417.1	43.4	449.5	68.4
10	401.9	4.6	412.1	34.4	444.2	56.6
11	397.7	4.6	407.8	34.4	439.5	56.6
12	393.9	4.6	403.9	34.4	435.3	56.6
13	389.5	4.6	399.4	34.4	430.4	56.6
14	386.5	4.6	396.3	34.4	427.1	56.6
15	382.2	4.6	391.9	34.4	422.4	56.6
16	384.2	5.0	394.0	43.4	424.7	68.4
17	408.1	7.1	418.5	50.3	451.1	75.6
18	447.0	7.1	458.4	50.3	494.1	75.6
19	448.1	3.9	459.5	37.2	495.2	54.0
20	441.3	3.9	452.6	37.2	487.8	54.0
21	430.8	3.9	441.7	37.2	476.1	54.0
22	408.1	3.7	418.5	34.2	451.0	51.3

Hour	2021 Base Load	2021 EE Curtailment	2030 Base Load	2030 EE Curtailment	2040 Base Load	2040 EE Curtailment
23	374.6	3.7	384.2	34.2	414.0	51.3
24	344.7	3.4	353.5	25.2	381.0	39.5

Detailed hourly load impacts are further included in Appendix D.

8.2 Distributed Energy Potential

The following section describes the hourly modeling for the demand response measures and distributed solar.

8.2.1 Demand Response Potential

Each measure is assumed to defer energy per event, as shown in Appendix B. Unlike the energy efficiency measures, demand response measures are assumed to only be active during peak periods. Analysis of the base load was performed to identify both peak hours and a requisite peak duration to prevent a new, higher peak deferred to a later time. Most demand response measures only defer energy, and as such, the majority of the energy that was avoided during an event is consumed at a later time. For the purposes of this analysis it was assumed that the deferred energy is consumed immediately after a demand response event ends for a customer. Similar to the energy efficiency analysis, three representative days were used for the analysis, composed of one summer day, one winter day, and one spring or fall day.

Each of these days assumed to be representative of activity for a certain number of months. The winter day was assumed to be representative of 3 months (i.e., December, January, and February); the summer day was assumed to be representative of 3 months (i.e., June, July, and August); the spring or fall day was assumed to be representative of 6 months (i.e., March, April, May, September, October, November). For the three representative days used to create the hourly analysis, a peak period was defined to ensure that the new peak after factoring in deferred energy did not exceed the original peak demand under the base load. Each of these days were modeled as if a demand response event was called for all achievable demand response measures in a given year. While all events do not need to be called simultaneously and limits will exist on the frequency of events, this analysis examines the maximum deferral available to PRPA under the forecast.

The demand response analysis was performed independent of the energy efficiency results. The peak periods are shown in the tables below.

Table 8-2.Demand Response Peak Periods

	Winter	Spring/Fall	Summer
Number of Hours	6	6	6
Beginning of Peak Period	5 pm	3 pm	2 pm
End of Peak Period	10 pm	8 pm	7 pm

The demand response measures are functional irrespective of the season, however, the season does impact the peak hours, altering the time of day when measures are likely to be deployed. The table below provides the peak load with and without demand response measures. The peak load with demand response assumes events are called for all measures, and the deferred energy replacement is added to the base load after the peak period ends.

Table 8-3. Demand Response Results, Medium Avoided Cost Scenario

	2021	2025	2030	2035	2040
Peak Load without Demand Response (MW)	617	622	632	651	682
Total Deferral Available (MW)	3.4	7.7	19.2	25.5	28.1
% of Peak Load Available to Defer	0.6%	1.2%	3.0%	3.9%	4.1%
Deferred Energy Replacement (MW)	0.5	4.8	16.3	22.6	25.2
Peak Load with Demand Response (MW)	613	615	613	625	653

As provided in the table below, savings can on average reduce the base load by as much as 19.2 MW by 2030, increasing to 28.1 MW by 2040.

Table 8-4. Demand Response Hourly MW Impact, Summer Extract, Medium Avoided Cost Scenario

Hour	2021 Base Load	2021 DR Curtailment	2030 Base Load	2030 DR Curtailment	2040 Base Load	2040 DR Curtailment
1	350.3	0.0	359.2	0.0	387.1	0.0
2	327.3	0.0	335.6	0.0	361.7	0.0
3	314.6	0.0	322.6	0.0	347.7	0.0
4	308.1	0.0	316.0	0.0	340.5	0.0
5	312.0	0.0	319.9	0.0	344.8	0.0
6	323.5	0.0	331.7	0.0	357.5	0.0
7	342.0	0.0	350.7	0.0	378.0	0.0
8	375.8	0.0	385.3	0.0	415.3	0.0
9	414.2	0.0	424.7	0.0	457.7	0.0
10	455.7	0.0	467.3	0.0	503.6	0.0
11	494.4	0.0	507.0	0.0	546.4	0.0
12	535.6	0.0	549.2	0.0	591.9	0.0
13	566.6	0.0	581.0	0.0	626.2	0.0
14	593.9	3.4	609.0	19.2	656.4	28.1
15	616.7	3.4	632.4	19.2	681.6	28.1

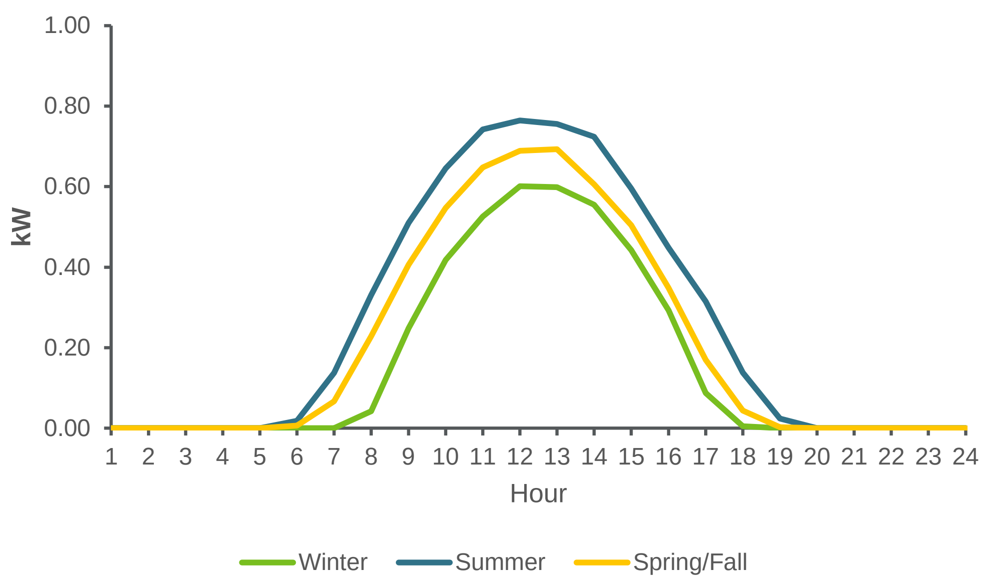
Hour	2021 Base Load	2021 DR Curtailment	2030 Base Load	2030 DR Curtailment	2040 Base Load	2040 DR Curtailment
16	608.5	3.4	624.0	19.2	672.5	28.1
17	583.7	3.4	598.5	19.2	645.1	28.1
18	576.6	3.4	591.3	19.2	637.3	28.1
19	567.3	3.4	581.8	19.2	627.0	28.1
20	543.1	-0.5	556.9	-16.3	600.2	-25.2
21	527.1	-0.5	540.5	-16.3	582.5	-25.2
22	499.0	-0.5	511.7	-16.3	551.5	-25.2
23	445.5	0.0	456.9	0.0	492.4	-0.4
24	396.3	0.0	406.4	0.0	438.0	0.0

Detailed hourly load impacts are further included in Appendix D.

8.2.2 Distributed Solar Potential

Distributed solar impacts were converted into hourly estimates based on the National Renewable Energy Laboratory's Solar Advisor Model (SAM)[22] hourly simulation of a sample 1 kW rooftop fixed-tilt system in Fort Collins. The hourly annual profile developed by the Solar Advisor Model was converted into average hourly estimates for a representative winter, summer, and spring or fall day. The sample system annual output is shown in the figure below.

Figure 8-2. Solar PV Representative Hourly Profile per Installed kW



[22] NREL System Advisor Model. Version 2017.9.5 rev4. https://sam.nrel.gov/

The hourly profiles are then multiplied by the installed kW of distributed solar to determine the total energy generated by distributed solar systems. The energy generated by distributed solar is assumed to offset the base load. In the low, medium, and high cost scenarios, there are no economically viable distributed solar capacity, and as such there is no estimated reduction in the base load.

Detailed hourly load impacts are further included in Appendix D.

9 Summary

The key results and findings from the DER study are displayed and discussed below. The section highlights the technical, economic, and achievable potential for energy efficiency, demand response, and distributed solar. Detailed results are further included in Appendix D.

9.1 Energy Efficiency

The Energy Efficiency summary of the technical, economic and achievable potential for the medium avoided cost scenario is summarized below.

Table 9-1. Energy Efficiency Savings Summary, Medium Avoided Cost Scenario

	Technical Potential		Economic Potential			Achievable Potential		
Year	***MWh***	***% of Load Forecast***	***MWh***	***% of Load Forecast***	***% of Technical Potential***	***MWh***	***% of Load Forecast***	***% of Technical Potential***
2021	1,181,269	36.4%	711,714	21.9%	60.2%	36,385	1.1%	3.1%
2025	1,239,928	37.8%	767,452	23.4%	61.9%	155,883	4.8%	12.6%
2030	1,313,173	39.4%	871,600	26.2%	66.4%	356,306	10.7%	27.1%
2035	1,382,130	40.4%	955,252	27.9%	69.1%	515,652	15.1%	37.3%
2040	1,450,130	40.4%	1,012,309	28.2%	69.8%	577,656	16.1%	39.8%

The main findings for EE measures:

- Under the medium avoided cost scenario, about 40% of the base case customer consumption is technically achievable through EE measures. However, not all of this potential is economic. PRPA may be able to achieve a 11% reduction in the base load 2030 and 16% of the base case customer consumption by 2040;
- The largest potential end-use savings category is the LED interior and exterior lighting, about one-third of the projected achievable potential in 2030. Most of the measures in the lighting category are economical and are modeled with a fast adoption and renewal ramp rates;
- Overall, the estimated EE energy savings is about 20% residential and 80% commercial & industrial in 2030;
- By 2030, it is projected that energy efficiency measures can reduce the hourly base load by up to 69.3 MW. The expected peak reduction is 50 MW on an average winter day, 43 MW on an average spring or fall day, and 69 MW on an average summer;
- To achieve the energy efficiency savings presented, approximately $139.8 million would be spent by PRPA through 2030 for the medium avoided cost scenario;
- From 2021 through 2025 the average annual utility cost (utility incentive and utility administrative cost) for the first year of installed measures is expected to be about $9.6 million to achieve an average 31,330 MWh incremental annual energy savings,

or $308/MWh (or a levelized first year cost of $32.8/MWh based on 13 year measure life and 5% discount rate). PRPA is expecting to spend of $14.1 million in 2020 on DER programs to save 34,000 MWh, or $415/MWh (or a levelized cost of $44.2/MWh based on 13 year measure life and 5% discount rate); and

- While PRPA's budget plan is higher than the savings and costs observed in the modeled EE estimates, it is important to note that the EE results described in this report are based on a least cost portfolio and do not include EE savings that result in a portfolio that has a levelized average utility cost above the avoided cost. The resulting energy savings estimates from 2021 through 2025 present PRPA with an opportunity to evaluate the effectiveness of their existing DER programs and a goal to strive towards.

9.2 Demand Response

A demand response measure summary of the technical, economic and achievable potential for the medium avoided cost scenario is provided below.

Table 9-2. Demand Response Summary, Medium Avoided Cost Scenario

	Technical Potential		Economic Potential			Achievable Potential		
Year	***MWh***	***% of Load Forecast***	***MWh***	***% of Load Forecast***	***% of Technical Potential***	***MWh***	***% of Load Forecast***	***% of Technical Potential***
2021	20,363	0.6%	2,970	0.09%	14.6%	463	0.01%	2.3%
2025	34,767	1.1%	3,348	0.10%	9.6%	823	0.03%	2.4%
2030	43,308	1.3%	3,807	0.11%	8.8%	1,925	0.06%	4.4%
2035	51,588	1.5%	4,246	0.12%	8.2%	2,661	0.08%	5.2%
2040	58,925	1.6%	5,778	0.2%	9.8%	3,206	0.09%	5.4%
Year	***MW***	***% of Summer Peak Load***	***MW***	***% of Summer Peak Load***	**% of Technical Potential**	***MW***	***% of Summer Peak Load***	**% of Technical Potential**
2021	90	13.4%	30	4.5%	33.4%	3	0.6%	3.8%
2025	114	16.8%	34	5.0%	29.5%	8	1.2%	6.8%
2030	134	19.4%	38	5.5%	28.2%	19	3.0%	14.4%
2035	153	21.6%	42	5.9%	27.3%	26	3.9%	16.8%
2040	171	23.0%	48	6.4%	27.8%	28	4.1%	16.6%

The main findings for the demand response measures:

- Under the medium avoided cost scenario, about 58,925 MWh of the base case customer consumption and about 171 MW is technically achievable through DR measures. PRPA may be able to defer as much as 19 MW of demand during peak periods by 2030 and 28 MW by 2040;

- The largest potential end-use savings category is the HVAC programmable communicating and direct load control thermostats, about 60% of the projected achievable potential by 2030. Most of the measures in the HVAC category are economical at the beginning of the study period and are modeled with a fast renewal ramp rate;
- By 2030, batteries have not yet become economically viable under the total resource cost test. However, anticipated cost reductions result in batteries becoming economic before 2040;
- Overall, the estimated DR load deferral capability is about 65% residential and 35% commercial & industrial; and
- In 2030, there is an anticipated maximum load deferral of 19.2 MW during peak periods through demand response. Nearly 3% of the peak load can be deferred through the measures.

9.3 Distributed Solar

A distributed solar measure summary of the technical, economic and achievable potential for the medium avoided cost scenario is provided below.

Table 9-3. Distributed Solar Summary, Medium Avoided Cost Scenario

	Technical Potential		Economic Potential			Achievable Potential		
Year	***MWh***	***% of Load Forecast***	***MWh***	***% of Load Forecast***	***% of Technical Potential***	***MWh***	***% of Load Forecast***	***% of Technical Potential***
2021	1,912,050	59%	0	0%	0%	0	0%	0%
2025	2,056,269	63%	0	0%	0%	0	0%	0%
2030	2,232,174	67%	0	0%	0%	0	0%	0%
2035	2,397,140	70%	0	0%	0%	0	0%	0%
2040	2,561,901	71%	0	0%	0%	0	0%	0%

The main findings for distributed solar PV measures:

- Distributed solar is not economically viable under the total resource cost test. There is significant technical potential and customers that find distributed solar economic can install systems which would reduce the base load;
- Although distribution system constraints were not evaluated for this study, the technical potential for distributed solar is comprised of nearly 40% residential and 60% commercial & industrial; and
- Installation of distributed solar would reduce the base load primarily during midday, peaking between 10 am and 2 pm, with the load reduction tapering off by 5 pm.

9.4 Concluding Remarks

By 2030, it is expected that PRPA's DER plan includes a mix of new energy efficiency and demand response measures. Under the medium avoided cost scenario, the evaluated energy efficiency measures could reduce PRPA's hourly load by about 50 MW, and reduce the annual base load customer consumption by nearly 10%. Evaluated demand response measures are anticipated to provide the capability to defer 20 MW of electricity during the peak load. For PRPA to achieve the DER savings assessed in this study, $168 million in costs would be incurred to account for utility incentives, installation costs, and program administration costs.

Table 9-4. Energy Savings Results Compared to Base Load Forecast, MWh, Medium Avoided Cost Scenario

	2021	2025	2030	2035	2040
Base Load	**3,246,452**	**3,276,068**	**3,329,157**	**3,424,440**	**3,587,996**
Energy Efficiency	**36,385**	**155,883**	**356,306**	**515,652**	**577,656**
% of Base Load	*1.1%*	*4.8%*	*10.7%*	*15.1%*	*16.1%*
Demand Response Deferral	**463**	**823**	**1,925**	**2,661**	**3,206**
% of Base Load	*0.0%*	*0.0%*	*0.1%*	*0.1%*	*0.1%*
Distributed Solar	**0**	**0**	**0**	**0**	**0**
% of Base Load	*0.0%*	*0.0%*	*0.0%*	*0.0%*	*0.0%*

Table 9-5. Load Reduction Results Compared to Peak Hourly Load Forecast, MW, Medium Avoided Cost Scenario

	2021	2025	2030	2035	2040
Peak Hourly Load	**673**	**679**	**691**	**710**	**744**
Maximum Hourly Energy Efficiency Savings	**7.1**	**26.2**	**69.3**	**105**	**119**
% of Peak Load	*1.1%*	*3.9%*	*10.0%*	*14.8%*	*16.0%*
Maximum Hourly Demand Response Deferral	**3.4**	**7.7**	**19.2**	**25.5**	**28.1**
% of Peak Load	*0.6%*	*1.2%*	*3.0%*	*3.9%*	*4.1%*
Maximum Hourly Distributed Solar Savings	**0**	**0**	**0**	**0**	**0**
% of Peak Load	*0.0%*	*0.0%*	*0.0%*	*0.0%*	*0.0%*

10 References

Applied Energy Group, Inc. "PacifiCorp Demand-Side Resource Potential Assessment for 2017-2036." February 14, 2017. https://www.pacificorp.com/environment/demand-side-management.html.

ICF International and Opinion Dynamics Corporation. "ComEd Energy Efficiency Potential Study, 2017–2030." May 2016. http://ilsagfiles.org/SAG_files/Potential_Studies/ComEd/ComEd_2017-2030_EE_Potential_Final_Report_5-2016.pdf.

Navigant Consulting, Inc. "2017 IRP Demand-Side Resource Conservation Potential Assessment Report." June 30, 2017. https://www.pse.com/-/media/PDFs/001-Energy-Supply/001-Resource-Planning/IRP17_AppJ.pdf.

Northwest Power and Conservation Council. "Seventh Northwest Conservation and Electric Power Plan." February 25, 2016. https://www.nwcouncil.org/reports/seventh-power-plan.

Public Service Company of Colorado. "2017/2018 Demand-Side Management Plan Electric and Natural Gas." Proceeding No. 16A-0512EG. July 21, 2016. https://www.xcelenergy.com/staticfiles/xe-responsive/Company/Rates%20&%20Regulations/Regulatory%20Filings/CO-Demand%20side%20management-2017%2018%20DSM%20PLAN_FINAL.pdf.

W. Wang et al. "Advanced Rooftop Control (ARC) Retrofit: Field-Test Results." Pacific Northwest National Laboratory. PNNL-22656. July 2013. https://www.pnnl.gov/main/publications/external/technical_reports/PNNL-22656.pdf

Alstone et al. "2025 California Demand Response Potential Study – Charting California's Demand Response Future: Final Report on Phase 2 Results." Lawrence Berkeley National Laboratory. LBNL-2001113. March 1, 2017. https://drrc.lbl.gov/publications/2025-california-demand-response

Xcel Energy. "Electric Vehicle Charging Station: Pilot Evaluation Report." May 2015. https://www.xcelenergy.com/energy_portfolio/innovation/electric_vehicles/ev_service_pilot.

Scott et al. "Refrigerated Warehouse Demand Response Strategy Guide." Lawrence Berkeley National Laboratory. LBNL-1004300. November 2015. http://eta-publications.lbl.gov/sites/default/files/refrigerated_warehouse_demand_reponse.pdf.

Appendix A. Energy Efficiency Measure Assumptions

The table below presents a list of key assumptions pertaining to the energy efficiency measures examined in the study. Administrative costs were assumed to be an additional 30% increase on top of the average program cost.

Table A-1. Energy Efficiency Measure Assumptions

EE Measure Name	Customer Segment	Description	Average Annual Savings (kWh/year)	Measure Life (years)	Average Installation Cost ($)	Measure Source	Administrative Cost ($)	Total Program Cost ($)	Active Hours per Year
Residential									
Heating									
Smart Thermostat installation - Electric Heating	Single Family	Thermostat - WiFi/Interactive	985	10	$175	PacifiCorp 2017 Demand Side Management (DSM) Report	$47	$222	6570
Smart Thermostat installation - Electric Heating	Multi-Family	Thermostat - WiFi/Interactive	68	10	$175	PacifiCorp 2017 DSM Report	$47	$222	6570
Smart Thermostat installation - Gas Heating	Single Family	Smart WiFi Thermostat	67	10	$175	ComEd 2016 EE Potential	$47	$222	6570
Smart Thermostat installation - Gas Heating	Multi-Family	Smart WiFi Thermostat	44	10	$175	ComEd 2016 EE Potential	$47	$222	6570
Programmable Thermostat installation - Heating	Single Family	Thermostat that can be programmed by the user to change temperature settings according to a schedule	93	10	$160	PSE 2017 DSM Report	$43	$203	6570
Programmable Thermostat installation - Heating	Multi-Family	Thermostat that can be programmed by the user to change temperature settings according to a schedule	357	10	$160	PSE 2017 DSM Report	$43	$203	6570

EE Measure Name	Customer Segment	Description	Average Annual Savings (kWh/year)	Measure Life (years)	Average Installation Cost ($)	Measure Source	Administrative Cost ($)	Total Program Cost ($)	Active Hours per Year
Weatherization: Air Sealing	Single Family	Seal air leaks to reduce air changes per hour (ACH) from 0.6 to 0.36	136	10	$2,398	PSE 2017 DSM Report	$646	$3,044	8760
Weatherization: Air Sealing	Multi-Family	Seal air leaks to reduce air changes per hour (ACH) from 0.6 to 0.36	271	10	$2,398	PSE 2017 DSM Report	$646	$3,044	8760
Weatherization: Insulation	Single Family	Adding attic and ceiling insulation	347	25	$1,540	PSE 2017 DSM Report	$415	$1,955	8760
High Efficiency Windows	Single Family	Windows with a U-value of 0.22	180	20	$1,998	PSE 2017 DSM Report	$538	$2,536	8760
High Efficiency Windows	Multi-Family	Windows with a U-value of 0.22	364	20	$999	PSE 2017 DSM Report	$269	$1,268	8760
Installation of ENERGY STAR® storm windows/doors	Single Family	Doors - Storm and Thermal	120	20	$683	PacifiCorp 2017 DSM Report	$184	$866	8760
Installation of ENERGY STAR® storm windows/doors	Multi-Family	Doors - Storm and Thermal	19	20	$683	PacifiCorp 2017 DSM Report	$184	$866	8760
Install Heat Recovery Ventilation	Single Family	Space Heating - Heat Recovery Ventilator - NEW HOMES ONLY	612	20	$1,304	PSE 2017 DSM Report / 7th Power Plan	$351	$1,655	6570
Install Heat Recovery Ventilation	Multi-Family	Space Heating - Heat Recovery Ventilator - NEW HOMES ONLY	107	20	$1,304	PSE 2017 DSM Report / 7th Power Plan	$351	$1,655	6570
Cooling									
Central Air Conditioner upgrade	Single Family	Replacing existing AC with an 18 SEER AC	288	13	$606	PSE 2017 DSM Report / ComEd 2016 EE Potential	$163	$769	2190

EE Measure Name	Customer Segment	Description	Average Annual Savings (kWh/year)	Measure Life (years)	Average Installation Cost ($)	Measure Source	Administrative Cost ($)	Total Program Cost ($)	Active Hours per Year
Central Air Conditioner upgrade	Multi-Family	Replacing existing AC with an 18 SEER AC	252	13	$529	PSE 2017 DSM Report / ComEd 2016 EE Potential	$142	$672	2190
Smart Thermostat installation - Cooling	Single Family	Thermostat - WiFi/Interactive	215	10	$175	PacifiCorp 2017 DSM Report / PRPA experience	$47	$222	2190
Smart Thermostat installation - Cooling	Multi-Family	Thermostat - WiFi/Interactive	215	10	$175	PacifiCorp 2017 DSM Report / PRPA experience	$47	$222	2190
High efficiency air handler/rooftop units	Multi-Family	Air Handler/Rooftop Cooling Unit with 17 SEER and 12 EER	185	20	$959	Xcel TRM 2017	$258	$1,218	2190
Ventilation									
ECM Furnace Blower Motor	Single Family	Use Electronically Commutated Motor (ECM) fan motor instead of PSC or Shaded Pole Motor in furnace	582	13	$742	PSE 2017 DSM Report	$200	$942	8760
ECM Furnace Blower Motor	Multi-Family	Use Electronically Commutated Motor (ECM) fan motor instead of PSC or Shaded Pole Motor in furnace	582	13	$742	PSE 2017 DSM Report	$200	$942	8760
Water Heating									
Heat-Pump Electric storage water heater	Single Family	Purchase heat pump electric storage water heater	1,108	13	$1,728	PSE 2017 DSM Report / PRPA experience	$465	$2,194	8760

EE Measure Name	Customer Segment	Description	Average Annual Savings (kWh/year)	Measure Life (years)	Average Installation Cost ($)	Measure Source	Administrative Cost ($)	Total Program Cost ($)	Active Hours per Year
Heat-Pump Electric storage water heater	Multi-Family	Purchase heat pump electric storage water heater	1,100	13	$1,715	PSE 2017 DSM Report / PRPA experience	$462	$2,177	8760
Lighting									
LED Upgrade (interior)	Single Family	Install LED bulb instead of incandescent bulb	695	5	$493	7th Power Plan - Residential Lighting / PRPA Experience	$133	$626	4380
LED Upgrade (interior)	Multi-Family	Install LED bulb instead of incandescent bulb	240	5	$170	7th Power Plan - Residential Lighting / PRPA Experience	$46	$216	4380
LED Upgrade (exterior)	Single Family	Exterior - General Service Screw-In	210	10	$55	PacifiCorp 2017 DSM Report	$15	$70	4288.75
Refrigeration									
ENERGY STAR® freezer	Single Family	High Efficiency Freezer	34	20	$82	PSE 2017 DSM Report	$22	$104	8760
ENERGY STAR® freezer	Multi-Family	High Efficiency Freezer	32	20	$77	PSE 2017 DSM Report	$21	$98	8760
ENERGY STAR® refrigerator	Single Family	High Efficiency Refrigerator	53	17	$214	PSE 2017 DSM Report	$58	$272	8760
ENERGY STAR® refrigerator	Multi-Family	High Efficiency Refrigerator	39	17	$157	PSE 2017 DSM Report	$42	$199	8760
Refrigerator Recycling	Single Family	Recycle post-1990 refrigerator instead keeping as 2nd refrigerator	463	5.75	$120	ComEd 2016 EE Potential / PRPA experience	$32	$152	8760

EE Measure Name	Customer Segment	Description	Average Annual Savings (kWh/year)	Measure Life (years)	Average Installation Cost ($)	Measure Source	Administrative Cost ($)	Total Program Cost ($)	Active Hours per Year
Refrigerator Recycling	Multi-Family	Recycle post-1990 refrigerator instead keeping as 2nd refrigerator	463	5.75	$120	ComEd 2016 EE Potential / PRPA experience	$32	$152	8760
Miscellaneous									
ENERGY STAR® pool pumps	Single Family	Pool Pump	703	15	$873	PacifiCorp 2017 DSM Report	$235	$1,108	2190
ENERGY STAR® dishwasher	Single Family	Dishwasher that meets ENERGY STAR specification	80	15.4	$37	PSE 2017 DSM Report	$10	$47	4380
ENERGY STAR® dishwasher	Multi-Family	Dishwasher that meets ENERGY STAR specification	80	15.4	$37	PSE 2017 DSM Report	$10	$47	4380
ENERGY STAR® clothes washers	Single Family	Clothes washer that meets ENERGY STAR specification	85	14.2	$142	PSE 2017 DSM Report / PRPA experience	$38	$180	4380
ENERGY STAR® clothes washers	Multi-Family	Clothes washer that meets ENERGY STAR specification	85	14.2	$142	PSE 2017 DSM Report / PRPA experience	$38	$180	4380
ENERGY STAR® clothes dryer	Single Family	Electric clothes dryer that meets ENERGY STAR specification	329	12	$335	PSE 2017 DSM Report	$90	$425	4380
ENERGY STAR® clothes dryer	Multi-Family	Electric clothes dryer that meets ENERGY STAR specification	329	12	$335	PSE 2017 DSM Report	$90	$425	4380
ENERGY STAR® electronics	all residential	Advanced power strip that turns off equipment plugged into it when not in use	140	5	$128	PSE 2017 DSM Report	$34	$162	8760

EE Measure Name	Customer Segment	Description	Average Annual Savings (kWh/year)	Measure Life (years)	Average Installation Cost ($)	Measure Source	Administrative Cost ($)	Total Program Cost ($)	Active Hours per Year
Faucet Aerators	all residential	Aerators on bathroom faucets that reduce flow to 0.5 gallons per minute	157	10	$44	PSE 2017 DSM Report	$12	$56	4380
Low Flow Showerheads	all residential	Low-Flow Showerheads, Electric WH - Showerhead that restricts flow to 1.5 gallons per minute	1,021	10	$60	PSE 2017 DSM Report	$16	$76	4380
Commercial									
Heating									
Smart Thermostat installation - Heating	Other	Thermostat - WiFi/Interactive	3,182	10	$3,443	PacifiCorp 2017 DSM Report	$927	$4,369	6570
Smart Thermostat installation - Heating	Education	Thermostat - WiFi/Interactive	75,212	10	$74,089	PacifiCorp 2017 DSM Report	$19,947	$94,036	6570
Smart Thermostat installation - Heating	Food Sales	Thermostat - WiFi/Interactive	4,560	10	$4,180	PacifiCorp 2017 DSM Report	$1,125	$5,306	6570
Smart Thermostat installation - Heating	Food Service	Thermostat - WiFi/Interactive	2,379	10	$2,211	PacifiCorp 2017 DSM Report	$595	$2,807	6570
Smart Thermostat installation - Heating	Healthcare	Thermostat - WiFi/Interactive	6,994	10	$3,206	PacifiCorp 2017 DSM Report	$863	$4,069	6570
Smart Thermostat installation - Heating	Lodging	Thermostat - WiFi/Interactive	4,778	10	$9,556	PacifiCorp 2017 DSM Report	$2,573	$12,129	6570
Smart Thermostat installation - Heating	Mixed	Thermostat - WiFi/Interactive	1,009	10	$1,092	PacifiCorp 2017 DSM Report	$294	$1,386	6570
Smart Thermostat installation - Heating	Office	Thermostat - WiFi/Interactive	3,656	10	$5,134	PacifiCorp 2017 DSM Report	$1,382	$6,516	6570
Smart Thermostat installation - Heating	Parking	Thermostat - WiFi/Interactive	42,888	10	$46,403	PacifiCorp 2017 DSM Report	$12,493	$58,896	6570

EE Measure Name	Customer Segment	Description	Average Annual Savings (kWh/year)	Measure Life (years)	Average Installation Cost ($)	Measure Source	Administrative Cost ($)	Total Program Cost ($)	Active Hours per Year
Smart Thermostat installation - Heating	Public Assembly	Thermostat - WiFi/Interactive	6,214	10	$6,724	PacifiCorp 2017 DSM Report	$1,810	$8,534	6570
Smart Thermostat installation - Heating	Public Service	Thermostat - WiFi/Interactive	50,669	10	$54,823	PacifiCorp 2017 DSM Report	$14,760	$69,583	6570
Smart Thermostat installation - Heating	Religious	Thermostat - WiFi/Interactive	9,740	10	$10,539	PacifiCorp 2017 DSM Report	$2,837	$13,376	6570
Smart Thermostat installation - Heating	Retail	Thermostat - WiFi/Interactive	3,881	10	$4,493	PacifiCorp 2017 DSM Report	$1,210	$5,703	6570
Smart Thermostat installation - Heating	Services	Thermostat - WiFi/Interactive	2,952	10	$3,194	PacifiCorp 2017 DSM Report	$860	$4,054	6570
Smart Thermostat installation - Heating	Storage	Thermostat - WiFi/Interactive	11,155	10	$10,370	PacifiCorp 2017 DSM Report	$2,792	$13,162	6570
Smart Thermostat installation - Heating	Utility	Thermostat - WiFi/Interactive	1,663	10	$1,800	PacifiCorp 2017 DSM Report	$485	$2,284	6570
Cooling									
Air-cooled Chiller upgrade	Other Category	Air-cooled chiller with an efficiency of 11.5 EER and 15.5 SEER	850	20	$4,387	PSE 2017 DSM Report	$1,181	$5,568	2190
Air-cooled Chiller upgrade	Education Category	Air-cooled chiller with an efficiency of 11.5 EER and 15.5 SEER	9,286	20	$74,384	PSE 2017 DSM Report	$20,026	$94,410	2190
Air-cooled Chiller upgrade	Food Sales Category	Air-cooled chiller with an efficiency of 11.5 EER and 15.5 SEER	600	20	$3,856	PSE 2017 DSM Report	$1,038	$4,894	2190
Air-cooled Chiller upgrade	Food Service Category	Air-cooled chiller with an efficiency of 11.5 EER and 15.5 SEER	758	20	$4,869	Assume same as Food Service Category	$1,311	$6,180	2190

EE Measure Name	Customer Segment	Description	Average Annual Savings (kWh/year)	Measure Life (years)	Average Installation Cost ($)	Measure Source	Administrative Cost ($)	Total Program Cost ($)	Active Hours per Year
Air-cooled Chiller upgrade	Healthcare Category	Air-cooled chiller with an efficiency of 11.5 EER and 15.5 SEER	748	20	$3,040	PSE 2017 DSM Report	$818	$3,858	2190
Air-cooled Chiller upgrade	Lodging Category	Air-cooled chiller with an efficiency of 11.5 EER and 15.5 SEER	734	20	$5,186	PSE 2017 DSM Report	$1,396	$6,583	2190
Air-cooled Chiller upgrade	Mixed	Air-cooled chiller with an efficiency of 11.5 EER and 15.5 SEER	362	20	$1,869	PSE 2017 DSM Report	$503	$2,373	2190
Air-cooled Chiller upgrade	Office Category	Air-cooled chiller with an efficiency of 11.5 EER and 15.5 SEER	1,007	20	$6,019	PSE 2017 DSM Report	$1,620	$7,639	2190
Air-cooled Chiller upgrade	Parking	Air-cooled chiller with an efficiency of 11.5 EER and 15.5 SEER	11,459	20	$59,129	Assume same as Other Category	$15,919	$75,048	2190
Air-cooled Chiller upgrade	Public Assembly Category	Air-cooled chiller with an efficiency of 11.5 EER and 15.5 SEER	1,414	20	$7,298	PSE 2017 DSM Report	$1,965	$9,263	2190
Air-cooled Chiller upgrade	Public Service Category	Air-cooled chiller with an efficiency of 11.5 EER and 15.5 SEER	6,653	20	$34,331	PSE 2017 DSM Report	$9,243	$43,575	2190
Air-cooled Chiller upgrade	Religious	Air-cooled chiller with an efficiency of 11.5 EER and 15.5 SEER	2,046	20	$10,559	PSE 2017 DSM Report	$2,843	$13,402	2190
Air-cooled Chiller upgrade	Services Category	Air-cooled chiller with an efficiency of 11.5 EER and 15.5 SEER	326	20	$1,680	Assume same as Other Category	$452	$2,133	2190
Air-cooled Chiller upgrade	Storage	Air-cooled chiller with an efficiency of 11.5 EER and 15.5 SEER	324	20	$3,896	PSE 2017 DSM Report	$1,049	$4,945	2190

EE Measure Name	Customer Segment	Description	Average Annual Savings (kWh/year)	Measure Life (years)	Average Installation Cost ($)	Measure Source	Administrative Cost ($)	Total Program Cost ($)	Active Hours per Year
Air-cooled Chiller upgrade	Utility	Air-cooled chiller with an efficiency of 11.5 EER and 15.5 SEER	444	20	$2,293	Assume same as Other Category	$617	$2,911	2190
Water-cooled Chiller upgrade	Healthcare Category	Centrifugal chiller with an efficiency of 0.60 Full Load Value (FLV) and 0.54 Integrated Part Load Value (IPLV)	370	20	$3,026	PSE 2017 DSM Report	$815	$3,841	2190
Water-cooled Chiller upgrade	Industrial	Centrifugal chiller with an efficiency of 0.60 Full Load Value (FLV) and 0.54 Integrated Part Load Value (IPLV)	3,295	20	$34,236	PSE 2017 DSM Report	$9,217	$43,454	2190
Water-cooled Chiller upgrade	Office Category	Centrifugal chiller with an efficiency of 0.60 Full Load Value (FLV) and 0.54 Integrated Part Load Value (IPLV)	498	20	$5,992	PSE 2017 DSM Report	$1,613	$7,605	2190
Evaporative pre-cooling installation on air-cooled condenser	Retail Category	Evaporative pre-cooling of air-cooled condensers on direct expansion HVAC units	8,356	20	$22,483	PSE 2017 DSM Report	$6,053	$28,536	2190
Evaporative pre-cooling installation on air-cooled condenser	Education Category	Evaporative pre-cooling of air-cooled condensers on direct expansion HVAC units	20,787	20	$88,038	PSE 2017 DSM Report	$23,703	$111,741	2190
Evaporative pre-cooling installation on air-cooled condenser	Healthcare Category	Evaporative pre-cooling of air-cooled condensers on direct expansion HVAC units	1,674	20	$3,598	PSE 2017 DSM Report	$969	$4,566	2190

EE Measure Name	Customer Segment	Description	Average Annual Savings (kWh/year)	Measure Life (years)	Average Installation Cost ($)	Measure Source	Administrative Cost ($)	Total Program Cost ($)	Active Hours per Year
Evaporative pre-cooling installation on air-cooled condenser	Industrial	Evaporative pre-cooling of air-cooled condensers on direct expansion HVAC units	14,928	20	$40,704	PSE 2017 DSM Report	$10,959	$51,663	2190
Evaporative pre-cooling installation on air-cooled condenser	Office Category	Evaporative pre-cooling of air-cooled condensers on direct expansion HVAC units	2,254	20	$7,124	PSE 2017 DSM Report	$1,918	$9,041	2190
Evaporative pre-cooling installation on air-cooled condenser	Utility	Evaporative pre-cooling of air-cooled condensers on direct expansion HVAC units	995	20	$2,714	PSE 2017 DSM Report	$731	$3,445	2190
High efficiency air handler/rooftop units	Other Category	Air Handler/Rooftop Cooling Unit with 14 SEER and 11.4 EER	2,160	20	$3,484	Xcel Technical Resource Manual 2017 (2017/2018 Demand-Side Management Plan)	$938	$4,422	2190
High efficiency air handler/rooftop units	Education Category	Air Handler/Rooftop Cooling Unit with 14 SEER and 11.4 EER	24,717	20	$59,072	Xcel Technical Resource Manual 2017 (2017/2018 Demand-Side Management Plan)	$15,904	$74,976	2190
High efficiency air handler/rooftop units	Food Sales Category	Air Handler/Rooftop Cooling Unit with 14 SEER and 11.4 EER	1,265	20	$3,062	Xcel Technical Resource Manual 2017 (2017/2018 Demand-Side Management Plan)	$824	$3,887	2190

EE Measure Name	Customer Segment	Description	Average Annual Savings (kWh/year)	Measure Life (years)	Average Installation Cost ($)	Measure Source	Administrative Cost ($)	Total Program Cost ($)	Active Hours per Year
High efficiency air handler/rooftop units	Food Service Category	Air Handler/Rooftop Cooling Unit with 14 SEER and 11.4 EER	2,398	20	$3,867	Xcel Technical Resource Manual 2017 (2017/2018 Demand-Side Management Plan)	$1,041	$4,908	2190
High efficiency air handler/rooftop units	Healthcare Category	Air Handler/Rooftop Cooling Unit with 14 SEER and 11.4 EER	1,913	20	$2,414	Xcel Technical Resource Manual 2017 (2017/2018 Demand-Side Management Plan)	$650	$3,064	2190
High efficiency air handler/rooftop units	Industrial	Air Handler/Rooftop Cooling Unit with 14 SEER and 11.4 EER	24,844	20	$27,312	Xcel Technical Resource Manual 2017 (2017/2018 Demand-Side Management Plan)	$7,353	$34,665	2190
High efficiency air handler/rooftop units	Lodging Category	Air Handler/Rooftop Cooling Unit with 14 SEER and 11.4 EER	2,238	20	$4,119	Xcel Technical Resource Manual 2017 (2017/2018 Demand-Side Management Plan)	$1,109	$5,228	2190
High efficiency air handler/rooftop units	Mixed	Air Handler/Rooftop Cooling Unit with 14 SEER and 11.4 EER	921	20	$1,485	Xcel Technical Resource Manual 2017 (2017/2018 Demand-Side Management Plan)	$400	$1,884	2190

EE Measure Name	Customer Segment	Description	Average Annual Savings (kWh/year)	Measure Life (years)	Average Installation Cost ($)	Measure Source	Administrative Cost ($)	Total Program Cost ($)	Active Hours per Year
High efficiency air handler/rooftop units	Office Category	Air Handler/Rooftop Cooling Unit with 14 SEER and 11.4 EER	4,348	20	$4,780	Xcel Technical Resource Manual 2017 (2017/2018 Demand-Side Management Plan)	$1,287	$6,067	2190
High efficiency air handler/rooftop units	Parking	Air Handler/Rooftop Cooling Unit with 14 SEER and 11.4 EER	29,119	20	$46,957	Xcel Technical Resource Manual 2017 (2017/2018 Demand-Side Management Plan)	$12,642	$59,600	2190
High efficiency air handler/rooftop units	Public Assembly Category	Air Handler/Rooftop Cooling Unit with 14 SEER and 11.4 EER	3,594	20	$5,796	Xcel Technical Resource Manual 2017 (2017/2018 Demand-Side Management Plan)	$1,560	$7,356	2190
High efficiency air handler/rooftop units	Public Service Category	Air Handler/Rooftop Cooling Unit with 14 SEER and 11.4 EER	24,802	20	$27,264	Xcel Technical Resource Manual 2017 (2017/2018 Demand-Side Management Plan)	$7,340	$34,605	2190
High efficiency air handler/rooftop units	Religious	Air Handler/Rooftop Cooling Unit with 14 SEER and 11.4 EER	3,509	20	$8,386	Xcel Technical Resource Manual 2017 (2017/2018 Demand-Side Management Plan)	$2,258	$10,643	2190

EE Measure Name	Customer Segment	Description	Average Annual Savings (kWh/year)	Measure Life (years)	Average Installation Cost ($)	Measure Source	Administrative Cost ($)	Total Program Cost ($)	Active Hours per Year
High efficiency air handler/rooftop units	Retail Category	Air Handler/Rooftop Cooling Unit with 14 SEER and 11.4 EER	1,526	20	$3,693	Xcel Technical Resource Manual 2017 (2017/2018 Demand-Side Management Plan)	$994	$4,687	2190
High efficiency air handler/rooftop units	Services Category	Air Handler/Rooftop Cooling Unit with 14 SEER and 11.4 EER	828	20	$1,334	Xcel Technical Resource Manual 2017 (2017/2018 Demand-Side Management Plan)	$359	$1,694	2190
High efficiency air handler/rooftop units	Storage	Air Handler/Rooftop Cooling Unit with 14 SEER and 11.4 EER	2,815	20	$3,094	Xcel Technical Resource Manual 2017 (2017/2018 Demand-Side Management Plan)	$833	$3,927	2190
High efficiency air handler/rooftop units	Utility	Air Handler/Rooftop Cooling Unit with 14 SEER and 11.4 EER	1,657	20	$1,821	Xcel Technical Resource Manual 2017 (2017/2018 Demand-Side Management Plan)	$490	$2,312	2190
Advanced RTU Controller (ARC) retrofit	Education Category	Packaged rooftop units with advanced controller upgrade	266,717	20	$132,649	PNNL-22656	$35,713	$168,362	2190
Advanced RTU Controller (ARC) retrofit	Food Sales Category	Packaged rooftop units with advanced controller upgrade	13,827	20	$13,434	PNNL-22656	$3,617	$17,050	2190

EE Measure Name	Customer Segment	Description	Average Annual Savings (kWh/year)	Measure Life (years)	Average Installation Cost ($)	Measure Source	Administrative Cost ($)	Total Program Cost ($)	Active Hours per Year
Advanced RTU Controller (ARC) retrofit	Food Service Category	Packaged rooftop units with advanced controller upgrade	17,458	20	$8,683	PNNL-22656	$2,338	$11,020	2190
Advanced RTU Controller (ARC) retrofit	Healthcare Category	Packaged rooftop units with advanced controller upgrade	10,899	20	$10,589	PNNL-22656	$2,851	$13,440	2190
Advanced RTU Controller (ARC) retrofit	Lodging Category	Packaged rooftop units with advanced controller upgrade	18,596	20	$9,249	PNNL-22656	$2,490	$11,739	2190
Advanced RTU Controller (ARC) retrofit	Mixed	Packaged rooftop units with advanced controller upgrade	6,703	20	$6,512	PNNL-22656	$1,753	$8,266	2190
Advanced RTU Controller (ARC) retrofit	Office Category	Packaged rooftop units with advanced controller upgrade	21,581	20	$10,733	PNNL-22656	$2,890	$13,623	2190
Advanced RTU Controller (ARC) retrofit	Public Service Category	Packaged rooftop units with advanced controller upgrade	123,102	20	$61,223	PNNL-22656	$16,483	$77,707	2190
Advanced RTU Controller (ARC) retrofit	Religious	Packaged rooftop units with advanced controller upgrade	37,863	20	$18,831	PNNL-22656	$5,070	$23,900	2190
Advanced RTU Controller (ARC) retrofit	Retail Category	Packaged rooftop units with advanced controller upgrade	16,672	20	$8,292	PNNL-22656	$2,232	$10,524	2190
Advanced RTU Controller (ARC) retrofit	Services Category	Packaged rooftop units with advanced controller upgrade	6,025	20	$5,854	PNNL-22656	$1,576	$7,429	2190
Smart Thermostat installation - Cooling	Other Category	Thermostat - WiFi/Interactive	2,556	5	$3,443	PacifiCorp 2017 DSM Report	$927	$4,369	2190
Smart Thermostat installation - Cooling	Education Category	Thermostat - WiFi/Interactive	37,045	5	$74,089	PacifiCorp 2017 DSM Report	$19,947	$94,036	2190

EE Measure Name	Customer Segment	Description	Average Annual Savings (kWh/year)	Measure Life (years)	Average Installation Cost ($)	Measure Source	Administrative Cost ($)	Total Program Cost ($)	Active Hours per Year
Smart Thermostat installation - Cooling	Food Sales Category	Thermostat - WiFi/Interactive	7,410	5	$4,180	PacifiCorp 2017 DSM Report	$1,125	$5,306	2190
Smart Thermostat installation - Cooling	Food Service Category	Thermostat - WiFi/Interactive	3,619	5	$2,211	PacifiCorp 2017 DSM Report	$595	$2,807	2190
Smart Thermostat installation - Cooling	Healthcare Category	Thermostat - WiFi/Interactive	4,031	5	$3,206	PacifiCorp 2017 DSM Report	$863	$4,069	2190
Smart Thermostat installation - Cooling	Lodging Category	Thermostat - WiFi/Interactive	6,660	5	$9,556	PacifiCorp 2017 DSM Report	$2,573	$12,129	2190
Smart Thermostat installation - Cooling	Mixed	Thermostat - WiFi/Interactive	811	5	$1,092	PacifiCorp 2017 DSM Report	$294	$1,386	2190
Smart Thermostat installation - Cooling	Office Category	Thermostat - WiFi/Interactive	4,434	5	$5,134	PacifiCorp 2017 DSM Report	$1,382	$6,516	2190
Smart Thermostat installation - Cooling	Parking	Thermostat - WiFi/Interactive	34,451	5	$46,403	PacifiCorp 2017 DSM Report	$12,493	$58,896	2190
Smart Thermostat installation - Cooling	Public Assembly Category	Thermostat - WiFi/Interactive	4,992	5	$6,724	PacifiCorp 2017 DSM Report	$1,810	$8,534	2190
Smart Thermostat installation - Cooling	Public Service Category	Thermostat - WiFi/Interactive	40,702	5	$54,823	PacifiCorp 2017 DSM Report	$14,760	$69,583	2190
Smart Thermostat installation - Cooling	Religious	Thermostat - WiFi/Interactive	7,824	5	$10,539	PacifiCorp 2017 DSM Report	$2,837	$13,376	2190
Smart Thermostat installation - Cooling	Retail Category	Thermostat - WiFi/Interactive	4,834	5	$4,493	PacifiCorp 2017 DSM Report	$1,210	$5,703	2190
Smart Thermostat installation - Cooling	Services Category	Thermostat - WiFi/Interactive	2,372	5	$3,194	PacifiCorp 2017 DSM Report	$860	$4,054	2190
Smart Thermostat installation - Cooling	Storage	Thermostat - WiFi/Interactive	5,499	5	$10,370	PacifiCorp 2017 DSM Report	$2,792	$13,162	2190

EE Measure Name	Customer Segment	Description	Average Annual Savings (kWh/year)	Measure Life (years)	Average Installation Cost ($)	Measure Source	Administrative Cost ($)	Total Program Cost ($)	Active Hours per Year
Smart Thermostat installation - Cooling	Utility	Thermostat - WiFi/Interactive	1,336	5	$1,800	PacifiCorp 2017 DSM Report	$485	$2,284	2190
Ventilation									
NEMA Super Premium Motors	Education Category	Installation of NEMA Super Premium motor (+1% efficiency)	1,631	20	$1,577	Xcel Technical Resource Manual 2017 (2017/2018 Demand-Side Management Plan)	$424	$2,001	8760
NEMA Super Premium Motors	Healthcare Category	Installation of NEMA Super Premium motor (+1% efficiency)	717	20	$693	Xcel Technical Resource Manual 2017 (2017/2018 Demand-Side Management Plan)	$187	$879	8760
NEMA Super Premium Motors	Industrial	Installation of NEMA Super Premium motor (+1% efficiency)	4,321	20	$4,176	Xcel Technical Resource Manual 2017 (2017/2018 Demand-Side Management Plan)	$1,124	$5,301	8760
NEMA Super Premium Motors	Office Category	Installation of NEMA Super Premium motor (+1% efficiency)	698	20	$675	Xcel Technical Resource Manual 2017 (2017/2018 Demand-Side Management Plan)	$182	$857	8760

EE Measure Name	Customer Segment	Description	Average Annual Savings (kWh/year)	Measure Life (years)	Average Installation Cost ($)	Measure Source	Administrative Cost ($)	Total Program Cost ($)	Active Hours per Year
NEMA Super Premium Motors	Utility	Installation of NEMA Super Premium motor (+1% efficiency)	13,244	20	$12,800	Xcel Technical Resource Manual 2017 (2017/2018 Demand-Side Management Plan)	$3,446	$16,246	8760
ECM-Variable Air Volume	Other	High efficiency electronically commutated permanent magnet (ECM or ECPM) motors with built-in variable speed control for VAV fans	3,703	18	$1,252	7th Power Plan - Commercial ECM-Variable Air Volume	$337	$1,589	8760
ECM-Variable Air Volume	Education	High efficiency electronically commutated permanent magnet (ECM or ECPM) motors with built-in variable speed control for VAV fans	79,702	18	$26,942	7th Power Plan - Commercial ECM-Variable Air Volume	$7,254	$34,195	8760
ECM-Variable Air Volume	Food Sales	High efficiency electronically commutated permanent magnet (ECM or ECPM) motors with built-in variable speed control for VAV fans	4,497	18	$1,520	7th Power Plan - Commercial ECM-Variable Air Volume	$409	$1,929	8760
ECM-Variable Air Volume	Food Service	High efficiency electronically commutated permanent magnet (ECM or ECPM) motors with built-in variable speed control for VAV fans	2,379	18	$804	7th Power Plan - Commercial ECM-Variable Air Volume	$216	$1,021	8760

EE Measure Name	Customer Segment	Description	Average Annual Savings (kWh/year)	Measure Life (years)	Average Installation Cost ($)	Measure Source	Administrative Cost ($)	Total Program Cost ($)	Active Hours per Year
ECM-Variable Air Volume	Healthcare	High efficiency electronically commutated permanent magnet (ECM or ECPM) motors with built-in variable speed control for VAV fans	3,449	18	$1,166	7th Power Plan - Commercial ECM-Variable Air Volume	$314	$1,480	8760
ECM-Variable Air Volume	Lodging	High efficiency electronically commutated permanent magnet (ECM or ECPM) motors with built-in variable speed control for VAV fans	10,280	18	$3,475	7th Power Plan - Commercial ECM-Variable Air Volume	$936	$4,410	8760
ECM-Variable Air Volume	Mixed	High efficiency electronically commutated permanent magnet (ECM or ECPM) motors with built-in variable speed control for VAV fans	1,175	18	$397	7th Power Plan - Commercial ECM-Variable Air Volume	$107	$504	8760
ECM-Variable Air Volume	Office	High efficiency electronically commutated permanent magnet (ECM or ECPM) motors with built-in variable speed control for VAV fans	5,523	18	$1,867	7th Power Plan - Commercial ECM-Variable Air Volume	$503	$2,370	8760
ECM-Variable Air Volume	Parking	High efficiency electronically commutated permanent magnet (ECM or ECPM) motors with built-in variable speed control for VAV fans	49,919	18	$16,874	7th Power Plan - Commercial ECM-Variable Air Volume	$4,543	$21,417	8760

EE Measure Name	Customer Segment	Description	Average Annual Savings (kWh/year)	Measure Life (years)	Average Installation Cost ($)	Measure Source	Administrative Cost ($)	Total Program Cost ($)	Active Hours per Year
ECM-Variable Air Volume	Public Assembly	High efficiency electronically commutated permanent magnet (ECM or ECPM) motors with built-in variable speed control for VAV fans	7,233	18	$2,445	7th Power Plan - Commercial ECM-Variable Air Volume	$658	$3,103	8760
ECM-Variable Air Volume	Public Service	High efficiency electronically commutated permanent magnet (ECM or ECPM) motors with built-in variable speed control for VAV fans	58,976	18	$19,936	7th Power Plan - Commercial ECM-Variable Air Volume	$5,367	$25,303	8760
ECM-Variable Air Volume	Religious	High efficiency electronically commutated permanent magnet (ECM or ECPM) motors with built-in variable speed control for VAV fans	11,337	18	$3,832	7th Power Plan - Commercial ECM-Variable Air Volume	$1,032	$4,864	8760
ECM-Variable Air Volume	Retail	High efficiency electronically commutated permanent magnet (ECM or ECPM) motors with built-in variable speed control for VAV fans	4,834	18	$1,634	7th Power Plan - Commercial ECM-Variable Air Volume	$440	$2,074	8760
ECM-Variable Air Volume	Services	High efficiency electronically commutated permanent magnet (ECM or ECPM) motors with built-in variable speed control for VAV fans	3,436	18	$1,162	7th Power Plan - Commercial ECM-Variable Air Volume	$313	$1,474	8760

EE Measure Name	Customer Segment	Description	Average Annual Savings (kWh/year)	Measure Life (years)	Average Installation Cost ($)	Measure Source	Administrative Cost ($)	Total Program Cost ($)	Active Hours per Year
ECM-Variable Air Volume	Storage	High efficiency electronically commutated permanent magnet (ECM or ECPM) motors with built-in variable speed control for VAV fans	11,155	18	$3,771	7th Power Plan - Commercial ECM-Variable Air Volume	$1,015	$4,786	8760
ECM-Variable Air Volume	Utility	High efficiency electronically commutated permanent magnet (ECM or ECPM) motors with built-in variable speed control for VAV fans	1,936	18	$654	7th Power Plan - Commercial ECM-Variable Air Volume	$176	$831	8760
Lighting									
LED Screw-in Upgrade from CFL (interior)	Other Category	Install LED fixture instead of CFL Fixture	2,597	15	$1,593	7th Power Plan - Commercial Indoor Lighting	$429	$2,023	4015
LED Screw-in Upgrade from CFL (interior)	Education Category	Install LED fixture instead of CFL Fixture	14,899	15	$14,647	7th Power Plan - Commercial Indoor Lighting	$3,943	$18,590	4015
LED Screw-in Upgrade from CFL (interior)	Food Sales Category	Install LED fixture instead of CFL Fixture	2,247	15	$1,239	7th Power Plan - Commercial Indoor Lighting	$334	$1,573	4015
LED Screw-in Upgrade from CFL (interior)	Food Service Category	Install LED fixture instead of CFL Fixture	3,107	15	$1,527	7th Power Plan - Commercial Indoor Lighting	$411	$1,938	4015
LED Screw-in Upgrade from CFL (interior)	Healthcare Category	Install LED fixture instead of CFL Fixture	2,417	15	$825	7th Power Plan - Commercial Indoor Lighting	$222	$1,047	4015

EE Measure Name	Customer Segment	Description	Average Annual Savings (kWh/year)	Measure Life (years)	Average Installation Cost ($)	Measure Source	Administrative Cost ($)	Total Program Cost ($)	Active Hours per Year
LED Screw-in Upgrade from CFL (interior)	Lodging Category	Install LED fixture instead of CFL Fixture	12,368	15	$7,588	7th Power Plan - Commercial Indoor Lighting	$2,043	$9,631	4015
LED Screw-in Upgrade from CFL (interior)	Mixed	Install LED fixture instead of CFL Fixture	824	15	$506	7th Power Plan - Commercial Indoor Lighting	$136	$642	4015
LED Screw-in Upgrade from CFL (interior)	Office Category	Install LED fixture instead of CFL Fixture	1,670	15	$2,254	7th Power Plan - Commercial Indoor Lighting	$607	$2,861	4015
LED Screw-in Upgrade from CFL (interior)	Parking	Install LED fixture instead of CFL Fixture	35,000	15	$21,479	7th Power Plan - Commercial Indoor Lighting	$5,783	$27,261	4015
LED Screw-in Upgrade from CFL (interior)	Public Assembly Category	Install LED fixture instead of CFL Fixture	3,276	15	$3,308	7th Power Plan - Commercial Indoor Lighting	$891	$4,199	4015
LED Screw-in Upgrade from CFL (interior)	Public Service Category	Install LED fixture instead of CFL Fixture	41,350	15	$25,376	7th Power Plan - Commercial Indoor Lighting	$6,832	$32,208	4015
LED Screw-in Upgrade from CFL (interior)	Religious	Install LED fixture instead of CFL Fixture	5,135	15	$5,186	7th Power Plan - Commercial Indoor Lighting	$1,396	$6,582	4015
LED Screw-in Upgrade from CFL (interior)	Retail Category	Install LED fixture instead of CFL Fixture	1,160	15	$1,080	7th Power Plan - Commercial Indoor Lighting	$291	$1,370	4015
LED Screw-in Upgrade from CFL (interior)	Services Category	Install LED fixture instead of CFL Fixture	2,409	15	$1,479	7th Power Plan - Commercial Indoor Lighting	$398	$1,877	4015
LED Screw-in Upgrade from CFL (interior)	Storage	Install LED fixture instead of CFL Fixture	1,344	15	$398	7th Power Plan - Commercial Indoor Lighting	$107	$505	4015

EE Measure Name	Customer Segment	Description	Average Annual Savings (kWh/year)	Measure Life (years)	Average Installation Cost ($)	Measure Source	Administrative Cost ($)	Total Program Cost ($)	Active Hours per Year
LED Screw-in Upgrade from CFL (interior)	Utility	Install LED fixture instead of CFL Fixture	1,358	15	$833	7th Power Plan - Commercial Indoor Lighting	$224	$1,057	4015
LED Linear Upgrade from T8/T12 (interior)	Other Category	Install LED fixture instead of linear T8 or T12 fluorescent or equiv.	5,128	15	$6,735	7th Power Plan - Commercial Indoor Lighting	$1,813	$8,549	4015
LED Linear Upgrade from T8/T12 (interior)	Education Category	Install LED fixture instead of linear T8 or T12 fluorescent or equiv.	106,243	15	$190,381	7th Power Plan - Commercial Indoor Lighting	$51,257	$241,638	4015
LED Linear Upgrade from T8/T12 (interior)	Food Sales Category	Install LED fixture instead of linear T8 or T12 fluorescent or equiv.	14,559	15	$11,567	7th Power Plan - Commercial Indoor Lighting	$3,114	$14,681	4015
LED Linear Upgrade from T8/T12 (interior)	Food Service Category	Install LED fixture instead of linear T8 or T12 fluorescent or equiv.	3,409	15	$3,170	7th Power Plan - Commercial Indoor Lighting	$853	$4,023	4015
LED Linear Upgrade from T8/T12 (interior)	Healthcare Category	Install LED fixture instead of linear T8 or T12 fluorescent or equiv.	8,651	15	$7,465	7th Power Plan - Commercial Indoor Lighting	$2,010	$9,475	4015
LED Linear Upgrade from T8/T12 (interior)	Lodging Category	Install LED fixture instead of linear T8 or T12 fluorescent or equiv.	2,960	15	$5,019	7th Power Plan - Commercial Indoor Lighting	$1,351	$6,371	4015
LED Linear Upgrade from T8/T12 (interior)	Mixed	Install LED fixture instead of linear T8 or T12 fluorescent or equiv.	1,627	15	$2,137	7th Power Plan - Commercial Indoor Lighting	$575	$2,712	4015
LED Linear Upgrade from T8/T12 (interior)	Office Category	Install LED fixture instead of linear T8 or T12 fluorescent or equiv.	7,060	15	$13,734	7th Power Plan - Commercial Indoor Lighting	$3,697	$17,431	4015
LED Linear Upgrade from T8/T12 (interior)	Parking	Install LED fixture instead of linear T8 or T12 fluorescent or equiv.	69,120	15	$90,788	7th Power Plan - Commercial Indoor Lighting	$24,443	$115,230	4015

EE Measure Name	Customer Segment	Description	Average Annual Savings (kWh/year)	Measure Life (years)	Average Installation Cost ($)	Measure Source	Administrative Cost ($)	Total Program Cost ($)	Active Hours per Year
LED Linear Upgrade from T8/T12 (interior)	Public Assembly Category	Install LED fixture instead of linear T8 or T12 fluorescent or equiv.	6,807	15	$12,386	7th Power Plan - Commercial Indoor Lighting	$3,335	$15,721	4015
LED Linear Upgrade from T8/T12 (interior)	Public Service Category	Install LED fixture instead of linear T8 or T12 fluorescent or equiv.	81,661	15	$107,260	7th Power Plan - Commercial Indoor Lighting	$28,878	$136,138	4015
LED Linear Upgrade from T8/T12 (interior)	Religious	Install LED fixture instead of linear T8 or T12 fluorescent or equiv.	10,669	15	$19,414	7th Power Plan - Commercial Indoor Lighting	$5,227	$24,641	4015
LED Linear Upgrade from T8/T12 (interior)	Retail Category	Install LED fixture instead of linear T8 or T12 fluorescent or equiv.	7,570	15	$12,396	7th Power Plan - Commercial Indoor Lighting	$3,337	$15,733	4015
LED Linear Upgrade from T8/T12 (interior)	Services Category	Install LED fixture instead of linear T8 or T12 fluorescent or equiv.	4,758	15	$6,250	7th Power Plan - Commercial Indoor Lighting	$1,683	$7,932	4015
LED Linear Upgrade from T8/T12 (interior)	Storage	Install LED fixture instead of linear T8 or T12 fluorescent or equiv.	5,719	15	$13,613	7th Power Plan - Commercial Indoor Lighting	$3,665	$17,278	4015
LED Linear Upgrade from T8/T12 (interior)	Utility	Install LED fixture instead of linear T8 or T12 fluorescent or equiv.	2,681	15	$3,521	7th Power Plan - Commercial Indoor Lighting	$948	$4,469	4015
LED Screw-in Upgrade from CFL (interior)	Industrial	Replace screw-in fixtures	4,957	15	$3,042	PacifiCorp 2017 DSM Report	$819	$3,861	8760
LED Linear Upgrade from T8/T12 (interior)	Industrial	Replace linear lighting fixtures	68,410	7	$21,582	PacifiCorp 2017 DSM Report	$5,810	$27,392	8760
LED High-bay Fixtures (interior)	Industrial	Replace high-bay fixtures	18,783	9	$4,113	PacifiCorp 2017 DSM Report	$1,107	$5,221	8760
LED Upgrade (exterior)	Other Category	Install LED instead of metal halide or high pressure sodium in an exterior location	1,202	12	$162	PSE 2017 DSM Report	$44	$206	4380

EE Measure Name	Customer Segment	Description	Average Annual Savings (kWh/year)	Measure Life (years)	Average Installation Cost ($)	Measure Source	Administrative Cost ($)	Total Program Cost ($)	Active Hours per Year
LED Upgrade (exterior)	Education Category	Install LED instead of metal halide or high pressure sodium in an exterior location	30,534	12	$5,798	PSE 2017 DSM Report	$1,561	$7,359	4380
LED Upgrade (exterior)	Food Sales Category	Install LED instead of metal halide or high pressure sodium in an exterior location	5,071	12	$1,022	PSE 2017 DSM Report	$275	$1,297	4380
LED Upgrade (exterior)	Food Service Category	Install LED instead of metal halide or high pressure sodium in an exterior location	4,863	12	$752	PSE 2017 DSM Report	$202	$954	4380
LED Upgrade (exterior)	Healthcare Category	Install LED instead of metal halide or high pressure sodium in an exterior location	4,484	12	$901	PSE 2017 DSM Report	$242	$1,143	4380
LED Upgrade (exterior)	Lodging Category	Install LED instead of metal halide or high pressure sodium in an exterior location	4,784	12	$808	PSE 2017 DSM Report	$217	$1,025	4380
LED Upgrade (exterior)	Mixed	Install LED instead of metal halide or high pressure sodium in an exterior location	381	12	$51	PSE 2017 DSM Report	$14	$65	4380
LED Upgrade (exterior)	Office Category	Install LED instead of metal halide or high pressure sodium in an exterior location	3,415	12	$617	PSE 2017 DSM Report	$166	$783	4380
LED Upgrade (exterior)	Parking	Install LED instead of metal halide or high pressure sodium in an exterior location	16,207	12	$2,184	PSE 2017 DSM Report	$588	$2,772	4380

EE Measure Name	Customer Segment	Description	Average Annual Savings (kWh/year)	Measure Life (years)	Average Installation Cost ($)	Measure Source	Administrative Cost ($)	Total Program Cost ($)	Active Hours per Year
LED Upgrade (exterior)	Public Assembly Category	Install LED instead of metal halide or high pressure sodium in an exterior location	5,190	12	$861	PSE 2017 DSM Report	$232	$1,093	4380
LED Upgrade (exterior)	Public Service Category	Install LED instead of metal halide or high pressure sodium in an exterior location	19,147	12	$2,581	PSE 2017 DSM Report	$695	$3,275	4380
LED Upgrade (exterior)	Religious	Install LED instead of metal halide or high pressure sodium in an exterior location	8,134	12	$1,349	PSE 2017 DSM Report	$363	$1,713	4380
LED Upgrade (exterior)	Retail Category	Install LED instead of metal halide or high pressure sodium in an exterior location	2,249	12	$425	PSE 2017 DSM Report	$114	$539	4380
LED Upgrade (exterior)	Services Category	Install LED instead of metal halide or high pressure sodium in an exterior location	1,116	12	$150	PSE 2017 DSM Report	$40	$191	4380
LED Upgrade (exterior)	Storage	Install LED instead of metal halide or high pressure sodium in an exterior location	6,637	12	$1,213	PSE 2017 DSM Report	$327	$1,539	4380
LED Upgrade (exterior)	Utility	Install LED instead of metal halide or high pressure sodium in an exterior location	629	12	$85	PSE 2017 DSM Report	$23	$108	4380
LED Screw-in Upgrade (exterior)	Industrial	Replace screw-in fixtures	6,359	8	$124	PacifiCorp 2017 DSM Report	$34	$158	4380
LED Area Lighting Upgrade (exterior)	Industrial	Replace exterior area lighting	39,261	15	$715	PacifiCorp 2017 DSM Report	$193	$908	4380

EE Measure Name	Customer Segment	Description	Average Annual Savings (kWh/year)	Measure Life (years)	Average Installation Cost ($)	Measure Source	Administrative Cost ($)	Total Program Cost ($)	Active Hours per Year
LED Linear Lighting Upgrade (exterior)	Industrial	Replace linear lighting fixtures	172	17	$47	PacifiCorp 2017 DSM Report	$13	$60	4380
Smart Lighting controllers / Occupancy sensors	Other Category	Sensor on a light fixture that turns off the light when no movement is detected for a period of time (indicating that a room is not occupied)	3,121	8	$2,452	PSE 2017 DSM Report	$660	$3,112	4015
Smart Lighting controllers / Occupancy sensors	Education Category	Sensor on a light fixture that turns off the light when no movement is detected for a period of time (indicating that a room is not occupied)	69,528	8	$54,629	PSE 2017 DSM Report	$14,708	$69,337	4015
Smart Lighting controllers / Occupancy sensors	Food Sales Category	Sensor on a light fixture that turns off the light when no movement is detected for a period of time (indicating that a room is not occupied)	12,201	8	$3,355	PSE 2017 DSM Report	$903	$4,259	4015
Smart Lighting controllers / Occupancy sensors	Food Service Category	Sensor on a light fixture that turns off the light when no movement is detected for a period of time (indicating that a room is not occupied)	4,036	8	$1,707	PSE 2017 DSM Report	$460	$2,167	4015

EE Measure Name	Customer Segment	Description	Average Annual Savings (kWh/year)	Measure Life (years)	Average Installation Cost ($)	Measure Source	Administrative Cost ($)	Total Program Cost ($)	Active Hours per Year
Smart Lighting controllers / Occupancy sensors	Healthcare Category	Sensor on a light fixture that turns off the light when no movement is detected for a period of time (indicating that a room is not occupied)	5,329	8	$2,443	PSE 2017 DSM Report	$658	$3,100	4015
Smart Lighting controllers / Occupancy sensors	Lodging Category	Sensor on a light fixture that turns off the light when no movement is detected for a period of time (indicating that a room is not occupied)	8,529	8	$5,864	PSE 2017 DSM Report	$1,579	$7,443	4015
Smart Lighting controllers / Occupancy sensors	Mixed	Sensor on a light fixture that turns off the light when no movement is detected for a period of time (indicating that a room is not occupied)	990	8	$778	PSE 2017 DSM Report	$209	$987	4015
Smart Lighting controllers / Occupancy sensors	Office Category	Sensor on a light fixture that turns off the light when no movement is detected for a period of time (indicating that a room is not occupied)	6,792	8	$4,150	PSE 2017 DSM Report	$1,117	$5,268	4015
Smart Lighting controllers / Occupancy sensors	Parking	Sensor on a light fixture that turns off the light when no movement is detected for a period of time (indicating that a room is not occupied)	42,062	8	$33,049	PSE 2017 DSM Report	$8,898	$41,946	4015

EE Measure Name	Customer Segment	Description	Average Annual Savings (kWh/year)	Measure Life (years)	Average Installation Cost ($)	Measure Source	Administrative Cost ($)	Total Program Cost ($)	Active Hours per Year
Smart Lighting controllers / Occupancy sensors	Public Assembly Category	Sensor on a light fixture that turns off the light when no movement is detected for a period of time (indicating that a room is not occupied)	6,200	8	$4,871	PSE 2017 DSM Report	$1,311	$6,183	4015
Smart Lighting controllers / Occupancy sensors	Public Service Category	Sensor on a light fixture that turns off the light when no movement is detected for a period of time (indicating that a room is not occupied)	49,694	8	$39,045	PSE 2017 DSM Report	$10,512	$49,557	4015
Smart Lighting controllers / Occupancy sensors	Religious	Sensor on a light fixture that turns off the light when no movement is detected for a period of time (indicating that a room is not occupied)	9,717	8	$7,635	PSE 2017 DSM Report	$2,056	$9,691	4015
Smart Lighting controllers / Occupancy sensors	Retail Category	Sensor on a light fixture that turns off the light when no movement is detected for a period of time (indicating that a room is not occupied)	9,685	8	$3,805	PSE 2017 DSM Report	$1,024	$4,829	4015
Smart Lighting controllers / Occupancy sensors	Services Category	Sensor on a light fixture that turns off the light when no movement is detected for a period of time (indicating that a room is not occupied)	2,895	8	$2,275	PSE 2017 DSM Report	$612	$2,887	4015

EE Measure Name	Customer Segment	Description	Average Annual Savings (kWh/year)	Measure Life (years)	Average Installation Cost ($)	Measure Source	Administrative Cost ($)	Total Program Cost ($)	Active Hours per Year
Smart Lighting controllers / Occupancy sensors	Storage	Sensor on a light fixture that turns off the light when no movement is detected for a period of time (indicating that a room is not occupied)	6,227	8	$4,281	PSE 2017 DSM Report	$1,153	$5,434	4015
Smart Lighting controllers / Occupancy sensors	Utility	Sensor on a light fixture that turns off the light when no movement is detected for a period of time (indicating that a room is not occupied)	1,631	8	$1,282	PSE 2017 DSM Report	$345	$1,627	4015
Smart Lighting controllers / Daylight sensors	Education Category	Sensor on a light fixture that turns off the light when sufficient natural light exists	97,487	8	$125,903	PSC of Colorado 2017/2018 DSM Plan	$33,897	$159,800	4015
Smart Lighting controllers / Daylight sensors	Lodging Category	Sensor on a light fixture that turns off the light when sufficient natural light exists	9,188	8	$25,632	PSC of Colorado 2017/2018 DSM Plan	$6,901	$32,533	4015
Smart Lighting controllers / Daylight sensors	Mixed	Sensor on a light fixture that turns off the light when sufficient natural light exists	1,351	8	$2,225	PSC of Colorado 2017/2018 DSM Plan	$599	$2,824	4015
Smart Lighting controllers / Daylight sensors	Office Category	Sensor on a light fixture that turns off the light when sufficient natural light exists	7,401	8	$11,081	PSC of Colorado 2017/2018 DSM Plan	$2,983	$14,064	4015
Smart Lighting controllers / Daylight sensors	Parking	Sensor on a light fixture that turns off the light when sufficient natural light exists	57,409	8	$94,542	PSC of Colorado 2017/2018 DSM Plan	$25,454	$119,996	4015

EE Measure Name	Customer Segment	Description	Average Annual Savings (kWh/year)	Measure Life (years)	Average Installation Cost ($)	Measure Source	Administrative Cost ($)	Total Program Cost ($)	Active Hours per Year
Smart Lighting controllers / Daylight sensors	Public Assembly Category	Sensor on a light fixture that turns off the light when sufficient natural light exists	8,065	8	$12,093	PSC of Colorado 2017/2018 DSM Plan	$3,256	$15,349	4015
Smart Lighting controllers / Daylight sensors	Public Service Category	Sensor on a light fixture that turns off the light when sufficient natural light exists	67,825	8	$111,696	PSC of Colorado 2017/2018 DSM Plan	$30,072	$141,768	4015
Smart Lighting controllers / Daylight sensors	Religious	Sensor on a light fixture that turns off the light when sufficient natural light exists	12,641	8	$18,955	PSC of Colorado 2017/2018 DSM Plan	$5,103	$24,058	4015
Smart Lighting controllers / Daylight sensors	Services Category	Sensor on a light fixture that turns off the light when sufficient natural light exists	5,571	8	$6,508	PSC of Colorado 2017/2018 DSM Plan	$1,752	$8,260	4015
Smart Lighting controllers / Daylight sensors	Storage	Sensor on a light fixture that turns off the light when sufficient natural light exists	7,359	8	$7,985	PSC of Colorado 2017/2018 DSM Plan	$2,150	$10,135	4015
Smart Lighting controllers / Daylight sensors	Utility	Sensor on a light fixture that turns off the light when sufficient natural light exists	2,227	8	$3,667	PSC of Colorado 2017/2018 DSM Plan	$987	$4,654	4015
Cooking									
Electric Combination Ovens	Food Sales	Electric combination ovens that meet ENERGY STAR specifications	7,543	12	$810	PSE 2017 DSM Report	$218	$1,028	5840

EE Measure Name	Customer Segment	Description	Average Annual Savings (kWh/year)	Measure Life (years)	Average Installation Cost ($)	Measure Source	Administrative Cost ($)	Total Program Cost ($)	Active Hours per Year
Electric Combination Ovens	Food Service	Electric combination ovens that meet ENERGY STAR specifications	15,086	12	$1,620	PSE 2017 DSM Report	$436	$2,057	5840
Electric Combination Ovens	Healthcare	Electric combination ovens that meet ENERGY STAR specifications	15,086	12	$1,620	PSE 2017 DSM Report	$436	$2,057	5840
Electric exhaust hood	Food Sales	Commercial cooking equipment exhaust hood with demand-controlled ventilation that operates only as much as needed	3,257	15	$2,471	PSE 2017 DSM Report	$665	$3,136	5840
Electric exhaust hood	Food Service	Commercial cooking equipment exhaust hood with demand-controlled ventilation that operates only as much as needed	12,326	15	$11,717	PSE 2017 DSM Report	$3,154	$14,871	5840
Electric exhaust hood	Healthcare	Commercial cooking equipment exhaust hood with demand-controlled ventilation that operates only as much as needed	2,407	15	$1,826	PSE 2017 DSM Report	$492	$2,317	5840
Refrigeration									
Refrigerator Floating-Head Pressure Controls	Food Sales	Controls that adjust operating pressure of a commercial refrigeration system based on ambient temperature conditions	45,218	15	$28,393	PSE 2017 DSM Report	$7,644	$36,037	8760

EE Measure Name	Customer Segment	Description	Average Annual Savings (kWh/year)	Measure Life (years)	Average Installation Cost ($)	Measure Source	Administrative Cost ($)	Total Program Cost ($)	Active Hours per Year
Refrigerator Floating-Head Pressure Controls	Food Service	Controls that adjust operating pressure of a commercial refrigeration system based on ambient temperature conditions	23,921	15	$15,021	PSE 2017 DSM Report	$4,044	$19,065	8760
Refrigerator/Freezer gaskets	Food Sales	replace gaskets on door perimeter	1,425	4	$207	PacifiCorp 2017 DSM Report	$56	$262	8760
Refrigerator/Freezer gaskets	Food Service	replace gaskets on door perimeter	3,607	4	$109	PacifiCorp 2017 DSM Report	$29	$139	8760
Office Equipment and Computing									
Advanced power strips	Other	Advanced power strip that turns off equipment plugged into it when not in use	110	5	$94	PSE 2017 DSM Report	$25	$119	8760
Advanced power strips	Education	Advanced power strip that turns off equipment plugged into it when not in use	2,300	5	$1,954	PSE 2017 DSM Report	$526	$2,481	8760
Advanced power strips	Food Sales	Advanced power strip that turns off equipment plugged into it when not in use	247	5	$210	PSE 2017 DSM Report	$57	$266	8760
Advanced power strips	Food Service	Advanced power strip that turns off equipment plugged into it when not in use	152	5	$129	PSE 2017 DSM Report	$35	$164	8760
Advanced power strips	Healthcare	Advanced power strip that turns off equipment plugged into it when not in use	76	5	$64	PSE 2017 DSM Report	$17	$82	8760

EE Measure Name	Customer Segment	Description	Average Annual Savings (kWh/year)	Measure Life (years)	Average Installation Cost ($)	Measure Source	Administrative Cost ($)	Total Program Cost ($)	Active Hours per Year
Advanced power strips	Industrial	Advanced power strip that turns off equipment plugged into it when not in use	1,011	5	$859	PSE 2017 DSM Report	$231	$1,090	8760
Advanced power strips	Lodging	Advanced power strip that turns off equipment plugged into it when not in use	155	5	$132	PSE 2017 DSM Report	$36	$168	8760
Advanced power strips	Mixed	Advanced power strip that turns off equipment plugged into it when not in use	35	5	$30	PSE 2017 DSM Report	$8	$38	8760
Advanced power strips	Office	Advanced power strip that turns off equipment plugged into it when not in use	512	5	$435	PSE 2017 DSM Report	$117	$553	8760
Advanced power strips	Parking	Advanced power strip that turns off equipment plugged into it when not in use	1,486	5	$1,263	PSE 2017 DSM Report	$340	$1,603	8760
Advanced power strips	Public Assembly	Advanced power strip that turns off equipment plugged into it when not in use	171	5	$146	PSE 2017 DSM Report	$39	$185	8760
Advanced power strips	Public Service	Advanced power strip that turns off equipment plugged into it when not in use	1,400	5	$1,190	PSE 2017 DSM Report	$320	$1,511	8760
Advanced power strips	Religious	Advanced power strip that turns off equipment plugged into it when not in use	327	5	$278	PSE 2017 DSM Report	$75	$353	8760

EE Measure Name	Customer Segment	Description	Average Annual Savings (kWh/year)	Measure Life (years)	Average Installation Cost ($)	Measure Source	Administrative Cost ($)	Total Program Cost ($)	Active Hours per Year
Advanced power strips	Retail	Advanced power strip that turns off equipment plugged into it when not in use	115	5	$98	PSE 2017 DSM Report	$26	$124	8760
Advanced power strips	Services	Advanced power strip that turns off equipment plugged into it when not in use	82	5	$69	PSE 2017 DSM Report	$19	$88	8760
Advanced power strips	Storage	Advanced power strip that turns off equipment plugged into it when not in use	222	5	$189	PSE 2017 DSM Report	$51	$239	8760
Advanced power strips	Utility	Advanced power strip that turns off equipment plugged into it when not in use	58	5	$49	PSE 2017 DSM Report	$13	$62	8760
Miscellaneous**									
Energy Assessment Retrocommissioning	Other Category	Commercial Retrocommissioning Program	6,781	7	$1,826	ComEd 2016 EE Potential; assume applies to all C&I categories / PRPA Experience	$492	$2,317	8760
Energy Assessment Retrocommissioning	Education Category	Commercial Retrocommissioning Program	145,934	7	$39,290	ComEd 2016 EE Potential; assume applies to all C&I categories / PRPA Experience	$10,578	$49,868	8760

EE Measure Name	Customer Segment	Description	Average Annual Savings (kWh/year)	Measure Life (years)	Average Installation Cost ($)	Measure Source	Administrative Cost ($)	Total Program Cost ($)	Active Hours per Year
Energy Assessment Retrocommissioning	Food Sales Category	Commercial Retrocommissioning Program	8,234	7	$2,217	ComEd 2016 EE Potential; assume applies to all C&I categories / PRPA Experience	$597	$2,814	8760
Energy Assessment Retrocommissioning	Food Service Category	Commercial Retrocommissioning Program	4,356	7	$1,173	ComEd 2016 EE Potential; assume applies to all C&I categories / PRPA Experience	$316	$1,488	8760
Energy Assessment Retrocommissioning	Healthcare Category	Commercial Retrocommissioning Program	6,314	7	$1,700	ComEd 2016 EE Potential; assume applies to all C&I categories / PRPA Experience	$458	$2,158	8760
Energy Assessment Retrocommissioning	Industrial	Commercial Retrocommissioning Program	93,029	7	$25,046	ComEd 2016 EE Potential; assume applies to all C&I categories / PRPA Experience	$6,743	$31,789	8760
Energy Assessment Retrocommissioning	Lodging Category	Commercial Retrocommissioning Program	18,822	7	$5,068	ComEd 2016 EE Potential; assume applies to all C&I categories / PRPA Experience	$1,364	$6,432	8760

EE Measure Name	Customer Segment	Description	Average Annual Savings (kWh/year)	Measure Life (years)	Average Installation Cost ($)	Measure Source	Administrative Cost ($)	Total Program Cost ($)	Active Hours per Year
Energy Assessment Retrocommissioning	Mixed	Commercial Retrocommissioning Program	2,151	7	$579	ComEd 2016 EE Potential; assume applies to all C&I categories / PRPA Experience	$156	$735	8760
Energy Assessment Retrocommissioning	Office Category	Commercial Retrocommissioning Program	10,113	7	$2,723	ComEd 2016 EE Potential; assume applies to all C&I categories / PRPA Experience	$733	$3,456	8760
Energy Assessment Retrocommissioning	Public Service Category	Commercial Retrocommissioning Program	107,984	7	$29,073	ComEd 2016 EE Potential; assume applies to all C&I categories / PRPA Experience	$7,827	$36,900	8760
Energy Assessment Retrocommissioning	Religious	Commercial Retrocommissioning Program	20,758	7	$5,589	ComEd 2016 EE Potential; assume applies to all C&I categories / PRPA Experience	$1,505	$7,093	8760
Energy Assessment Retrocommissioning	Retail Category	Commercial Retrocommissioning Program	8,850	7	$2,383	ComEd 2016 EE Potential; assume applies to all C&I categories / PRPA Experience	$642	$3,024	8760

EE Measure Name	Customer Segment	Description	Average Annual Savings (kWh/year)	Measure Life (years)	Average Installation Cost ($)	Measure Source	Administrative Cost ($)	Total Program Cost ($)	Active Hours per Year
Energy Assessment Retrocommissioning	Services Category	Commercial Retrocommissioning Program	6,292	7	$1,694	ComEd 2016 EE Potential; assume applies to all C&I categories / PRPA Experience	$456	$2,150	8760
Energy Assessment Retrocommissioning	Storage	Commercial Retrocommissioning Program	20,425	7	$5,499	ComEd 2016 EE Potential; assume applies to all C&I categories / PRPA Experience	$1,481	$6,980	8760
Energy Assessment Retrocommissioning	Utility	Commercial Retrocommissioning Program	3,545	7	$954	ComEd 2016 EE Potential; assume applies to all C&I categories / PRPA Experience	$257	$1,211	8760
Energy Management System with Data Analysis	Other Category	Energy management measures for commercial buildings, excluding single-zone ducted systems. Suite of measures, most of which are focused on making HVAC systems work better through controls changes.	4,709	5	$1,304	7th Power Plan - Commercial Energy Management Systems (Com-EM-7P_V5.xlsm)	$351	$1,655	8760

EE Measure Name	Customer Segment	Description	Average Annual Savings (kWh/year)	Measure Life (years)	Average Installation Cost ($)	Measure Source	Administrative Cost ($)	Total Program Cost ($)	Active Hours per Year
Energy Management System with Data Analysis	Education Category	Energy management measures for commercial buildings, excluding single-zone ducted systems. Suite of measures, most of which are focused on making HVAC systems work better through controls changes.	90,202	5	$28,064	7th Power Plan - Commercial Energy Management Systems (Com-EM-7P_V5.xlsm)	$7,556	$35,620	8760
Energy Management System with Data Analysis	Food Sales Category	Energy management measures for commercial buildings, excluding single-zone ducted systems. Suite of measures, most of which are focused on making HVAC systems work better through controls changes.	9,313	5	$1,583	7th Power Plan - Commercial Energy Management Systems (Com-EM-7P_V5.xlsm)	$426	$2,010	8760
Energy Management System with Data Analysis	Food Service Category	Energy management measures for commercial buildings, excluding single-zone ducted systems. Suite of measures, most of which are focused on making HVAC systems work better through controls changes.	6,427	5	$838	7th Power Plan - Commercial Energy Management Systems (Com-EM-7P_V5.xlsm)	$226	$1,063	8760

EE Measure Name	Customer Segment	Description	Average Annual Savings (kWh/year)	Measure Life (years)	Average Installation Cost ($)	Measure Source	Administrative Cost ($)	Total Program Cost ($)	Active Hours per Year
Energy Management System with Data Analysis	Healthcare Category	Energy management measures for commercial buildings, excluding single-zone ducted systems. Suite of measures, most of which are focused on making HVAC systems work better through controls changes.	8,635	5	$1,214	7th Power Plan - Commercial Energy Management Systems (Com-EM-7P_V5.xlsm)	$327	$1,541	8760
Energy Management System with Data Analysis	Industrial	Energy management measures for commercial buildings, excluding single-zone ducted systems. Suite of measures, most of which are focused on making HVAC systems work better through controls changes.	16,382	5	$17,890	7th Power Plan - Commercial Energy Management Systems (Com-EM-7P_V5.xlsm)	$4,817	$22,707	8760
Energy Management System with Data Analysis	Lodging Category	Energy management measures for commercial buildings, excluding single-zone ducted systems. Suite of measures, most of which are focused on making HVAC systems work better through controls changes.	14,407	5	$3,620	7th Power Plan - Commercial Energy Management Systems (Com-EM-7P_V5.xlsm)	$975	$4,594	8760

EE Measure Name	Customer Segment	Description	Average Annual Savings (kWh/year)	Measure Life (years)	Average Installation Cost ($)	Measure Source	Administrative Cost ($)	Total Program Cost ($)	Active Hours per Year
Energy Management System with Data Analysis	Mixed	Energy management measures for commercial buildings, excluding single-zone ducted systems. Suite of measures, most of which are focused on making HVAC systems work better through controls changes.	1,494	5	$414	7th Power Plan - Commercial Energy Management Systems (Com-EM-7P_V5.xlsm)	$111	$525	8760
Energy Management System with Data Analysis	Office Category	Energy management measures for commercial buildings, excluding single-zone ducted systems. Suite of measures, most of which are focused on making HVAC systems work better through controls changes.	6,300	5	$1,945	7th Power Plan - Commercial Energy Management Systems (Com-EM-7P_V5.xlsm)	$524	$2,468	8760
Energy Management System with Data Analysis	Public Service Category	Energy management measures for commercial buildings, excluding single-zone ducted systems. Suite of measures, most of which are focused on making HVAC systems work better through controls changes.	74,988	5	$20,766	7th Power Plan - Commercial Energy Management Systems (Com-EM-7P_V5.xlsm)	$5,591	$26,357	8760

EE Measure Name	Customer Segment	Description	Average Annual Savings (kWh/year)	Measure Life (years)	Average Installation Cost ($)	Measure Source	Administrative Cost ($)	Total Program Cost ($)	Active Hours per Year
Energy Management System with Data Analysis	Religious	Energy management measures for commercial buildings, excluding single-zone ducted systems. Suite of measures, most of which are focused on making HVAC systems work better through controls changes.	14,415	5	$3,992	7th Power Plan - Commercial Energy Management Systems (Com-EM-7P_V5.xlsm)	$1,075	$5,067	8760
Energy Management System with Data Analysis	Retail Category	Energy management measures for commercial buildings, excluding single-zone ducted systems. Suite of measures, most of which are focused on making HVAC systems work better through controls changes.	7,103	5	$1,702	7th Power Plan - Commercial Energy Management Systems (Com-EM-7P_V5.xlsm)	$458	$2,160	8760
Energy Management System with Data Analysis	Services Category	Energy management measures for commercial buildings, excluding single-zone ducted systems. Suite of measures, most of which are focused on making HVAC systems work better through controls changes.	4,369	5	$1,210	7th Power Plan - Commercial Energy Management Systems (Com-EM-7P_V5.xlsm)	$326	$1,536	8760

EE Measure Name	Customer Segment	Description	Average Annual Savings (kWh/year)	Measure Life (years)	Average Installation Cost ($)	Measure Source	Administrative Cost ($)	Total Program Cost ($)	Active Hours per Year
Energy Management System with Data Analysis	Storage	Energy management measures for commercial buildings, excluding single-zone ducted systems. Suite of measures, most of which are focused on making HVAC systems work better through controls changes.	3,597	5	$3,928	7th Power Plan - Commercial Energy Management Systems (Com-EM-7P_V5.xlsm)	$1,058	$4,985	8760

The initial cost references for the EE measures as the starting point costs in the modeling are based on PRPA program information or other EE potential assessments. Where applicable, HDR used cost trend projections to adjust the future costs of some of the EE measures. Analysis from the U.S. EIA study on Updated Buildings Sector Appliance and Equipment Costs and Efficiency[23] was used to project the cost trends in the following EE measures through 2040.

Table A-2. Forward Cost Projections by EE Measure Technology

Technology Category	2015-2019	2020-2024	2025-2029	2030-2034	2035-2039
Residential Interior LED Lighting	-12.3%	-5.5%	-5.5%	-5.4%	-5.4%
Residential Exterior LED Lighting	-4.9%	-6.5%	-6.5%	-3.9%	-3.9%
Residential Clothes Washer	-	+0.9%	+0.9%	-	-
Residential Clothes Dryer	-	+0.9%	+0.9%	-	-
Commercial Interior LED Lighting	-4.6%	-4.6%	-4.4%	-2.1%	-2.1%

[23] EIA Updated Buildings Sector Appliance and Equipment Costs and Efficiency, June 2018. Appendix A & C. https://www.eia.gov/analysis/studies/buildings/equipcosts/

Technology Category	2015-2019	2020-2024	2025-2029	2030-2034	2035-2039
Commercial Exterior LED Lighting	-4.6%	-4.6%	-4.4%	-2.1%	-2.1%
Industrial Interior LED Lighting	-4.6%	-4.6%	-4.4%	-2.1%	-2.1%
Industrial Linear LED Lighting	-12.3%	-2.8%	-2.8%	-1.6%	-1.6%
Industrial High Bay LED Lighting	-9.6%	-4.5%	-4.5%	-3.7%	-3.7%
Commercial / Industrial Exterior LED Lighting	-4.6%	-4.6%	-4.4%	-2.1%	-2.1%

Appendix B. Demand Response Measure Assumptions

The following table presents key assumptions used in the evaluation of demand response measures.

Table B-1.Demand Response Measure Assumptions

DR Measure	Description	kW Installed by DR measure (kW/year)	kW Deferred by DR measure (kW/year)	Deferred energy replacement	Measure Life (years)	Average Program Cost ($/unit)	Administrative Cost ($/unit)	Source
Residential								
HVAC Programmable Communicating Thermostat (PCTs)	Smart thermostat that adapts to user behavior and can be controlled by WiFi	0.95	0.48	100%	10	$452	$122	2025 California Demand Response Potential Study for load shed, life and cost values (Page 163 and 164).
HVAC DLC	Remotely activated switches to allow air conditioners to be switched on/off for a short time during peak periods and critical events	0.51	0.26	100%	10	$234	$63	Based on results of the PRPA demand response pilot program of 2015. Residential and business HVAC and WH DLC was tested for Fort Collins. There were 1700 HVAC customers and 2000 WH customer participants.
Water Heater DLC	Remotely activated switches to allow electric water heaters to be switched on/off for a short time during peak periods and critical events	0.35	0.18	100%	10	$161	$43	Based on results of the PRPA demand response pilot program of 2015. Residential and business HVAC and WH DLC was tested for Fort Collins. There were 1700 HVAC customers and 2000 WH customer participants.

DR Measure	Description	kW Installed by DR measure (kW/year)	kW Deferred by DR measure (kW/year)	Deferred energy replacement	Measure Life (years)	Average Program Cost ($/unit)	Administrative Cost ($/unit)	Source
Battery and Plug-in Hybrid Vehicles DLC - Charging Interruption during peak hours	Two way communication capable DR device(DLC switch)/ or advanced controller with communication, separate smart metering capability	1.30	0.87	100%	10	$2,700	$727	Xcel Energy Colorado EV Charging Station Pilot Evaluation Results - May 2015. Avg energy = 2663.7kWh /yr /vehicle. Total demand = 1.31kW /vehicle. Per PRPA call no of EV in 2019 = 2000 increase to 37,000 by 2030 5,327,400 kWh/yr.
BESS (5kW) Automated Demand Response	BESS with advanced metering with communication and controller to curtail power during peak periods.	5.00	3.33	100%	10	$13,600	$3,662	Deferred kW and kWh computed, see EV BESS analysis page.
BESS (5 -10 kW) Automated Demand Response	Advanced metering with communication and controller to curtail power during peak periods.	10.00	6.67	100%	10	$20,300	$5,465	Deferred kW and kWh computed, see EV BESS analysis page
Distributed Solar		5.40	5.40	0%	20	$20,656	$5,561	Industry Average
Commercial / Industrial								
HVAC Automated Demand Response	Demand response programs where PRPA is able to control customer's HVAC load for DR purposes.	0.60	0.30	100%	15	$400	$108	2025 California Demand Response Potential Study for load shed, life and cost values (Page 132).

DR Measure	Description	kW Installed by DR measure (kW/year)	kW Deferred by DR measure (kW/year)	Deferred energy replacement	Measure Life (years)	Average Program Cost ($/unit)	Administrative Cost ($/unit)	Source
HVAC DLC and PCTs	Similar to residential customers, remotely activated switches to allow air conditioners to be switched on/off for a short time during peak periods and critical events.	0.35	0.18	100%	15	$160	$43	Used the same results as the residential values based on the PRPA demand response pilot program of 2015. Peak shed value from pilot matched the base case values in the 2025 California DR Potential Study (Page 131). Assumed kWh energy reduction also matches.
50kW BESS Automated Demand Response	BESS with advanced metering with communication and controller to curtail power during peak periods.	50.0	16.7	100%	10	$61,875	$16,659	Deferred kW and kWh computed, see EV BESS analysis page
150kW BESS Automated Demand Response	BESS with advanced metering with communication and controller to curtail power during peak periods.	150.0	50.0	100%	10	$182,625	$49,168	Deferred kW and kWh computed, see EV BESS analysis page
Industrial Process - Automated Demand Response	Generic automated DR strategy- automatic temporary reduction of an industrial process throughput or full interruption during peak hrs	61.44	30.72	100%	10	$25,598	$6,892	2025 California Demand Response Potential Study for load shed, life and cost values (Page 190 and 191).
Industrial Process - Manual Demand Response	Generic manual DR strategy- manual temporary reduction of an industrial process throughput or full interruption during peak hrs	51.20	25.60	100%	10	$3,000	$808	2025 California Demand Response Potential Study for load shed, life and cost values (Page 190 and 191).

DR Measure	Description	kW Installed by DR measure (kW/year)	kW Deferred by DR measure (kW/year)	Deferred energy replacement	Measure Life (years)	Average Program Cost ($/unit)	Administrative Cost ($/unit)	Source
Lighting - Luminaire, Zonal, and Standard Control Options	Generic automated DR strategy- automatic temporary reduction of lighting in retail/office buildings. Assumed to be a composite of luminaire, zonal, and standard control options.	2.93	1.47	0%	10	$4,948	$1,332	2025 California Demand Response Potential Study for load shed, life and cost values. Values represent the average of the medium size office/retail options for the base case (Page 145 and 146).
Refrigerated Warehouse - Automated Demand Response	Automated DR strategies - temporary shut off, temp set point adjustments during peak hrs	1.10	0.55	100%	15	$10,000	$2,692	Refrigerated Warehouse Demand Response Strategy Guide - Lawrence Berkeley Labs Nov 2015. Cap cost buildup does not include cost of chillers
Commercial Distributed Solar		34.5	34.5	0%	20	$105,586	$28,427	Industry Average
Industrial Distributed Solar		643.5	643.5	0%	20	$1,512,228	$407,138	Industry Average
System Wide								
Voltage Regulation	Intentional reduction on system voltage to lower load. Requires remotely operated load tap changers on feeder distribution transformers.	2900	1,933	0%	20	$2,280,000		System-wide PRPA impact based on scaled proportion. Based on results of the PRPA demand response pilot program in 2015. Voltage regulation was tested for Longmont. Longmont represents 27% of the electrical demand for the PRPA system.

The initial cost references for the DR measures as the starting point costs in the modeling are based on PRPA program information or other DR potential assessments. Where applicable, HDR used cost trend projections to adjust the future costs of the DR measures. The National Renewable Energy Laboratory's Annual Technology Baseline 2018[24] was used to project the cost reductions in batteries and solar panels through 2040.

Table B-2. Forward Cost Projections of Compound Annual Growth Rate by DER Technology

Technology Category	2015-2019	2020-2024	2025-2029	2030-2034	2035-2039
Battery Storage	-11.3%	-8.3%	-6.4%	-2.4%	-2.4%
Residential Solar PV	-5.0%	-5.0%	-5.0%	-1.3%	-1.3%
Commercial Solar PV	-4.3%	-4.3%	-4.3%	-0.8%	-0.8%
Industrial Solar PV	-4.3%	-4.3%	-4.3%	-0.8%	-0.8%

[24] National Renewable Energy Laboratory. "Annual Technology Baseline 2018," July 2018. https://atb.nrel.gov/.

Appendix C. Detailed Avoided Cost Assumptions

The sections below contain detailed assumptions regarding the avoided cost assumptions used in each of the models.

C.1 Energy Efficiency Avoided Cost Assumptions

Low Avoided Cost Scenario

In this case, the avoided energy costs are measured based on market rates, and the avoided capacity costs are measured based on avoiding construction an aeroderivative LM6000 (AERO) unit, blended with energy costs assuming a 60% load factor. The assumptions used in deriving the blended avoided cost of $59.38 are shown in the table below.

Table C-1. Low Case Avoided Cost Scenario Assumptions[25]

	AERO
Gross Capacity (MW)	83
Economic Life	30
Discount Rate	5%
Capacity Factor (%)	60%
Annual Energy (MWh)	436,248
Capital Cost ($/kW)	$1,202
Replacement Cost ($/kW)	N/A
Fixed O&M ($/kW-yr)	$10.10
Firm Gas Cost ($/kW-yr)	$25.33
Avoided Capacity Costs ($/kW-yr)	**$113.60**
Energy Cost	$37.77
Avoided Energy Costs ($/MWh)	**$37.77**
Blended Avoided Cost ($/MWh)	**$59.38**

Medium Avoided Cost Scenario

The avoided energy costs for the medium scenario are measured based on a coal retirement scenario. The avoided energy costs are based on solar and wind PPAs, and the avoided capacity cost are measured based on avoiding a batteries with a 72% electric load carrying capacity. The assumptions used in deriving the blended avoided cost of $67.47 are shown in the table below.

[25] Avoided cost assumptions include transmission losses (assumed to be 1.8%) and distribution losses (assumed to be 3.0%).

Table C-2. Avoided Cost Assumptions for Medium Scenario[26]

	Wind	Solar	Battery
Installed Capacity (MW)	200	300	300
Economic Life	30	30	30
Discount Rate	5%	5%	5%
Capacity Factor (%)	45%	28%	N/A
Annual Energy (MWh)	788,400	735,840	N/A
Capital Cost ($/kW)	N/A	N/A	$2,219
Fixed O&M ($/kW-yr)	N/A	N/A	N/A
Avoided Capacity Costs ($/kW-yr)	**N/A**	**N/A**	**$144.35**
PPA Cost ($/MWh)	$26.25	$33.68	**N/A**
Ancillary Services ($/MWh)	$3.39	$0.82	N/A
Transmission Costs ($/MWh)	$15.50	N/A	N/A
Avoided Energy Costs ($/MWh)	**$45.14**	**$34.50**	**N/A**
Blended Avoided Cost ($/MWh)	**$67.47**		

New solar projects are assumed to be located close to interconnection points and therefore not require wheeling or construction of long transmission lines. New wind projects are assumed to be subject to regional tariffs.

High Avoided Cost Scenario

The high avoided cost scenario is designed as a storage and non-carbon energy scenario. This scenario contains a blend of solar, wind and battery resources. For solar and wind, all avoided costs are treated as energy costs as neither are a dispatchable resource that offers continuous firm capacity. The costs associated with the battery resources are measured as the avoided capacity costs and blended based on the assumptions in the table below. The blended avoided cost is $76.62/MWh for the mix of resources presented.

Table C-3. Avoided Cost Assumptions for High Scenario[27]

	Wind	Solar	Battery
Installed Capacity (MW)	200	300	300
Economic Life	30	30	15
Discount Rate	5%	5%	5%
Capacity Factor (%)	45%	28%	N/A

[26] Avoided cost assumptions include transmission losses (assumed to be 1.8%) and distribution losses (assumed to be 3.0%). Battery costs are assumed to decrease 2% per year. The four technologies are blended as a weighted average based on the annual energy generated.

[27] Avoided cost assumptions include transmission losses (assumed to be 1.8%) and distribution losses (assumed to be 3.0%). Battery costs are assumed to decrease 3% per year. The four technologies are blended as a weighted average based on the annual energy generated.

	Wind	Solar	Battery
Annual Energy (MWh)	788,400	735,840	N/A
Capital Cost ($/kW)	N/A	N/A	$2,959
Fixed O&M ($/kW-yr)	$38.84	$21.00	N/A
Avoided Capacity Costs ($/kW-yr)	**N/A**	**N/A**	**$192.47**
PPA Cost ($/MWh)	$26.25	$33.68	N/A
Ancillary Services ($/MWh)	$3.39	$0.82	N/A
Transmission Costs ($/MWh)	$15.50	N/A	N/A
Avoided Energy Costs ($/MWh)	**$45.14**	**$34.50**	**N/A**
Blended Avoided Cost ($/MWh)	**$76.62**		

C.2 Demand Response Avoided Cost Assumptions

Low Avoided Cost Scenario

In this case, the avoided energy costs are measured based on market rates, and the avoided capacity costs are measured based on the fixed costs of avoiding construction an AERO unit. The assumptions used in deriving the avoided cost values are shown in the table below.

Table C-4. Low Case Avoided Cost Scenario Assumptions[28]

	AERO
Gross Capacity (MW)	83
Economic Life	30
Discount Rate	5%
Capital Cost ($/kW)	$1,145
Fixed O&M ($/kW-yr)	$10.10
Firm Gas Cost ($/kW-yr)	$25.33
Avoided Capacity Costs ($/kW-yr)	**$113.60**
Energy Cost ($/MWh)	$37.77
Avoided Energy Costs ($/MWh)	**$37.77**

Medium Avoided Cost Scenario

The avoided energy costs for the medium scenario are measured based on a coal retirement scenario. The avoided energy cost is determined by solar and wind PPAs. The avoided capacity costs is calculated as the fixed costs for batteries.

[28] Avoided cost assumptions include transmission losses (assumed to be 1.8%) and distribution losses (assumed to be 3.0%).

Table C-5. Medium Case Avoided Cost Scenario Assumptions[29]

	Wind	Solar	Battery
Installed Capacity (MW)	200	300	300
Economic Life	30	30	30
Discount Rate	5%	5%	5%
Capacity Factor (%)	45%	28%	N/A
Annual Energy (MWh)	788,400	735,840	N/A
Capital Cost ($/kW)	N/A	N/A	$2,219
Fixed O&M ($/kW-yr)	N/A	N/A	N/A
Avoided Capacity Costs ($/kW-yr)	**N/A**	**N/A**	**$144.35**
PPA Cost ($/MWh)	$26.25	$33.68	**N/A**
Ancillary Services ($/MWh)	$3.39	$0.82	N/A
Transmission Costs ($/MWh)	$15.50	N/A	N/A
Avoided Energy Costs ($/MWh)	**$45.14**	**$34.50**	**N/A**
Blended Energy Cost ($/MWh)	**$40.00**		**N/A**

High Avoided Cost Scenario

The high avoided cost scenario is calculated as a storage and non-carbon energy scenario. This scenario contains a blend of solar, wind and battery resources. For solar and wind, all avoided costs are treated as energy costs as neither are a dispatchable resource that offers continuous firm capacity. The costs associated with the battery resources are measured as the avoided capacity costs and blended based on the assumptions in the table below.

Table C-6. High Case Avoided Cost Scenario Assumptions[30]

	Wind	Solar	Battery
Installed Capacity (MW)	200	300	300
Economic Life	30	30	30
Discount Rate	5%	5%	5%
Capacity Factor (%)	45%	28%	N/A
Annual Energy (MWh)	788,400	735,840	N/A
Capital Cost ($/kW)	N/A	N/A	$2,959
Fixed O&M ($/kW-yr)	N/A	N/A	N/A
Avoided Capacity Costs ($/kW-yr)	**N/A**	**N/A**	**$192.47**
PPA Cost ($/MWh)	$26.25	$33.68	**N/A**

[29] Avoided cost assumptions include transmission losses (assumed to be 1.8%) and distribution losses (assumed to be 3.0%). Battery costs are assumed to decrease 2% per year.

[30] Avoided cost assumptions include transmission losses (assumed to be 1.8%) and distribution losses (assumed to be 3.0%). Battery costs are assumed to decrease 2% per year.

	Wind	Solar	Battery
Ancillary Services ($/MWh)	$3.39	$0.82	N/A
Transmission Costs ($/MWh)	$15.50	N/A	N/A
Avoided Energy Costs ($/MWh)	**$45.14**	**$34.50**	**N/A**
Blended Energy Cost ($/MWh)	**$40.00**		**N/A**

C.3 Distributed Solar Avoided Cost Assumptions

Low Avoided Cost Scenario

In this case, the avoided energy costs are measured based on market energy prices, and the avoided capacity costs are measured based on the fixed costs of avoiding construction an AERO unit. Given that solar output is assumed to be primarily available outside of peak hours, distributed solar will not add significant capacity to curtail evening loads. It was assumed that roughly 30% of the solar load is produced during peak hours, and as such, the avoided capacity costs are adjusted to reflect the reduced capacity benefit distributed solar provides. The market energy cost is based on a 20 year levelized average of the around the clock power price forecast to correspond with an anticipated average 20 year life of solar PV systems. The assumptions used in deriving the avoided cost values are shown in the table below.

Table C-7. Low Case Avoided Cost Scenario Assumptions[31]

	AERO
Gross Capacity (MW)	83
Economic Life	30
Discount Rate	5%
Capital Cost ($/kW)	$1,202
Fixed O&M ($/kW-yr)	$10.10
Firm Gas Cost ($/kW-yr)	$25.33
Solar Capacity Credit	30%
Avoided Capacity Costs ($/kW-yr)	**$34.08**
Market Energy ($/MWh)	$42.49
Avoided Energy Costs ($/MWh)	**$42.49**
Blended Avoided Cost ($/MWh)	**$61.94**

Medium Avoided Cost Scenario

The avoided energy costs for the medium scenario are measured based on avoiding utility-scale solar. The avoided energy cost is determined by the utility solar costs. It is assumed there is no capacity benefit. All utility-scale solar fixed costs are blended with energy costs using a capacity factor of 28%.

[31] Avoided cost assumptions include transmission losses (assumed to be 1.8%) and distribution losses (assumed to be 3.0%).

Table C-8. Medium Case Avoided Cost Scenario Assumptions[32]

	Solar
Economic Life	30
Discount Rate	5%
Annual Capacity Factor	28%
Annual Energy (MWh/MW-yr)	2,453
PPA Cost ($/MWh)	$33.68
Fixed O&M ($/kW-yr)	N/A
Ancillary Services ($/MWh)	$0.78
Transmission Cost ($/MWh)	N/A
Avoided Energy Costs ($/MWh)	**$34.46**

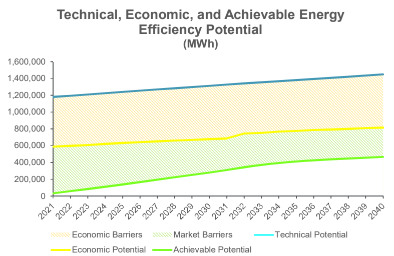
High Avoided Cost Scenario

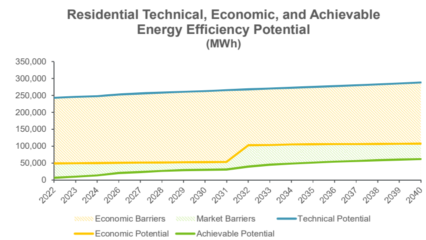
The avoided energy costs for the high scenario are measured based on the same assumptions as the medium avoided cost scenario.

[32] Avoided cost assumptions include transmission losses (assumed to be 1.8%) and distribution losses (assumed to be 3.0%).

Appendix D. Distributed Energy Resources Results by Avoided Cost Scenario

EE.Low: Energy Efficiency Low Avoided Cost Scenario Results





Combined

Technical Potential (MWh)	2021	2025	2030	2035	2040
Heating	29,905	32,310	35,437	38,592	42,105
Cooling	178,715	192,422	209,184	224,819	240,042
Ventilation	33,929	33,102	32,209	31,425	30,744
Water Heating	16,009	17,151	18,531	19,851	21,281
Lighting	437,265	435,517	435,002	435,191	436,379
Cooking	33,850	36,496	39,741	42,749	45,594
Office Equipment & Computing	4,396	4,740	5,161	5,552	5,921
Refrigeration	83,923	89,596	96,546	102,993	109,144
Miscellaneous	363,277	398,594	441,360	480,959	518,920
Total Technical Potential (MWh)	**1,181,269**	**1,239,928**	**1,313,173**	**1,382,130**	**1,450,130**

Economic Potential (MWh)	2021	2025	2030	2035	2040
Heating	9,962	10,688	11,569	12,404	13,282
Cooling	83,082	89,569	97,523	104,899	111,888
Ventilation	10,047	9,012	7,864	6,861	5,984
Water Heating	-	-	-	-	-
Lighting	129,231	132,130	128,447	179,721	175,830
Cooking	21,088	22,736	24,758	26,632	28,404
Office Equipment & Computing	-	-	-	-	-
Refrigeration	78,698	83,998	90,497	96,514	102,198
Miscellaneous	257,073	284,408	317,443	349,786	378,709
Total Economic Potential (MWh)	**589,181**	**632,540**	**678,100**	**776,817**	**816,295**

Achievable Potential (MWh)	2021	2025	2030	2035	2040
Heating	321	2,573	7,281	9,303	9,962
Cooling	376	7,536	41,980	72,734	83,174
Ventilation	19	365	2,004	4,149	4,440
Water Heating	-	-	-	-	-
Lighting	22,083	63,853	80,203	110,755	125,299
Cooking	680	5,473	15,582	16,995	13,538
Office Equipment & Computing	-	-	-	-	-
Refrigeration	2,687	20,543	54,266	63,884	50,192
Miscellaneous	6,203	37,053	79,810	134,130	180,080
Total Achievable Potential (MWh)	**32,370**	**137,396**	**281,126**	**411,951**	**466,685**

Incremental Achievable Potential (MWh)	2021	2025	2030	2035	2040
Heating	321	717	1,206	981	1,273
Cooling	376	3,292	8,318	4,213	1,524
Ventilation	19	146	446	320	13
Water Heating	-	-	-	-	-
Lighting	22,083	7,415	9,100	16,671	22,696
Cooking	680	1,532	1,907	703	1,630
Office Equipment & Computing	-	-	-	-	-
Refrigeration	2,687	5,857	7,200	1,635	3,023
Miscellaneous	6,203	9,087	17,611	28,290	35,819
Total Incremental Achievable Potential (MWh	**32,370**	**28,046**	**45,789**	**52,812**	**65,977**

Total Achievable Incremental Costs ($000s	2021	2025	2030	2035	2040
Heating	$90	$202	$340	$277	$358
Cooling	$201	$1,686	$4,237	$2,159	$815
Ventilation	$7	$50	$153	$110	$4
Water Heating	-	-	-	-	-
Lighting	$6,215	$2,337	$2,743	$4,541	$5,267
Cooking	$75	$168	$209	$77	$179
Office Equipment & Computing	-	-	-	-	-
Refrigeration	$1,464	$3,266	$4,034	$643	$1,510
Miscellaneous	$1,526	$2,244	$4,423	$7,105	$9,284
Total Incremental Costs ($000s)	**$9,578**	**$9,953**	**$16,140**	**$14,913**	**$17,417**

Multi-Year Cumulative Costs ($000s)	2021-2025	2026-2030	2031-2035	2036-2040
Heating	$724	$1,419	$1,448	$1,680
Cooling	$3,893	$17,562	$15,861	$5,947
Ventilation	$125	$562	$736	$141
Water Heating	-	-	-	-
Lighting	$18,532	$12,608	$20,004	$25,319
Cooking	$601	$1,110	$588	$689
Office Equipment & Computing	-	-	-	-
Refrigeration	$11,705	$21,441	$9,348	$5,337
Miscellaneous	$9,158	$17,021	$30,365	$41,935
Total 5-Year Costs ($000s)	**$44,738**	**$71,724**	**$78,351**	**$81,047**
Participant Cost	$8,812	$14,128	$15,433	$15,964
Utility Incentives	$26,436	$42,383	$46,298	$47,892
Utility Administrative Costs	$9,490	$15,214	$16,620	$17,192

Residential

Technical Potential (MWh)	2021	2025	2030	2035	2040
Heating	25,544	27,607	30,316	33,083	36,230
Cooling	38,384	41,122	44,431	47,594	51,024
Ventilation	18,079	17,835	17,533	17,236	16,945
Water Heating	16,009	17,151	18,531	19,851	21,281
Lighting	58,594	57,855	56,942	56,043	55,159
Cooking	n/a	n/a	n/a	n/a	n/a
Office Equipment & Computing	n/a	n/a	n/a	n/a	n/a
Refrigeration	14,481	14,726	15,019	15,294	15,609
Miscellaneous	69,383	74,332	80,315	86,032	92,231
Total Technical Potential (MWh)	**240,472**	**250,627**	**263,087**	**275,134**	**288,478**

Economic Potential (MWh)	2021	2025	2030	2035	2040
Heating	7,739	8,292	8,959	9,597	10,288
Cooling	1,101	1,180	1,275	1,365	1,464
Ventilation	-	-	-	-	-
Water Heating	-	-	-	-	-
Lighting	7,672	7,582	7,471	56,043	55,159
Cooking	n/a	n/a	n/a	n/a	n/a
Office Equipment & Computing	n/a	n/a	n/a	n/a	n/a
Refrigeration	9,255	9,127	8,970	8,815	8,663
Miscellaneous	22,675	24,292	26,247	29,998	32,159
Total Economic Potential (MWh)	**48,442**	**50,473**	**52,922**	**105,818**	**107,733**

Achievable Potential (MWh)	2021	2025	2030	2035	2040
Heating	250	1,996	5,639	7,198	7,716
Cooling	36	284	802	1,024	1,098
Ventilation	-	-	-	-	-
Water Heating	-	-	-	-	-
Lighting	1,273	3,642	4,907	26,028	35,671
Cooking	n/a	n/a	n/a	n/a	n/a
Office Equipment & Computing	n/a	n/a	n/a	n/a	n/a
Refrigeration	298	2,197	3,448	989	0
Miscellaneous	1,687	9,182	15,695	16,215	17,602
Total Achievable Potential (MWh)	**3,543**	**17,301**	**30,491**	**51,453**	**62,088**

Incremental Achievable Potential (MWh)	2021	2025	2030	2035	2040
Heating	250	556	933	759	989
Cooling	36	79	133	108	141
Ventilation	-	-	-	-	-
Water Heating	-	-	-	-	-
Lighting	1,273	407	1,442	3,383	13,082
Cooking	n/a	n/a	n/a	n/a	n/a
Office Equipment & Computing	n/a	n/a	n/a	n/a	n/a
Refrigeration	298	580	593	-	-
Miscellaneous	1,687	2,001	1,433	1,764	1,908
Total Incremental Achievable Potential (MWh	**3,543**	**3,623**	**4,534**	**6,013**	**16,120**

Total Achievable Incremental Costs ($000s	2021	2025	2030	2035	2040
Heating	$51	$113	$189	$154	$200
Cooling	$30	$66	$111	$90	$118
Ventilation	-	-	-	-	-
Water Heating	-	-	-	-	-
Lighting	$270	$66	$172	$734	$2,211
Cooking	n/a	n/a	n/a	n/a	n/a
Office Equipment & Computing	n/a	n/a	n/a	n/a	n/a
Refrigeration	$81	$157	$161	$0	$0
Miscellaneous	$274	$334	$231	$254	$359
Total Incremental Costs ($000s)	**$705**	**$736**	**$863**	**$1,231**	**$2,887**

Multi-Year Cumulative Costs ($000s)	2021-2025	2026-2030	2031-2035	2036-2040
Heating	$404	$788	$803	$936
Cooling	$237	$463	$472	$550
Ventilation	-	-	-	-
Water Heating	-	-	-	-
Lighting	$706	$324	$5,702	$8,392
Cooking	n/a	n/a	n/a	n/a
Office Equipment & Computing	n/a	n/a	n/a	n/a
Refrigeration	$596	$936	$268	-
Miscellaneous	$1,509	$1,344	$1,078	$1,594
Total 5-Year Costs ($000s)	**$3,452**	**$3,854**	**$8,324**	**$11,472**
Participant Cost	$680	$759	$1,640	$2,260
Utility Incentives	$2,040	$2,278	$4,919	$6,779
Utility Administrative Costs	$732	$818	$1,766	$2,433

Commercial/Industrial

Technical Potential (MWh)	2021	2025	2030	2035	2040
Heating	4,362	4,703	5,121	5,509	5,875
Cooling	140,331	151,300	164,753	177,225	189,018
Ventilation	15,850	15,268	14,677	14,189	13,799
Water Heating	n/a	n/a	n/a	n/a	n/a
Lighting	378,672	377,662	378,060	379,148	381,220
Cooking	33,850	36,496	39,741	42,749	45,594
Office Equipment & Computing	4,396	4,740	5,161	5,552	5,921
Refrigeration	69,442	74,870	81,527	87,699	93,535
Miscellaneous	293,894	324,262	361,046	394,927	426,689
Total Technical Potential (MWh)	**940,797**	**989,301**	**1,050,086**	**1,106,996**	**1,161,652**

Economic Potential (MWh)	2021	2025	2030	2035	2040
Heating	2,223	2,397	2,610	2,807	2,994
Cooling	81,981	88,389	96,248	103,534	110,424
Ventilation	10,047	9,012	7,864	6,861	5,984
Water Heating	n/a	n/a	n/a	n/a	n/a
Lighting	121,560	124,548	120,976	123,678	120,671
Cooking	21,088	22,736	24,758	26,632	28,404
Office Equipment & Computing	-	-	-	-	-
Refrigeration	69,442	74,870	81,527	87,699	93,535
Miscellaneous	234,398	260,115	291,195	319,789	346,550
Total Economic Potential (MWh)	**540,739**	**582,067**	**625,178**	**670,999**	**708,562**

Achievable Potential (MWh)	2021	2025	2030	2035	2040
Heating	72	577	1,642	2,105	2,245
Cooling	340	7,252	41,178	71,710	82,077
Ventilation	19	365	2,004	4,149	4,440
Water Heating	n/a	n/a	n/a	n/a	n/a
Lighting	20,810	60,211	75,296	84,727	89,628
Cooking	680	5,473	15,582	16,995	13,538
Office Equipment & Computing	-	-	-	-	-
Refrigeration	2,389	18,346	50,818	62,896	50,192
Miscellaneous	4,516	27,870	64,115	117,915	162,478
Total Achievable Potential (MWh)	**28,827**	**120,095**	**250,635**	**360,497**	**404,597**

Incremental Achievable Potential (MWh)	2021	2025	2030	2035	2040
Heating	72	161	273	222	284
Cooling	340	3,213	8,185	4,105	1,383
Ventilation	19	146	446	320	13
Water Heating	n/a	n/a	n/a	n/a	n/a
Lighting	20,810	7,008	7,658	13,288	9,613
Cooking	680	1,532	1,907	703	1,630
Office Equipment & Computing	-	-	-	-	-
Refrigeration	2,389	5,277	6,607	1,635	3,023
Miscellaneous	4,516	7,086	16,178	26,526	33,911
Total Incremental Achievable Potential (MWh	**28,827**	**24,423**	**41,255**	**46,799**	**49,858**

Total Achievable Incremental Costs ($000s	2021	2025	2030	2035	2040
Heating	$40	$90	$151	$123	$158
Cooling	$171	$1,620	$4,126	$2,069	$697
Ventilation	$7	$50	$153	$110	$4
Water Heating	n/a	n/a	n/a	n/a	n/a
Lighting	$5,945	$2,271	$2,571	$3,808	$3,056
Cooking	$75	$168	$209	$77	$179
Office Equipment & Computing	-	-	-	-	-
Refrigeration	$1,383	$3,109	$3,874	$643	$1,510
Miscellaneous	$1,252	$1,910	$4,192	$6,851	$8,926
Total Incremental Costs ($000s)	**$8,873**	**$9,217**	**$15,276**	**$13,682**	**$14,531**

Multi-Year Cumulative Costs ($000s)	2021-2025	2026-2030	2031-2035	2036-2040
Heating	$320	$631	$644	$744
Cooling	$3,655	$17,100	$15,389	$5,397
Ventilation	$125	$562	$736	$141
Water Heating	n/a	n/a	n/a	n/a
Lighting	$17,827	$12,284	$14,302	$16,927
Cooking	$601	$1,110	$588	$689
Office Equipment & Computing	-	-	-	-
Refrigeration	$11,109	$20,506	$9,080	$5,337
Miscellaneous	$7,649	$15,677	$29,287	$40,341
Total 5-Year Costs ($000s)	**$41,286**	**$67,870**	**$70,027**	**$69,576**
Participant Cost	$8,132	$13,368	$13,793	$13,704
Utility Incentives	$24,396	$40,105	$41,380	$41,113
Utility Administrative Costs	$8,758	$14,397	$14,854	$14,759

EE.Hourly.Low: Hourly Energy Efficiency Results, Medium Avoided Cost Scenario

	Winter	2021		2025		2030		2035		2040	
	12/19	Base Load (MW)	Total EE Curtailment	Base Load (MW)	Total EE Curtailment	Base Load (MW)	Total EE Curtailment	Base Load (MW)	Total EE Curtailment	Base Load (MW)	Total EE Curtailment
8449	1	326.9	3.3	329.9	12.5	335.2	22.9	344.8	30.9	361.3	34.5
8450	2	318.4	3.3	321.3	12.5	326.5	22.9	335.8	30.9	351.9	34.5
8451	3	315.3	3.3	318.2	12.5	323.3	22.9	332.6	30.9	348.4	34.5
8452	4	316.6	3.3	319.4	12.5	324.6	22.9	333.9	30.9	349.9	34.5
8453	5	326.0	3.3	329.0	12.5	334.3	22.9	343.9	30.9	360.3	34.5
8454	6	348.9	3.8	352.1	15.5	357.8	29.1	368.0	42.2	385.6	47.7
8455	7	386.2	3.5	389.7	14.7	396.1	28.0	407.4	41.0	426.8	46.4
8456	8	405.2	4.2	408.9	17.7	415.5	32.3	427.4	47.4	447.8	54.1
8457	9	406.7	4.2	410.4	17.7	417.1	32.3	429.0	47.4	449.5	54.1
8458	10	401.9	3.8	405.5	15.6	412.1	28.7	423.9	39.0	444.2	43.2
8459	11	397.7	3.8	401.3	15.6	407.8	28.7	419.5	39.0	439.5	43.2
8460	12	393.9	3.8	397.5	15.6	403.9	28.7	415.5	39.0	435.3	43.2
8461	13	389.5	3.8	393.0	15.6	399.4	28.7	410.8	39.0	430.4	43.2
8462	14	386.5	3.8	390.0	15.6	396.3	28.7	407.7	39.0	427.1	43.2
8463	15	382.2	3.8	385.7	15.6	391.9	28.7	403.2	39.0	422.4	43.2
8464	16	384.2	4.2	387.8	17.7	394.0	32.3	405.3	47.4	424.7	54.1
8465	17	408.1	6.3	411.8	23.3	418.5	39.2	430.5	54.5	451.1	61.2
8466	18	447.0	6.3	451.1	23.3	458.4	39.2	471.5	54.5	494.1	61.2
8467	19	448.1	3.8	452.2	15.5	459.5	29.1	472.7	42.2	495.2	47.7
8468	20	441.3	3.8	445.4	15.5	452.6	29.1	465.5	42.2	487.8	47.7
8469	21	430.8	3.8	434.7	15.5	441.7	29.1	454.4	42.2	476.1	47.7
8470	22	408.1	3.7	411.8	14.6	418.5	26.5	430.4	39.3	451.0	45.4
8471	23	374.6	3.7	378.0	14.6	384.2	26.5	395.2	39.3	414.0	45.4
8472	24	344.7	3.3	347.8	12.5	353.5	22.9	363.6	30.9	381.0	34.5

	Spring/Fall	2021		2025		2030		2035		2040	
	09/15	Base Load (MW)	Total EE Curtailment	Base Load (MW)	Total EE Curtailment	Base Load (MW)	Total EE Curtailment	Base Load (MW)	Total EE Curtailment	Base Load (MW)	Total EE Curtailment
6169	1	313.1	3.3	315.9	12.5	321.0	22.9	330.2	30.9	346.0	34.5
6170	2	298.0	3.3	300.8	12.5	305.6	22.9	314.4	30.9	329.4	34.5
6171	3	289.5	3.3	292.1	12.5	296.9	22.9	305.4	30.9	320.0	34.5
6172	4	284.7	3.3	287.3	12.5	291.9	22.9	300.3	30.9	314.6	34.5
6173	5	286.6	3.3	289.2	12.5	293.9	22.9	302.3	30.9	316.7	34.5
6174	6	302.0	3.8	304.8	15.5	309.7	29.1	318.6	42.2	333.8	47.7
6175	7	331.5	1.7	334.5	9.9	340.0	22.2	349.7	35.1	366.4	40.6
6176	8	349.7	4.2	352.9	17.7	358.7	32.3	368.9	47.4	386.5	54.1
6177	9	370.4	4.2	373.8	17.7	379.8	32.3	390.7	47.4	409.4	54.1
6178	10	391.3	3.8	394.9	15.6	401.3	28.7	412.8	39.0	432.5	43.2
6179	11	410.7	3.8	414.4	15.6	421.2	28.7	433.2	39.0	453.9	43.2
6180	12	426.4	3.8	430.3	15.6	437.2	28.7	449.8	39.0	471.2	43.2
6181	13	441.4	3.8	445.5	15.6	452.7	28.7	465.6	39.0	487.9	43.2
6182	14	457.2	3.8	461.4	15.6	468.8	28.7	482.2	39.0	505.3	43.2
6183	15	471.3	3.8	475.6	15.6	483.3	28.7	497.2	39.0	520.9	43.2
6184	16	479.5	4.2	483.9	17.7	491.8	32.3	505.8	47.4	530.0	54.1
6185	17	482.9	4.2	487.4	17.7	495.2	32.3	509.4	47.4	533.8	54.1
6186	18	475.4	4.2	479.7	17.7	487.5	32.3	501.4	47.4	525.4	54.1
6187	19	451.8	3.8	455.9	15.5	463.3	29.1	476.5	42.2	499.3	47.7
6188	20	444.8	3.8	448.9	15.5	456.2	29.1	469.2	42.2	491.6	47.7
6189	21	427.0	3.8	430.9	15.5	437.9	29.1	450.4	42.2	471.9	47.7
6190	22	392.5	3.7	396.1	14.6	402.5	26.5	414.0	39.3	433.8	45.4
6191	23	354.1	3.7	357.3	14.6	363.1	26.5	373.5	39.3	391.4	45.4
6192	24	319.9	3.3	322.8	12.5	328.1	22.9	337.5	30.9	353.6	34.5

	Summer	2021		2025		2030		2035		2040	
	07/10	Base Load (MW)	Total EE Curtailment	Base Load (MW)	Total EE Curtailment	Base Load (MW)	Total EE Curtailment	Base Load (MW)	Total EE Curtailment	Base Load (MW)	Total EE Curtailment
4561	1	350.3	3.4	353.5	15.5	359.2	40.9	369.5	62.7	387.1	71.2
4562	2	327.3	3.4	330.3	15.5	335.6	40.9	345.2	62.7	361.7	71.2
4563	3	314.6	3.4	317.5	15.5	322.6	40.9	331.9	62.7	347.7	71.2
4564	4	308.1	3.4	310.9	15.5	316.0	40.9	325.0	62.7	340.5	71.2
4565	5	312.0	3.4	314.8	15.5	319.9	40.9	329.1	62.7	344.8	71.2
4566	6	323.5	1.9	326.4	13.0	331.7	40.3	341.2	66.9	357.5	77.2
4567	7	342.0	1.9	345.1	13.0	350.7	40.3	360.8	66.9	378.0	77.2
4568	8	375.8	4.3	379.2	20.8	385.3	50.3	396.4	79.2	415.3	90.7
4569	9	414.2	4.3	418.0	20.8	424.7	50.3	436.9	79.2	457.7	90.7
4570	10	455.7	3.9	459.8	18.7	467.3	46.7	480.6	70.8	503.6	79.9
4571	11	494.4	3.9	498.9	18.7	507.0	46.7	521.5	70.8	546.4	79.9
4572	12	535.6	3.9	540.5	18.7	549.2	46.7	564.9	70.8	591.9	79.9
4573	13	566.6	3.9	571.7	18.7	581.0	46.7	597.6	70.8	626.2	79.9
4574	14	593.9	3.9	599.3	18.7	609.0	46.7	626.4	70.8	656.4	79.9
4575	15	616.7	3.9	622.3	18.7	632.4	46.7	650.5	70.8	681.6	79.9
4576	16	608.5	4.3	614.0	20.8	624.0	50.3	641.9	79.2	672.5	90.7
4577	17	583.7	4.3	589.0	20.8	598.5	50.3	615.7	79.2	645.1	90.7
4578	18	576.6	4.3	581.8	20.8	591.3	50.3	608.2	79.2	637.3	90.7
4579	19	567.3	1.9	572.5	13.0	581.8	40.3	598.4	66.9	627.0	77.2
4580	20	543.1	1.9	548.0	13.0	556.9	40.3	572.8	66.9	600.2	77.2
4581	21	527.1	3.9	531.9	18.5	540.5	47.2	556.0	74.0	582.5	84.3
4582	22	499.0	3.8	503.5	17.6	511.7	44.5	526.3	71.1	551.5	82.0
4583	23	445.5	3.8	449.6	17.6	456.9	44.5	470.0	71.1	492.4	82.0
4584	24	396.3	3.4	399.9	15.5	406.4	40.9	418.1	62.7	438.0	71.2

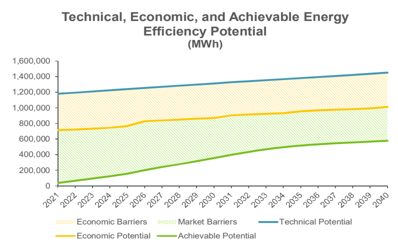
EE.Hourly.Low: Hourly Energy Efficiency Results, Medium Avoided Cost Scenario

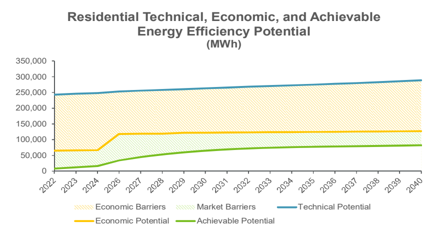
Peak Hours	Winter 12/19	2021 Base Load (MW)	2021 Load w/EE Curtailment	2025 Base Load (MW)	2025 Load w/EE Curtailment	2030 Base Load (MW)	2030 Load w/EE Curtailment	2035 Base Load (MW)	2035 Load w/EE Curtailment	2040 Base Load (MW)	2040 Load w/EE Curtailment
20	1	327	324	330	317	335	312	345	314	361	327
22	2	318	315	321	309	326	304	336	305	352	317
24	3	315	312	318	306	323	300	333	302	348	314
23	4	317	313	319	307	325	302	334	303	350	315
21	5	326	323	329	317	334	311	344	313	360	326
18	6	349	345	352	337	358	329	368	326	386	338
14	7	386	383	390	375	396	368	407	366	427	380
8	8	405	401	409	391	416	383	427	380	448	394
7	9	407	403	410	393	417	385	429	382	450	395
9	10	402	398	406	390	412	383	424	385	444	401
10	11	398	394	401	386	408	379	419	381	439	396
11	12	394	390	397	382	404	375	415	377	435	392
12	13	389	386	393	377	399	371	411	372	430	387
13	14	386	383	390	374	396	368	408	369	427	384
16	15	382	378	386	370	392	363	403	364	422	379
15	16	384	380	388	370	394	362	405	358	425	371
5	17	408	402	412	389	419	379	430	376	451	390
2	18	447	441	451	428	458	419	472	417	494	433
1	19	448	444	452	437	460	430	473	430	495	448
3	20	441	438	445	430	453	423	466	423	488	440
4	21	431	427	435	419	442	413	454	412	476	428
6	22	408	404	412	397	418	392	430	391	451	406
17	23	375	371	378	363	384	358	395	356	414	369
19	24	345	341	348	335	353	331	364	333	381	346

Peak Hours	Spring/Fall 09/15	2021 Base Load (MW)	2021 Load w/EE Curtailment	2025 Base Load (MW)	2025 Load w/EE Curtailment	2030 Base Load (MW)	2030 Load w/EE Curtailment	2035 Base Load (MW)	2035 Load w/EE Curtailment	2040 Base Load (MW)	2040 Load w/EE Curtailment
19	1	313	310	316	303	321	298	330	299	346	311
21	2	298	295	301	288	306	283	314	284	329	295
22	3	290	286	292	280	297	274	305	275	320	285
24	4	285	281	287	275	292	269	300	269	315	280
23	5	287	283	289	277	294	271	302	271	317	282
20	6	302	298	305	289	310	281	319	276	334	286
17	7	332	330	335	325	340	318	350	315	366	326
16	8	350	346	353	335	359	326	369	322	387	332
14	9	370	366	374	356	380	348	391	343	409	355
13	10	391	388	395	379	401	373	413	374	433	389
11	11	411	407	414	399	421	392	433	394	454	411
10	12	426	423	430	415	437	409	450	411	471	428
8	13	441	438	445	430	453	424	466	427	488	445
5	14	457	453	461	446	469	440	482	443	505	462
4	15	471	468	476	460	483	455	497	458	521	478
2	16	480	475	484	466	492	460	506	458	530	476
1	17	483	479	487	470	495	463	509	462	534	480
3	18	475	471	480	462	487	455	501	454	525	471
6	19	452	448	456	440	463	434	477	434	499	452
7	20	445	441	449	433	456	427	469	427	492	444
9	21	427	423	431	415	438	409	450	408	472	424
12	22	392	389	396	381	402	376	414	375	434	388
15	23	354	350	357	343	363	337	374	334	391	346
18	24	320	317	323	310	328	305	337	307	354	319

Peak Hours	Summer 07/10	2021 Base Load (MW)	2021 Load w/EE Curtailment	2025 Base Load (MW)	2025 Load w/EE Curtailment	2030 Base Load (MW)	2030 Load w/EE Curtailment	2035 Base Load (MW)	2035 Load w/EE Curtailment	2040 Base Load (MW)	2040 Load w/EE Curtailment
18	1	350	347	353	338	359	318	369	307	387	316
20	2	327	324	330	315	336	295	345	283	362	291
22	3	315	311	317	302	323	282	332	269	348	277
24	4	308	305	311	295	316	275	325	262	341	269
23	5	312	309	315	299	320	279	329	266	345	274
21	6	323	322	326	313	332	291	341	274	357	280
19	7	342	340	345	332	351	310	361	294	378	301
17	8	376	371	379	358	385	335	396	317	415	325
15	9	414	410	418	397	425	374	437	358	458	367
13	10	456	452	460	441	467	421	481	410	504	424
12	11	494	490	499	480	507	460	522	451	546	467
9	12	536	532	540	522	549	502	565	494	592	512
7	13	567	563	572	553	581	534	598	527	626	546
3	14	594	590	599	581	609	562	626	556	656	576
1	15	617	613	622	604	632	586	651	580	682	602
2	16	608	604	614	593	624	574	642	563	673	582
4	17	584	579	589	568	599	548	616	536	645	554
5	18	577	572	582	561	591	541	608	529	637	547
6	19	567	565	573	560	582	542	598	532	627	550
8	20	543	541	548	535	557	517	573	506	600	523
10	21	527	523	532	513	540	493	556	482	583	498
11	22	499	495	504	486	512	467	526	455	551	469
14	23	446	442	450	432	457	412	470	399	492	410
16	24	396	393	400	384	406	365	418	355	438	367

EE.Med: Energy Efficiency Medium Avoided Cost Scenario Results





Combined

Technical Potential (MWh)	2021	2025	2030	2035	2040
Heating	29,905	32,310	35,437	38,592	42,105
Cooling	178,715	192,422	209,184	224,819	240,042
Ventilation	33,929	33,102	32,209	31,425	30,744
Water Heating	16,009	17,151	18,531	19,851	21,281
Lighting	437,265	435,517	435,002	435,191	436,379
Cooking	33,850	36,496	39,741	42,749	45,594
Office Equipment & Computing	4,396	4,740	5,161	5,552	5,921
Refrigeration	83,923	89,596	96,546	102,993	109,144
Miscellaneous	363,277	398,594	441,360	480,959	518,920
Total Technical Potential (MWh)	**1,181,269**	**1,239,928**	**1,313,173**	**1,382,130**	**1,450,130**

Economic Potential (MWh)	2021	2025	2030	2035	2040
Heating	16,564	17,345	18,291	19,183	20,113
Cooling	114,141	122,979	133,803	143,867	153,525
Ventilation	15,850	15,268	14,677	14,189	13,799
Water Heating	-	-	-	-	-
Lighting	148,100	155,813	222,840	233,014	234,473
Cooking	23,358	25,183	27,423	29,498	31,461
Office Equipment & Computing	-	-	-	-	-
Refrigeration	78,698	83,998	90,497	96,514	102,198
Miscellaneous	315,003	346,867	387,212	422,947	456,739
Total Economic Potential (MWh)	**711,714**	**767,452**	**894,742**	**959,213**	**1,012,309**

Achievable Potential (MWh)	2021	2025	2030	2035	2040
Heating	534	4,175	11,512	14,398	15,145
Cooling	873	12,508	60,566	100,659	114,240
Ventilation	28	565	3,371	7,638	8,992
Water Heating	-	-	-	-	-
Lighting	25,214	72,884	116,404	146,510	162,148
Cooking	753	6,062	17,260	19,080	15,297
Office Equipment & Computing	-	-	-	-	-
Refrigeration	2,687	20,543	54,266	63,884	50,192
Miscellaneous	6,296	39,146	92,927	163,482	211,641
Total Achievable Potential (MWh)	**36,385**	**155,883**	**356,306**	**515,652**	**577,656**

Incremental Achievable Potential (MWh)	2021	2025	2030	2035	2040
Heating	534	1,147	1,884	1,502	1,915
Cooling	873	5,001	11,881	6,667	3,731
Ventilation	28	231	796	718	116
Water Heating	-	-	-	-	-
Lighting	25,214	9,604	21,552	27,907	22,078
Cooking	753	1,696	2,113	740	1,744
Office Equipment & Computing	-	-	-	-	-
Refrigeration	2,687	5,857	7,200	1,635	3,023
Miscellaneous	6,296	10,037	22,224	36,257	43,475
Total Incremental Achievable Potential (MWh)	**36,385**	**33,573**	**67,649**	**75,426**	**76,082**

Total Achievable Incremental Costs ($000s)	2021	2025	2030	2035	2040
Heating	$590	$1,193	$1,886	$1,455	$1,798
Cooling	$624	$3,220	$7,495	$4,325	$2,664
Ventilation	$18	$156	$588	$605	$132
Water Heating	-	-	-	-	-
Lighting	$8,128	$4,166	$6,882	$9,668	$7,682
Cooking	$131	$295	$368	$106	$267
Office Equipment & Computing	-	-	-	-	-
Refrigeration	$1,464	$3,266	$4,034	$643	$1,510
Miscellaneous	$1,556	$2,548	$5,904	$9,674	$11,737
Total Incremental Costs ($000s)	**$12,510**	**$14,846**	**$27,158**	**$26,476**	**$25,789**

Multi-Year Cumulative Costs ($000s)	2021-2025	2026-2030	2031-2035	2036-2040
Heating	$4,447	$7,907	$7,684	$8,529
Cooling	$8,329	$31,043	$29,110	$15,671
Ventilation	$374	$2,014	$3,376	$1,475
Water Heating	-	-	-	-
Lighting	$24,262	$28,058	$38,119	$37,392
Cooking	$1,056	$1,950	$959	$989
Office Equipment & Computing	-	-	-	-
Refrigeration	$11,705	$21,441	$9,348	$5,337
Miscellaneous	$9,858	$21,686	$41,603	$54,513
Total 5-Year Costs ($000s)	**$60,030**	**$114,100**	**$130,201**	**$123,906**
Participant Cost	$11,824	$22,474	$25,646	$24,406
Utility Incentives	$35,472	$67,423	$76,937	$73,217
Utility Administrative Costs	$12,734	$24,203	$27,618	$26,283

	2021	2025	2030	2035	2040
Base Load	3,246,452	3,276,068	3,329,157	3,424,440	3,587,996
Incremental Achievable Potential (% of Base Load	1.12%	1.02%	2.03%	2.20%	2.12%
Total Cost per MWh	$343.83	$442.19	$401.45	$351.02	$338.97
Utility Cost per MWh	$276.10	$355.09	$322.38	$281.88	$272.20

Residential

Technical Potential (MWh)	2021	2025	2030	2035	2040
Heating	25,544	27,607	30,316	33,083	36,230
Cooling	38,384	41,122	44,431	47,594	51,024
Ventilation	18,079	17,835	17,533	17,236	16,945
Water Heating	16,009	17,151	18,531	19,851	21,281
Lighting	58,594	57,855	56,942	56,043	55,159
Cooking	n/a	n/a	n/a	n/a	n/a
Office Equipment & Computing	n/a	n/a	n/a	n/a	n/a
Refrigeration	14,481	14,726	15,019	15,294	15,609
Miscellaneous	69,383	74,332	80,315	86,032	92,231
Total Technical Potential (MWh)	**240,472**	**250,627**	**263,087**	**275,134**	**288,478**

Economic Potential (MWh)	2021	2025	2030	2035	2040
Heating	12,936	13,432	14,031	14,600	15,225
Cooling	12,268	13,143	14,201	15,212	16,308
Ventilation	-	-	-	-	-
Water Heating	-	-	-	-	-
Lighting	7,672	7,582	56,942	56,043	55,159
Cooking	n/a	n/a	n/a	n/a	n/a
Office Equipment & Computing	n/a	n/a	n/a	n/a	n/a
Refrigeration	9,255	9,127	8,970	8,815	8,663
Miscellaneous	22,675	24,292	28,004	29,998	32,159
Total Economic Potential (MWh)	**64,805**	**67,577**	**122,148**	**124,668**	**127,514**

Achievable Potential (MWh)	2021	2025	2030	2035	2040
Heating	417	3,233	8,831	10,961	11,479
Cooling	396	3,164	8,938	11,409	12,231
Ventilation	-	-	-	-	-
Water Heating	-	-	-	-	-
Lighting	1,273	3,642	28,668	37,295	40,001
Cooking	n/a	n/a	n/a	n/a	n/a
Office Equipment & Computing	n/a	n/a	n/a	n/a	n/a
Refrigeration	298	2,197	3,448	989	-
Miscellaneous	1,687	9,182	15,714	16,562	18,313
Total Achievable Potential (MWh)	**4,071**	**21,418**	**65,599**	**77,215**	**82,024**

Incremental Achievable Potential (MWh)	2021	2025	2030	2035	2040
Heating	417	883	1,439	1,140	1,451
Cooling	396	881	1,479	1,202	1,567
Ventilation	-	-	-	-	-
Water Heating	-	-	-	-	-
Lighting	1,273	407	12,405	9,530	8,042
Cooking	n/a	n/a	n/a	n/a	n/a
Office Equipment & Computing	n/a	n/a	n/a	n/a	n/a
Refrigeration	298	580	593	-	-
Miscellaneous	1,687	2,001	1,444	1,873	1,925
Total Incremental Achievable Potential (MWh)	**4,071**	**4,752**	**17,360**	**13,746**	**12,985**

Total Achievable Incremental Costs ($000s)	2021	2025	2030	2035	2040
Heating	$500	$991	$1,544	$1,176	$1,441
Cooling	$331	$736	$1,237	$1,005	$1,310
Ventilation	-	-	-	-	-
Water Heating	-	-	-	-	-
Lighting	$270	$66	$3,541	$2,161	$1,321
Cooking	n/a	n/a	n/a	n/a	n/a
Office Equipment & Computing	n/a	n/a	n/a	n/a	n/a
Refrigeration	$81	$157	$161	-	-
Miscellaneous	$274	$334	$238	$307	$364
Total Incremental Costs ($000s)	**$1,456**	**$2,285**	**$6,720**	**$4,649**	**$4,436**

Multi-Year Cumulative Costs ($000s)	2021-2025	2026-2030	2031-2035	2036-2040
Heating	$3,723	$6,481	$6,227	$6,847
Cooling	$2,644	$5,157	$5,259	$6,127
Ventilation	-	-	-	-
Water Heating	-	-	-	-
Lighting	$706	$11,354	$10,646	$8,390
Cooking	n/a	n/a	n/a	n/a
Office Equipment & Computing	n/a	n/a	n/a	n/a
Refrigeration	$596	$936	$268	-
Miscellaneous	$1,509	$1,356	$1,250	$1,761
Total 5-Year Costs ($000s)	**$9,178**	**$25,284**	**$23,650**	**$23,125**
Participant Cost	$1,808	$4,980	$4,658	$4,555
Utility Incentives	$5,423	$14,941	$13,975	$13,665
Utility Administrative Costs	$1,947	$5,363	$5,017	$4,905

Commercial/Industrial

Technical Potential (MWh)	2021	2025	2030	2035	2040
Heating	4,362	4,703	5,121	5,509	5,875
Cooling	140,331	151,300	164,753	177,225	189,018
Ventilation	15,850	15,268	14,677	14,189	13,799
Water Heating	n/a	n/a	n/a	n/a	n/a
Lighting	378,672	377,662	378,060	379,148	381,220
Cooking	33,850	36,496	39,741	42,749	45,594
Office Equipment & Computing	4,396	4,740	5,161	5,552	5,921
Refrigeration	69,442	74,870	81,527	87,699	93,535
Miscellaneous	293,894	324,262	361,046	394,927	426,689
Total Technical Potential (MWh)	**940,797**	**989,301**	**1,050,086**	**1,106,996**	**1,161,652**

Economic Potential (MWh)	2021	2025	2030	2035	2040
Heating	3,629	3,912	4,260	4,583	4,888
Cooling	101,873	109,836	119,602	128,656	137,217
Ventilation	15,850	15,268	14,677	14,189	13,799
Water Heating	n/a	n/a	n/a	n/a	n/a
Lighting	140,429	148,231	165,897	176,971	179,314
Cooking	23,358	25,183	27,423	29,498	31,461
Office Equipment & Computing	-	-	-	-	-
Refrigeration	69,442	74,870	81,527	87,699	93,535
Miscellaneous	292,329	322,575	359,208	392,950	424,580
Total Economic Potential (MWh)	**646,909**	**699,875**	**772,594**	**834,545**	**884,795**

Achievable Potential (MWh)	2021	2025	2030	2035	2040
Heating	117	942	2,681	3,437	3,666
Cooling	477	9,344	51,628	89,250	102,009
Ventilation	28	565	3,371	7,638	8,992
Water Heating	n/a	n/a	n/a	n/a	n/a
Lighting	23,941	69,242	87,736	109,215	122,147
Cooking	753	6,062	17,260	19,080	15,297
Office Equipment & Computing	-	-	-	-	-
Refrigeration	2,389	18,346	50,818	62,896	50,192
Miscellaneous	4,609	29,964	77,213	146,920	193,328
Total Achievable Potential (MWh)	**32,314**	**134,465**	**290,707**	**438,437**	**495,632**

Incremental Achievable Potential (MWh)	2021	2025	2030	2035	2040
Heating	117	264	445	363	464
Cooling	477	4,120	10,402	5,464	2,164
Ventilation	28	231	796	718	116
Water Heating	n/a	n/a	n/a	n/a	n/a
Lighting	23,941	9,197	9,147	18,377	14,036
Cooking	753	1,696	2,113	740	1,744
Office Equipment & Computing	-	-	-	-	-
Refrigeration	2,389	5,277	6,607	1,635	3,023
Miscellaneous	4,609	8,036	20,780	34,383	41,551
Total Incremental Achievable Potential (MWh)	**32,314**	**28,821**	**50,289**	**61,680**	**63,097**

Total Achievable Incremental Costs ($000s)	2021	2025	2030	2035	2040
Heating	$90	$203	$342	$279	$357
Cooling	$293	$2,484	$6,259	$3,320	$1,354
Ventilation	$18	$156	$588	$605	$132
Water Heating	n/a	n/a	n/a	n/a	n/a
Lighting	$7,858	$4,100	$3,341	$7,506	$6,361
Cooking	$131	$295	$368	$106	$267
Office Equipment & Computing	-	-	-	-	-
Refrigeration	$1,383	$3,109	$3,874	$643	$1,510
Miscellaneous	$1,282	$2,214	$5,666	$9,368	$11,372
Total Incremental Costs ($000s)	**$11,055**	**$12,561**	**$20,437**	**$21,827**	**$21,353**

Multi-Year Cumulative Costs ($000s)	2021-2025	2026-2030	2031-2035	2036-2040
Heating	$724	$1,427	$1,457	$1,681
Cooling	$5,684	$25,886	$23,851	$9,544
Ventilation	$374	$2,014	$3,376	$1,475
Water Heating	n/a	n/a	n/a	n/a
Lighting	$23,556	$16,704	$27,473	$29,002
Cooking	$1,056	$1,950	$959	$989
Office Equipment & Computing	-	-	-	-
Refrigeration	$11,109	$20,506	$9,080	$5,337
Miscellaneous	$8,349	$20,330	$40,354	$52,752
Total 5-Year Costs ($000s)	**$50,852**	**$88,816**	**$106,550**	**$100,781**
Participant Cost	$10,016	$17,494	$20,987	$19,851
Utility Incentives	$30,049	$52,482	$62,961	$59,553
Utility Administrative Costs	$10,787	$18,840	$22,602	$21,378

EE.Hourly.Med: Hourly Energy Efficiency Results, Medium Avoided Cost Scenario

	Winter	2021		2025		2030		2035		2040	
	12/19	Base Load (MW)	Total EE Curtailment	Base Load (MW)	Total EE Curtailment	Base Load (MW)	Total EE Curtailment	Base Load (MW)	Total EE Curtailment	Base Load (MW)	Total EE Curtailment
8449	1	326.9	3.4	329.9	13.0	335.2	25.2	344.8	35.4	361.3	39.5
8450	2	318.4	3.4	321.3	13.0	326.5	25.2	335.8	35.4	351.9	39.5
8451	3	315.3	3.4	318.2	13.0	323.3	25.2	332.6	35.4	348.4	39.5
8452	4	316.6	3.4	319.4	13.0	324.6	25.2	333.9	35.4	349.9	39.5
8453	5	326.0	3.4	329.0	13.0	334.3	25.2	343.9	35.4	360.3	39.5
8454	6	348.9	3.9	352.1	16.1	357.8	37.2	368.0	49.7	385.6	54.0
8455	7	386.2	3.6	389.7	15.3	396.1	36.0	407.4	48.5	426.8	52.7
8456	8	405.2	5.0	408.9	20.6	415.5	43.4	427.4	61.0	447.8	68.4
8457	9	406.7	5.0	410.4	20.6	417.1	43.4	429.0	61.0	449.5	68.4
8458	10	401.9	4.6	405.5	18.5	412.1	34.4	423.9	50.0	444.2	56.6
8459	11	397.7	4.6	401.3	18.5	407.8	34.4	419.5	50.0	439.5	56.6
8460	12	393.9	4.6	397.5	18.5	403.9	34.4	415.5	50.0	435.3	56.6
8461	13	389.5	4.6	393.0	18.5	399.4	34.4	410.8	50.0	430.4	56.6
8462	14	386.5	4.6	390.0	18.5	396.3	34.4	407.7	50.0	427.1	56.6
8463	15	382.2	4.6	385.7	18.5	391.9	34.4	403.2	50.0	422.4	56.6
8464	16	384.2	5.0	387.8	20.6	394.0	43.4	405.3	61.0	424.7	68.4
8465	17	408.1	7.1	411.8	26.2	418.5	50.3	430.5	68.1	451.1	75.6
8466	18	447.0	7.1	451.1	26.2	458.4	50.3	471.5	68.1	494.1	75.6
8467	19	448.1	3.9	452.2	16.1	459.5	37.2	472.7	49.7	495.2	54.0
8468	20	441.3	3.9	445.4	16.1	452.6	37.2	465.5	49.7	487.8	54.0
8469	21	430.8	3.9	434.7	16.1	441.7	37.2	454.4	49.7	476.1	54.0
8470	22	408.1	3.7	411.8	15.1	418.5	34.2	430.4	46.4	451.0	51.3
8471	23	374.6	3.7	378.0	15.1	384.2	34.2	395.2	46.4	414.0	51.3
8472	24	344.7	3.4	347.8	13.0	353.5	25.2	363.6	35.4	381.0	39.5

	Spring/Fall	2021		2025		2030		2035		2040	
	09/15	Base Load (MW)	Total EE Curtailment	Base Load (MW)	Total EE Curtailment	Base Load (MW)	Total EE Curtailment	Base Load (MW)	Total EE Curtailment	Base Load (MW)	Total EE Curtailment
6169	1	313.1	3.4	315.9	13.0	321.0	25.2	330.2	35.4	346.0	39.5
6170	2	298.0	3.4	300.8	13.0	305.6	25.2	314.4	35.4	329.4	39.5
6171	3	289.5	3.4	292.1	13.0	296.9	25.2	305.4	35.4	320.0	39.5
6172	4	284.7	3.4	287.3	13.0	291.9	25.2	300.3	35.4	314.6	39.5
6173	5	286.6	3.4	289.2	13.0	293.9	25.2	302.3	35.4	316.7	39.5
6174	6	302.0	3.9	304.8	16.1	309.7	37.2	318.6	49.7	333.8	54.0
6175	7	331.5	1.8	334.5	10.5	340.0	30.2	349.7	42.6	366.4	46.8
6176	8	349.7	5.0	352.9	20.6	358.7	43.4	368.9	61.0	386.5	68.4
6177	9	370.4	5.0	373.8	20.6	379.8	43.4	390.7	61.0	409.4	68.4
6178	10	391.3	4.6	394.9	18.5	401.3	34.4	412.8	50.0	432.5	56.6
6179	11	410.7	4.6	414.4	18.5	421.2	34.4	433.2	50.0	453.9	56.6
6180	12	426.4	4.6	430.3	18.5	437.2	34.4	449.8	50.0	471.2	56.6
6181	13	441.4	4.6	445.5	18.5	452.7	34.4	465.6	50.0	487.9	56.6
6182	14	457.2	4.6	461.4	18.5	468.8	34.4	482.2	50.0	505.3	56.6
6183	15	471.3	4.6	475.6	18.5	483.3	34.4	497.2	50.0	520.9	56.6
6184	16	479.5	5.0	483.9	20.6	491.8	43.4	505.8	61.0	530.0	68.4
6185	17	482.9	5.0	487.4	20.6	495.2	43.4	509.4	61.0	533.8	68.4
6186	18	475.4	5.0	479.7	20.6	487.5	43.4	501.4	61.0	525.4	68.4
6187	19	451.8	3.9	455.9	16.1	463.3	37.2	476.5	49.7	499.3	54.0
6188	20	444.8	3.9	448.9	16.1	456.2	37.2	469.2	49.7	491.6	54.0
6189	21	427.0	3.9	430.9	16.1	437.9	37.2	450.4	49.7	471.9	54.0
6190	22	392.5	3.7	396.1	15.1	402.5	34.2	414.0	46.4	433.8	51.3
6191	23	354.1	3.7	357.3	15.1	363.1	34.2	373.5	46.4	391.4	51.3
6192	24	319.9	3.4	322.8	13.0	328.1	25.2	337.5	35.4	353.6	39.5

	Summer	2021		2025		2030		2035		2040	
	07/10	Base Load (MW)	Total EE Curtailment	Base Load (MW)	Total EE Curtailment	Base Load (MW)	Total EE Curtailment	Base Load (MW)	Total EE Curtailment	Base Load (MW)	Total EE Curtailment
4561	1	350.3	3.7	353.5	18.1	359.2	51.1	369.5	79.4	387.1	89.9
4562	2	327.3	3.7	330.3	18.1	335.6	51.1	345.2	79.4	361.7	89.9
4563	3	314.6	3.7	317.5	18.1	322.6	51.1	331.9	79.4	347.7	89.9
4564	4	308.1	3.7	310.9	18.1	316.0	51.1	325.0	79.4	340.5	89.9
4565	5	312.0	3.7	314.8	18.1	319.9	51.1	329.1	79.4	344.8	89.9
4566	6	323.5	2.1	326.4	15.6	331.7	56.2	341.2	86.5	357.5	97.2
4567	7	342.0	2.1	345.1	15.6	350.7	56.2	360.8	86.5	378.0	97.2
4568	8	375.8	5.3	379.2	25.7	385.3	69.3	396.4	104.9	415.3	118.8
4569	9	414.2	5.3	418.0	25.7	424.7	69.3	436.9	104.9	457.7	118.8
4570	10	455.7	5.0	459.8	23.6	467.3	60.3	480.6	93.9	503.6	107.0
4571	11	494.4	5.0	498.9	23.6	507.0	60.3	521.5	93.9	546.4	107.0
4572	12	535.6	5.0	540.5	23.6	549.2	60.3	564.9	93.9	591.9	107.0
4573	13	566.6	5.0	571.7	23.6	581.0	60.3	597.6	93.9	626.2	107.0
4574	14	593.9	5.0	599.3	23.6	609.0	60.3	626.4	93.9	656.4	107.0
4575	15	616.7	5.0	622.3	23.6	632.4	60.3	650.5	93.9	681.6	107.0
4576	16	608.5	5.3	614.0	25.7	624.0	69.3	641.9	104.9	672.5	118.8
4577	17	583.7	5.3	589.0	25.7	598.5	69.3	615.7	104.9	645.1	118.8
4578	18	576.6	5.3	581.8	25.7	591.3	69.3	608.2	104.9	637.3	118.8
4579	19	567.3	2.1	572.5	15.6	581.8	56.2	598.4	86.5	627.0	97.2
4580	20	543.1	2.1	548.0	15.6	556.9	56.2	572.8	86.5	600.2	97.2
4581	21	527.1	4.2	531.9	21.2	540.5	63.1	556.0	93.7	582.5	104.3
4582	22	499.0	4.1	503.5	20.2	511.7	60.1	526.3	90.4	551.5	101.7
4583	23	445.5	4.1	449.6	20.2	456.9	60.1	470.0	90.4	492.4	101.7
4584	24	396.3	3.7	399.9	18.1	406.4	51.1	418.1	79.4	438.0	89.9

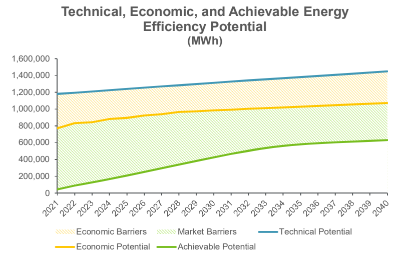
EE.Hourly.Med: Hourly Energy Efficiency Results, Medium Avoided Cost Scenario

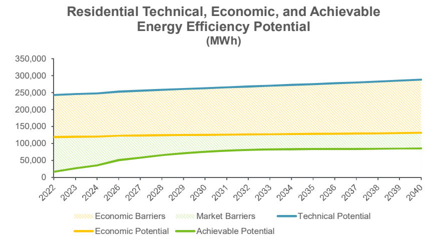
	Winter	2021		2025		2030		2035		2040	
Peak Hours	12/19	Base Load (MW)	Load w/EE Curtailment	Base Load (MW)	Load w/EE Curtailment	Base Load (MW)	Load w/EE Curtailment	Base Load (MW)	Load w/EE Curtailment	Base Load (MW)	Load w/EE Curtailment
20	1	327	324	330	317	335	310	345	309	361	322
22	2	318	315	321	308	326	301	336	300	352	312
24	3	315	312	318	305	323	298	333	297	348	309
23	4	317	313	319	306	325	299	334	298	350	310
21	5	326	323	329	316	334	309	344	308	360	321
18	6	349	345	352	336	358	321	368	318	386	332
14	7	386	383	390	374	396	360	407	359	427	374
8	8	405	400	409	388	416	372	427	366	448	379
7	9	407	402	410	390	417	374	429	368	450	381
9	10	402	397	406	387	412	378	424	374	444	388
10	11	398	393	401	383	408	373	419	369	439	383
11	12	394	389	397	379	404	370	415	365	435	379
12	13	389	385	393	375	399	365	411	361	430	374
13	14	386	382	390	371	396	362	408	358	427	371
16	15	382	378	386	367	392	358	403	353	422	366
15	16	384	379	388	367	394	351	405	344	425	356
5	17	408	401	412	386	419	368	430	362	451	375
2	18	447	440	451	425	458	408	472	403	494	418
1	19	448	444	452	436	460	422	473	423	495	441
3	20	441	437	445	429	453	415	466	416	488	434
4	21	431	427	435	419	442	405	454	405	476	422
6	22	408	404	412	397	418	384	430	384	451	400
17	23	375	371	378	363	384	350	395	349	414	363
19	24	345	341	348	335	353	328	364	328	381	341

	Spring/Fall	2021		2025		2030		2035		2040	
Peak Hours	09/15	Base Load (MW)	Load w/EE Curtailment	Base Load (MW)	Load w/EE Curtailment	Base Load (MW)	Load w/EE Curtailment	Base Load (MW)	Load w/EE Curtailment	Base Load (MW)	Load w/EE Curtailment
19	1	313	310	316	303	321	296	330	295	346	306
21	2	298	295	301	288	306	280	314	279	329	290
22	3	290	286	292	279	297	272	305	270	320	280
24	4	285	281	287	274	292	267	300	265	315	275
23	5	287	283	289	276	294	269	302	267	317	277
20	6	302	298	305	289	310	273	319	269	334	280
17	7	332	330	335	324	340	310	350	307	366	320
16	8	350	345	353	332	359	315	369	308	387	318
14	9	370	365	374	353	380	336	391	330	409	341
13	10	391	387	395	376	401	367	413	363	433	376
11	11	411	406	414	396	421	387	433	383	454	397
10	12	426	422	430	412	437	403	450	400	471	415
8	13	441	437	445	427	453	418	466	416	488	431
5	14	457	453	461	443	469	434	482	432	505	449
4	15	471	467	476	457	483	449	497	447	521	464
2	16	480	475	484	463	492	448	506	445	530	462
1	17	483	478	487	467	495	452	509	448	534	465
3	18	475	470	480	459	487	444	501	440	525	457
6	19	452	448	456	440	463	426	477	427	499	445
7	20	445	441	449	433	456	419	469	420	492	438
9	21	427	423	431	415	438	401	450	401	472	418
12	22	392	389	396	381	402	368	414	368	434	382
15	23	354	350	357	342	363	329	374	327	391	340
18	24	320	317	323	310	328	303	337	302	354	314

	Summer	2021		2025		2030		2035		2040	
Peak Hours	07/10	Base Load (MW)	Load w/EE Curtailment	Base Load (MW)	Load w/EE Curtailment	Base Load (MW)	Load w/EE Curtailment	Base Load (MW)	Load w/EE Curtailment	Base Load (MW)	Load w/EE Curtailment
18	1	350	347	353	335	359	308	369	290	387	297
20	2	327	324	330	312	336	285	345	266	362	272
22	3	315	311	317	299	323	272	332	252	348	258
24	4	308	304	311	293	316	265	325	246	341	251
23	5	312	308	315	297	320	269	329	250	345	255
21	6	323	321	326	311	332	276	341	255	357	260
19	7	342	340	345	330	351	295	361	274	378	281
17	8	376	370	379	354	385	316	396	291	415	296
15	9	414	409	418	392	425	355	437	332	458	339
13	10	456	451	460	436	467	407	481	387	504	397
12	11	494	489	499	475	507	447	522	428	546	439
9	12	536	531	540	517	549	489	565	471	592	485
7	13	567	562	572	548	581	521	598	504	626	519
3	14	594	589	599	576	609	549	626	533	656	549
1	15	617	612	622	599	632	572	651	557	682	575
2	16	608	603	614	588	624	555	642	537	673	554
4	17	584	578	589	563	599	529	616	511	645	526
5	18	577	571	582	556	591	522	608	503	637	518
6	19	567	565	573	557	582	526	598	512	627	530
8	20	543	541	548	532	557	501	573	486	600	503
10	21	527	523	532	511	540	477	556	462	583	478
	Winter										
	12/19	Base Load (MW)	Total EE Curtailment	Base Load (MW)	Total EE Curtailment	Base Load (MW)	Total EE Curtailment	Base Load (MW)	Total EE Curtailment	Base Load (MW)	Total EE Curtailment

EE.High: Energy Efficiency High Avoided Cost Scenario Results





Combined

Technical Potential (MWh)	2021	2025	2030	2035	2040
Heating	29,905	32,310	35,437	38,592	42,105
Cooling	178,715	192,422	209,184	224,819	240,042
Ventilation	33,929	33,102	32,209	31,425	30,744
Water Heating	16,009	17,151	18,531	19,851	21,281
Lighting	437,265	435,517	435,002	435,191	436,379
Cooking	33,850	36,496	39,741	42,749	45,594
Office Equipment & Computing	4,396	4,740	5,161	5,552	5,921
Refrigeration	83,923	89,596	96,546	102,993	109,144
Miscellaneous	363,277	398,594	441,360	480,959	518,920
Total Technical Potential (MWh)	**1,181,269**	**1,239,928**	**1,313,173**	**1,382,130**	**1,450,130**

Economic Potential (MWh)	2021	2025	2030	2035	2040
Heating	17,298	18,135	19,152	20,109	21,101
Cooling	118,480	127,638	138,849	149,281	159,319
Ventilation	15,850	15,268	14,677	14,189	13,799
Water Heating	-	-	-	-	-
Lighting	190,669	265,060	294,254	283,575	275,161
Cooking	33,850	36,496	39,741	42,749	45,594
Office Equipment & Computing	-	-	-	-	-
Refrigeration	78,698	83,998	90,497	96,514	102,198
Miscellaneous	315,003	348,493	387,212	422,947	456,739
Total Economic Potential (MWh)	**769,847**	**895,086**	**984,382**	**1,029,364**	**1,073,911**

Achievable Potential (MWh)	2021	2025	2030	2035	2040
Heating	558	4,365	12,054	15,092	15,886
Cooling	1,001	13,554	63,639	104,687	118,581
Ventilation	28	565	3,371	7,638	8,992
Water Heating	-	-	-	-	-
Lighting	32,276	120,833	173,176	195,711	201,922
Cooking	1,092	8,785	25,013	28,717	23,432
Office Equipment & Computing	-	-	-	-	-
Refrigeration	2,687	20,543	54,266	63,884	50,192
Miscellaneous	6,296	39,153	93,140	164,043	211,678
Total Achievable Potential (MWh)	**43,937**	**207,799**	**424,658**	**579,773**	**630,683**

Incremental Achievable Potential (MWh)	2021	2025	2030	2035	2040
Heating	558	1,200	1,974	1,576	2,009
Cooling	1,001	5,331	12,490	7,206	4,352
Ventilation	28	231	796	718	116
Water Heating	-	-	-	-	-
Lighting	32,276	16,321	29,278	30,977	27,495
Cooking	1,092	2,458	3,062	912	2,269
Office Equipment & Computing	-	-	-	-	-
Refrigeration	2,687	5,857	7,200	1,635	3,023
Miscellaneous	6,296	10,044	22,302	36,285	43,411
Total Incremental Achievable Potential (MWh	**43,937**	**41,442**	**77,101**	**79,309**	**82,674**

Total Achievable Incremental Costs ($000s	2021	2025	2030	2035	2040
Heating	$638	$1,303	$2,071	$1,605	$1,990
Cooling	$725	$3,484	$7,983	$4,741	$3,140
Ventilation	$18	$156	$588	$605	$132
Water Heating	-	-	-	-	-
Lighting	$13,693	$8,914	$12,427	$10,802	$11,375
Cooking	$459	$1,033	$1,286	$273	$774
Office Equipment & Computing	-	-	-	-	-
Refrigeration	$1,464	$3,266	$4,034	$643	$1,510
Miscellaneous	$1,556	$2,555	$5,956	$9,688	$11,715
Total Incremental Costs ($000s)	**$18,552**	**$20,710**	**$34,346**	**$28,357**	**$30,637**

Multi-Year Cumulative Costs ($000s)	2021-2025	2026-2030	2031-2035	2036-2040
Heating	$4,838	$8,678	$8,471	$9,437
Cooling	$9,193	$33,049	$31,308	$17,986
Ventilation	$374	$2,014	$3,376	$1,475
Water Heating	-	-	-	-
Lighting	$56,978	$63,228	$44,898	$52,785
Cooking	$3,691	$6,817	$3,109	$2,726
Office Equipment & Computing	-	-	-	-
Refrigeration	$11,705	$21,441	$9,348	$5,337
Miscellaneous	$9,864	$21,834	$41,809	$54,424
Total 5-Year Costs ($000s)	**$96,642**	**$157,061**	**$142,319**	**$144,170**
Participant Cost	$19,035	$30,936	$28,033	$28,397
Utility Incentives	$57,106	$92,809	$84,098	$85,191
Utility Administrative Costs	$20,500	$33,316	$30,189	$30,581

Residential

Technical Potential (MWh)	2021	2025	2030	2035	2040
Heating	25,544	27,607	30,316	33,083	36,230
Cooling	38,384	41,122	44,431	47,594	51,024
Ventilation	18,079	17,835	17,533	17,236	16,945
Water Heating	16,009	17,151	18,531	19,851	21,281
Lighting	58,594	57,855	56,942	56,043	55,159
Cooking	n/a	n/a	n/a	n/a	n/a
Office Equipment & Computing	n/a	n/a	n/a	n/a	n/a
Refrigeration	14,481	14,726	15,019	15,294	15,609
Miscellaneous	69,383	74,332	80,315	86,032	92,231
Total Technical Potential (MWh)	**240,472**	**250,627**	**263,087**	**275,134**	**288,478**

Economic Potential (MWh)	2021	2025	2030	2035	2040
Heating	12,936	13,432	14,031	14,600	15,225
Cooling	15,200	16,284	17,594	18,847	20,205
Ventilation	-	-	-	-	-
Water Heating	-	-	-	-	-
Lighting	7,672	57,855	56,942	56,043	55,159
Cooking	n/a	n/a	n/a	n/a	n/a
Office Equipment & Computing	n/a	n/a	n/a	n/a	n/a
Refrigeration	9,255	9,127	8,970	8,815	8,663
Miscellaneous	22,675	25,918	28,004	29,998	32,159
Total Economic Potential (MWh)	**67,737**	**122,616**	**125,542**	**128,303**	**131,411**

Achievable Potential (MWh)	2021	2025	2030	2035	2040
Heating	417	3,233	8,831	10,961	11,479
Cooling	490	3,920	11,074	14,135	15,154
Ventilation	-	-	-	-	-
Water Heating	-	-	-	-	-
Lighting	1,273	25,026	36,189	40,137	40,808
Cooking	n/a	n/a	n/a	n/a	n/a
Office Equipment & Computing	n/a	n/a	n/a	n/a	n/a
Refrigeration	298	2,197	3,448	989	-0
Miscellaneous	1,687	9,189	15,926	17,123	18,350
Total Achievable Potential (MWh)	**4,165**	**43,565**	**75,469**	**83,344**	**85,790**

Incremental Achievable Potential (MWh)	2021	2025	2030	2035	2040
Heating	417	883	1,439	1,140	1,451
Cooling	490	1,092	1,833	1,490	1,941
Ventilation	-	-	-	-	-
Water Heating	-	-	-	-	-
Lighting	1,273	3,500	13,894	10,008	8,158
Cooking	n/a	n/a	n/a	n/a	n/a
Office Equipment & Computing	n/a	n/a	n/a	n/a	n/a
Refrigeration	298	580	593	-	-
Miscellaneous	1,687	2,008	1,522	1,902	1,861
Total Incremental Achievable Potential (MWh	**4,165**	**8,062**	**19,281**	**14,539**	**13,411**

Total Achievable Incremental Costs ($000s	2021	2025	2030	2035	2040
Heating	$500	$991	$1,544	$1,176	$1,441
Cooling	$410	$912	$1,532	$1,245	$1,623
Ventilation	-	-	-	-	-
Water Heating	-	-	-	-	-
Lighting	$270	$1,326	$3,998	$2,272	$1,341
Cooking	n/a	n/a	n/a	n/a	n/a
Office Equipment & Computing	n/a	n/a	n/a	n/a	n/a
Refrigeration	$81	$157	$161	-	-
Miscellaneous	$274	$340	$290	$320	$342
Total Incremental Costs ($000s)	**$1,535**	**$3,727**	**$7,525**	**$5,014**	**$4,747**

Multi-Year Cumulative Costs ($000s)	2021-2025	2026-2030	2031-2035	2036-2040
Heating	$3,723	$6,481	$6,227	$6,847
Cooling	$3,276	$6,390	$6,516	$7,591
Ventilation	-	-	-	-
Water Heating	-	-	-	-
Lighting	$10,437	$14,977	$11,729	$8,622
Cooking	n/a	n/a	n/a	n/a
Office Equipment & Computing	n/a	n/a	n/a	n/a
Refrigeration	$596	$936	$268	-
Miscellaneous	$1,515	$1,504	$1,455	$1,671
Total 5-Year Costs ($000s)	**$19,548**	**$30,287**	**$26,195**	**$24,731**
Participant Cost	$3,850	$5,966	$5,160	$4,871
Utility Incentives	$11,551	$17,897	$15,479	$14,614
Utility Administrative Costs	$4,146	$6,425	$5,557	$5,246

Commercial/Industrial

Technical Potential (MWh)	2021	2025	2030	2035	2040
Heating	4,362	4,703	5,121	5,509	5,875
Cooling	140,331	151,300	164,753	177,225	189,018
Ventilation	15,850	15,268	14,677	14,189	13,799
Water Heating	n/a	n/a	n/a	n/a	n/a
Lighting	378,672	377,662	378,060	379,148	381,220
Cooking	33,850	36,496	39,741	42,749	45,594
Office Equipment & Computing	4,396	4,740	5,161	5,552	5,921
Refrigeration	69,442	74,870	81,527	87,699	93,535
Miscellaneous	293,894	324,262	361,046	394,927	426,689
Total Technical Potential (MWh)	**940,797**	**989,301**	**1,050,086**	**1,106,996**	**1,161,652**

Economic Potential (MWh)	2021	2025	2030	2035	2040
Heating	4,362	4,703	5,121	5,509	5,875
Cooling	103,281	111,354	121,255	130,434	139,114
Ventilation	15,850	15,268	14,677	14,189	13,799
Water Heating	n/a	n/a	n/a	n/a	n/a
Lighting	182,997	207,205	237,312	227,532	220,002
Cooking	33,850	36,496	39,741	42,749	45,594
Office Equipment & Computing	-	-	-	-	-
Refrigeration	69,442	74,870	81,527	87,699	93,535
Miscellaneous	292,329	322,575	359,208	392,950	424,580
Total Economic Potential (MWh)	**702,111**	**772,470**	**858,840**	**901,061**	**942,500**

Achievable Potential (MWh)	2021	2025	2030	2035	2040
Heating	141	1,132	3,223	4,132	4,407
Cooling	510	9,635	52,565	90,552	103,428
Ventilation	28	565	3,371	7,638	8,992
Water Heating	n/a	n/a	n/a	n/a	n/a
Lighting	31,003	95,806	136,986	155,574	161,115
Cooking	1,092	8,785	25,013	28,717	23,432
Office Equipment & Computing	-	-	-	-	-
Refrigeration	2,389	18,346	50,818	62,896	50,192
Miscellaneous	4,609	29,964	77,213	146,920	193,328
Total Achievable Potential (MWh)	**39,771**	**164,234**	**349,189**	**496,428**	**544,893**

Incremental Achievable Potential (MWh)	2021	2025	2030	2035	2040
Heating	141	317	535	436	558
Cooling	510	4,239	10,657	5,716	2,411
Ventilation	28	231	796	718	116
Water Heating	n/a	n/a	n/a	n/a	n/a
Lighting	31,003	12,821	15,384	20,969	19,337
Cooking	1,092	2,458	3,062	912	2,269
Office Equipment & Computing	-	-	-	-	-
Refrigeration	2,389	5,277	6,607	1,635	3,023
Miscellaneous	4,609	8,036	20,780	34,383	41,551
Total Incremental Achievable Potential (MWh	**39,771**	**33,380**	**57,820**	**64,770**	**69,263**

Total Achievable Incremental Costs ($000s	2021	2025	2030	2035	2040
Heating	$138	$312	$527	$429	$549
Cooling	$315	$2,571	$6,451	$3,496	$1,518
Ventilation	$18	$156	$588	$605	$132
Water Heating	n/a	n/a	n/a	n/a	n/a
Lighting	$13,423	$7,588	$8,429	$8,529	$10,034
Cooking	$459	$1,033	$1,286	$273	$774
Office Equipment & Computing	-	-	-	-	-
Refrigeration	$1,383	$3,109	$3,874	$643	$1,510
Miscellaneous	$1,282	$2,214	$5,666	$9,368	$11,372
Total Incremental Costs ($000s)	**$17,018**	**$16,983**	**$26,820**	**$23,343**	**$25,890**

Multi-Year Cumulative Costs ($000s)	2021-2025	2026-2030	2031-2035	2036-2040
Heating	$1,114	$2,197	$2,244	$2,590
Cooling	$5,916	$26,659	$24,791	$10,395
Ventilation	$374	$2,014	$3,376	$1,475
Water Heating	n/a	n/a	n/a	n/a
Lighting	$46,541	$48,250	$33,169	$44,163
Cooking	$3,691	$6,817	$3,109	$2,726
Office Equipment & Computing	-	-	-	-
Refrigeration	$11,109	$20,506	$9,080	$5,337
Miscellaneous	$8,349	$20,330	$40,354	$52,752
Total 5-Year Costs ($000s)	**$77,094**	**$126,774**	**$116,124**	**$119,438**
Participant Cost	$15,185	$24,971	$22,873	$23,526
Utility Incentives	$45,555	$74,912	$68,619	$70,577
Utility Administrative Costs	$16,353	$26,891	$24,632	$25,335

EE.Hourly.High: Hourly Energy Efficiency Results, Medium Avoided Cost Scenario

	Winter	2021		2025		2030		2035		2040	
	12/19	Base Load (MW)	Total EE Curtailment	Base Load (MW)	Total EE Curtailment	Base Load (MW)	Total EE Curtailment	Base Load (MW)	Total EE Curtailment	Base Load (MW)	Total EE Curtailment
8449	1	326.9	3.4	329.9	13.0	335.2	25.3	344.8	35.6	361.3	39.6
8450	2	318.4	3.4	321.3	13.0	326.5	25.3	335.8	35.6	351.9	39.6
8451	3	315.3	3.4	318.2	13.0	323.3	25.3	332.6	35.6	348.4	39.6
8452	4	316.6	3.4	319.4	13.0	324.6	25.3	333.9	35.6	349.9	39.6
8453	5	326.0	3.4	329.0	13.0	334.3	25.3	343.9	35.6	360.3	39.6
8454	6	348.9	3.9	352.1	21.5	357.8	40.3	368.0	52.1	385.6	55.6
8455	7	386.2	3.6	389.7	20.6	396.1	39.2	407.4	50.9	426.8	54.4
8456	8	405.2	6.9	408.9	32.6	415.5	58.8	427.4	74.9	447.8	79.8
8457	9	406.7	6.9	410.4	32.6	417.1	58.8	429.0	74.9	449.5	79.8
8458	10	401.9	6.5	405.5	25.6	412.1	48.1	423.9	63.3	444.2	67.8
8459	11	397.7	6.5	401.3	25.6	407.8	48.1	419.5	63.3	439.5	67.8
8460	12	393.9	6.5	397.5	25.6	403.9	48.1	415.5	63.3	435.3	67.8
8461	13	389.5	6.5	393.0	25.6	399.4	48.1	410.8	63.3	430.4	67.8
8462	14	386.5	6.5	390.0	25.6	396.3	48.1	407.7	63.3	427.1	67.8
8463	15	382.2	6.5	385.7	25.6	391.9	48.1	403.2	63.3	422.4	67.8
8464	16	384.2	6.9	387.8	32.6	394.0	58.8	405.3	74.9	424.7	79.8
8465	17	408.1	8.9	411.8	38.2	418.5	65.7	430.5	82.1	451.1	87.0
8466	18	447.0	8.9	451.1	38.2	458.4	65.7	471.5	82.1	494.1	87.0
8467	19	448.1	3.9	452.2	21.5	459.5	40.3	472.7	52.1	495.2	55.6
8468	20	441.3	3.9	445.4	21.5	452.6	40.3	465.5	52.1	487.8	55.6
8469	21	430.8	3.9	434.7	21.5	441.7	40.3	454.4	52.1	476.1	55.6
8470	22	408.1	3.7	411.8	20.0	418.5	36.0	430.4	47.2	451.0	51.6
8471	23	374.6	3.7	378.0	20.0	384.2	36.0	395.2	47.2	414.0	51.6
8472	24	344.7	3.4	347.8	13.0	353.5	25.3	363.6	35.6	381.0	39.6

	Spring/Fall	2021		2025		2030		2035		2040	
	09/15	Base Load (MW)	Total EE Curtailment	Base Load (MW)	Total EE Curtailment	Base Load (MW)	Total EE Curtailment	Base Load (MW)	Total EE Curtailment	Base Load (MW)	Total EE Curtailment
6169	1	313.1	3.4	315.9	13.0	321.0	25.3	330.2	35.6	346.0	39.6
6170	2	298.0	3.4	300.8	13.0	305.6	25.3	314.4	35.6	329.4	39.6
6171	3	289.5	3.4	292.1	13.0	296.9	25.3	305.4	35.6	320.0	39.6
6172	4	284.7	3.4	287.3	13.0	291.9	25.3	300.3	35.6	314.6	39.6
6173	5	286.6	3.4	289.2	13.0	293.9	25.3	302.3	35.6	316.7	39.6
6174	6	302.0	3.9	304.8	21.5	309.7	40.3	318.6	52.1	333.8	55.6
6175	7	331.5	1.8	334.5	15.9	340.0	33.4	349.7	45.0	366.4	48.5
6176	8	349.7	6.9	352.9	32.6	358.7	58.8	368.9	74.9	386.5	79.8
6177	9	370.4	6.9	373.8	32.6	379.8	58.8	390.7	74.9	409.4	79.8
6178	10	391.3	6.5	394.9	25.6	401.3	48.1	412.8	63.3	432.5	67.8
6179	11	410.7	6.5	414.4	25.6	421.2	48.1	433.2	63.3	453.9	67.8
6180	12	426.4	6.5	430.3	25.6	437.2	48.1	449.8	63.3	471.2	67.8
6181	13	441.4	6.5	445.5	25.6	452.7	48.1	465.6	63.3	487.9	67.8
6182	14	457.2	6.5	461.4	25.6	468.8	48.1	482.2	63.3	505.3	67.8
6183	15	471.3	6.5	475.6	25.6	483.3	48.1	497.2	63.3	520.9	67.8
6184	16	479.5	6.9	483.9	32.6	491.8	58.8	505.8	74.9	530.0	79.8
6185	17	482.9	6.9	487.4	32.6	495.2	58.8	509.4	74.9	533.8	79.8
6186	18	475.4	6.9	479.7	32.6	487.5	58.8	501.4	74.9	525.4	79.8
6187	19	451.8	3.9	455.9	21.5	463.3	40.3	476.5	52.1	499.3	55.6
6188	20	444.8	3.9	448.9	21.5	456.2	40.3	469.2	52.1	491.6	55.6
6189	21	427.0	3.9	430.9	21.5	437.9	40.3	450.4	52.1	471.9	55.6
6190	22	392.5	3.7	396.1	20.0	402.5	36.0	414.0	47.2	433.8	51.6
6191	23	354.1	3.7	357.3	20.0	363.1	36.0	373.5	47.2	391.4	51.6
6192	24	319.9	3.4	322.8	13.0	328.1	25.3	337.5	35.6	353.6	39.6

	Summer	2021		2025		2030		2035		2040	
	07/10	Base Load (MW)	Total EE Curtailment	Base Load (MW)	Total EE Curtailment	Base Load (MW)	Total EE Curtailment	Base Load (MW)	Total EE Curtailment	Base Load (MW)	Total EE Curtailment
4561	1	350.3	3.7	353.5	18.5	359.2	52.6	369.5	81.5	387.1	91.9
4562	2	327.3	3.7	330.3	18.5	335.6	52.6	345.2	81.5	361.7	91.9
4563	3	314.6	3.7	317.5	18.5	322.6	52.6	331.9	81.5	347.7	91.9
4564	4	308.1	3.7	310.9	18.5	316.0	52.6	325.0	81.5	340.5	91.9
4565	5	312.0	3.7	314.8	18.5	319.9	52.6	329.1	81.5	344.8	91.9
4566	6	323.5	2.2	326.4	21.4	331.7	60.7	341.2	90.9	357.5	100.8
4567	7	342.0	2.2	345.1	21.4	350.7	60.7	360.8	90.9	378.0	100.8
4568	8	375.8	7.2	379.2	38.1	385.3	86.1	396.4	120.9	415.3	132.1
4569	9	414.2	7.2	418.0	38.1	424.7	86.1	436.9	120.9	457.7	132.1
4570	10	455.7	6.8	459.8	31.1	467.3	75.4	480.6	109.2	503.6	120.1
4571	11	494.4	6.8	498.9	31.1	507.0	75.4	521.5	109.2	546.4	120.1
4572	12	535.6	6.8	540.5	31.1	549.2	75.4	564.9	109.2	591.9	120.1
4573	13	566.6	6.8	571.7	31.1	581.0	75.4	597.6	109.2	626.2	120.1
4574	14	593.9	6.8	599.3	31.1	609.0	75.4	626.4	109.2	656.4	120.1
4575	15	616.7	6.8	622.3	31.1	632.4	75.4	650.5	109.2	681.6	120.1
4576	16	608.5	7.2	614.0	38.1	624.0	86.1	641.9	120.9	672.5	132.1
4577	17	583.7	7.2	589.0	38.1	598.5	86.1	615.7	120.9	645.1	132.1
4578	18	576.6	7.2	581.8	38.1	591.3	86.1	608.2	120.9	637.3	132.1
4579	19	567.3	2.2	572.5	21.4	581.8	60.7	598.4	90.9	627.0	100.8

	Winter										
	12/19	Base Load (MW)	Total EE Curtailment	Base Load (MW)	Total EE Curtailment	Base Load (MW)	Total EE Curtailment	Base Load (MW)	Total EE Curtailment	Base Load (MW)	Total EE Curtailment
8449	1	326.9	3.4	329.9	13.0	335.2	25.3	344.8	35.6	361.3	39.6
8450	2	318.4	3.4	321.3	13.0	326.5	25.3	335.8	35.6	351.9	39.6
8451	3	315.3	3.4	318.2	13.0	323.3	25.3	332.6	35.6	348.4	39.6

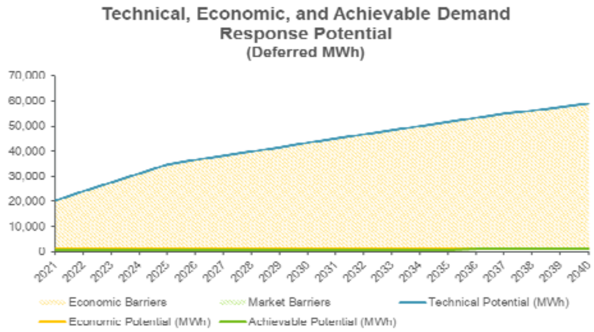
EE.Hourly.High: Hourly Energy Efficiency Results, Medium Avoided Cost Scenario

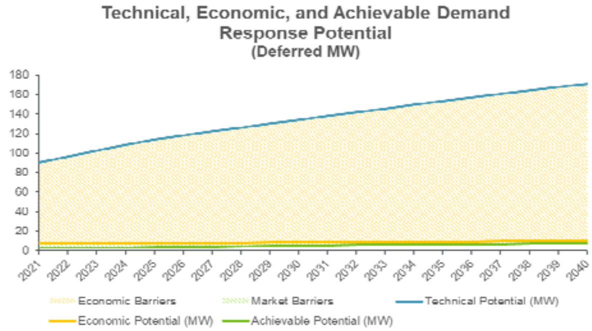
	Winter	2021		2025		2030		2035		2040	
Peak Hours	12/19	Base Load (MW)	Load w/EE Curtailment	Base Load (MW)	Load w/EE Curtailment	Base Load (MW)	Load w/EE Curtailment	Base Load (MW)	Load w/EE Curtailment	Base Load (MW)	Load w/EE Curtailment
20	1	327	324	330	317	335	310	345	309	361	322
22	2	318	315	321	308	326	301	336	300	352	312
24	3	315	312	318	305	323	298	333	297	348	309
23	4	317	313	319	306	325	299	334	298	350	310
21	5	326	323	329	316	334	309	344	308	360	321
18	6	349	345	352	331	358	317	368	316	386	330
14	7	386	383	390	369	396	357	407	357	427	372
8	8	405	398	409	376	416	357	427	352	448	368
7	9	407	400	410	378	417	358	429	354	450	370
9	10	402	395	406	380	412	364	424	361	444	376
10	11	398	391	401	376	408	360	419	356	439	372
11	12	394	387	397	372	404	356	415	352	435	368
12	13	389	383	393	367	399	351	411	348	430	363
13	14	386	380	390	364	396	348	408	344	427	359
16	15	382	376	386	360	392	344	403	340	422	355
15	16	384	377	388	355	394	335	405	330	425	345
5	17	408	399	412	374	419	353	430	348	451	364
2	18	447	438	451	413	458	393	472	389	494	407
1	19	448	444	452	431	460	419	473	421	495	440
3	20	441	437	445	424	453	412	466	413	488	432
4	21	431	427	435	413	442	401	454	402	476	420
6	22	408	404	412	392	418	382	430	383	451	399
17	23	375	371	378	358	384	348	395	348	414	362
19	24	345	341	348	335	353	328	364	328	381	341

	Spring/Fall	2021		2025		2030		2035		2040	
Peak Hours	09/15	Base Load (MW)	Load w/EE Curtailment	Base Load (MW)	Load w/EE Curtailment	Base Load (MW)	Load w/EE Curtailment	Base Load (MW)	Load w/EE Curtailment	Base Load (MW)	Load w/EE Curtailment
19	1	313	310	316	303	321	296	330	295	346	306
21	2	298	295	301	288	306	280	314	279	329	290
22	3	290	286	292	279	297	272	305	270	320	280
24	4	285	281	287	274	292	267	300	265	315	275
23	5	287	283	289	276	294	269	302	267	317	277
20	6	302	298	305	283	310	269	319	266	334	278
17	7	332	330	335	319	340	307	350	305	366	318
16	8	350	343	353	320	359	300	369	294	387	307
14	9	370	364	374	341	380	321	391	316	409	330
13	10	391	385	395	369	401	353	413	349	433	365
11	11	411	404	414	389	421	373	433	370	454	386
10	12	426	420	430	405	437	389	450	386	471	403
8	13	441	435	445	420	453	405	466	402	488	420
5	14	457	451	461	436	469	421	482	419	505	437
4	15	471	465	476	450	483	435	497	434	521	453
2	16	480	473	484	451	492	433	506	431	530	450
1	17	483	476	487	455	495	436	509	434	534	454
3	18	475	469	480	447	487	429	501	426	525	446
6	19	452	448	456	434	463	423	477	424	499	444
7	20	445	441	449	427	456	416	469	417	492	436
9	21	427	423	431	409	438	398	450	398	472	416
12	22	392	389	396	376	402	366	414	367	434	382
15	23	354	350	357	337	363	327	374	326	391	340
18	24	320	317	323	310	328	303	337	302	354	314

	Summer	2021		2025		2030		2035		2040	
Peak Hours	07/10	Base Load (MW)	Load w/EE Curtailment	Base Load (MW)	Load w/EE Curtailment	Base Load (MW)	Load w/EE Curtailment	Base Load (MW)	Load w/EE Curtailment	Base Load (MW)	Load w/EE Curtailment
18	1	350	347	353	335	359	307	369	288	387	295
20	2	327	324	330	312	336	283	345	264	362	270
22	3	315	311	317	299	323	270	332	250	348	256
24	4	308	304	311	292	316	263	325	244	341	249
23	5	312	308	315	296	320	267	329	248	345	253
21	6	323	321	326	305	332	271	341	250	357	257
19	7	342	340	345	324	351	290	361	270	378	277
17	8	376	369	379	341	385	299	396	275	415	283
15	9	414	407	418	380	425	339	437	316	458	326
13	10	456	449	460	429	467	392	481	371	504	384
12	11	494	488	499	468	507	432	522	412	546	426
9	12	536	529	540	509	549	474	565	456	592	472
7	13	567	560	572	541	581	506	598	488	626	506
3	14	594	587	599	568	609	534	626	517	656	536
1	15	617	610	622	591	632	557	651	541	682	562
2	16	608	601	614	576	624	538	642	521	673	540
4	17	584	576	589	551	599	512	616	495	645	513
5	18	577	569	582	544	591	505	608	487	637	505
6	19	567	565	573	551	582	521	598	508	627	526
8	20	543	541	548	527	557	496	573	482	600	499
10	21	527	523	532	505	540	473	556	458	583	475
11	22	499	495	504	478	512	448	526	433	551	448
14	23	446	441	450	424	457	394	470	377	492	389
16	24	396	393	400	381	406	354	418	337	438	346

DR.Low: Demand Response Low Avoided Cost Scenario Results





Combined

Technical Potential (MWh)	2021	2025	2030	2035	2040
HVAC	3,533	3,813	4,152	4,475	4,820
Water Heating	508	624	765	901	1,048
Batteries	12,944	26,272	33,523	40,601	46,750
Industrial Processes	657	796	963	1,116	1,259
Lighting	2,291	2,828	3,463	4,040	4,571
Refrigeration	7	7	8	9	9
Voltage Reduction	424	427	434	447	468
Total Technical Potential (MWh)	**20,363**	**34,767**	**43,308**	**51,588**	**58,925**

Economic Potential (MWh)	2021	2025	2030	2035	2040
HVAC	124	135	150	163	175
Water Heating	-	-	-	-	-
Batteries	-	-	-	-	-
Industrial Processes	332	392	464	531	593
Lighting	-	-	-	-	-
Refrigeration	-	-	-	-	-
Voltage Reduction	424	427	434	447	468
Total Economic Potential (MWh)	**879**	**955**	**1,048**	**1,140**	**1,236**

Achievable Potential (MWh)	2021	2025	2030	2035	2040
HVAC	0	10	55	97	108
Water Heating	-	-	-	-	-
Batteries	-	-	-	-	-
Industrial Processes	1	28	172	302	339
Lighting	-	-	-	-	-
Refrigeration	-	-	-	-	-
Voltage Reduction	424	427	434	447	468
Total Achievable Potential (MWh)	**425**	**465**	**661**	**846**	**914**

Total Achievable Incremental Costs ($000s)	2021	2025	2030	2035	2040
HVAC	$6	$55	$144	$77	$81
Water Heating	-	-	-	-	-
Batteries	-	-	-	-	-
Industrial Processes	$1	$11	$31	$29	$36
Lighting	-	-	-	-	-
Refrigeration	-	-	-	-	-
Voltage Reduction	$2,280	-	-	-	-
Total Incremental Costs ($000s)	**$2,287**	**$66**	**$175**	**$106**	**$118**

Multi-Year Cumulative Cost ($000s)	2021-2025	2026-2030	2031-2035	2036-2040
HVAC	$125	$593	$548	$330
Water Heating	-	-	-	-
Batteries	-	-	-	-
Industrial Processes	$23	$121	$147	$167
Lighting	-	-	-	-
Refrigeration	-	-	-	-
Voltage Reduction	$2,280	-	-	-
Total 5-Year Costs ($000s)	**$2,428**	**$714**	**$695**	**$497**
Participant Cost	$27	$130	$127	$91
Utility Incentives	$2,361	$391	$381	$272
Utility Administrative Costs	$40	$192	$187	$134

Combined

Technical Potential (MW)	2021	2025	2030	2035	2040
HVAC	49.1	53.0	57.7	62.1	66.9
Water Heating	3.5	4.3	5.3	6.3	7.3
Batteries	14.3	28.6	37.3	45.7	53.2
Industrial Processes	4.6	5.5	6.7	7.8	8.7
Lighting	15.9	19.6	24.0	28.1	31.7
Refrigeration	0.0	0.1	0.1	0.1	0.1
Voltage Reduction	2.9	3.0	3.0	3.1	3.3
Total Technical Potential (MW)	**90.4**	**114.1**	**134.1**	**153.1**	**171.2**

Economic Potential (MW)	2021	2025	2030	2035	2040
HVAC	1.7	1.9	2.1	2.3	2.4
Water Heating	-	-	-	-	-
Batteries	-	-	-	-	-
Industrial Processes	2.3	2.7	3.2	3.7	4.1
Lighting	-	-	-	-	-
Refrigeration	-	-	-	-	-
Voltage Reduction	2.9	3.0	3.0	3.1	3.3
Total Economic Potential (MW)	**7.0**	**7.6**	**8.3**	**9.0**	**9.8**

Achievable Potential (MW)	2021	2025	2030	2035	2040
HVAC	0.0	0.1	0.8	1.4	1.5
Water Heating	-	-	-	-	-
Batteries	-	-	-	-	-
Industrial Processes	0.01	0.2	1.2	2.1	2.4
Lighting	-	-	-	-	-
Refrigeration	-	-	-	-	-
Voltage Reduction	2.9	3.0	3.0	3.1	3.3
Total Achievable Potential (MW)	**3.0**	**3.3**	**5.0**	**6.6**	**7.1**

Incremental Achievable Potential (MW)	2021	2025	2030	2035	2040
HVAC	0.0	0.1	0.2	0.1	0.1
Water Heating	-	-	-	-	-
Batteries	-	-	-	-	-
Industrial Processes	0.01	0.1	0.3	0.2	0.3
Lighting	-	-	-	-	-
Refrigeration	-	-	-	-	-
Voltage Reduction	2.9	0.0	0.0	0.0	0.0
Total Achievable Potential (MW)	**3.0**	**0.2**	**0.4**	**0.3**	**0.4**
Incremental Cost per Unit Capacity	$773.74	$424.70	$414.00	$309.85	$278.52

DR.Low: Demand Response Low Avoided Cost Scenario Results

Residential

Technical Potential (MWh)	2021	2025	2030	2035	2040
HVAC	3,267	3,522	3,831	4,126	4,445
Water Heating	508	624	765	901	1,048
Batteries	11,608	23,803	29,732	35,619	40,687
Industrial Processes	n/a	n/a	n/a	n/a	n/a
Lighting	n/a	n/a	n/a	n/a	n/a
Refrigeration	n/a	n/a	n/a	n/a	n/a
Voltage Reduction	n/a	n/a	n/a	n/a	n/a
Total Technical Potential (MWh)	**15,383**	**27,949**	**34,328**	**40,646**	**46,180**

Economic Potential (MWh)	2021	2025	2030	2035	2040
HVAC	-	-	-	-	-
Water Heating	-	-	-	-	-
Batteries	-	-	-	-	-
Industrial Processes	n/a	n/a	n/a	n/a	n/a

Residential

Technical Potential (MW)	2021	2025	2030	2035	2040
HVAC	45.4	48.9	53.2	57.3	61.7
Water Heating	3.5	4.3	5.3	6.3	7.3
Batteries	11.8	23.9	30.0	36.2	41.5
Industrial Processes	n/a	n/a	n/a	n/a	n/a
Lighting	n/a	n/a	n/a	n/a	n/a
Refrigeration	n/a	n/a	n/a	n/a	n/a
Voltage Reduction	n/a	n/a	n/a	n/a	n/a
Total Technical Potential (MW)	**60.7**	**77.1**	**88.6**	**99.7**	**110.5**

Economic Potential (MW)	2021	2025	2030	2035	2040
HVAC	-	-	-	-	-
Water Heating	-	-	-	-	-
Batteries	-	-	-	-	-
Industrial Processes	n/a	n/a	n/a	n/a	n/a

Combined

Technical Potential (MWh)	2021	2025	2030	2035	2040
HVAC	3,533	3,813	4,152	4,475	4,820
Water Heating	508	624	765	901	1,048
Batteries	12,944	26,272	33,523	40,601	46,750
Industrial Processes	657	796	963	1,116	1,259
Lighting	2,291	2,828	3,463	4,040	4,571
Refrigeration	7	7	8	9	9
Voltage Reduction	424	427	434	447	468
Total Technical Potential (MWh)	**20,363**	**34,767**	**43,308**	**51,588**	**58,925**

Economic Potential (MWh)	2021	2025	2030	2035	2040
HVAC	124	135	150	163	175
Water Heating	-	-	-	-	-
Batteries	-	-	-	-	-
Industrial Processes	332	392	464	531	593
Lighting	-	-	-	-	-
Refrigeration	-	-	-	-	-
Voltage Reduction	424	427	434	447	468
Total Economic Potential (MWh)	**879**	**955**	**1,048**	**1,140**	**1,236**

Achievable Potential (MWh)	2021	2025	2030	2035	2040
HVAC	0	10	55	97	108
Water Heating	-	-	-	-	-
Batteries	-	-	-	-	-
Industrial Processes	1	28	172	302	339
Lighting	-	-	-	-	-
Refrigeration	-	-	-	-	-
Voltage Reduction	424	427	434	447	468
Total Achievable Potential (MWh)	**425**	**465**	**661**	**846**	**914**

Total Achievable Incremental Costs ($000s)	2021	2025	2030	2035	2040
HVAC	$6	$55	$144	$77	$81
Water Heating	-	-	-	-	-
Batteries	-	-	-	-	-
Industrial Processes	$1	$11	$31	$29	$36
Lighting	-	-	-	-	-
Refrigeration	-	-	-	-	-
Voltage Reduction	$2,280	-	-	-	-
Total Incremental Costs ($000s)	**$2,287**	**$66**	**$175**	**$106**	**$118**

Multi-Year Cumulative Cost ($000s)	2021-2025	2026-2030	2031-2035	2036-2040
HVAC	$125	$593	$548	$330
Water Heating	-	-	-	-
Batteries	-	-	-	-
Industrial Processes	$23	$121	$147	$167
Lighting	-	-	-	-
Refrigeration	-	-	-	-
Voltage Reduction	$2,280	-	-	-
Total 5-Year Costs ($000s)	**$2,428**	**$714**	**$695**	**$497**
Participant Cost	$27	$130	$127	$91
Utility Incentives	$2,361	$391	$381	$272
Utility Administrative Costs	$40	$192	$187	$134

Combined

Technical Potential (MW)	2021	2025	2030	2035	2040
HVAC	49.1	53.0	57.7	62.1	66.9
Water Heating	3.5	4.3	5.3	6.3	7.3
Batteries	14.3	28.6	37.3	45.7	53.2
Industrial Processes	4.6	5.5	6.7	7.8	8.7
Lighting	15.9	19.6	24.0	28.1	31.7
Refrigeration	0.0	0.1	0.1	0.1	0.1
Voltage Reduction	2.9	3.0	3.0	3.1	3.3
Total Technical Potential (MW)	**90.4**	**114.1**	**134.1**	**153.1**	**171.2**

Economic Potential (MW)	2021	2025	2030	2035	2040
HVAC	1.7	1.9	2.1	2.3	2.4
Water Heating	-	-	-	-	-
Batteries	-	-	-	-	-
Industrial Processes	2.3	2.7	3.2	3.7	4.1
Lighting	-	-	-	-	-
Refrigeration	-	-	-	-	-
Voltage Reduction	2.9	3.0	3.0	3.1	3.3
Total Economic Potential (MW)	**7.0**	**7.6**	**8.3**	**9.0**	**9.8**

Achievable Potential (MW)	2021	2025	2030	2035	2040
HVAC	0.0	0.1	0.8	1.4	1.5
Water Heating	-	-	-	-	-
Batteries	-	-	-	-	-
Industrial Processes	0.01	0.2	1.2	2.1	2.4
Lighting	-	-	-	-	-
Refrigeration	-	-	-	-	-
Voltage Reduction	2.9	3.0	3.0	3.1	3.3
Total Achievable Potential (MW)	**3.0**	**3.3**	**5.0**	**6.6**	**7.1**

Incremental Achievable Potential (MW)	2021	2025	2030	2035	2040
HVAC	0.0	0.1	0.2	0.1	0.1
Water Heating	-	-	-	-	-
Batteries	-	-	-	-	-
Industrial Processes	0.01	0.1	0.3	0.2	0.3
Lighting	-	-	-	-	-
Refrigeration	-	-	-	-	-
Voltage Reduction	2.9	0.0	0.0	0.0	0.0
Total Achievable Potential (MW)	**3.0**	**0.2**	**0.4**	**0.3**	**0.4**
Incremental Cost per Unit Capacity	$773.74	$424.70	$414.00	$309.85	$278.52

Residential

Technical Potential (MWh)	2021	2025	2030	2035	2040
HVAC	3,267	3,522	3,831	4,126	4,445
Water Heating	508	624	765	901	1,048
Batteries	11,608	23,803	29,732	35,619	40,687
Industrial Processes	n/a	n/a	n/a	n/a	n/a
Lighting	n/a	n/a	n/a	n/a	n/a
Refrigeration	n/a	n/a	n/a	n/a	n/a
Voltage Reduction	n/a	n/a	n/a	n/a	n/a
Total Technical Potential (MWh)	**15,383**	**27,949**	**34,328**	**40,646**	**46,180**

Residential

Technical Potential (MW)	2021	2025	2030	2035	2040
HVAC	45.4	48.9	53.2	57.3	61.7
Water Heating	3.5	4.3	5.3	6.3	7.3
Batteries	11.8	23.9	30.0	36.2	41.5
Industrial Processes	n/a	n/a	n/a	n/a	n/a
Lighting	n/a	n/a	n/a	n/a	n/a
Refrigeration	n/a	n/a	n/a	n/a	n/a
Voltage Reduction	n/a	n/a	n/a	n/a	n/a
Total Technical Potential (MW)	**60.7**	**77.1**	**88.6**	**99.7**	**110.5**

DR.Hourly.Low: Demand Response Low Avoided Cost Scenario Results

	Winter	2021		2025		2030		2035		2040	
	12/19	Base Load (MW)	Total Deferral Available	Base Load (MW)	Total Deferral Available	Base Load (MW)	Total Deferral Available	Base Load (MW)	Total Deferral Available	Base Load (MW)	Total Deferral Available
8449	1	326.9	0.0	329.9	-0.3	335.2	-2.0	344.8	-3.5	361.3	-3.8
8450	2	318.4	0.0	321.3	0.0	326.5	0.0	335.8	0.0	351.9	0.0
8451	3	315.3	0.0	318.2	0.0	323.3	0.0	332.6	0.0	348.4	0.0
8452	4	316.6	0.0	319.4	0.0	324.6	0.0	333.9	0.0	349.9	0.0
8453	5	326.0	0.0	329.0	0.0	334.3	0.0	343.9	0.0	360.3	0.0
8454	6	348.9	0.0	352.1	0.0	357.8	0.0	368.0	0.0	385.6	0.0
8455	7	386.2	0.0	389.7	0.0	396.1	0.0	407.4	0.0	426.8	0.0
8456	8	405.2	0.0	408.9	0.0	415.5	0.0	427.4	0.0	447.8	0.0
8457	9	406.7	0.0	410.4	0.0	417.1	0.0	429.0	0.0	449.5	0.0
8458	10	401.9	0.0	405.5	0.0	412.1	0.0	423.9	0.0	444.2	0.0
8459	11	397.7	0.0	401.3	0.0	407.8	0.0	419.5	0.0	439.5	0.0
8460	12	393.9	0.0	397.5	0.0	403.9	0.0	415.5	0.0	435.3	0.0
8461	13	389.5	0.0	393.0	0.0	399.4	0.0	410.8	0.0	430.4	0.0
8462	14	386.5	0.0	390.0	0.0	396.3	0.0	407.7	0.0	427.1	0.0
8463	15	382.2	0.0	385.7	0.0	391.9	0.0	403.2	0.0	422.4	0.0
8464	16	384.2	0.0	387.8	0.0	394.0	0.0	405.3	0.0	424.7	0.0
8465	17	408.1	2.9	411.8	3.2	418.5	4.9	430.5	6.4	451.1	6.7
8466	18	447.0	2.9	451.1	3.2	458.4	4.9	471.5	6.4	494.1	6.7
8467	19	448.1	2.9	452.2	3.2	459.5	4.9	472.7	6.4	495.2	6.7
8468	20	441.3	2.9	445.4	3.2	452.6	4.9	465.5	6.4	487.8	6.7
8469	21	430.8	2.9	434.7	3.2	441.7	4.9	454.4	6.4	476.1	6.7
8470	22	408.1	2.9	411.8	3.2	418.5	4.9	430.4	6.4	451.0	6.7
8471	23	374.6	0.0	378.0	-0.3	384.2	-2.0	395.2	-3.5	414.0	-3.8
8472	24	344.7	0.0	347.8	-0.3	353.5	-2.0	363.6	-3.5	381.0	-3.8
		448.1 MW	**2.9 MW**	**452.2 MW**	**3.2 MW**	**459.5 MW**	**4.9 MW**	**472.7 MW**	**6.4 MW**	**495.2 MW**	**6.7 MW**

	Spring/Fall	2021		2025		2030		2035		2040	
	09/15	Base Load (MW)	Total Deferral Available	Base Load (MW)	Total Deferral Available	Base Load (MW)	Total Deferral Available	Base Load (MW)	Total Deferral Available	Base Load (MW)	Total Deferral Available
6169	1	313.1	0.0	315.9	0.0	321.0	0.0	330.2	0.0	346.0	0.0
6170	2	298.0	0.0	300.8	0.0	305.6	0.0	314.4	0.0	329.4	0.0
6171	3	289.5	0.0	292.1	0.0	296.9	0.0	305.4	0.0	320.0	0.0
6172	4	284.7	0.0	287.3	0.0	291.9	0.0	300.3	0.0	314.6	0.0
6173	5	286.6	0.0	289.2	0.0	293.9	0.0	302.3	0.0	316.7	0.0
6174	6	302.0	0.0	304.8	0.0	309.7	0.0	318.6	0.0	333.8	0.0
6175	7	331.5	0.0	334.5	0.0	340.0	0.0	349.7	0.0	366.4	0.0
6176	8	349.7	0.0	352.9	0.0	358.7	0.0	368.9	0.0	386.5	0.0
6177	9	370.4	0.0	373.8	0.0	379.8	0.0	390.7	0.0	409.4	0.0
6178	10	391.3	0.0	394.9	0.0	401.3	0.0	412.8	0.0	432.5	0.0
6179	11	410.7	0.0	414.4	0.0	421.2	0.0	433.2	0.0	453.9	0.0
6180	12	426.4	0.0	430.3	0.0	437.2	0.0	449.8	0.0	471.2	0.0
6181	13	441.4	0.0	445.5	0.0	452.7	0.0	465.6	0.0	487.9	0.0
6182	14	457.2	0.0	461.4	0.0	468.8	0.0	482.2	0.0	505.3	0.0
6183	15	471.3	2.9	475.6	3.2	483.3	4.9	497.2	6.4	520.9	6.7
6184	16	479.5	2.9	483.9	3.2	491.8	4.9	505.8	6.4	530.0	6.7
6185	17	482.9	2.9	487.4	3.2	495.2	4.9	509.4	6.4	533.8	6.7
6186	18	475.4	2.9	479.7	3.2	487.5	4.9	501.4	6.4	525.4	6.7
6187	19	451.8	2.9	455.9	3.2	463.3	4.9	476.5	6.4	499.3	6.7
6188	20	444.8	2.9	448.9	3.2	456.2	4.9	469.2	6.4	491.6	6.7
6189	21	427.0	0.0	430.9	-0.3	437.9	-2.0	450.4	-3.5	471.9	-3.8
6190	22	392.5	0.0	396.1	-0.3	402.5	-2.0	414.0	-3.5	433.8	-3.8
6191	23	354.1	0.0	357.3	-0.3	363.1	-2.0	373.5	-3.5	391.4	-3.8
6192	24	319.9	0.0	322.8	0.0	328.1	0.0	337.5	0.0	353.6	0.0
		482.9 MW	**2.9 MW**	**487.4 MW**	**3.2 MW**	**495.2 MW**	**4.9 MW**	**509.4 MW**	**6.4 MW**	**533.8 MW**	**6.7 MW**

	Summer	2021		2025		2030		2035		2040	
	07/10	Base Load (MW)	Total Deferral Available	Base Load (MW)	Total Deferral Available	Base Load (MW)	Total Deferral Available	Base Load (MW)	Total Deferral Available	Base Load (MW)	Total Deferral Available
4561	1	350.3	0.0	353.5	0.0	359.2	0.0	369.5	0.0	387.1	0.0
4562	2	327.3	0.0	330.3	0.0	335.6	0.0	345.2	0.0	361.7	0.0
4563	3	314.6	0.0	317.5	0.0	322.6	0.0	331.9	0.0	347.7	0.0
4564	4	308.1	0.0	310.9	0.0	316.0	0.0	325.0	0.0	340.5	0.0
4565	5	312.0	0.0	314.8	0.0	319.9	0.0	329.1	0.0	344.8	0.0
4566	6	323.5	0.0	326.4	0.0	331.7	0.0	341.2	0.0	357.5	0.0
4567	7	342.0	0.0	345.1	0.0	350.7	0.0	360.8	0.0	378.0	0.0
4568	8	375.8	0.0	379.2	0.0	385.3	0.0	396.4	0.0	415.3	0.0
4569	9	414.2	0.0	418.0	0.0	424.7	0.0	436.9	0.0	457.7	0.0
4570	10	455.7	0.0	459.8	0.0	467.3	0.0	480.6	0.0	503.6	0.0
4571	11	494.4	0.0	498.9	0.0	507.0	0.0	521.5	0.0	546.4	0.0
4572	12	535.6	0.0	540.5	0.0	549.2	0.0	564.9	0.0	591.9	0.0
4573	13	566.6	0.0	571.7	0.0	581.0	0.0	597.6	0.0	626.2	0.0
4574	14	593.9	2.9	599.3	3.2	609.0	4.9	626.4	6.4	656.4	6.7
4575	15	616.7	2.9	622.3	3.2	632.4	4.9	650.5	6.4	681.6	6.7
4576	16	608.5	2.9	614.0	3.2	624.0	4.9	641.9	6.4	672.5	6.7
4577	17	583.7	2.9	589.0	3.2	598.5	4.9	615.7	6.4	645.1	6.7
4578	18	576.6	2.9	581.8	3.2	591.3	4.9	608.2	6.4	637.3	6.7
4579	19	567.3	2.9	572.5	3.2	581.8	4.9	598.4	6.4	627.0	6.7
4580	20	543.1	0.0	548.0	-0.3	556.9	-2.0	572.8	-3.5	600.2	-3.8
4581	21	527.1	0.0	531.9	-0.3	540.5	-2.0	556.0	-3.5	582.5	-3.8
4582	22	499.0	0.0	503.5	-0.3	511.7	-2.0	526.3	-3.5	551.5	-3.8
4583	23	445.5	0.0	449.6	0.0	456.9	0.0	470.0	0.0	492.4	0.0
4584	24	396.3	0.0	399.9	0.0	406.4	0.0	418.1	0.0	438.0	0.0
		616.7 MW	**2.9 MW**	**622.3 MW**	**3.2 MW**	**632.4 MW**	**4.9 MW**	**650.5 MW**	**6.4 MW**	**681.6 MW**	**6.7 MW**

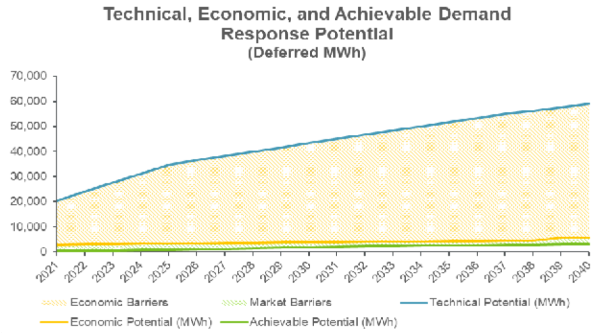
DR.Hourly.Low: Demand Response Low Avoided Cost Scenario Results

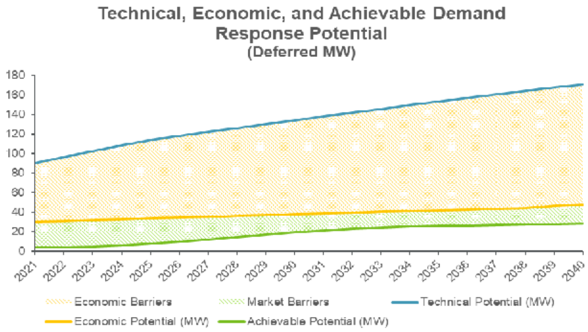
	Winter	2021		2025		2030		2035		2040	
Peak Hours	12/19	Base Load (MW)	Load w/DR Curtailment	Base Load (MW)	Load w/DR Curtailment	Base Load (MW)	Load w/DR Curtailment	Base Load (MW)	Load w/DR Curtailment	Base Load (MW)	Load w/DR Curtailment
20	1	327	327	330	330	335	337	345	348	361	365
22	2	318	318	321	321	326	326	336	336	352	352
24	3	315	315	318	318	323	323	333	333	348	348
23	4	317	317	319	319	325	325	334	334	350	350
21	5	326	326	329	329	334	334	344	344	360	360
18	6	349	349	352	352	358	358	368	368	386	386
14	7	386	386	390	390	396	396	407	407	427	427
8	8	405	405	409	409	416	416	427	427	448	448
7	9	407	407	410	410	417	417	429	429	450	450
9	10	402	402	406	406	412	412	424	424	444	444
10	11	398	398	401	401	408	408	419	419	439	439
11	12	394	394	397	397	404	404	415	415	435	435
12	13	389	389	393	393	399	399	411	411	430	430
13	14	386	386	390	390	396	396	408	408	427	427
16	15	382	382	386	386	392	392	403	403	422	422
15	16	384	384	388	388	394	394	405	405	425	425
5	17	408	405	412	409	419	414	430	424	451	444
2	18	447	444	451	448	458	454	472	465	494	487
1	19	448	445	452	449	460	455	473	466	495	488
3	20	441	438	445	442	453	448	466	459	488	481
4	21	431	428	435	431	442	437	454	448	476	469
6	22	408	405	412	409	418	414	430	424	451	444
17	23	375	375	378	378	384	386	395	399	414	418
19	24	345	345	348	348	353	355	364	367	381	385

	Spring/Fall	2021		2025		2030		2035		2040	
Peak Hours	09/15	Base Load (MW)	Load w/DR Curtailment	Base Load (MW)	Load w/DR Curtailment	Base Load (MW)	Load w/DR Curtailment	Base Load (MW)	Load w/DR Curtailment	Base Load (MW)	Load w/DR Curtailment
19	1	313	313	316	316	321	321	330	330	346	346
21	2	298	298	301	301	306	306	314	314	329	329
22	3	290	290	292	292	297	297	305	305	320	320
24	4	285	285	287	287	292	292	300	300	315	315
23	5	287	287	289	289	294	294	302	302	317	317
20	6	302	302	305	305	310	310	319	319	334	334
17	7	332	332	335	335	340	340	350	350	366	366
16	8	350	350	353	353	359	359	369	369	387	387
14	9	370	370	374	374	380	380	391	391	409	409
13	10	391	391	395	395	401	401	413	413	433	433
11	11	411	411	414	414	421	421	433	433	454	454
10	12	426	426	430	430	437	437	450	450	471	471
8	13	441	441	445	445	453	453	466	466	488	488
5	14	457	457	461	461	469	469	482	482	505	505
4	15	471	468	476	472	483	478	497	491	521	514
2	16	480	477	484	481	492	487	506	499	530	523
1	17	483	480	487	484	495	490	509	503	534	527
3	18	475	472	480	476	487	483	501	495	525	519
6	19	452	449	456	453	463	458	477	470	499	493
7	20	445	442	449	446	456	451	469	463	492	485
9	21	427	427	431	431	438	440	450	454	472	476
12	22	392	392	396	396	402	404	414	417	434	438
15	23	354	354	357	358	363	365	374	377	391	395
18	24	320	320	323	323	328	328	337	337	354	354

	Summer	2021		2025		2030		2035		2040	
Peak Hours	07/10	Base Load (MW)	Load w/DR Curtailment	Base Load (MW)	Load w/DR Curtailment	Base Load (MW)	Load w/DR Curtailment	Base Load (MW)	Load w/DR Curtailment	Base Load (MW)	Load w/DR Curtailment
18	1	350	350	353	353	359	359	369	369	387	387
20	2	327	327	330	330	336	336	345	345	362	362
22	3	315	315	317	317	323	323	332	332	348	348
24	4	308	308	311	311	316	316	325	325	341	341
23	5	312	312	315	315	320	320	329	329	345	345
21	6	323	323	326	326	332	332	341	341	357	357
19	7	342	342	345	345	351	351	361	361	378	378
17	8	376	376	379	379	385	385	396	396	415	415
15	9	414	414	418	418	425	425	437	437	458	458
13	10	456	456	460	460	467	467	481	481	504	504
12	11	494	494	499	499	507	507	522	522	546	546
9	12	536	536	540	540	549	549	565	565	592	592
7	13	567	567	572	572	581	581	598	598	626	626
3	14	594	591	599	596	609	604	626	620	656	650
1	15	617	614	622	619	632	628	651	644	682	675
2	16	608	606	614	611	624	619	642	636	673	666
4	17	584	581	589	586	599	594	616	609	645	638
5	18	577	574	582	579	591	586	608	602	637	631
6	19	567	564	573	569	582	577	598	592	627	620
8	20	543	543	548	548	557	559	573	576	600	604
10	21	527	527	532	532	540	542	556	559	583	586
11	22	499	499	504	504	512	514	526	530	551	555
14	23	446	446	450	450	457	457	470	470	492	492
16	24	396	396	400	400	406	406	418	418	438	438

DR.Med: Demand Response Low Avoided Cost Scenario Results





Combined

Technical Potential (MWh)	2021	2025	2030	2035	2040
HVAC	3,533	3,813	4,152	4,475	4,820
Water Heating	508	624	765	901	1,048
Batteries	12,944	26,272	33,523	40,601	46,750
Industrial Processes	657	796	963	1,116	1,259
Lighting	2,291	2,828	3,463	4,040	4,571
Refrigeration	7	7	8	9	9
Voltage Reduction	424	427	434	447	468
Total Technical Potential (MWh)	**20,363**	**34,767**	**43,308**	**51,588**	**58,925**

Economic Potential (MWh)	2021	2025	2030	2035	2040
HVAC	1,382	1,501	1,644	1,781	1,928
Water Heating	508	624	765	901	1,048
Batteries	-	-	-	-	1,077
Industrial Processes	657	796	963	1,116	1,259
Lighting	-	-	-	-	-
Refrigeration	-	-	-	-	-
Voltage Reduction	424	427	434	447	468
Total Economic Potential (MWh)	**2,970**	**3,348**	**3,807**	**4,246**	**5,778**

Achievable Potential (MWh)	2021	2025	2030	2035	2040
HVAC	36	294	851	1,047	1,103
Water Heating	2	44	283	514	602
Batteries	-	-	-	-	263
Industrial Processes	2	57	356	653	769
Lighting	-	-	-	-	-
Refrigeration	-	-	-	-	-
Voltage Reduction	424	427	434	447	468
Total Achievable Potential (MWh)	**463**	**823**	**1,925**	**2,661**	**3,206**

Total Achievable Incremental Costs ($000s)	2021	2025	2030	2035	2040
HVAC	$464	$1,098	$1,662	$1,305	$1,772
Water Heating	$12	$133	$404	$389	$525
Batteries	-	-	-	-	$146
Industrial Processes	$8	$89	$275	$294	$357
Lighting	-	-	-	-	-
Refrigeration	-	-	-	-	-
Voltage Reduction	$2,280	-	-	-	-
Total Incremental Costs ($000s)	**$2,764**	**$1,320**	**$2,341**	**$1,989**	**$2,800**

Multi-Year Cumulative Cost ($000s)	2021-2025	2026-2030	2031-2035	2036-2040
HVAC	$3,839	$7,717	$7,054	$8,252
Water Heating	$289	$1,567	$1,983	$2,353
Batteries	-	-	-	$336
Industrial Processes	$194	$1,056	$1,417	$1,705
Lighting	-	-	-	-
Refrigeration	-	-	-	-
Voltage Reduction	$2,280	-	-	-
Total 5-Year Costs ($000s)	**$6,602**	**$10,339**	**$10,453**	**$12,646**
Participant Cost	$790	$1,889	$1,910	$2,310
Utility Incentives	$4,649	$5,667	$5,729	$6,931
Utility Administrative Costs	$1,164	$2,784	$2,814	$3,405

Combined

Technical Potential (MW)	2021	2025	2030	2035	2040
HVAC	49.1	53.0	57.7	62.1	66.9
Water Heating	3.5	4.3	5.3	6.3	7.3
Batteries	14.3	28.6	37.3	45.7	53.2
Industrial Processes	4.6	5.5	6.7	7.8	8.7
Lighting	15.9	19.6	24.0	28.1	31.7
Refrigeration	0.0	0.1	0.1	0.1	0.1
Voltage Reduction	2.9	3.0	3.0	3.1	3.3
Total Technical Potential (MW)	**90.4**	**114.1**	**134.1**	**153.1**	**171.2**

Economic Potential (MW)	2021	2025	2030	2035	2040
HVAC	19.2	20.8	22.8	24.7	26.8
Water Heating	3.5	4.3	5.3	6.3	7.3
Batteries	-	-	-	-	1.5
Industrial Processes	4.6	5.5	6.7	7.8	8.7
Lighting	-	-	-	-	-
Refrigeration	-	-	-	-	-
Voltage Reduction	2.9	3.0	3.0	3.1	3.3
Total Economic Potential (MW)	**30.2**	**33.7**	**37.9**	**41.9**	**47.6**

Achievable Potential (MW)	2021	2025	2030	2035	2040
HVAC	0.5	4.1	11.8	14.5	15.3
Water Heating	0.01	0.3	2.0	3.6	4.2
Batteries	-	-	-	-	0.4
Industrial Processes	0.02	0.4	2.5	4.5	5.3
Lighting	-	-	-	-	-
Refrigeration	-	-	-	-	-
Voltage Reduction	2.9	3.0	3.0	3.1	3.3
Total Achievable Potential (MW)	**3.5**	**7.8**	**19.3**	**25.7**	**28.5**

Incremental Achievable Potential (MW)	2021	2025	2030	2035	2040
HVAC	0.5	1.2	1.8	1.4	1.9
Water Heating	0.01	0.1	0.4	0.4	0.6
Batteries	-	-	-	-	0.2
Industrial Processes	0.02	0.2	0.5	0.5	0.7
Lighting	-	-	-	-	-
Refrigeration	-	-	-	-	-
Voltage Reduction	2.9	0.0	0.0	0.0	0.0
Total Achievable Potential (MW)	**3.5**	**1.5**	**2.8**	**2.4**	**3.3**
Incremental Cost per Unit Capacity	$797.83	$880.56	$849.91	$837.73	$843.51

DR.Med: Demand Response Low Avoided Cost Scenario Results

Residential

Technical Potential (MWh)	2021	2025	2030	2035	2040
HVAC	834	1,097	1,416	1,724	2,053
Water Heating	508	624	765	901	1,048
Batteries	11,608	23,803	29,732	35,619	40,687
Industrial Processes	n/a	n/a	n/a	n/a	n/a
Lighting	n/a	n/a	n/a	n/a	n/a
Refrigeration	n/a	n/a	n/a	n/a	n/a
Voltage Reduction	n/a	n/a	n/a	n/a	n/a
Total Technical Potential (MWh)	**15,383**	**27,949**	**34,328**	**40,646**	**46,180**

Economic Potential (MWh)	2021	2025	2030	2035	2040
HVAC	1,258	1,365	1,495	1,619	1,753
Water Heating	508	624	765	901	1,048
Batteries	-	-	-	-	1,077
Industrial Processes	n/a	n/a	n/a	n/a	n/a
Lighting	n/a	n/a	n/a	n/a	n/a
Refrigeration	n/a	n/a	n/a	n/a	n/a
Voltage Reduction	n/a	n/a	n/a	n/a	n/a
Total Economic Potential (MWh)	**1,766**	**1,989**	**2,260**	**2,520**	**3,877**

Achievable Potential (MWh)	2021	2025	2030	2035	2040
HVAC	35	285	796	949	996
Water Heating	2	44	283	514	602
Batteries	-	-	-	-	263
Industrial Processes	n/a	n/a	n/a	n/a	n/a
Lighting	n/a	n/a	n/a	n/a	n/a
Refrigeration	n/a	n/a	n/a	n/a	n/a
Voltage Reduction	n/a	n/a	n/a	n/a	n/a
Total Achievable Potential (MWh)	**37**	**329**	**1,079**	**1,463**	**1,861**

Total Achievable Incremental Costs ($000s)	2021	2025	2030	2035	2040
HVAC	$459	$1,042	$1,518	$1,228	$1,691
Water Heating	$12	$133	$404	$389	$525
Batteries	-	-	-	-	$146
Industrial Processes	n/a	n/a	n/a	n/a	n/a
Lighting	n/a	n/a	n/a	n/a	n/a
Refrigeration	n/a	n/a	n/a	n/a	n/a
Total Incremental Costs ($000s)	**$470**	**$1,175**	**$1,922**	**$1,617**	**$2,362**

Technical Potential (MW)	2021	2025	2030	2035	2040
HVAC	45.4	48.9	53.2	57.3	61.7
Water Heating	3.5	4.3	5.3	6.3	7.3
Batteries	11.8	23.9	30.0	36.2	41.5
Industrial Processes	n/a	n/a	n/a	n/a	n/a
Lighting	n/a	n/a	n/a	n/a	n/a
Refrigeration	n/a	n/a	n/a	n/a	n/a
Voltage Reduction	n/a	n/a	n/a	n/a	n/a
Total Technical Potential (MW)	**60.7**	**77.1**	**88.6**	**99.7**	**110.5**

Economic Potential (MW)	2021	2025	2030	2035	2040
HVAC	17.5	19.0	20.8	22.5	24.3
Water Heating	3.5	4.3	5.3	6.3	7.3
Batteries	-	-	-	-	1.5
Industrial Processes	n/a	n/a	n/a	n/a	n/a
Lighting	n/a	n/a	n/a	n/a	n/a
Refrigeration	n/a	n/a	n/a	n/a	n/a
Voltage Reduction	n/a	n/a	n/a	n/a	n/a
Total Economic Potential (MW)	**21.0**	**23.3**	**26.1**	**28.7**	**33.1**

Achievable Potential (MW)	2021	2025	2030	2035	2040
HVAC	0.5	4.0	11.1	13.2	13.8
Water Heating	0.0	0.3	2.0	3.6	4.2
Batteries	-	-	-	-	0.4
Industrial Processes	n/a	n/a	n/a	n/a	n/a
Lighting	n/a	n/a	n/a	n/a	n/a
Refrigeration	n/a	n/a	n/a	n/a	n/a
Voltage Reduction	n/a	n/a	n/a	n/a	n/a
Total Achievable Potential (MW)	**0.5**	**4.3**	**13.0**	**16.8**	**18.4**

Multi-Year Cumulative Cost ($000s)	2021-2025	2026-2030	2031-2035	2036-2040	2041-2045
HVAC	$3,714	$7,125	$6,506	$7,923	
Water Heating	$289	$1,567	$1,983	$2,353	
Batteries	-	-	-	$336	
Industrial Processes	n/a	n/a	n/a	n/a	
Lighting	n/a	n/a	n/a	n/a	
Refrigeration	n/a	n/a	n/a	n/a	
Total 5-Year Costs ($000s)	**$4,003**	**$8,691**	**$8,489**	**$10,611**	
Participant Cost	$731	$1,588	$1,551	$1,939	
Utility Incentives	$2,194	$4,763	$4,652	$5,816	
Utility Administrative Costs	$1,078	$2,340	$2,285	$2,857	

Commercial

Technical Potential (MWh)	2021	2025	2030	2035	2040
HVAC	265	290	321	349	375
Water Heating	n/a	n/a	n/a	n/a	n/a
Batteries	1,336	2,469	3,791	4,982	6,063
Industrial Processes	657	796	963	1,116	1,259
Lighting	2,291	2,828	3,463	4,040	4,571
Refrigeration	7	7	8	9	9
Voltage Reduction	424	427	434	447	468
Total Technical Potential (MWh)	**4,980**	**6,818**	**8,980**	**10,942**	**12,744**

Economic Potential (MWh)	2021	2025	2030	2035	2040
HVAC	124	135	150	163	175
Water Heating	n/a	n/a	n/a	n/a	n/a
Batteries	-	-	-	-	-
Industrial Processes	657	796	963	1,116	1,259
Lighting	-	-	-	-	-
Refrigeration	-	-	-	-	-
Voltage Reduction	424	427	434	447	468
Total Economic Potential (MWh)	**1,204**	**1,359**	**1,547**	**1,726**	**1,902**

Achievable Potential (MWh)	2021	2025	2030	2035	2040
HVAC	0	10	55	97	108
Water Heating	n/a	n/a	n/a	n/a	n/a
Batteries	-	-	-	-	-
Industrial Processes	2	57	356	653	769
Lighting	-	-	-	-	-
Refrigeration	-	-	-	-	-
Voltage Reduction	424	427	434	447	468
Total Achievable Potential (MWh)	**426**	**494**	**846**	**1,197**	**1,345**

Total Achievable Incremental Costs ($000s)	2021	2025	2030	2035	2040
HVAC	$6	$55	$144	$77	$81
Water Heating	n/a	n/a	n/a	n/a	n/a
Batteries	-	-	-	-	-
Industrial Processes	$8	$89	$275	$294	$357
Lighting	-	-	-	-	-
Refrigeration	-	-	-	-	-
Voltage Reduction	$2,280	-	-	-	-
Total Incremental Costs ($000s)	**$2,294**	**$145**	**$419**	**$372**	**$438**

Technical Potential (MW)	2021	2025	2030	2035	2040
HVAC	3.7	4.0	4.5	4.8	5.2
Water Heating	n/a	n/a	n/a	n/a	n/a
Batteries	2.6	4.7	7.3	9.6	11.7
Industrial Processes	4.6	5.5	6.7	7.8	8.7
Lighting	15.9	19.6	24.0	28.1	31.7
Refrigeration	0.0	0.1	0.1	0.1	0.1
Voltage Reduction	2.9	3.0	3.0	3.1	3.3
Total Technical Potential (MW)	**29.7**	**37.0**	**45.6**	**53.4**	**60.7**

Economic Potential (MW)	2021	2025	2030	2035	2040
HVAC	1.7	1.9	2.1	2.3	2.4
Water Heating	n/a	n/a	n/a	n/a	n/a
Batteries	-	-	-	-	-
Industrial Processes	4.6	5.5	6.7	7.8	8.7
Lighting	-	-	-	-	-
Refrigeration	-	-	-	-	-
Voltage Reduction	2.9	3.0	3.0	3.1	3.3
Total Economic Potential (MW)	**9.2**	**10.4**	**11.8**	**13.1**	**14.4**

Achievable Potential (MW)	2021	2025	2030	2035	2040
HVAC	0.01	0.1	0.8	1.4	1.5
Water Heating	n/a	n/a	n/a	n/a	n/a
Batteries	-	-	-	-	-
Industrial Processes	0.02	0.4	2.5	4.5	5.3
Lighting	-	-	-	-	-
Refrigeration	-	-	-	-	-
Voltage Reduction	2.9	3.0	3.0	3.1	3.3
Total Achievable Potential (MW)	**3.0**	**3.5**	**6.3**	**9.0**	**10.1**

Multi-Year Cumulative Cost ($000s)	2021-2025	2026-2030	2031-2035	2036-2040	2041-2045
HVAC	$125	$593	$548	$330	
Water Heating	n/a	n/a	n/a	n/a	
Batteries	-	-	-	-	
Industrial Processes	$194	$1,056	$1,417	$1,705	
Lighting	-	-	-	-	
Refrigeration	-	-	-	-	
Voltage Reduction	$2,280	-	-	-	
Total 5-Year Costs ($000s)	**$2,598**	**$1,648**	**$1,965**	**$2,035**	
Participant Cost	$58	$301	$359	$372	
Utility Incentives	$2,455	$903	$1,077	$1,115	
Utility Administrative Costs	$86	$444	$529	$548	

DR.Hourly.Med: Demand Response Low Avoided Cost Scenario Results

	Winter	2021		2025		2030		2035		2040	
	12/19	Base Load (MW)	Total Deferral Available	Base Load (MW)	Total Deferral Available	Base Load (MW)	Total Deferral Available	Base Load (MW)	Total Deferral Available	Base Load (MW)	Total Deferral Available
8449	1	326.9	-0.5	329.9	-4.8	335.2	-16.3	344.8	-22.6	361.3	-25.2
8450	2	318.4	0.0	321.3	0.0	326.5	0.0	335.8	0.0	351.9	-0.4
8451	3	315.3	0.0	318.2	0.0	323.3	0.0	332.6	0.0	348.4	0.0
8452	4	316.6	0.0	319.4	0.0	324.6	0.0	333.9	0.0	349.9	0.0
8453	5	326.0	0.0	329.0	0.0	334.3	0.0	343.9	0.0	360.3	0.0
8454	6	348.9	0.0	352.1	0.0	357.8	0.0	368.0	0.0	385.6	0.0
8455	7	386.2	0.0	389.7	0.0	396.1	0.0	407.4	0.0	426.8	0.0
8456	8	405.2	0.0	408.9	0.0	415.5	0.0	427.4	0.0	447.8	0.0
8457	9	406.7	0.0	410.4	0.0	417.1	0.0	429.0	0.0	449.5	0.0
8458	10	401.9	0.0	405.5	0.0	412.1	0.0	423.9	0.0	444.2	0.0
8459	11	397.7	0.0	401.3	0.0	407.8	0.0	419.5	0.0	439.5	0.0
8460	12	393.9	0.0	397.5	0.0	403.9	0.0	415.5	0.0	435.3	0.0
8461	13	389.5	0.0	393.0	0.0	399.4	0.0	410.8	0.0	430.4	0.0
8462	14	386.5	0.0	390.0	0.0	396.3	0.0	407.7	0.0	427.1	0.0
8463	15	382.2	0.0	385.7	0.0	391.9	0.0	403.2	0.0	422.4	0.0
8464	16	384.2	0.0	387.8	0.0	394.0	0.0	405.3	0.0	424.7	0.0
8465	17	408.1	2.9	411.8	3.7	418.5	8.1	430.5	12.4	451.1	14.3
8466	18	447.0	2.9	451.1	3.7	458.4	8.1	471.5	12.4	494.1	14.3
8467	19	448.1	2.9	452.2	3.7	459.5	8.1	472.7	12.4	495.2	14.3
8468	20	441.3	2.9	445.4	3.7	452.6	8.1	465.5	12.4	487.8	14.3
8469	21	430.8	2.9	434.7	3.7	441.7	8.1	454.4	12.4	476.1	14.3
8470	22	408.1	2.9	411.8	3.7	418.5	8.1	430.4	12.4	451.0	14.3
8471	23	374.6	-0.5	378.0	-4.8	384.2	-16.3	395.2	-22.6	414.0	-25.2
8472	24	344.7	-0.5	347.8	-4.8	353.5	-16.3	363.6	-22.6	381.0	-25.2
		448.1 MW	**2.9 MW**	**452.2 MW**	**3.7 MW**	**459.5 MW**	**8.1 MW**	**472.7 MW**	**12.4 MW**	**495.2 MW**	**14.3 MW**

	Spring/Fall	2021		2025		2030		2035		2040	
	09/15	Base Load (MW)	Total Deferral Available	Base Load (MW)	Total Deferral Available	Base Load (MW)	Total Deferral Available	Base Load (MW)	Total Deferral Available	Base Load (MW)	Total Deferral Available
6169	1	313.1	0.0	315.9	0.0	321.0	0.0	330.2	0.0	346.0	0.0
6170	2	298.0	0.0	300.8	0.0	305.6	0.0	314.4	0.0	329.4	0.0
6171	3	289.5	0.0	292.1	0.0	296.9	0.0	305.4	0.0	320.0	0.0
6172	4	284.7	0.0	287.3	0.0	291.9	0.0	300.3	0.0	314.6	0.0
6173	5	286.6	0.0	289.2	0.0	293.9	0.0	302.3	0.0	316.7	0.0
6174	6	302.0	0.0	304.8	0.0	309.7	0.0	318.6	0.0	333.8	0.0
6175	7	331.5	0.0	334.5	0.0	340.0	0.0	349.7	0.0	366.4	0.0
6176	8	349.7	0.0	352.9	0.0	358.7	0.0	368.9	0.0	386.5	0.0
6177	9	370.4	0.0	373.8	0.0	379.8	0.0	390.7	0.0	409.4	0.0
6178	10	391.3	0.0	394.9	0.0	401.3	0.0	412.8	0.0	432.5	0.0
6179	11	410.7	0.0	414.4	0.0	421.2	0.0	433.2	0.0	453.9	0.0
6180	12	426.4	0.0	430.3	0.0	437.2	0.0	449.8	0.0	471.2	0.0
6181	13	441.4	0.0	445.5	0.0	452.7	0.0	465.6	0.0	487.9	0.0
6182	14	457.2	0.0	461.4	0.0	468.8	0.0	482.2	0.0	505.3	0.0
6183	15	471.3	2.9	475.6	3.7	483.3	8.1	497.2	12.4	520.9	14.3
6184	16	479.5	2.9	483.9	3.7	491.8	8.1	505.8	12.4	530.0	14.3
6185	17	482.9	2.9	487.4	3.7	495.2	8.1	509.4	12.4	533.8	14.3
6186	18	475.4	2.9	479.7	3.7	487.5	8.1	501.4	12.4	525.4	14.3
6187	19	451.8	2.9	455.9	3.7	463.3	8.1	476.5	12.4	499.3	14.3
6188	20	444.8	2.9	448.9	3.7	456.2	8.1	469.2	12.4	491.6	14.3
6189	21	427.0	-0.5	430.9	-4.8	437.9	-16.3	450.4	-22.6	471.9	-25.2
6190	22	392.5	-0.5	396.1	-4.8	402.5	-16.3	414.0	-22.6	433.8	-25.2
6191	23	354.1	-0.5	357.3	-4.8	363.1	-16.3	373.5	-22.6	391.4	-25.2
6192	24	319.9	0.0	322.8	0.0	328.1	0.0	337.5	0.0	353.6	-0.4
		482.9 MW	**2.9 MW**	**487.4 MW**	**3.7 MW**	**495.2 MW**	**8.1 MW**	**509.4 MW**	**12.4 MW**	**533.8 MW**	**14.3 MW**

	Summer	2021		2025		2030		2035		2040	
	07/10	Base Load (MW)	Total Deferral Available	Base Load (MW)	Total Deferral Available	Base Load (MW)	Total Deferral Available	Base Load (MW)	Total Deferral Available	Base Load (MW)	Total Deferral Available
4561	1	350.3	0.0	353.5	0.0	359.2	0.0	369.5	0.0	387.1	0.0
4562	2	327.3	0.0	330.3	0.0	335.6	0.0	345.2	0.0	361.7	0.0
4563	3	314.6	0.0	317.5	0.0	322.6	0.0	331.9	0.0	347.7	0.0
4564	4	308.1	0.0	310.9	0.0	316.0	0.0	325.0	0.0	340.5	0.0
4565	5	312.0	0.0	314.8	0.0	319.9	0.0	329.1	0.0	344.8	0.0
4566	6	323.5	0.0	326.4	0.0	331.7	0.0	341.2	0.0	357.5	0.0
4567	7	342.0	0.0	345.1	0.0	350.7	0.0	360.8	0.0	378.0	0.0
4568	8	375.8	0.0	379.2	0.0	385.3	0.0	396.4	0.0	415.3	0.0
4569	9	414.2	0.0	418.0	0.0	424.7	0.0	436.9	0.0	457.7	0.0
4570	10	455.7	0.0	459.8	0.0	467.3	0.0	480.6	0.0	503.6	0.0
4571	11	494.4	0.0	498.9	0.0	507.0	0.0	521.5	0.0	546.4	0.0
4572	12	535.6	0.0	540.5	0.0	549.2	0.0	564.9	0.0	591.9	0.0
4573	13	566.6	0.0	571.7	0.0	581.0	0.0	597.6	0.0	626.2	0.0
4574	14	593.9	3.4	599.3	7.7	609.0	19.2	626.4	25.5	656.4	28.1
4575	15	616.7	3.4	622.3	7.7	632.4	19.2	650.5	25.5	681.6	28.1
4576	16	608.5	3.4	614.0	7.7	624.0	19.2	641.9	25.5	672.5	28.1
4577	17	583.7	3.4	589.0	7.7	598.5	19.2	615.7	25.5	645.1	28.1
4578	18	576.6	3.4	581.8	7.7	591.3	19.2	608.2	25.5	637.3	28.1
4579	19	567.3	3.4	572.5	7.7	581.8	19.2	598.4	25.5	627.0	28.1
4580	20	543.1	-0.5	548.0	-4.8	556.9	-16.3	572.8	-22.6	600.2	-25.2
4581	21	527.1	-0.5	531.9	-4.8	540.5	-16.3	556.0	-22.6	582.5	-25.2
4582	22	499.0	-0.5	503.5	-4.8	511.7	-16.3	526.3	-22.6	551.5	-25.2
4583	23	445.5	0.0	449.6	0.0	456.9	0.0	470.0	0.0	492.4	-0.4
4584	24	396.3	0.0	399.9	0.0	406.4	0.0	418.1	0.0	438.0	0.0
		616.7 MW	**3.4 MW**	**622.3 MW**	**7.7 MW**	**632.4 MW**	**19.2 MW**	**650.5 MW**	**25.5 MW**	**681.6 MW**	**28.1 MW**

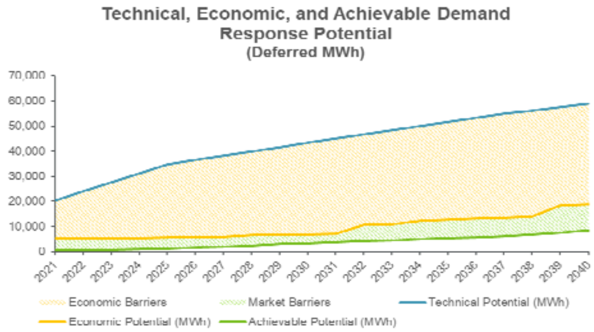
DR.Hourly.Med: Demand Response Low Avoided Cost Scenario Results

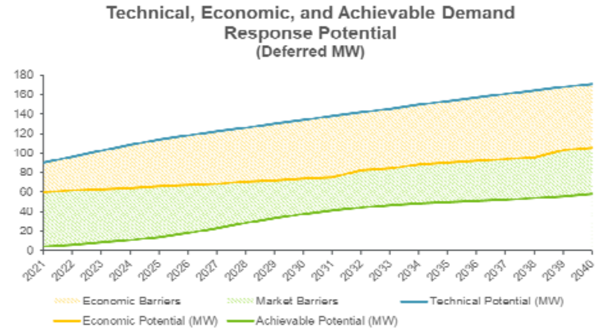
	Winter	2021		2025		2030		2035		2040	
Peak Hours	12/19	Base Load (MW)	Load w/DR Curtailment	Base Load (MW)	Load w/DR Curtailment	Base Load (MW)	Load w/DR Curtailment	Base Load (MW)	Load w/DR Curtailment	Base Load (MW)	Load w/DR Curtailment
20	1	327	327	330	335	335	351	345	367	361	386
22	2	318	318	321	321	326	326	336	336	352	352
24	3	315	315	318	318	323	323	333	333	348	348
23	4	317	317	319	319	325	325	334	334	350	350
21	5	326	326	329	329	334	334	344	344	360	360
18	6	349	349	352	352	358	358	368	368	386	386
14	7	386	386	390	390	396	396	407	407	427	427
8	8	405	405	409	409	416	416	427	427	448	448
7	9	407	407	410	410	417	417	429	429	450	450
9	10	402	402	406	406	412	412	424	424	444	444
10	11	398	398	401	401	408	408	419	419	439	439
11	12	394	394	397	397	404	404	415	415	435	435
12	13	389	389	393	393	399	399	411	411	430	430
13	14	386	386	390	390	396	396	408	408	427	427
16	15	382	382	386	386	392	392	403	403	422	422
15	16	384	384	388	388	394	394	405	405	425	425
5	17	408	405	412	408	419	410	430	418	451	437
2	18	447	444	451	447	458	450	472	459	494	480
1	19	448	445	452	448	460	451	473	460	495	481
3	20	441	438	445	442	453	444	466	453	488	473
4	21	431	428	435	431	442	434	454	442	476	462
6	22	408	405	412	408	418	410	430	418	451	437
17	23	375	375	378	383	384	400	395	418	414	439
19	24	345	345	348	353	353	370	364	386	381	406

	Spring/Fall	2021		2025		2030		2035		2040	
Peak Hours	09/15	Base Load (MW)	Load w/DR Curtailment	Base Load (MW)	Load w/DR Curtailment	Base Load (MW)	Load w/DR Curtailment	Base Load (MW)	Load w/DR Curtailment	Base Load (MW)	Load w/DR Curtailment
19	1	313	313	316	316	321	321	330	330	346	346
21	2	298	298	301	301	306	306	314	314	329	329
22	3	290	290	292	292	297	297	305	305	320	320
24	4	285	285	287	287	292	292	300	300	315	315
23	5	287	287	289	289	294	294	302	302	317	317
20	6	302	302	305	305	310	310	319	319	334	334
17	7	332	332	335	335	340	340	350	350	366	366
16	8	350	350	353	353	359	359	369	369	387	387
14	9	370	370	374	374	380	380	391	391	409	409
13	10	391	391	395	395	401	401	413	413	433	433
11	11	411	411	414	414	421	421	433	433	454	454
10	12	426	426	430	430	437	437	450	450	471	471
8	13	441	441	445	445	453	453	466	466	488	488
5	14	457	457	461	461	469	469	482	482	505	505
4	15	471	468	476	472	483	475	497	485	521	507
2	16	480	477	484	480	492	484	506	493	530	516
1	17	483	480	487	484	495	487	509	497	534	519
3	18	475	472	480	476	487	479	501	489	525	511
6	19	452	449	456	452	463	455	477	464	499	485
7	20	445	442	449	445	456	448	469	457	492	477
9	21	427	428	431	436	438	454	450	473	472	497
12	22	392	393	396	401	402	419	414	437	434	459
15	23	354	355	357	362	363	379	374	396	391	417
18	24	320	320	323	323	328	328	337	337	354	354

	Summer	2021		2025		2030		2035		2040	
Peak Hours	07/10	Base Load (MW)	Load w/DR Curtailment	Base Load (MW)	Load w/DR Curtailment	Base Load (MW)	Load w/DR Curtailment	Base Load (MW)	Load w/DR Curtailment	Base Load (MW)	Load w/DR Curtailment
18	1	350	350	353	353	359	359	369	369	387	387
20	2	327	327	330	330	336	336	345	345	362	362
22	3	315	315	317	317	323	323	332	332	348	348
24	4	308	308	311	311	316	316	325	325	341	341
23	5	312	312	315	315	320	320	329	329	345	345
21	6	323	323	326	326	332	332	341	341	357	357
19	7	342	342	345	345	351	351	361	361	378	378
17	8	376	376	379	379	385	385	396	396	415	415
15	9	414	414	418	418	425	425	437	437	458	458
13	10	456	456	460	460	467	467	481	481	504	504
12	11	494	494	499	499	507	507	522	522	546	546
9	12	536	536	540	540	549	549	565	565	592	592
7	13	567	567	572	572	581	581	598	598	626	626
3	14	594	590	599	592	609	590	626	601	656	628
1	15	617	613	622	615	632	613	651	625	682	653
2	16	608	605	614	606	624	605	642	616	673	644
4	17	584	580	589	581	599	579	616	590	645	617
5	18	577	573	582	574	591	572	608	583	637	609
6	19	567	564	573	565	582	563	598	573	627	599
8	20	543	544	548	553	557	573	573	595	600	625
10	21	527	528	532	537	540	557	556	579	583	608
11	22	499	499	504	508	512	528	526	549	551	577
14	23	446	446	450	450	457	457	470	470	492	493
16	24	396	396	400	400	406	406	418	418	438	438

DR.High: Demand Response High Avoided Cost Scenario Results





Combined

Technical Potential (MWh)	2021	2025	2030	2035	2040
HVAC	3,533	3,813	4,152	4,475	4,820
Water Heating	508	624	765	901	1,048
Batteries	12,944	26,272	33,523	40,601	46,750
Industrial Processes	657	796	963	1,116	1,259
Lighting	2,291	2,828	3,463	4,040	4,571
Refrigeration	7	7	8	9	9
Voltage Reduction	424	427	434	447	468
Total Technical Potential (MWh)	**20,363**	**34,767**	**43,308**	**51,588**	**58,925**

Economic Potential (MWh)	2021	2025	2030	2035	2040
HVAC	3,533	3,813	4,152	4,475	4,820
Water Heating	508	624	765	901	1,048
Batteries	-	-	656	5,842	11,360
Industrial Processes	657	796	963	1,116	1,259
Lighting	-	-	-	-	-
Refrigeration	-	-	-	-	-
Voltage Reduction	424	427	434	447	468
Total Economic Potential (MWh)	**5,121**	**5,660**	**6,970**	**12,781**	**18,954**

Achievable Potential (MWh)	2021	2025	2030	2035	2040
HVAC	92	755	2,158	2,627	2,754
Water Heating	2	44	283	514	602
Batteries	-	-	206	1,100	3,995
Industrial Processes	2	57	356	653	769
Lighting	-	-	-	-	-
Refrigeration	-	-	-	-	-
Voltage Reduction	424	427	434	447	468
Total Achievable Potential (MWh)	**520**	**1,284**	**3,438**	**5,341**	**8,589**

Total Achievable Incremental Costs ($000s)	2021	2025	2030	2035	2040
HVAC	$1,235	$2,892	$4,347	$3,397	$4,590
Water Heating	$12	$133	$404	$389	$525
Batteries	-	-	$89	$627	$1,688
Industrial Processes	$8	$89	$275	$294	$357
Lighting	-	-	-	-	-
Refrigeration	-	-	-	-	-
Voltage Reduction	$2,280	-	-	-	-
Total Incremental Costs ($000s)	**$3,535**	**$3,114**	**$5,115**	**$4,708**	**$7,160**

Multi-Year Cumulative Cost ($000s)	2021-2025	2026-2030	2031-2035	2036-2040
HVAC	$10,149	$20,227	$18,396	$21,417
Water Heating	$289	$1,567	$1,983	$2,353
Batteries	-	$342	$1,897	$6,102
Industrial Processes	$194	$1,056	$1,417	$1,705
Lighting	-	-	-	-
Refrigeration	-	-	-	-
Voltage Reduction	$2,280	-	-	-
Total 5-Year Costs ($000s)	**$12,913**	**$23,192**	**$23,692**	**$31,578**
Participant Cost	$1,943	$4,237	$4,328	$5,769
Utility Incentives	$8,108	$12,711	$12,985	$17,307
Utility Administrative Costs	$2,863	$6,244	$6,379	$8,502

Combined

Technical Potential (MW)	2021	2025	2030	2035	2040
HVAC	49.1	53.0	57.7	62.1	66.9
Water Heating	3.5	4.3	5.3	6.3	7.3
Batteries	14.3	28.6	37.3	45.7	53.2
Industrial Processes	4.6	5.5	6.7	7.8	8.7
Lighting	15.9	19.6	24.0	28.1	31.7
Refrigeration	0.0	0.1	0.1	0.1	0.1
Voltage Reduction	2.9	3.0	3.0	3.1	3.3
Total Technical Potential (MW)	**90.4**	**114.1**	**134.1**	**153.1**	**171.2**

Economic Potential (MW)	2021	2025	2030	2035	2040
HVAC	49.1	53.0	57.7	62.1	66.9
Water Heating	3.5	4.3	5.3	6.3	7.3
Batteries	-	-	0.9	10.8	19.1
Industrial Processes	4.6	5.5	6.7	7.8	8.7
Lighting	-	-	-	-	-
Refrigeration	-	-	-	-	-
Voltage Reduction	2.9	3.0	3.0	3.1	3.3
Total Economic Potential (MW)	**60.1**	**65.8**	**73.6**	**90.1**	**105.4**

Achievable Potential (MW)	2021	2025	2030	2035	2040
HVAC	1.3	10.5	30.0	36.5	38.3
Water Heating	0.01	0.3	2.0	3.6	4.2
Batteries	-	-	0.3	1.9	7.0
Industrial Processes	0.02	0.4	2.5	4.5	5.3
Lighting	-	-	-	-	-
Refrigeration	-	-	-	-	-
Voltage Reduction	2.9	3.0	3.0	3.1	3.3
Total Achievable Potential (MW)	**4.3**	**14.2**	**37.7**	**49.6**	**58.1**

Incremental Achievable Potential (MW)	2021	2025	2030	2035	2040
HVAC	1.3	3.0	4.5	3.5	4.7
Water Heating	0.01	0.1	0.4	0.4	0.6
Batteries	-	-	0.1	0.5	1.5
Industrial Processes	0.02	0.2	0.5	0.5	0.7
Lighting	-	-	-	-	-
Refrigeration	-	-	-	-	-
Voltage Reduction	2.9	0.0	0.0	0.0	0.0
Total Achievable Potential (MW)	**4.3**	**3.3**	**5.5**	**5.0**	**7.5**
Incremental Cost per Unit Capacity	$831.52	$940.86	$927.56	$938.94	$950.17

DR.High: Demand Response High Avoided Cost Scenario Results

Residential Technical Potential (MWh)	2019	2025	2030	2035	2040
HVAC	3,267	3,522	3,831	4,126	4,445
Water Heating	508	624	765	901	1,048
Batteries	11,608	23,803	29,732	35,619	40,687
Industrial Processes	n/a	n/a	n/a	n/a	n/a
Lighting	n/a	n/a	n/a	n/a	n/a
Refrigeration	n/a	n/a	n/a	n/a	n/a
Voltage Reduction	n/a	n/a	n/a	n/a	n/a
Total Technical Potential (MWh)	**15,383**	**27,949**	**34,328**	**40,646**	**46,180**

Economic Potential (MWh)	2021	2025	2030	2035	2040
HVAC	3,267	3,522	3,831	4,126	4,445
Water Heating	508	624	765	901	1,048
Batteries	-	-	656	860	5,297
Industrial Processes	n/a	n/a	n/a	n/a	n/a
Lighting	n/a	n/a	n/a	n/a	n/a
Refrigeration	n/a	n/a	n/a	n/a	n/a
Voltage Reduction	n/a	n/a	n/a	n/a	n/a
Total Economic Potential (MWh)	**3,775**	**4,146**	**5,252**	**5,887**	**10,790**

Achievable Potential (MWh)	2021	2025	2030	2035	2040
HVAC	91	735	2,039	2,418	2,524
Water Heating	2	44	283	514	602
Batteries	-	-	206	449	1,258
Industrial Processes	n/a	n/a	n/a	n/a	n/a
Lighting	n/a	n/a	n/a	n/a	n/a
Refrigeration	n/a	n/a	n/a	n/a	n/a
Voltage Reduction	n/a	n/a	n/a	n/a	n/a
Total Achievable Potential (MWh)	**93**	**779**	**2,528**	**3,381**	**4,384**

Total Achievable Incremental Costs ($000s)	2021	2025	2030	2035	2040
HVAC	$1,220	$2,744	$3,963	$3,191	$4,373
Water Heating	$12	$133	$404	$389	$525
Batteries	-	-	$89	$64	$647
Industrial Processes	n/a	n/a	n/a	n/a	n/a
Voltage Reduction	424	427	434	447	468
Total Technical Potential (MWh)	**20,363**	**34,767**	**43,308**	**51,588**	**58,925**

Economic Potential (MWh)	2021	2025	2030	2035	2040
HVAC	3,533	3,813	4,152	4,475	4,820
Water Heating	508	624	765	901	1,048
Batteries	-	-	656	5,842	11,360
Industrial Processes	657	796	963	1,116	1,259
Lighting	-	-	-	-	-
Refrigeration	-	-	-	-	-
Voltage Reduction	424	427	434	447	468
Total Economic Potential (MWh)	**5,121**	**5,660**	**6,970**	**12,781**	**18,954**

Achievable Potential (MWh)	2021	2025	2030	2035	2040
HVAC	92	755	2,158	2,627	2,754
Water Heating	2	44	283	514	602
Batteries	-	-	206	1,100	3,995
Industrial Processes	2	57	356	653	769
Lighting	-	-	-	-	-
Refrigeration	-	-	-	-	-
Voltage Reduction	424	427	434	447	468
Total Achievable Potential (MWh)	**520**	**1,284**	**3,438**	**5,341**	**8,589**

Total Achievable Incremental Costs ($000s)	2021	2025	2030	2035	2040
HVAC	$1,235	$2,892	$4,347	$3,397	$4,590
Water Heating	$12	$133	$404	$389	$525
Batteries	-	-	$89	$627	$1,688
Industrial Processes	$8	$89	$275	$294	$357
Lighting	-	-	-	-	-
Refrigeration	-	-	-	-	-
Voltage Reduction	$2,280	-	-	-	-
Total Incremental Costs ($000s)	**$3,535**	**$3,114**	**$5,115**	**$4,708**	**$7,160**

Multi-Year Cumulative Cost ($000s)	2021-2025	2026-2030	2031-2035	2036-2040
HVAC	$10,149	$20,227	$18,396	$21,417
Water Heating	$289	$1,567	$1,983	$2,353
Batteries	-	$342	$1,897	$6,102
Industrial Processes	$194	$1,056	$1,417	$1,705
Lighting	-	-	-	-
Refrigeration	-	-	-	-
Voltage Reduction	$2,280	-	-	-
Total 5-Year Costs ($000s)	**$12,913**	**$23,192**	**$23,692**	**$31,578**
Participant Cost	$1,943	$4,237	$4,328	$5,769
Utility Incentives	$8,108	$12,711	$12,985	$17,307
Utility Administrative Costs	$2,863	$6,244	$6,379	$8,502

Residential Technical Potential (MWh)	2019	2025	2030	2035	2040
HVAC	3,267	3,522	3,831	4,126	4,445

Residential Technical Potential (MW)	2019	2025	2030	2035	2040
HVAC	45.4	48.9	53.2	57.3	61.7
Water Heating	3.5	4.3	5.3	6.3	7.3
Batteries	11.8	23.9	30.0	36.2	41.5
Industrial Processes	n/a	n/a	n/a	n/a	n/a
Lighting	n/a	n/a	n/a	n/a	n/a
Refrigeration	n/a	n/a	n/a	n/a	n/a
Voltage Reduction	n/a	n/a	n/a	n/a	n/a
Total Technical Potential (MW)	**60.7**	**77.1**	**88.6**	**99.7**	**110.5**

Economic Potential (MW)	2021	2025	2030	2035	2040
HVAC	45.4	48.9	53.2	57.3	61.7
Water Heating	3.5	4.3	5.3	6.3	7.3
Batteries	-	-	0.9	1.2	7.5
Industrial Processes	n/a	n/a	n/a	n/a	n/a
Lighting	n/a	n/a	n/a	n/a	n/a
Refrigeration	n/a	n/a	n/a	n/a	n/a
Voltage Reduction	n/a	n/a	n/a	n/a	n/a
Total Economic Potential (MW)	**48.9**	**53.3**	**59.5**	**64.8**	**76.5**

Achievable Potential (MW)	2021	2025	2030	2035	2040
HVAC	1.3	10.2	28.3	33.6	35.0
Water Heating	0.0	0.3	2.0	3.6	4.2
Batteries	-	-	0.3	0.6	1.8
Industrial Processes	n/a	n/a	n/a	n/a	n/a
Lighting	n/a	n/a	n/a	n/a	n/a
Refrigeration	n/a	n/a	n/a	n/a	n/a
Voltage Reduction	n/a	n/a	n/a	n/a	n/a
Total Achievable Potential (MW)	**1.3**	**10.5**	**30.6**	**37.8**	**41.0**

Multi-Year Cumulative Cost ($000s)	2021-2025	2026-2030	2031-2035	2036-2040	2041-2045
HVAC	$9,817	$18,647	$16,935	$20,538	
Water Heating	$289	$1,567	$1,983	$2,353	
Batteries	-	$342	$360	$1,635	
Industrial Processes	n/a	n/a	n/a	n/a	
Voltage Reduction	2.9	3.0	3.0	3.1	3.3
Total Technical Potential (MW)	**90.4**	**114.1**	**134.1**	**153.1**	**171.2**

Economic Potential (MW)	2021	2025	2030	2035	2040
HVAC	49.1	53.0	57.7	62.1	66.9
Water Heating	3.5	4.3	5.3	6.3	7.3
Batteries	-	-	0.9	10.8	19.1
Industrial Processes	4.6	5.5	6.7	7.8	8.7
Lighting	-	-	-	-	-
Refrigeration	-	-	-	-	-
Voltage Reduction	2.9	3.0	3.0	3.1	3.3
Total Economic Potential (MW)	**60.1**	**65.8**	**73.6**	**90.1**	**105.4**

Achievable Potential (MW)	2021	2025	2030	2035	2040
HVAC	1.3	10.5	30.0	36.5	38.3
Water Heating	0.01	0.3	2.0	3.6	4.2
Batteries	-	-	0.3	1.9	7.0
Industrial Processes	0.02	0.4	2.5	4.5	5.3
Lighting	-	-	-	-	-
Refrigeration	-	-	-	-	-
Voltage Reduction	2.9	3.0	3.0	3.1	3.3
Total Achievable Potential (MW)	**4.3**	**14.2**	**37.7**	**49.6**	**58.1**

Incremental Achievable Potential (MW)	2021	2025	2030	2035	2040
HVAC	1.3	3.0	4.5	3.5	4.7
Water Heating	0.01	0.1	0.4	0.4	0.6
Batteries	-	-	0.1	0.5	1.5
Industrial Processes	0.02	0.2	0.5	0.5	0.7
Lighting	-	-	-	-	-
Refrigeration	-	-	-	-	-
Voltage Reduction	2.9	0.0	0.0	0.0	0.0
Total Achievable Potential (MW)	**4.3**	**3.3**	**5.5**	**5.0**	**7.5**
Incremental Cost per Unit Capacity	$831.52	$940.86	$927.56	$938.94	$950.17

Residential Technical Potential (MW)	2019	2025	2030	2035	2040
HVAC	45.4	48.9	53.2	57.3	61.7

DR.Hourly.High: Demand Response High Avoided Cost Scenario Results

	Winter	2021		2025		2030		2035		2040	
	12/19	Base Load (MW)	Total Deferral Available	Base Load (MW)	Total Deferral Available	Base Load (MW)	Total Deferral Available	Base Load (MW)	Total Deferral Available	Base Load (MW)	Total Deferral Available
8449	1	326.9	-0.7	329.9	-6.6	335.2	-22.1	344.8	-30.3	361.3	-34.0
8450	2	318.4	0.0	321.3	0.0	326.5	-0.3	335.8	-0.6	351.9	-1.8
8451	3	315.3	0.0	318.2	0.0	323.3	0.0	332.6	0.0	348.4	0.0
8452	4	316.6	0.0	319.4	0.0	324.6	0.0	333.9	0.0	349.9	0.0
8453	5	326.0	0.0	329.0	0.0	334.3	0.0	343.9	0.0	360.3	0.0
8454	6	348.9	0.0	352.1	0.0	357.8	0.0	368.0	0.0	385.6	0.0
8455	7	386.2	0.0	389.7	0.0	396.1	0.0	407.4	0.0	426.8	0.0
8456	8	405.2	0.0	408.9	0.0	415.5	0.0	427.4	0.0	447.8	0.0
8457	9	406.7	0.0	410.4	0.0	417.1	0.0	429.0	0.0	449.5	0.0
8458	10	401.9	0.0	405.5	0.0	412.1	0.0	423.9	0.0	444.2	0.0
8459	11	397.7	0.0	401.3	0.0	407.8	0.0	419.5	0.0	439.5	0.0
8460	12	393.9	0.0	397.5	0.0	403.9	0.0	415.5	0.0	435.3	0.0
8461	13	389.5	0.0	393.0	0.0	399.4	0.0	410.8	0.0	430.4	0.0
8462	14	386.5	0.0	390.0	0.0	396.3	0.0	407.7	0.0	427.1	0.0
8463	15	382.2	0.0	385.7	0.0	391.9	0.0	403.2	0.0	422.4	0.0
8464	16	384.2	0.0	387.8	0.0	394.0	0.0	405.3	0.0	424.7	0.0
8465	17	408.1	3.0	411.8	4.7	418.5	11.6	430.5	18.5	451.1	25.5
8466	18	447.0	3.0	451.1	4.7	458.4	11.6	471.5	18.5	494.1	25.5
8467	19	448.1	3.0	452.2	4.7	459.5	11.6	472.7	18.5	495.2	25.5
8468	20	441.3	3.0	445.4	4.7	452.6	11.6	465.5	18.5	487.8	25.5
8469	21	430.8	3.0	434.7	4.7	441.7	11.6	454.4	18.5	476.1	25.5
8470	22	408.1	3.0	411.8	4.7	418.5	11.6	430.4	18.5	451.0	25.5
8471	23	374.6	-0.7	378.0	-6.6	384.2	-22.1	395.2	-31.6	414.0	-39.3
8472	24	344.7	-0.7	347.8	-6.6	353.5	-22.1	363.6	-31.6	381.0	-39.3
		448.1 MW	**3.0 MW**	**452.2 MW**	**4.7 MW**	**459.5 MW**	**11.6 MW**	**472.7 MW**	**18.5 MW**	**495.2 MW**	**25.5 MW**

	Spring/Fall	2021		2025		2030		2035		2040	
	09/15	Base Load (MW)	Total Deferral Available	Base Load (MW)	Total Deferral Available	Base Load (MW)	Total Deferral Available	Base Load (MW)	Total Deferral Available	Base Load (MW)	Total Deferral Available
6169	1	313.1	0.0	315.9	0.0	321.0	0.0	330.2	0.0	346.0	0.0
6170	2	298.0	0.0	300.8	0.0	305.6	0.0	314.4	0.0	329.4	0.0
6171	3	289.5	0.0	292.1	0.0	296.9	0.0	305.4	0.0	320.0	0.0
6172	4	284.7	0.0	287.3	0.0	291.9	0.0	300.3	0.0	314.6	0.0
6173	5	286.6	0.0	289.2	0.0	293.9	0.0	302.3	0.0	316.7	0.0
6174	6	302.0	0.0	304.8	0.0	309.7	0.0	318.6	0.0	333.8	0.0
6175	7	331.5	0.0	334.5	0.0	340.0	0.0	349.7	0.0	366.4	0.0
6176	8	349.7	0.0	352.9	0.0	358.7	0.0	368.9	0.0	386.5	0.0
6177	9	370.4	0.0	373.8	0.0	379.8	0.0	390.7	0.0	409.4	0.0
6178	10	391.3	0.0	394.9	0.0	401.3	0.0	412.8	0.0	432.5	0.0
6179	11	410.7	0.0	414.4	0.0	421.2	0.0	433.2	0.0	453.9	0.0
6180	12	426.4	0.0	430.3	0.0	437.2	0.0	449.8	0.0	471.2	0.0
6181	13	441.4	0.0	445.5	0.0	452.7	0.0	465.6	0.0	487.9	0.0
6182	14	457.2	0.0	461.4	0.0	468.8	0.0	482.2	0.0	505.3	0.0
6183	15	471.3	3.0	475.6	4.7	483.3	11.6	497.2	18.5	520.9	25.5
6184	16	479.5	3.0	483.9	4.7	491.8	11.6	505.8	18.5	530.0	25.5
6185	17	482.9	3.0	487.4	4.7	495.2	11.6	509.4	18.5	533.8	25.5
6186	18	475.4	3.0	479.7	4.7	487.5	11.6	501.4	18.5	525.4	25.5
6187	19	451.8	3.0	455.9	4.7	463.3	11.6	476.5	18.5	499.3	25.5
6188	20	444.8	3.0	448.9	4.7	456.2	11.6	469.2	18.5	491.6	25.5
6189	21	427.0	-0.7	430.9	-6.6	437.9	-22.1	450.4	-31.6	471.9	-39.3
6190	22	392.5	-0.7	396.1	-6.6	402.5	-22.1	414.0	-31.6	433.8	-39.3
6191	23	354.1	-0.7	357.3	-6.6	363.1	-22.1	373.5	-30.3	391.4	-34.0
6192	24	319.9	0.0	322.8	0.0	328.1	-0.3	337.5	-0.6	353.6	-1.8
		482.9 MW	**3.0 MW**	**487.4 MW**	**4.7 MW**	**495.2 MW**	**11.6 MW**	**509.4 MW**	**18.5 MW**	**533.8 MW**	**25.5 MW**

	Summer	2021		2025		2030		2035		2040	
	07/10	Base Load (MW)	Total Deferral Available	Base Load (MW)	Total Deferral Available	Base Load (MW)	Total Deferral Available	Base Load (MW)	Total Deferral Available	Base Load (MW)	Total Deferral Available
4561	1	350.3	0.0	353.5	0.0	359.2	0.0	369.5	0.0	387.1	0.0
4562	2	327.3	0.0	330.3	0.0	335.6	0.0	345.2	0.0	361.7	0.0
4563	3	314.6	0.0	317.5	0.0	322.6	0.0	331.9	0.0	347.7	0.0
4564	4	308.1	0.0	310.9	0.0	316.0	0.0	325.0	0.0	340.5	0.0
4565	5	312.0	0.0	314.8	0.0	319.9	0.0	329.1	0.0	344.8	0.0
4566	6	323.5	0.0	326.4	0.0	331.7	0.0	341.2	0.0	357.5	0.0
4567	7	342.0	0.0	345.1	0.0	350.7	0.0	360.8	0.0	378.0	0.0
4568	8	375.8	0.0	379.2	0.0	385.3	0.0	396.4	0.0	415.3	0.0
4569	9	414.2	0.0	418.0	0.0	424.7	0.0	436.9	0.0	457.7	0.0
4570	10	455.7	0.0	459.8	0.0	467.3	0.0	480.6	0.0	503.6	0.0
4571	11	494.4	0.0	498.9	0.0	507.0	0.0	521.5	0.0	546.4	0.0
4572	12	535.6	0.0	540.5	0.0	549.2	0.0	564.9	0.0	591.9	0.0
4573	13	566.6	0.0	571.7	0.0	581.0	0.0	597.6	0.0	626.2	0.0
4574	14	593.9	3.6	599.3	9.5	609.0	25.0	626.4	34.5	656.4	42.2
4575	15	616.7	3.6	622.3	9.5	632.4	25.0	650.5	34.5	681.6	42.2
4576	16	608.5	3.6	614.0	9.5	624.0	25.0	641.9	34.5	672.5	42.2
4577	17	583.7	3.6	589.0	9.5	598.5	25.0	615.7	34.5	645.1	42.2
4578	18	576.6	3.6	581.8	9.5	591.3	25.0	608.2	34.5	637.3	42.2
4579	19	567.3	3.6	572.5	9.5	581.8	25.0	598.4	34.5	627.0	42.2
4580	20	543.1	-0.7	548.0	-6.6	556.9	-22.1	572.8	-31.6	600.2	-39.3
4581	21	527.1	-0.7	531.9	-6.6	540.5	-22.1	556.0	-31.6	582.5	-39.3
4582	22	499.0	-0.7	503.5	-6.6	511.7	-22.1	526.3	-30.3	551.5	-34.0
4583	23	445.5	0.0	449.6	0.0	456.9	-0.3	470.0	-0.6	492.4	-1.8
4584	24	396.3	0.0	399.9	0.0	406.4	0.0	418.1	0.0	438.0	0.0
		616.7 MW	**3.6 MW**	**622.3 MW**	**9.5 MW**	**632.4 MW**	**25.0 MW**	**650.5 MW**	**34.5 MW**	**681.6 MW**	**42.2 MW**

DR.Hourly.High: Demand Response High Avoided Cost Scenario Results

	Winter	2021		2025		2030		2035		2040	
Peak Hours	12/19	Base Load (MW)	Load w/DR Curtailment	Base Load (MW)	Load w/DR Curtailment	Base Load (MW)	Load w/DR Curtailment	Base Load (MW)	Load w/DR Curtailment	Base Load (MW)	Load w/DR Curtailment
20	1	327	328	330	336	335	357	345	375	361	395
22	2	318	318	321	321	326	327	336	336	352	354
24	3	315	315	318	318	323	323	333	333	348	348
23	4	317	317	319	319	325	325	334	334	350	350
21	5	326	326	329	329	334	334	344	344	360	360
18	6	349	349	352	352	358	358	368	368	386	386
14	7	386	386	390	390	396	396	407	407	427	427
8	8	405	405	409	409	416	416	427	427	448	448
7	9	407	407	410	410	417	417	429	429	450	450
9	10	402	402	406	406	412	412	424	424	444	444
10	11	398	398	401	401	408	408	419	419	439	439
11	12	394	394	397	397	404	404	415	415	435	435
12	13	389	389	393	393	399	399	411	411	430	430
13	14	386	386	390	390	396	396	408	408	427	427
16	15	382	382	386	386	392	392	403	403	422	422
15	16	384	384	388	388	394	394	405	405	425	425
5	17	408	405	412	407	419	407	430	412	451	426
2	18	447	444	451	446	458	447	472	453	494	469
1	19	448	445	452	447	460	448	473	454	495	470
3	20	441	438	445	441	453	441	466	447	488	462
4	21	431	428	435	430	442	430	454	436	476	451
6	22	408	405	412	407	418	407	430	412	451	425
17	23	375	375	378	385	384	406	395	427	414	453
19	24	345	345	348	354	353	376	364	395	381	420

	Spring/Fall	2021		2025		2030		2035		2040	
Peak Hours	09/15	Base Load (MW)	Load w/DR Curtailment	Base Load (MW)	Load w/DR Curtailment	Base Load (MW)	Load w/DR Curtailment	Base Load (MW)	Load w/DR Curtailment	Base Load (MW)	Load w/DR Curtailment
19	1	313	313	316	316	321	321	330	330	346	346
21	2	298	298	301	301	306	306	314	314	329	329
22	3	290	290	292	292	297	297	305	305	320	320
24	4	285	285	287	287	292	292	300	300	315	315
23	5	287	287	289	289	294	294	302	302	317	317
20	6	302	302	305	305	310	310	319	319	334	334
17	7	332	332	335	335	340	340	350	350	366	366
16	8	350	350	353	353	359	359	369	369	387	387
14	9	370	370	374	374	380	380	391	391	409	409
13	10	391	391	395	395	401	401	413	413	433	433
11	11	411	411	414	414	421	421	433	433	454	454
10	12	426	426	430	430	437	437	450	450	471	471
8	13	441	441	445	445	453	453	466	466	488	488
5	14	457	457	461	461	469	469	482	482	505	505
4	15	471	468	476	471	483	472	497	479	521	495
2	16	480	476	484	479	492	480	506	487	530	504
1	17	483	480	487	483	495	484	509	491	534	508
3	18	475	472	480	475	487	476	501	483	525	500
6	19	452	449	456	451	463	452	477	458	499	474
7	20	445	442	449	444	456	445	469	451	492	466
9	21	427	428	431	438	438	460	450	482	472	511
12	22	392	393	396	403	402	425	414	446	434	473
15	23	354	355	357	364	363	385	374	404	391	425
18	24	320	320	323	323	328	328	337	338	354	355

	Summer	2021		2025		2030		2035		2040	
Peak Hours	07/10	Base Load (MW)	Load w/DR Curtailment	Base Load (MW)	Load w/DR Curtailment	Base Load (MW)	Load w/DR Curtailment	Base Load (MW)	Load w/DR Curtailment	Base Load (MW)	Load w/DR Curtailment
18	1	350	350	353	353	359	359	369	369	387	387
20	2	327	327	330	330	336	336	345	345	362	362
22	3	315	315	317	317	323	323	332	332	348	348
24	4	308	308	311	311	316	316	325	325	341	341
23	5	312	312	315	315	320	320	329	329	345	345
21	6	323	323	326	326	332	332	341	341	357	357
19	7	342	342	345	345	351	351	361	361	378	378
17	8	376	376	379	379	385	385	396	396	415	415
15	9	414	414	418	418	425	425	437	437	458	458
13	10	456	456	460	460	467	467	481	481	504	504
12	11	494	494	499	499	507	507	522	522	546	546
9	12	536	536	540	540	549	549	565	565	592	592
7	13	567	567	572	572	581	581	598	598	626	626
3	14	594	590	599	590	609	584	626	592	656	614
1	15	617	613	622	613	632	607	651	616	682	639
2	16	608	605	614	605	624	599	642	607	673	630
4	17	584	580	589	579	599	574	616	581	645	603
5	18	577	573	582	572	591	566	608	574	637	595
6	19	567	564	573	563	582	557	598	564	627	585
8	20	543	544	548	555	557	579	573	604	600	639
10	21	527	528	532	538	540	563	556	588	583	622
11	22	499	500	504	510	512	534	526	557	551	585
14	23	446	446	450	450	457	457	470	471	492	494
16	24	396	396	400	400	406	406	418	418	438	438