2023 CONSERVATION POTENTIAL ASSESSMENT

Clark Public Utilities

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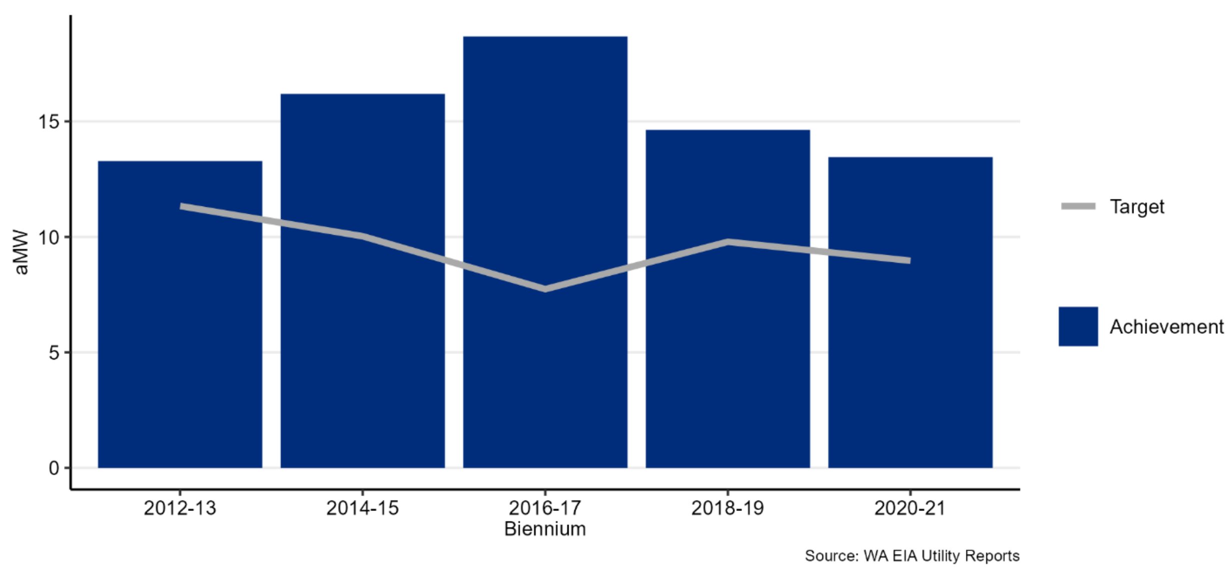
Executive Summary

Overview

This report describes the methodology and results of a conservation potential assessment (CPA) conducted by Lighthouse Energy Consulting (Lighthouse) for Clark Public Utilities. The CPA estimated the cost-effective energy efficiency savings potential for the period of 2024 to 2043. This report describes the results of the full 20-year period, with additional detail on the two- and 10-year periods that are the focus of Washington's Energy Independence Act (EIA). The initial two years of this study are also the final two years of the four-year period covered by Clark Public Utilities' first Clean Energy Implementation Plan (CEIP). If desired, the results of this study can be used to update the conservation target identified in that CEIP.

Clark Public Utilities provides electricity service to more than 225,000 customers across Clark County, Washington. The EIA requires that utilities with more than 25,000 customers identify and acquire all cost-effective energy efficiency resources and meet targets set every two years through a CPA. Clark Public Utilities' history of consistently exceeding its biennium conservation targets is shown in Figure 1, which is based on EIA compliance data reported to Washington's Department of Commerce.

Figure 1: Historic Targets and Achievements



The EIA specifies the requirements for setting conservation targets in RCW 19.285.040 and WAC 194-37-070 Section (5), parts (a) through (d). The methodology used in this assessment complies with these requirements and is consistent with the methodology used by the Northwest Power and Conservation Council (Council) in the 2021 Power Plan. Washington's Clean Energy Transformation Act (CETA) has additional requirements for CPAs; namely, that the assessment of cost-effectiveness make use of specific values for the social cost of carbon. Appendix III details these requirements and how this assessment fulfills those requirements.

This CPA used much of the 2021 Power Plan materials, with customizations to make the results specific to Clark Public Utilities' service territory and customers. Notable changes in this CPA relative to Clark Public Utilities' previous assessment include the following:

- Energy Efficiency Measures
  - This assessment uses the measure savings, costs, and other characteristics based on the measures included in the final 2021 Power Plan, with updates to dozens of measures based on new information from the Regional Technical Forum (RTF) and additional customizations to make the measures specific to Clark Public Utilities.
- Avoided Costs
  - A new market price forecast was incorporated, which has increased significantly from the 2021 CPA update
  - Lighthouse worked with Clark Public Utilities to estimate new values for summer and winter capacity
- Customer Characteristics
  - Updated counts of residential homes
  - Updated HVAC and other appliance saturations
  - New estimates of commercial floor area
  - New forecast of Clark Public Utilities' industrial sector loads
  - Updated customer growth rates
- Program Impacts
  - Consideration of Clark Public Utilities' recent conservation program achievements

Results

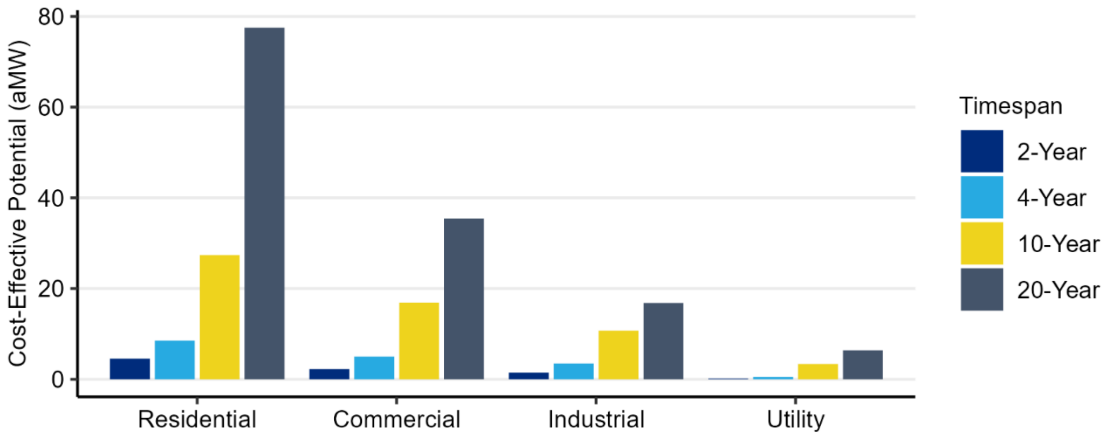
Table 1 and Figure 2 show the cost-effective energy efficiency potential by sector over two-, four-, 10-, and 20-year periods. Over the 20-year planning period, Clark Public Utilities has 136 aMW of cost-effective conservation available, which is approximately 18% of its projected 2043 load. The EIA focuses on the two- and 10-year potential, which are 8.43 aMW and 58.36 aMW, respectively.

Table 1: Cost-Effective Energy Savings Potential by Sector (aMW)

Sector	2-Year	4-Year	10-Year	20-Year
Residential	4.56	8.51	27.39	77.51
Commercial	2.24	5.01	16.90	35.44
Industrial	1.48	3.49	10.70	16.83
Utility	0.15	0.50	3.37	6.38
Total	**8.43**	**17.52**	**58.36**	**136.15**

Note: In this and all subsequent tables, totals may not match due to rounding.

Figure 2: Cost-Effective Energy Savings Potential by Sector



The residential sector has the largest potential, followed by the commercial and industrial sectors. This correlates with the loads of Clark Public Utilities' sectors. A much smaller amount of potential is available in the utility sector.

This assessment does not specify how the energy efficiency potential will be achieved. Possible mechanisms include:

- Clark Public Utilities' energy efficiency programs
- Clark Public Utilities' behavior program
- Market transformation driven by the Northwest Energy Efficiency Alliance (NEEA)
- State building codes
- State or federal product standards.

Often, the savings associated with a measure will be acquired by several of the above mechanisms over the course of its technological maturity. For example, heat pump water heaters started as one of NEEA's market transformation initiatives. Subsequently, they became a regular offering in utility programs across the Northwest and are starting to work their way into federal product standards.

Energy efficiency also contributes to reductions in peak demand. This assessment used hourly load and savings shapes developed by the Council to identify when the savings from each measure occur and estimate the demand savings at the time of Clark Public Utilities' system peak. The cost-effective energy savings potential identified in this assessment will result in nearly 253 MW of peak demand savings over the 20-year planning period, as shown in Table 2. This represents approximately 21% of Clark Public Utilities' estimated 2043 peak demand.

Table 2: Cost-Effective Peak Demand Savings Potential by Sector (MW)

Sector	2-Year	4-Year	10-Year	20-Year
Residential	10.56	19.63	65.31	185.08
Commercial	2.63	5.96	19.69	40.48
Industrial	1.76	4.16	12.69	20.03
Utility	0.17	0.57	3.81	7.22
Total	**15.13**	**30.32**	**101.51**	**252.81**

This CPA used ramp rates to identify the share of the potential available in each year that could be acquired. The ramp rates are based on those used by the Council for the 2021 Power Plan and reflect the market and program maturity of each measure. For this CPA, Lighthouse selected ramp rates that would align the near-term potential of each measure with Clark Public Utilities' recent and expected program achievements and the savings from NEEA's market transformation initiatives that are estimated to occur in Clark Public Utilities' service territory. Clark Public Utilities staff provided program achievement data for 2021 and 2022. Lighthouse assigned appropriate ramp rates for each measure so that the future acquisition of energy efficiency was aligned with this program data while allowing for the acquisition of all cost-effective energy efficiency over the 20-year planning period.

The estimate of annual energy efficiency potential by sector is shown in Figure 3. The available cost-effective potential starts at approximately 4 aMW in 2024 and grows to a maximum of 9 aMW in 2036. After that point, the annual potential declines through the remainder of the study period as the remaining available opportunities for energy efficiency are acquired. The higher residential potential in 2024-26 is due to savings expected as part of a behavior program offered in those years.

Figure 3: Annual Incremental Energy Efficiency Potential

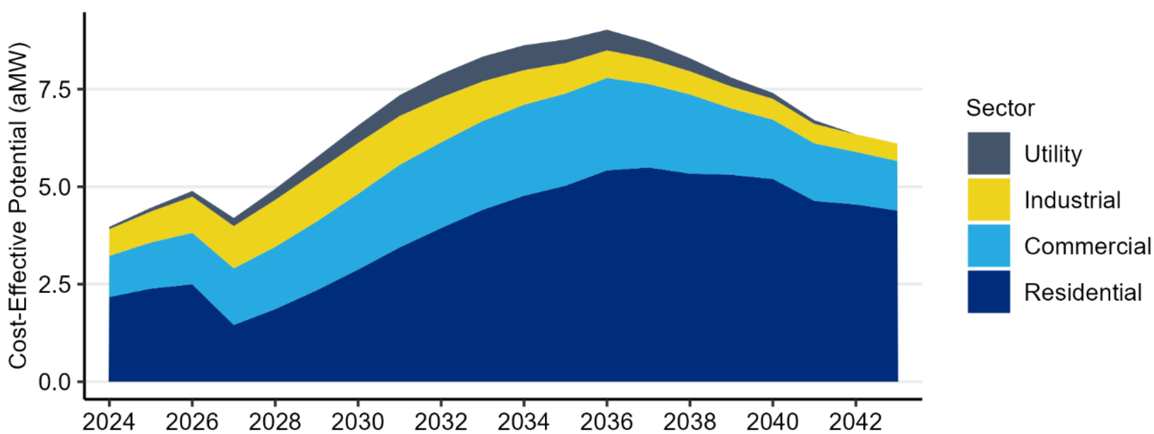
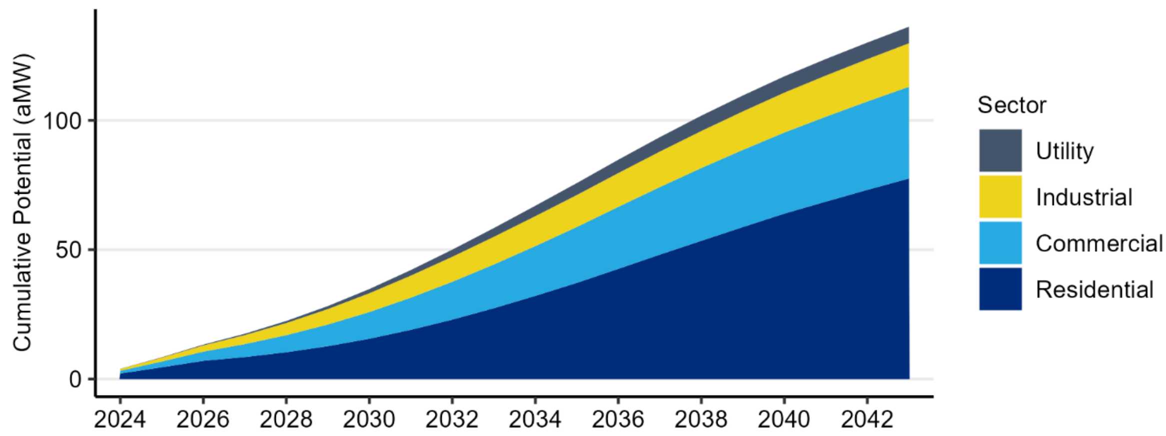


Figure 4 shows how the energy efficiency potential grows on a cumulative basis through the study period, totaling more than 136 aMW over the 20-year planning period.

Figure 4: Annual Cumulative Energy Efficiency Potential



Comparison to Previous Assessment

Table 3 shows a comparison of the two-, 10-, and 20-year cost-effective potential by sector as quantified by the previous 2021 CPA and this 2023 CPA. The two-year comparison shows a slight decrease in the overall potential with increases and decreases within the individual sectors. Over the longer term, the 10-year potential has increased by 17%, with even more potential over the 20-year period.

Table 3: Comparison of 2021 and 2023 CPA Cost-Effective Potential (MWh)

Sector	2-Year Potential			10-Year Potential			20-Year Potential		
	2021 CPA	2023 CPA	% Change	2021 CPA	2023 CPA	% Change	2021 CPA	2023 CPA	% Change
Residential	3.91	4.56	17%	19.81	27.39	38%	38.37	77.51	102%
Commercial	3.28	2.24	-32%	15.66	16.90	8%	27.78	35.44	28%
Industrial	2.13	1.48	-31%	12.43	10.70	-14%	19.67	16.83	-14%
Utility	0.05	0.15	213%	2.17	3.37	55%	6.38	6.38	0%
Total	**9.37**	**8.43**	**-10%**	**50.07**	**58.36**	**17%**	**92.20**	**136.15**	**48%**

Discussion of the factors leading to these changes is provided below.

Avoided Costs

The updated market prices used in this CPA have increased. The 20-year levelized value of the forecasted prices used in this CPA is approximately $52/MWh, an increase of 63% from the previous value of $32/MWh used in the prior CPA. In addition, Lighthouse worked with Clark Public Utilities staff to update the way that generation capacity is valued, including values for both summer and winter capacity.

These updated avoided costs have resulted in more measures passing the cost-effectiveness screening and additional cost-effective potential over the twenty-year period.

Customer Characteristics

This CPA used updated customer data for each sector. The initial count of homes is based on residential account data provided by Clark Public Utilities and has increased 5% from the number used in the 2021

CPA. In addition, the number of homes was forecast to grow 2.5% per year, an increase from the previous CPA.

Lighthouse also used the American Community Survey (ACS) and some early release data from the 2022 RBSA to update HVAC and appliance saturations. These updates resulted in higher saturations of heat pump technology, slightly reducing the remaining potential for these measures.

In the commercial sector, Clark Public Utilities provided updated load data by commercial building type. Lighthouse converted these loads to estimates of floor area by applying energy use intensities (EUI) from the 2019 Commercial Building Stock Assessment (CBSA). This updated data resulted in an increase of 7% in the estimated initial year floor area. Similar to the residential sector, the assumed future growth in commercial floor area is higher than the 2021 CPA.

The loads in the industrial sector have also increased slightly relative to the 2021 CPA. Similar to loads from the commercial sector, industrial loads have increased by 7% relative to the 2021 CPA. However, no growth was assumed for the industrial sector.

Program History & Forecasts

As described above, Lighthouse used ramp rates to align the cost-effective potential in the near term with Clark Public Utilities' recent and expected program achievements, as well as savings from NEEA's market transformation work. Clark Public Utilities' residential savings and expected savings from NEEA are higher than forecast in the 2021 CPA, resulting in an increase in the near-term residential potential. Expected savings from the commercial and industrial sectors are lower, however. Lighthouse also accounted for the recent program accomplishments in each sector by reducing the overall potential.

Conclusion

This report summarizes the CPA conducted for Clark Public Utilities for the 2024 to 2043 timeframe. The CPA identified slightly less potential available in the near-term relative to the 2021 CPA, but more potential available in the mid- and long-term.

The lower near-term potential in some sectors is due to alignment with recent program achievements, particularly in the commercial and industrial sectors. In the mid- and long-term, higher avoided costs and customer forecasts have resulted in additional cost-effective potential.

Introduction

Objectives

This report describes the methodology and results of a CPA conducted for Clark Public Utilities by Lighthouse. The CPA estimated the cost-effective energy savings potential available in Clark Public Utilities' service territory over the period of 2024 to 2043. This report describes the results of the full 20-year study period, with additional details on the two- and 10-year periods that are the focus of Washington's EIA.

This assessment was conducted in a manner consistent with the requirements of Washington's RCW 19.285, and WAC 194-37. As such, this report is part of the documentation of Clark Public Utilities' compliance with these requirements. The state of Washington's recently passed CETA includes an additional requirement for CPAs to use specific values for the social cost of carbon, which were incorporated into this analysis.

The results of this assessment can be used to assist Clark Public Utilities in planning its energy efficiency programs by identifying the amount of cost-effective energy savings available in various sectors, end uses, and measures. The results of this CPA can also be used to update the four-year energy efficiency target included in Clark Public Utilities' CEIP, if desired. Finally, the results can be used to inform Clark Public Utilities' integrated resource planning.

Background

Washington State's EIA defines "qualifying utilities" as those with 25,000 customers or more and requires them to achieve all conservation that is cost-effective, reliable, and feasible. Since Clark Public Utilities serves more than 25,000 customers, it is required to comply with the EIA. The requirements of the EIA specify that all qualifying utilities complete the following by January 1 of every even-numbered year:[1]

- Identify the achievable cost-effective conservation potential for the upcoming 10 years using methodologies consistent with the Council's latest power plan.
- Establish a biennial acquisition target for cost-effective conservation that is no lower than the utility's pro rata share for that two-year period of its cost-effective conservation potential for the subsequent 10 years.[2]

Appendix III further details how this assessment complies with each of the requirements specified for CPAs by Washington's EIA.

Study Uncertainties

There are uncertainties inherent in any long-term planning effort. While this assessment makes use of the latest forecasts of customers, loads, energy prices, and other variables, these are still subject to uncertainties and limitations, as recent global events have shown. These uncertainties include, but are not limited to:

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[1] Washington RCW 19.285.040

[2] In CA No. 2011-03, the State Auditor's Office has defined "pro rata" as "a proportion of an exactly calculable factor" and expects utilities to have analysis and documentation to support their identified targets, which could be more or less than 20% of the 10-year potential.

- Customer Characteristic Data: This assessment used the best available data to reflect Clark Public Utilities' customers. In some cases, however, the assessment relied upon data beyond Clark Public Utilities' service territory due to limitations of available data and adequate sample sizes. There are uncertainties, therefore, related to the extent that this data is reflective of Clark Public Utilities' customer base.
- Measure Data: Estimates of measure savings and costs are based on values prepared by the Council and RTF. These estimates will vary across the region due to local climate variations and market conditions. Additionally, some measure inputs such as applicability are based on limited data or professional judgement.
- Market Price Forecasts: This assessment uses an updated market price forecast. Market prices and forecasts are continually changing.
- Utility System Assumptions: Measures in this CPA receive cost credits based on their ability to provide transmission and distribution system capacity. The actual value of these credits is dependent on local conditions, which vary across Clark Public Utilities' service territory. Additionally, a value for generation capacity is included, but the value of this credit is subject to the evolving need for capacity in the Northwest.
- Load and Customer Growth Forecasts: This CPA projects future customer growth over a 20-year period. Any forecast over a similar time period will inherently include a significant level of uncertainty.

Due to these uncertainties and the continually changing planning environment, the EIA requires qualifying utilities to update their CPAs every two years to reflect the best available data and latest market conditions.

Report Organization

The remainder of this report is organized into the following sections:

- Methodology
- Historic Conservation Achievement
- Customer Characteristics
- Results
- Scenario Results
- Summary
- References & Appendices

Methodology

This section provides an overview of the methodology used to develop the estimate of cost-effective conservation potential for Clark Public Utilities.

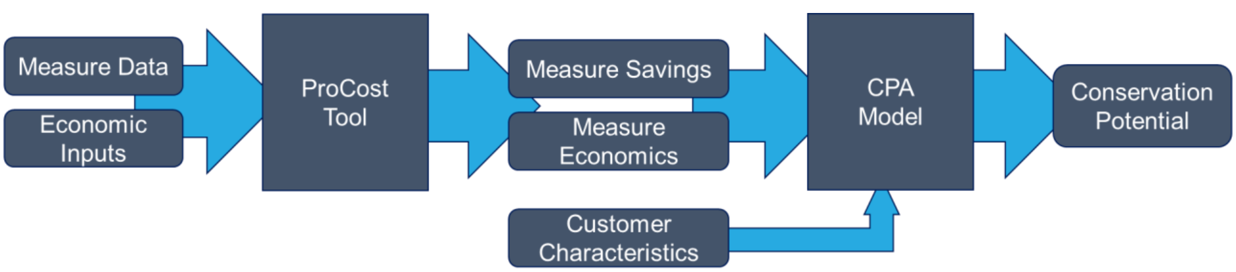
Requirements for this CPA are laid out in RCW 19.285.040 and WAC 194-37-070, Section 5 parts (a) through (d). Additional requirements are specified in the rules of Washington's CETA. The methodology used to produce this assessment is consistent with these requirements and follows much of the methodology used by the Council in developing its regional power plans, including the final 2021 Power Plan.

Appendix III provides a detailed breakdown of the requirements of the EIA and CETA and how this assessment complies with those standards.

High-level Methodology

The methodology used for this assessment is illustrated in Figure 5. At a high level, the process combines data on individual energy efficiency measures and economic assumptions using the Council's ProCost tool. This tool calculates a benefit-cost ratio using the Total Resource Cost (TRC) test, which is used to determine whether a measure is cost-effective. The TRC test includes all of the costs and benefits of energy efficiency measures, regardless of who receives the benefit or pays the cost. The measure savings and economic results are combined with customer data in Lighthouse's CPA model, which quantifies the number of remaining implementation opportunities. The savings associated with each of these opportunities are aggregated in the CPA model to determine the overall potential.

Figure 5: Conservation Potential Assessment Methodology



Economic Inputs

Lighthouse worked closely with Clark Public Utilities staff to define the economic inputs that were used in this CPA. These inputs include avoided energy costs, carbon costs, transmission and distribution capacity costs, and generation capacity costs. Each of these are discussed below.

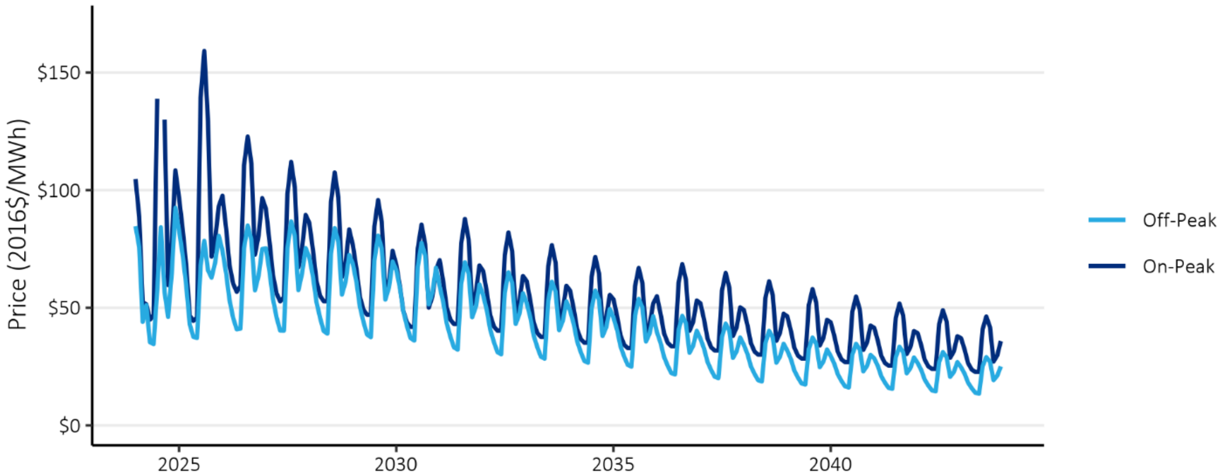
Avoided Energy Costs

Avoided energy costs represent the value of energy savings, either through the value of avoided energy purchases or the opportunity cost of additional sales made possible by reducing customer demands. The EIA requires utilities to "set avoided costs equal to a forecast of market prices."[3] For this CPA, Clark Public Utilities provided a forecast of avoided on- and off-peak energy prices at the Mid-Columbia trading hub from The Energy Authority. Figure 6 below shows the market price forecast that was used for the base

[3] WAC 194-37-070

case scenario of this assessment. Lighthouse also developed high and low variations of this forecast for the avoided cost scenarios, which are discussed later in this report and are discussed in Appendix IV.

Figure 6: Avoided Energy Costs



Social Cost of Carbon

In addition to avoiding purchases of energy, energy efficiency measures have the potential to avoid emissions of greenhouse gases like carbon dioxide. The EIA requires that CPAs include the social cost of carbon, which the U.S. EPA defines as "a measure of the long-term damage done by a ton of carbon dioxide emissions in a given year." It includes, among other things, changes in agricultural productivity, human health, property damages from increased flood risk, and changes in energy system costs, including increases in the costs of cooling and decreases in heating costs.[4] In addition to this requirement, Washington's CETA requires that utilities use the social cost of carbon values developed in 2016 by the Federal Interagency Workgroup using a 2.5% discount rate.

To implement the cost of carbon emissions, additional assumptions must be made about the intensity of carbon emissions. This assessment uses an updated forecast of marginal emissions rates developed by the Council in 2022, with modifications to reflect that CETA requires carbon-free energy beginning in 2030.

Renewable Portfolio Standard Compliance Costs

By reducing Clark Public Utilities' overall load, energy efficiency reduces the cost of complying with Washington's requirements for renewable and carbon-neutral energy. Currently, Clark Public Utilities is required to source 15% of its power from renewable energy resources, which it does through the purchase of renewable energy credits (RECs). In 2030, CETA requires all sales to be greenhouse gas neutral, while allowing up to 20% of the requirement to be met through REC purchases. Conservation can reduce the cost of complying with these requirements by reducing Clark Public Utilities' load. Further details are discussed in Appendix IV.

[4] See https://www.epa.gov/sites/production/files/2016-12/documents/social_cost_of_carbon_fact_sheet.pdf

Deferred Transmission and Distribution System Costs

Unlike supply-side resources, energy efficiency does not require capacity on transmission and distribution infrastructure. Instead, it frees up capacity by reducing the peak demands on these systems and can help defer future capacity expansions and the associated capital costs.

In the development of the 2021 Power Plan, the Council developed a standard methodology for calculating these values and surveyed Northwest utilities to update the values associated with these cost deferrals. This CPA uses the values developed by the Council through that process: $3.54 and $7.82 per kW-year (in 2016 dollars) for transmission and distribution capacity, respectively. These values are slightly higher than the values used in the Clark Public Utilities' 2021 CPA as they reflect small updates to the Council values as the 2021 Power Plan was finalized.

These values are applied to the demand savings coincident with the timing of the respective system peaks.

Program Administration Costs

In each of the past three power plans, the Council has assumed that program administrative costs are equal to 20% of the cost of each measure. This CPA uses that assumption, which is also consistent with Clark Public Utilities' previous CPAs.

Risk Mitigation

Investing in energy efficiency can reduce the risks that utilities face by the fact that it is made in small increments over time, rather than the large, singular sums required for generation resources.

This CPA follows the process used in Clark Public Utilities' previous CPAs. A scenario analysis is used to account for uncertainty, where present, in avoided cost values. The variation in inputs covers a range of possible outcomes and the amount of cost-effective energy efficiency potential is presented under each scenario. In selecting its biennial target from this range of outcomes, Clark Public Utilities is selecting its preferred risk strategy and the associated risk credit. This process is similar to the one used by the Council to identify the risk mitigation credit in the regional power plans.

Northwest Power Act Credit

The EIA requires that utilities give energy efficiency measures a 10% cost credit. This benefit is specified in the Northwest Electric Power Planning and Conservation Act and is included by the Council in their power planning work.

Other Financial Assumptions

In addition, this assessment makes use of an assumed discount rate to convert future costs and benefits to present-year values so that values occurring in different years can be compared. This assessment uses a real discount rate of 3.75%, which is the value developed for the 2021 Power Plan. Energy efficiency benefits accrue over the lifetime of the measure, so a lower discount rate results in higher present values for benefits occurring in future years.

Measure Characterization

Measure characterization is the process of defining each individual measure, including the savings, cost, lifetime, non-energy impacts, and a load or savings shape that defines when the savings occur. The

Council's 2021 Power Plan materials are the primary source for this information, although Lighthouse incorporated updated information from the RTF for many measures.

Measure savings are typically defined by a "last in" approach. With this methodology, each measure's savings is determined as if it was the last measure installed. For example, savings from home weatherization measures are determined based on the assumption that the home's heating system has already been upgraded. Similarly, the heating system measures are quantified based on the assumption that the home has already been weatherized. This approach is conservative but prevents over-counting savings over the long term as homes are likely to install both measures.

Measure savings also consider measure interaction. Interaction occurs when measures in one end use impact the energy use of other end uses. Examples of this include energy efficient lighting and other appliances. The efficiency of these appliances results in less wasted energy released as heat, which impacts the demands on heating and cooling systems.

These measure characteristics, along with the economic assumptions, are used as inputs to the Council's ProCost tool. This tool determines the savings at the generator, after factoring in line losses, as well as the demand savings that occur coincident with Clark Public Utilities' system peak. It also determines the levelized-cost and benefit-cost ratios, the latter of which is used to determine whether measures are cost-effective.

Customer Characteristics

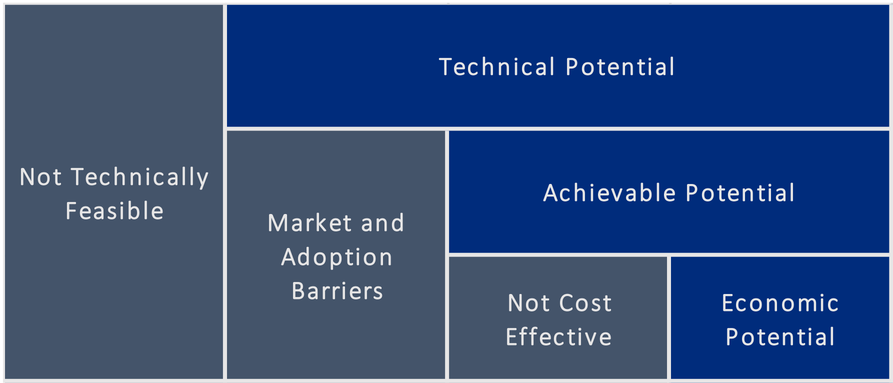
The assessment of customer characteristics is used to determine the number of available measure installation opportunities for each measure. This includes both the number of opportunities overall, as well as the share, or saturation, which have already been completed. The characterization of Clark Public Utilities' customer base was completed using data provided by Clark Public Utilities, NEEA's commercial and residential building stock assessments, U.S. Census data, and other data sources. Details for each sector are described subsequently in this report.

This CPA used baseline measure saturation data from the Council's 2021 Power Plan. This data was developed from NEEA's stock assessments, market research and other studies. This data was supplemented with Clark Public Utilities' conservation achievements, where applicable. This achievement is discussed in the next section.

Energy Efficiency Potential

The energy efficiency measure data and customer characteristics are combined in Lighthouse's CPA model. The model calculates the economic or cost-effective potential by progressing through the types of energy efficiency potential shown in Figure 7. Each is discussed in further detail below.

Figure 7: Types of Energy Efficiency Potential



First, technical potential is the theoretical maximum of energy efficiency available, regardless of cost or market constraints. It is determined by multiplying the measure savings by the number of remaining feasible installation opportunities.

The model then applies several filters that incorporate market and adoption barriers, resulting in the achievable potential. These filters include an assumption about the maximum potential adoption and the pace of annual achievements. Energy efficiency planners generally assume that not all measure opportunities will be installed; some portion of the technically possible measure opportunities will remain unavailable due to unsurmountable barriers. In the Northwest, planners have historically assumed that 85% of all measure opportunities can be achieved. This assumption came from a pilot program conducted in Hood River, Oregon, where home weatherization measures were offered at no cost. The pilot was able to reach over 90% of homes and complete 85% of identified measure opportunities. In the 2021 Power Plan, the Council took a more nuanced approach to this assumption. Measures that are likely to be subject to future codes or product standards have higher maximum achievability assumptions. This CPA follows the Council's new approach.

In addition to the factors that consider the maximum possible achievement, ramp rates are used to identify the portion of the available potential that can be acquired each year. The selection of ramp rates incorporates the different levels of program and market maturity as well as the practical constraints of what utility programs can accomplish each year.

Finally, economic, or cost-effective potential is determined by limiting the achievable potential to those measures that pass an economic screen. Per the EIA, this assessment uses the TRC test to determine economic potential. The TRC evaluates all measure costs and benefits, regardless of who pays the cost or receives the benefit. The costs and benefits include the full incremental capital cost of the measure, any operations and maintenance costs, program administrative costs, avoided energy and carbon costs, deferred capacity costs, and quantifiable non-energy impacts. Because the TRC test considers the full cost of energy efficiency measures, Clark Public Utilities could pay up to the full cost of measures with its incentives without needing to reevaluate the cost-effectiveness of the measure, although practical constraints such as program budgets may limit this.

Recent Conservation Achievement

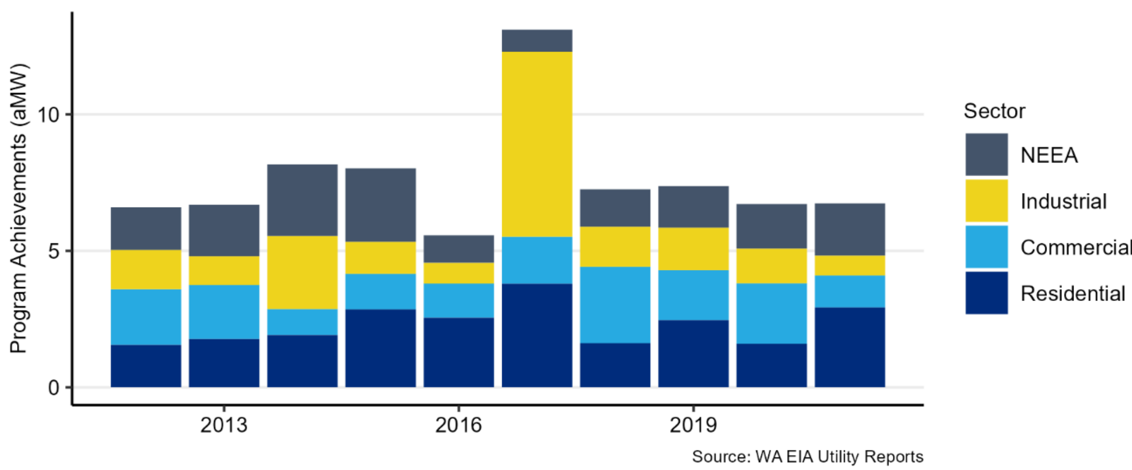
Clark Public Utilities has a long history of energy efficiency achievement and, according to the RTF's 2021 Regional Conservation Progress Report, has averaged savings equal to 1.2% of its retail sales in each year over the 2016-2021 time period, putting it among top saving utilities in the region.

Clark Public Utilities currently offers programs for its residential, commercial, and industrial customers. In addition to these programs, Clark Public Utilities receives credit for the market transformation initiatives of NEEA that occur within its service territory. NEEA's work has helped to bring energy efficient emerging technologies, like ductless heat pumps and heat pump water heaters, to the Northwest.

Overall

Figure 8 summarizes Clark Public Utilities' conservation achievements from 2012-2021 by sector, as reported under Washington's EIA.

Figure 8: Recent Conservation Achievements by Sector



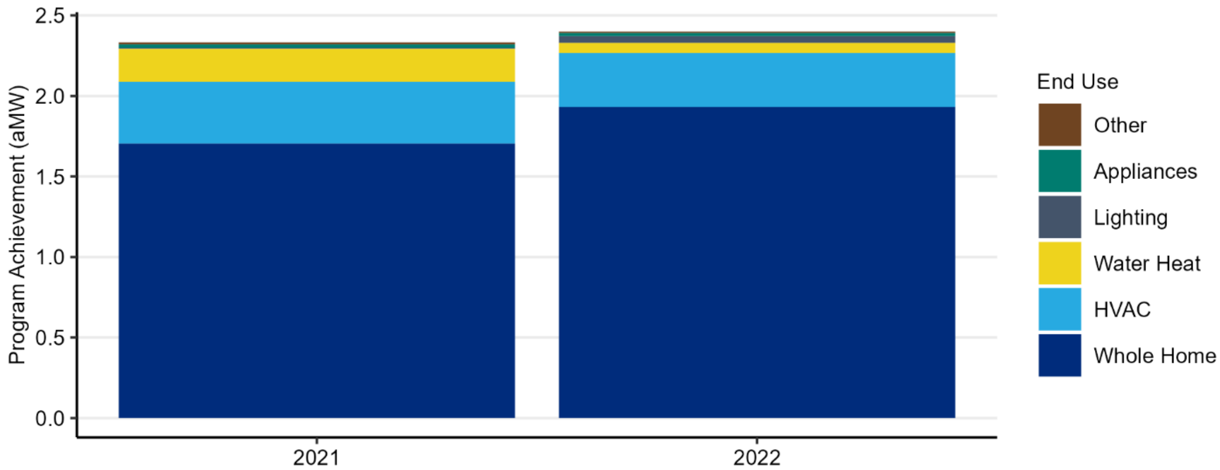
The average savings over this eight-year period is 7.62 aMW per year. Savings from NEEA's market transformation initiatives are primarily in the residential sector, so most of the historical savings are from Clark Public Utilities' residential sector.

Clark Public Utilities provided additional details on Clark Public Utilities' program savings for 2021 and 2022 for each sector, which are discussed below. In addition to counting past achievements against the available potential, these achievements also serve as a reference point for identifying rates of future acquisition.

Residential

The recent residential program achievements by end use are shown in Figure 9. Most of the savings are in the whole home end use, which are primarily savings from Clark Public Utilities' behavior program. Beyond that program, the primary sources of savings come from the HVAC and water heating end uses. Note that the HVAC end use includes both weatherization and heating system equipment. Smaller amounts of savings were achieved in the lighting, appliances, and other end uses. The other end use includes electronics and electric vehicle supply equipment. Residential savings averaged approximately 2.4 aMW per year over this two-year period.

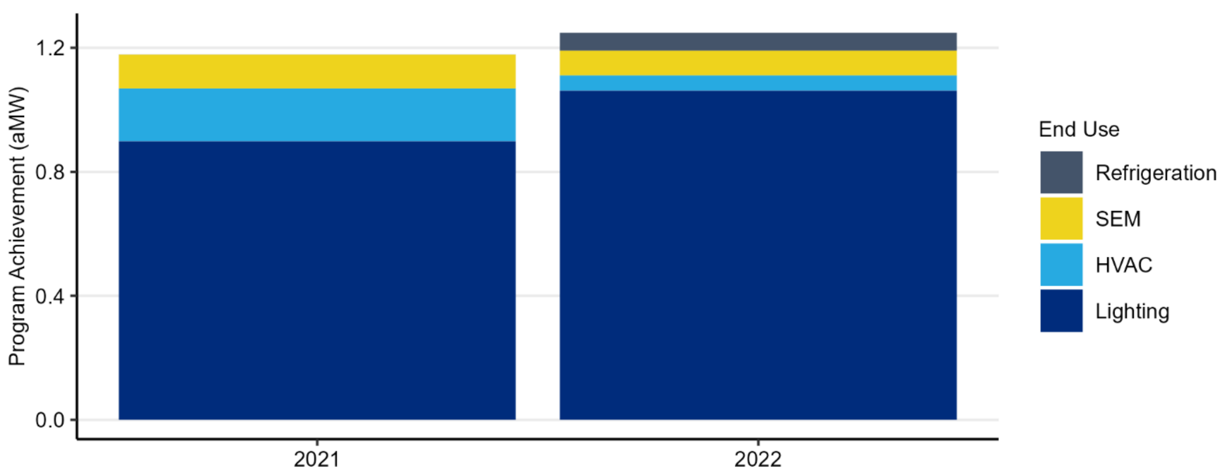
Figure 9: 2021-2022 Residential Program Achievements by End Use



Commercial

The majority of Clark Public Utilities' commercial savings are in the lighting end use, as shown in Figure 10. Smaller amounts of savings come from projects in the HVAC, strategic energy management (SEM), and refrigeration end uses. Commercial savings averaged 1.2 aMW per year over this two-year period.

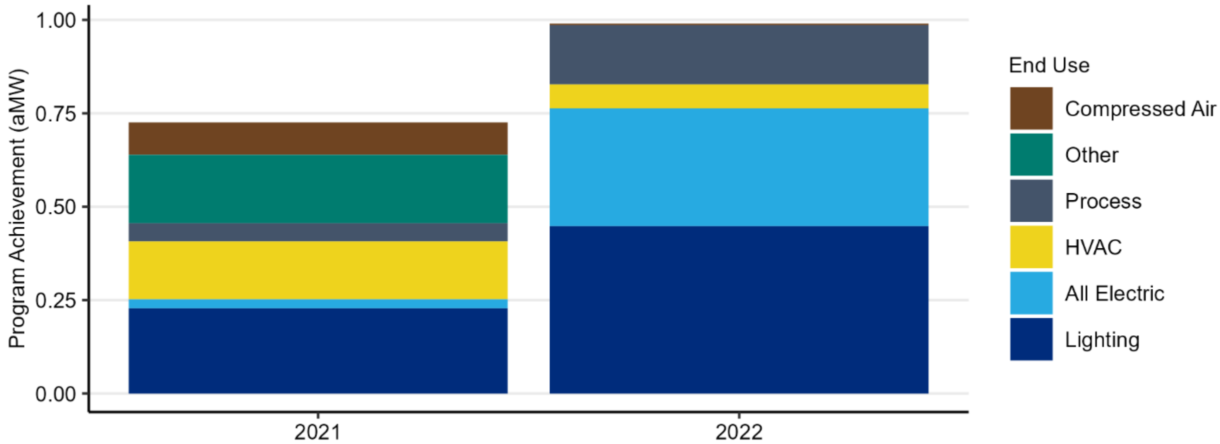
Figure 10: 2021-2022 Commercial Program Achievements by End Use



Industrial

In the industrial sector, lighting savings make up the largest historical source of savings while savings from numerous other end uses contribute additional savings. Savings from the industrial sector are often lumpy, with savings varying from year to year depending on the projects identified and chosen for capital investment by industrial facilities. These savings are summarized in Figure 11 below. Industrial savings averaged just under 0.9 aMW per year over this period.

Figure 11: 2021-2022 Industrial Program Achievements by End Use



Customer Characteristics

This section describes the characterization of Clark Public Utilities' customer base. This process includes defining the makeup and characteristics of each individual sector. Defining the customer base determines the type and quantity of remaining opportunities to implement energy efficiency measures. Information about the local climate and service territory population is used to characterize some measures. This information is summarized in Table 4.

Table 4: Service Territory Characteristics

Heating Zone	Cooling Zone	Total Homes (2022)	Total Population (2022)
1	1	207,817	516,779

The count of homes is based on residential account data provided by Clark Public Utilities and reflects a 5% increase from the 2020 value used in the 2021 CPA. Future residential growth was assumed to be 2.5% per year, based on Clark Public Utilities projections.

Lighthouse also applied a demolition rate based on assumptions for Washington State from the Council's 2021 Power Plan. The demolition rate quantifies the rate at which existing homes are converted to new homes through demolition or major renovation, where codes for new construction apply. The population is based on census data for Clark County.

Residential

Within the residential sector, the key characteristics are the number and type of homes as well as the saturation of end use appliances such as space and water heating equipment. Lighthouse updated the distribution of home types based on American Community Survey (ACS) data. HVAC and other appliance saturation data was based on a combination of data from the ACS and early data from NEEA's 2022 Residential Building Stock Assessment. Table 5 and Table 6 summarize the characteristics that were used for this assessment for existing homes and new homes, respectively.

Table 5: Residential Existing Home Characteristics

	Single Family	Low Rise Multifamily	High Rise Multifamily	Manufactured
Share of Homes	74%	6%	15%	4%
HVAC Equipment				
Electric Forced Air Furnace	6%	0%	0%	55%
Air Source Heat Pump	25%	5%	5%	26%
Ductless Heat Pump	14%	0%	0%	6%
Electric Zonal/Baseboard	9%	91%	91%	3%
Central Air Conditioning	44%	0%	0%	0%
Room Air Conditioning	15%	29%	29%	29%
Other Appliances				
Electric Water Heater	58%	95%	95%	90%
Refrigerator	131%	104%	104%	126%
Freezer	44%	5%	5%	39%
Clothes Washer	96%	35%	35%	94%
Electric Clothes Dryer	83%	29%	29%	94%
Dishwasher	98%	60%	60%	77%
Electric Oven	80%	98%	98%	100%

	Single Family	Low Rise Multifamily	High Rise Multifamily	Manufactured
Desktop	81%	27%	27%	65%
Laptop	87%	29%	29%	29%
Monitor	104%	31%	31%	65%

Table 6: Residential New Home Characteristics

	Single Family	Low Rise Multifamily	High Rise Multifamily	Manufactured
HVAC Equipment				
Electric Forced Air Furnace	6%	0%	0%	55%
Air Source Heat Pump	25%	5%	5%	26%
Ductless Heat Pump	14%	0%	0%	6%
Electric Zonal/Baseboard	9%	91%	91%	3%
Central Air Conditioning	44%	0%	0%	0%
Room Air Conditioning	15%	29%	29%	29%
Other Appliances				
Electric Water Heater	58%	95%	95%	90%
Refrigerator	131%	104%	104%	126%
Freezer	44%	5%	5%	39%
Clothes Washer	96%	35%	35%	94%
Electric Clothes Dryer	83%	29%	29%	94%
Dishwasher	98%	60%	60%	77%
Electric Oven	80%	98%	98%	100%
Desktop	81%	27%	27%	65%
Laptop	87%	29%	29%	29%
Monitor	104%	31%	31%	65%

In the tables above, numbers greater than 100% imply an average of more than one appliance per home. For example, the single-family refrigerator saturation of 131% means that single family homes average approximately 1.3 refrigerators per home.

Commercial

In the commercial sector, building floor area is the primary variable in determining the number of conservation opportunities, as many of the commercial measures are quantified based on the applicable amount of floor area. To estimate the commercial floor area in Clark Public Utilities' service territory, Clark Public Utilities provided 2022 sales by commercial building type. The sales were converted to estimates of floor area by applying energy use intensities (EUIs) from the 2019 CBSA. Based on the updated sales data, the estimated floor area increased by 7% from the 2021 CPA. The commercial floor area was assigned a growth rate of 1.6% based Clark Public Utilities' forecast.

Table 7 summarizes the resulting floor area estimates for each of the 18 commercial building segments.

Table 7: Commercial Floor Area by Segment

Building Type	2022 Floor Area (square feet)
Large Office	6,706,376
Medium Office	6,374,120
Small Office	9,230,160
Extra Large Retail	7,120,887
Large Retail	2,141,653
Medium Retail	3,371,346
Small Retail	5,150,362
School (K-12)	14,771,674
University	1,230,061
Warehouse	3,647,076
Supermarket	1,380,173
Mini Mart	618,871
Restaurant	2,125,828
Lodging	7,274,195
Hospital	2,510,489
Residential Care	954,046
Assembly	11,572,614
Other Commercial	10,691,877
Total	96,871,807

Industrial

The methodology used to estimate potential in the industrial sector is different from the residential and commercial sectors. Instead of building a bottom-up estimate of the savings associated with individual measures, potential in the industrial sector is quantified using a top-down approach that uses the annual energy consumption within individual industrial segments, which is then further disaggregated into end uses. Savings for individual measures are calculated by applying the assumed savings, expressed as a percentage, to the applicable end use consumption within each industrial segment.

To quantify the industrial segment loads, Clark Public Utilities provided 2022 energy consumption data for its industrial customers categorized by industry. The overall industrial consumption totals 1,017,457 MWh, as summarized in Table 8. This represents a 7% increase over the 2021 CPA.

Lighthouse assumed no load growth in the industrial sector, consistent with Clark Public Utilities' forecasts.

Table 8: Industrial Sector Sales by Segment

Segment	2022 Sales (MWh)
Water Supply	48,866
Sewage Treatment	36,591
Other Food	74,482
Wood - Lumber	8,625
Wood - Other	8,858
Pulp and Paper Mills (Kraft)	1,813
Paper Conversion Plants	13,872
Refinery	912
Chemical Manufacturing	125,018
Silicon Growing/Manufacturing	205
Cement/Concrete Products	4,101
Primary Metal Manufacturing	2,848
Fabricated Metal Manufacturing	36,686
Semiconductor Manufacturing	493,183
Transportation Equipment	25,771
Misc. Manufacturing	104,453
Refrigerated Warehouse	7,625
Fruit Storage	8,363
Indoor Agriculture	15,185
Total	**1,017,457**

Utility Distribution System

The 2021 Power Plan used a new approach for quantifying the potential energy savings in measures that improve the efficiency of utility distribution systems. The Council's new approach estimates potential savings based on the 2018 sales within each sector and estimates costs from estimates of the number of distribution substations and feeders for each utility. Table 9 summarizes the assumptions used for this sector.

Table 9: Utility Distribution System Efficiency Assumptions

Characteristic	Count
Distribution Substations*	42
Residential/Commercial Substations*	35
Urban Feeders*	68
Rural Feeders*	29
2018 Residential Sales (MWh)	2,364,873
2018 Commercial Sales (MWh)	1,335,558
2018 Industrial/Other Sales (MWh)	764,602

**Note that these are estimates from the Council and may not reflect Clark Public Utilities' actual system*

Results

This section discusses the results of the 2023 CPA. It begins with a discussion of the high-level achievable and cost-effective conservation potential and then covers the cost-effective potential within individual sectors and end uses.

Achievable Conservation Potential

The achievable conservation potential is the amount of energy efficiency available without considering the cost-effectiveness of measures. It considers market barriers and the practical limits of acquiring energy savings by efficiency programs, but not the cost.

Figure 12 shows the supply curve of achievable potential over the 20-year study period. A supply curve depicts the cumulative potential available against the levelized cost of energy savings, with the measures sorted in order of ascending cost. No economic screening is applied. Levelized costs are used to make the costs comparable between measures with different lifetimes as well as supply-side resources considered in utility integrated resource plans. The costs include credits for deferred transmission and distribution system costs, avoided generation capacity, avoided periodic replacements, and non-energy impacts. With these credits, some of the lowest-cost measures have a net levelized cost that is negative, meaning that the credits exceed the measure costs.

Figure 12: 20-Year Supply Curve

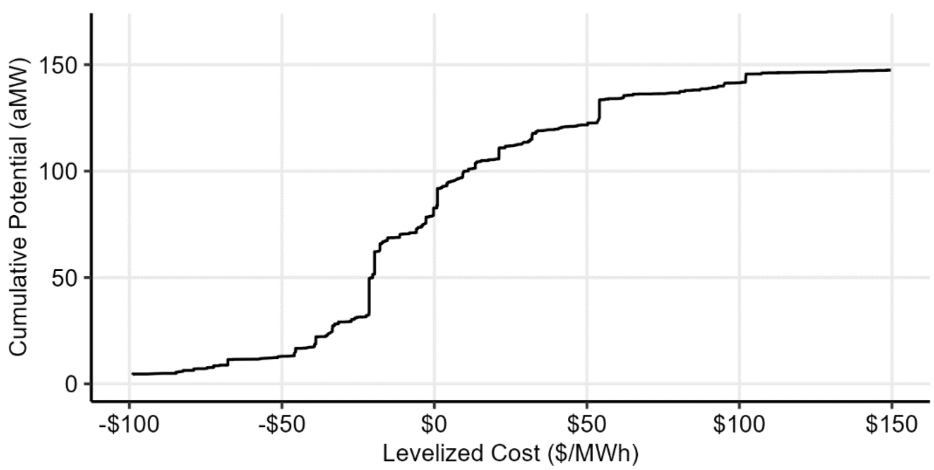


Figure 12 shows that approximately 75 aMW of potential are available at a levelized cost at or below $0/MWh. As discussed above, these are measures where benefits such as the deferral of capacity costs and non-energy benefits exceed the measure costs. Clark Public Utilities could acquire approximately 125 aMW of savings at costs of $50/MWh or below. A total of 169 aMW is available in Clark Public Utilities' service territory over the 20-year period, but only potential below $150/MWh is shown in the supply curve. After a cost just above $50/MWh, the supply curve flattens and any increases in potential come at increasingly higher costs.

Supply curves based on levelized cost are limited in that not all energy savings are equally valued. For example, two measures could have the same levelized cost but provide different reductions in peak demand. An alternative to the supply curve based on levelized cost is one based on the benefit-cost ratio. This is shown below in Figure 13.

Figure 13: 20-Year Benefit-Cost Ratio Supply Curve

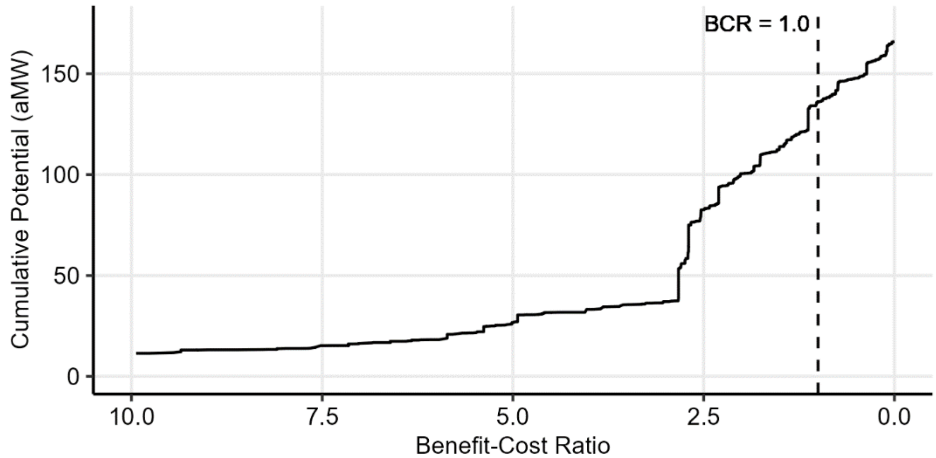


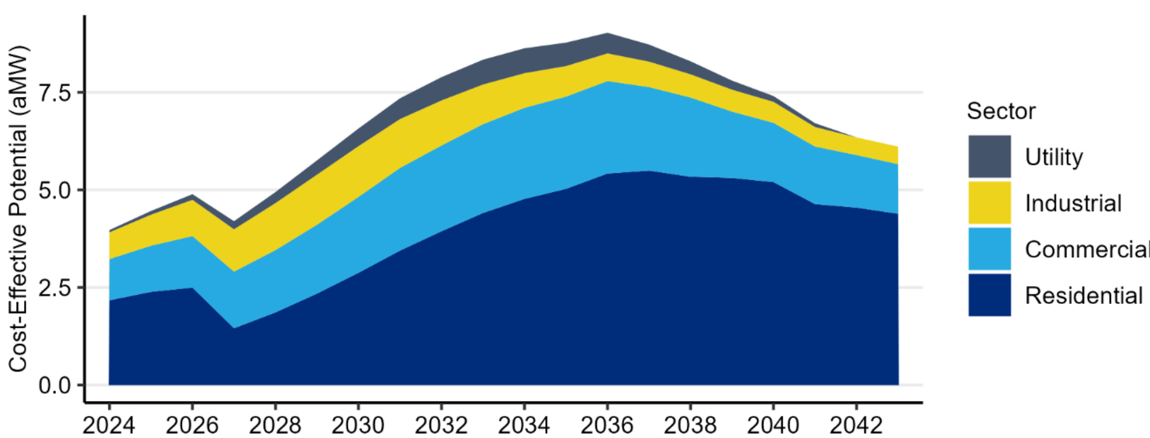
Figure 13 includes a dashed line where the benefit-cost ratio is equal to one. There are 136 aMW of cost-effective savings potential to the left of this line, with benefit-cost ratios greater than one. This is the 20-year cost-effective potential identified earlier in this report. Although there are steps in the line, the slope of the line is fairly consistent from the point where the benefit-cost ratio is equal to 2.5 to 0. This suggests approximately equal sensitivities to higher and lower avoided costs, which would effectively shift the dashed line to the right or left, respectively. However, more than 80% of the achievable potential is already cost-effective, so there is a limited amount of achievable potential that could become cost effective with higher avoided costs.

The economic or cost-effective potential is described further below.

Cost-Effective Conservation Potential

Figure 14 shows the cost-effective potential by sector on an annual basis. Most of the potential is in Clark Public Utilities' residential sector, followed by the commercial and industrial sectors, with smaller amounts available in the utility sector.

Figure 14: Annual Cost-Effective Potential by Sector



Lighthouse used the ramp rates from the 2021 Power Plan were used to establish reasonable rates of acquisition for all sectors. This included making modifications to the assigned ramp rates for some measures to align the near-term potential with recent and expected savings in each sector. Appendix VII has more detail on the alignment of ramp rates with program expectations.

Sector Summary

The sections below describe the cost-effective potential within each sector.

Residential

Relative to the 2021 CPA, the cost-effective potential in the residential sector has increased moderately in the near term, with more significant increases in the long-term.

Figure 15 shows the cost-effective potential by end use for the first 10 years of the study period. There is a large chunk of savings from Clark Public Utilities' behavior program expected in the near term, which are part of the "whole home" end use. Lighthouse only included savings from this program through 2026. Beyond these savings, measures in the HVAC (which includes both equipment and weatherization) and water heating end uses make up the largest share of residential potential in the initial 10 years. Savings in the other end use includes savings from the cooking and lighting end uses.

The savings potential grows during the initial 10 years of the study as the expected market share of efficient equipment and adoption of other energy efficiency measures increases.

Figure 15: Annual Residential Potential by End Use

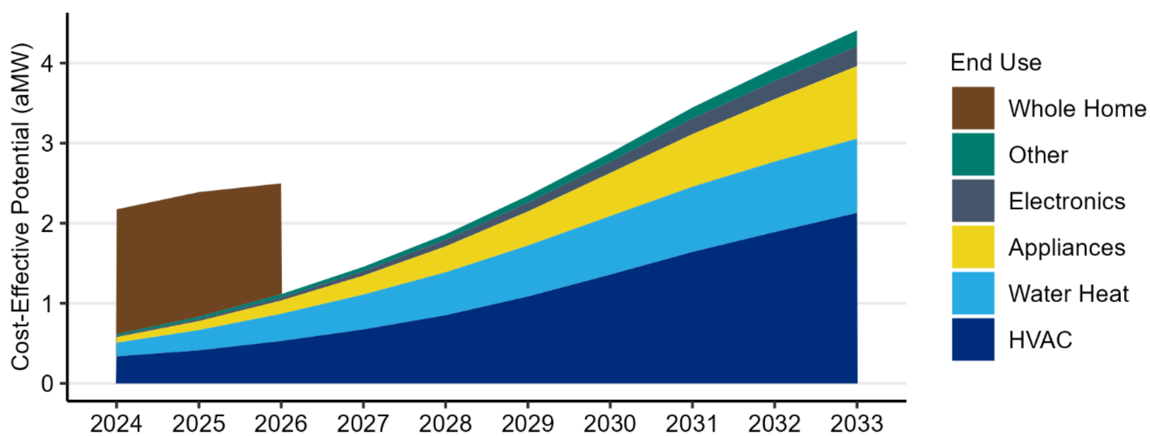
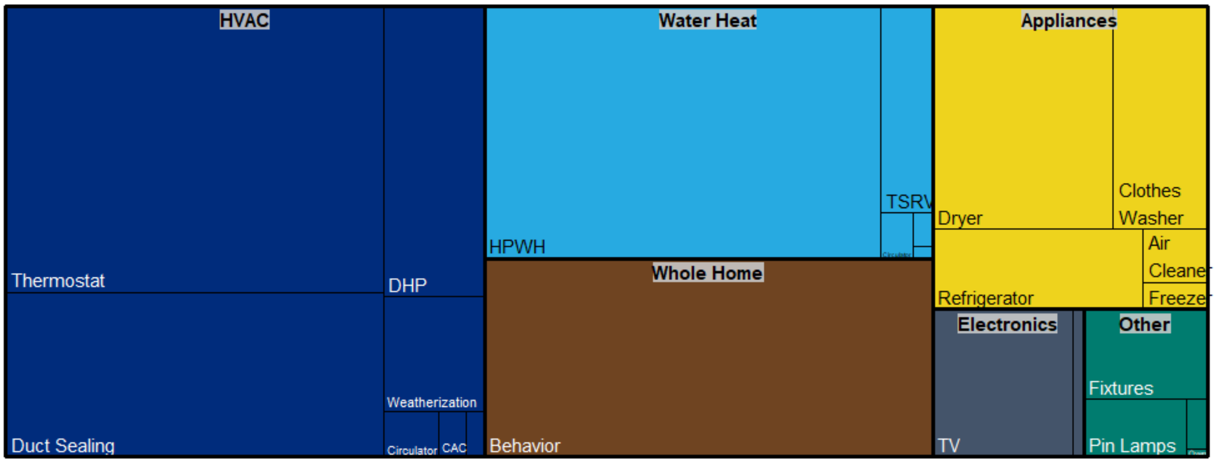


Figure 16 shows how the 10-year potential breaks down into end uses and measure categories. The area of each block represents its share of the total 10-year residential potential. Smart thermostats, ductless heat pumps, and duct sealing make up most of the potential in the HVAC end use, while heat pump water heaters (HPWH) and thermostatic restriction valves (TSRV) are the key measures within the water heating end use. The potential from some weatherization measures as well as most air source heat pump measures did not pass the cost-effectiveness screening in this CPA, even with the higher avoided costs and updated capacity values.

Figure 16: Residential Potential by End Use and Measure Category

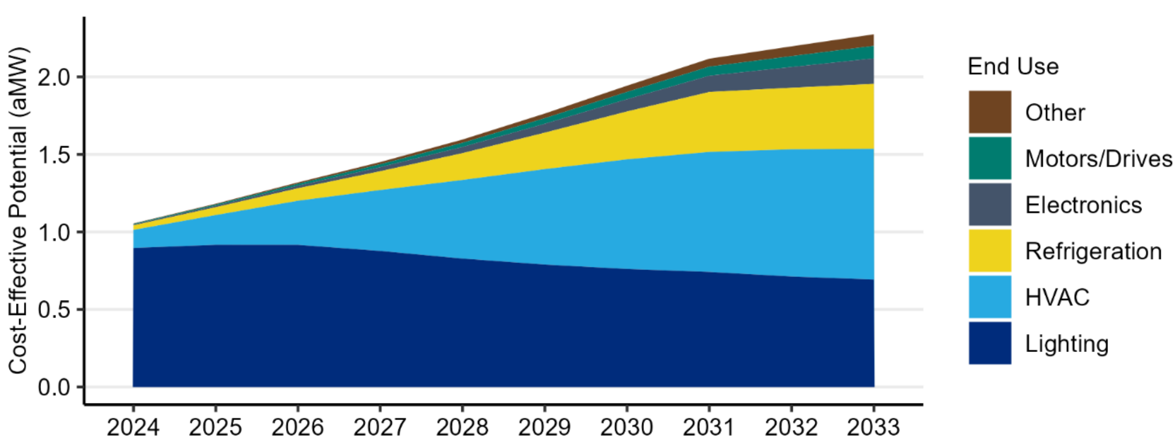


Note that some residential measures, such as smart thermostats and heat pump water heaters, can provide benefits as both energy efficiency and demand response resources. Any demand response benefits were not included in this CPA, although energy efficiency programs can help build a stock of equipment that could be called upon by demand response programs. Lighthouse assessed the demand response potential of these measures in Clark Public Utilities' *2023 Demand Response Potential Assessment*.

Commercial

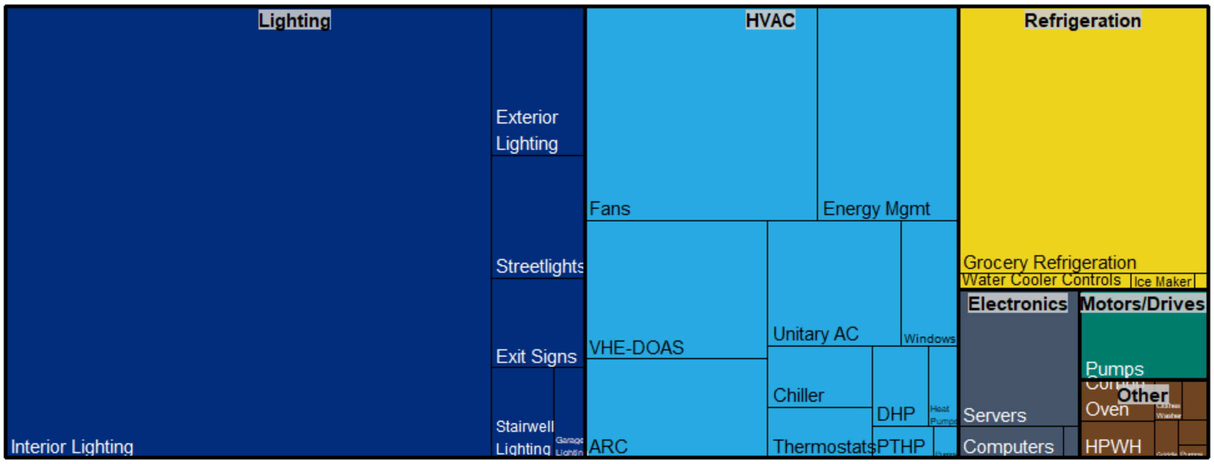
In the commercial sector, lighting, HVAC, and refrigeration measures are the end uses with the highest potential. The potential in the lighting end use declines over time, a reflection of the limited lighting potential remaining after being mainstay of commercial programs for many years. In contrast, the potential in the HVAC and refrigeration end uses grows, showing opportunities for program growth in these areas. In Figure 17, the other category includes measures in the compressed air, food preparation, and water heating end uses.

Figure 17: Annual Commercial Potential by End Use



The key end uses and measure categories within the commercial sector are shown in Figure 18. The area of each block is proportional to its share of the 10-year commercial potential. The potential in the lighting end use includes measures applicable to both interior and exterior lighting as well as other lighting applications. In the HVAC end use, the potential is distributed across a range of equipment types, which reflects the range of building sizes and HVAC equipment types used across the sector.

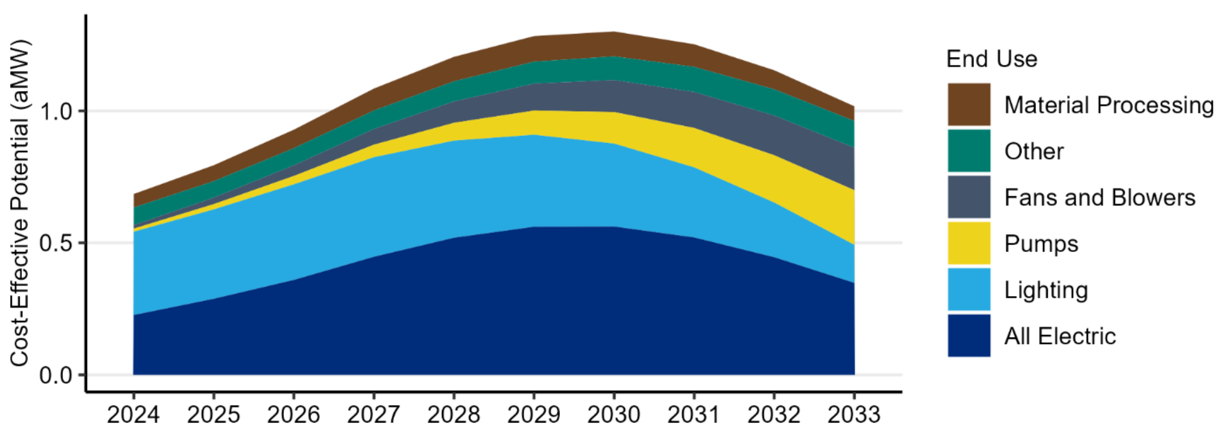
Figure 18: Commercial Potential by End Use and Measure Category



Industrial

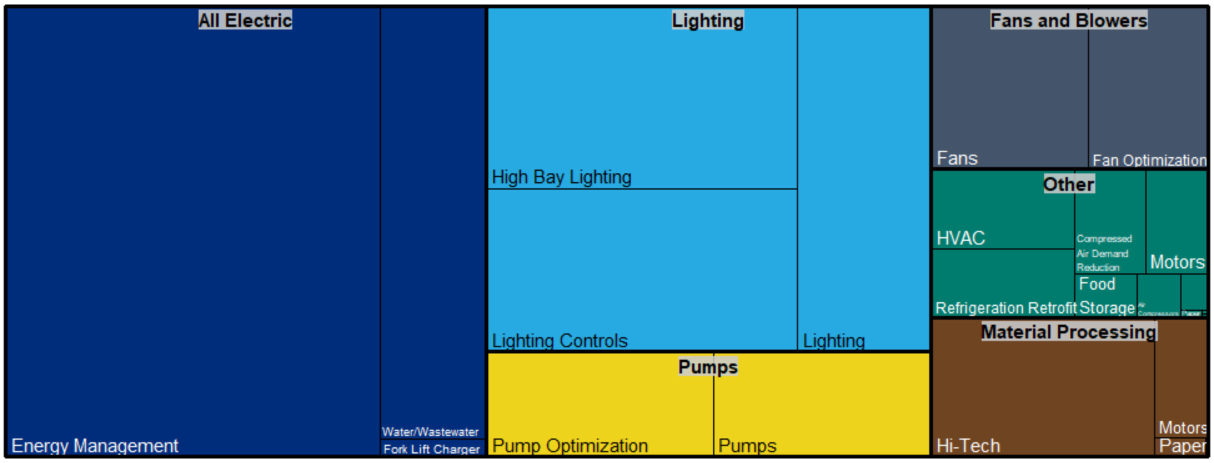
The annual industrial sector potential is shown in Figure 19. The all electric and lighting end uses have the most potential, although, like the commercial sector, the available lighting potential decreases over time. The all electric end use includes measures applicable to all end uses, such as strategic energy management programs. Smaller amounts of potential are available through measures in the pumps, fans and blowers, and material processing end uses. The other category in Figure 19 includes a variety of end uses, including material handling, HVAC, refrigeration, compressed air, and several other small end uses.

Figure 19: Annual Industrial Potential by End Use



The breakdown of 10-year industrial potential into end uses and measure categories is shown in Figure 20.

Figure 20: Industrial Potential by End Use and Measure Category

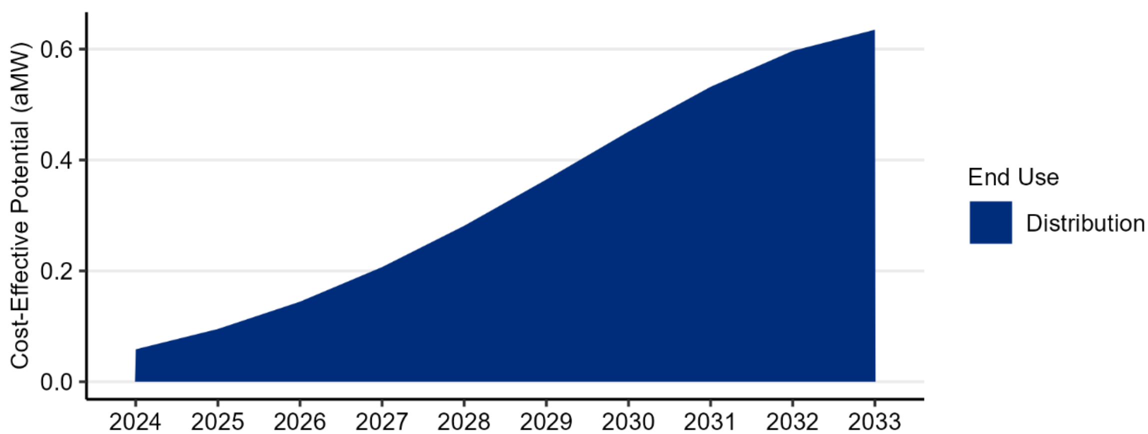


Utility

Measures in the utility sector involve the regulation of voltage to improve the efficiency of the distribution system. This CPA includes the measures characterized for the 2021 Power Plan, which are based on Clark Public Utilities' load and estimates of the number of distribution substations and feeders.

The annual distribution system potential is shown in Figure 21. The Council characterized three measures in the draft 2021 Power Plan, which use increasingly sophisticated control systems. Note that the scale for this figure has changed relative to the figures above, as the potential in this sector is much smaller than those sectors.

Figure 21: Annual Distribution System Potential



Savings Shape

This section provides further details on the shape of the cost-effective potential identified in this CPA, including breakdowns of energy savings by on- and off-peak periods and month, as well as further detail on the peak demand savings.

Methodology

Each of the measures included in this CPA have one or more savings components. While most measures have just a single savings component, numerous measures have more than one. Efficient heat pumps, for example, can provide both heating and cooling savings, each of which are quantified as a separate savings component. Water-saving measures often have two distinct savings components: the reduction of water heating loads in homes and buildings, and the reduced loads at wastewater treatment plants through the reduction of wastewater influent. Each measure savings component was assigned a load profile and a ratio that allocated the total measure savings to each savings component. These ratios and load profiles were applied to the annual potential results, enabling the calculation of more detailed breakdowns in the savings potential. Lighthouse used the load shapes that were developed by the Council for the 2021 Power Plan for this analysis.

Results

Figure 22 shows the shape of the monthly savings for on- and off-peak energy savings. Like the annual results discussed above, most of the savings in each period are in the residential sector. This sector also contributes a larger share of its savings during the winter months, while the savings from other sectors are more consistent across the months of the year.

Figure 22: On- and Off-Peak Savings by Month and Sector

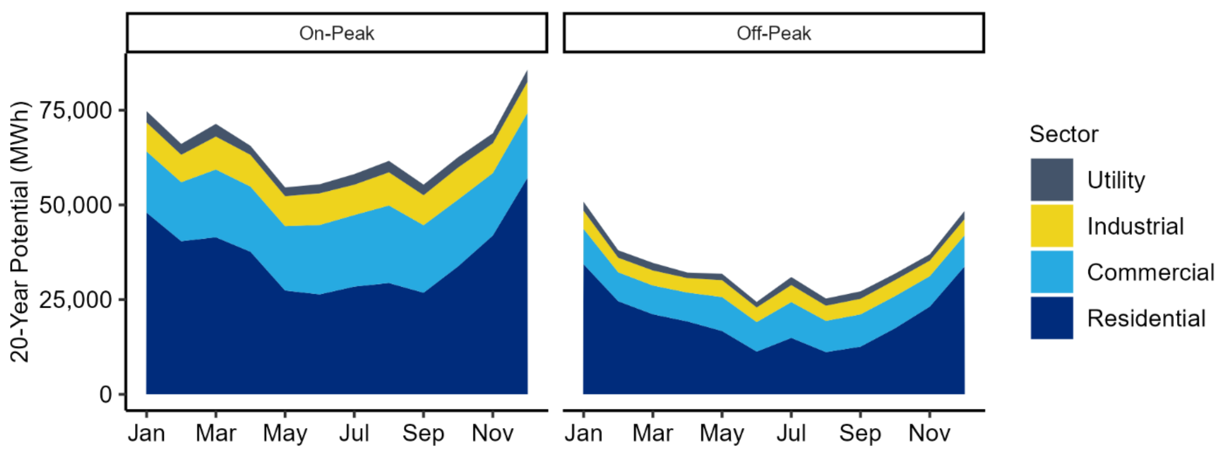


Figure 23 shows a similar breakdown as above, only by end use instead of sector. While each of the end use categories contributes more on-peak savings, the HVAC end use is a primary contributor to on-peak savings in the winter months while the savings from other end uses are more evenly spread across the year.

Figure 23: On- and Off-Peak Savings by Month and End Use

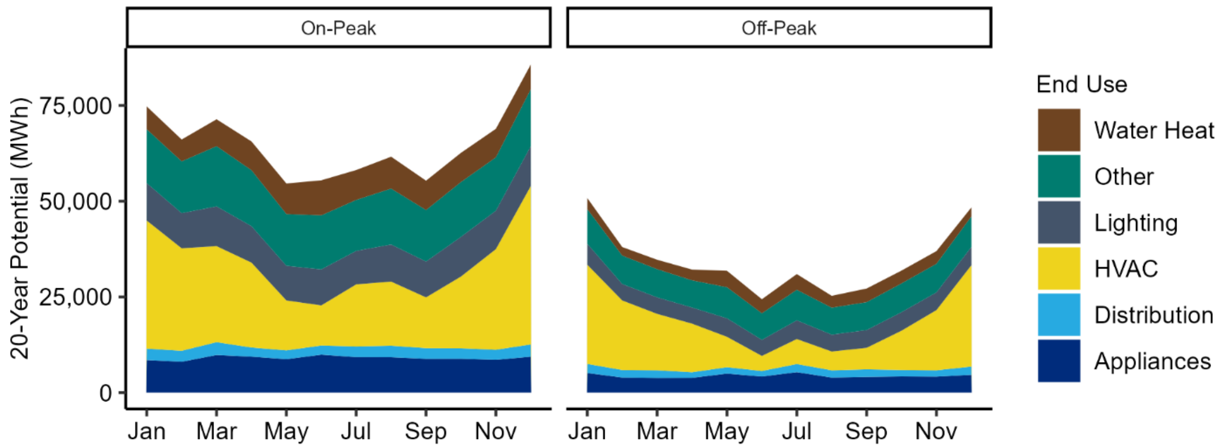


Figure 24 and Figure 25 show the monthly peak demand savings by sector and end use, respectively. Like above, the residential sector and HVAC end use contribute the most to reductions in peak demand. For this breakdown, Lighthouse assumed morning peaks in the winter and shoulder season months with evening peaks in the summer.

Figure 24: Monthly Peak Savings by Sector

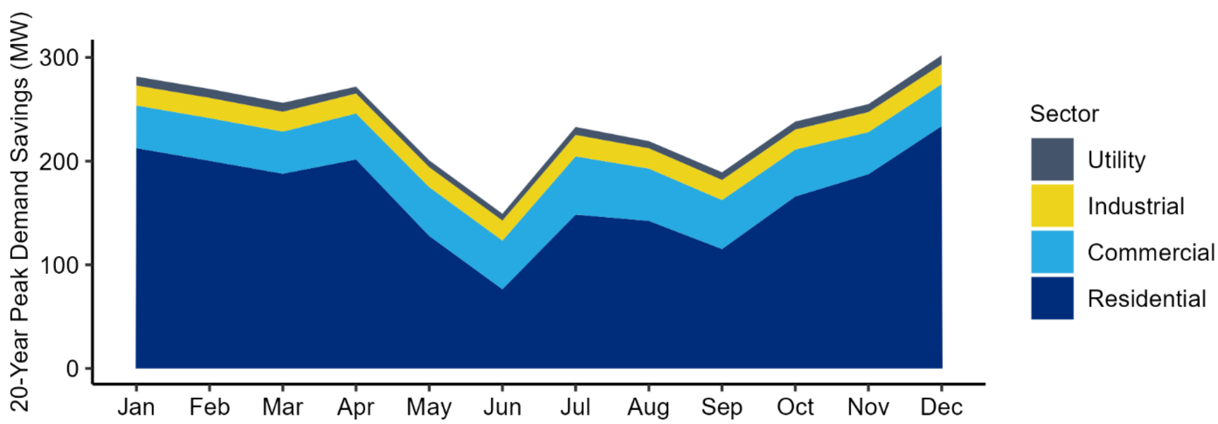


Figure 25: Monthly Peak Savings by End Use

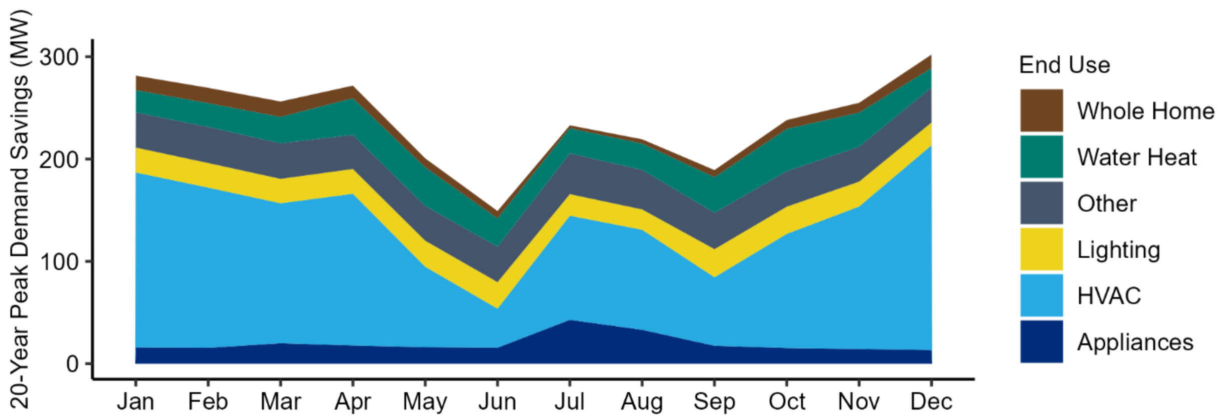
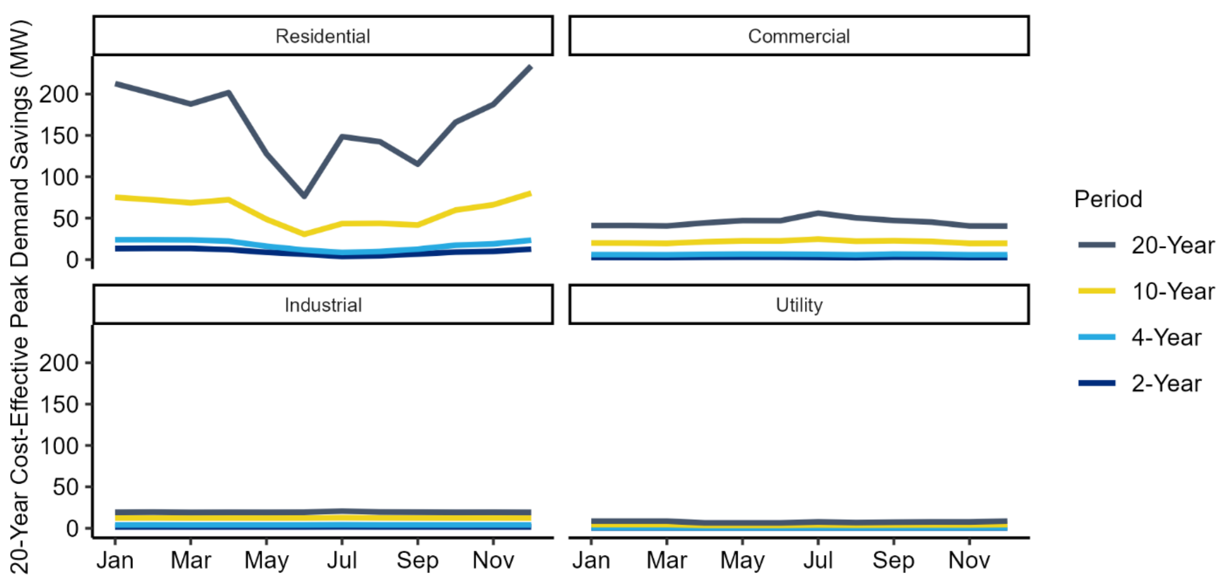


Figure 26 shows the monthly peak demand savings by sector, month, and time period. Like the figures above, the residential sector shows the highest levels of peak demand savings, but the month-to-month shape of the residential begins fairly flat but takes on a more seasonal profile over time, including a more pronounced increase in summer peak demand savings. This highlights the fact that much of the peak demand savings in the residential sector are in measures that were given slower ramp rates and are projected to be acquired more slowly. In the commercial sector, the savings take on a slightly more summer-oriented savings shape over time.

Figure 26: Monthly Peak Demand Savings by Sector, Month, and Time Period



Scenario Results

This section discusses the results of two additional scenarios that were considered in addition to the base case scenario covered in the previous section. These scenarios feature low and high variations in the avoided costs values, covering a range of possible outcomes to reflect uncertainty in future values. These scenarios allow Clark Public Utilities to understand the sensitivity of the cost-effective potential to variations in avoided cost. All other inputs were held constant.

Table 10 summarizes the avoided cost assumptions used in each scenario, which are discussed further in Appendix IV.

Table 10: Avoided Cost Assumptions by Scenario

		Low Scenario	Base Scenario	High Scenario
Energy Values	**Avoided Energy Costs (20-Year Levelized Price, 2016$)**	Market Forecast minus 20%-80% ($27/MWh)	Market Forecast ($52/MWh)	Market Forecast plus 20%-80% ($77/MWh)
	Social Cost CO_2	Federal 2.5% Discount Rate Values	Federal 2.5% Discount Rate Values	Federal 2.5% Discount Rate Values
	RPS Compliance	WA EIA & CETA Requirements	WA EIA & CETA Requirements	WA EIA & CETA Requirements
Capacity Values	**Distribution Capacity (2016$)**	$7.82/kW-year	$7.82/kW-year	$7.82/kW-year
	Transmission Capacity (2016$)	$3.54/kW-year	$3.54/kW-year	$3.54/kW-year
	Generation Capacity (2016$) **Winter** **Summer**	$57/kW-year $49/kW-year	$69/kW-year $59/kW-year	$84/kW-year $72/kW-year
	Implied Risk Adder (2016$)	-$25/MWh -$10-12/kW-year	N/A	25$/MWh $13-15/kW-year
	NW Power Act Credit	10%	10%	10%

Instead of using a single risk adder applied to each unit of energy, the two alternate scenarios consider potential futures with higher and lower values for the avoided cost inputs where some degree of uncertainty exists, including variations in the value of both energy and capacity. The implied risk adder is calculated for the low and high scenarios by totaling the differences in both energy and capacity-based values relative to the base scenario. Further discussion of these values is provided in Appendix IV.

Table 11 summarizes the cost-effective potential across each avoided cost scenario. As discussed above, the results show roughly equal sensitivities to both higher and lower avoided cost scenarios over all but the 20-year timeframe.

Table 11: Cost Effective Potential (aMW) by Avoided Cost Scenario

Scenario	2-Year	4-Year	10-Year	20-Year
Low Scenario	7.92	16.30	53.26	117.11
Base Case	8.43	17.52	58.36	136.15
High Scenario	9.82	19.52	61.77	141.38

Overall, energy efficiency remains a low-risk resource for Clark Public Utilities since it is purchased in small increments over time, making it unlikely that the significant amounts of the resource be acquired that were over-valued.

Summary

This report has summarized the results of the 2023 CPA conducted for Clark Public Utilities. The assessment provided estimates of the cost-effective energy savings potential for the 20-year period beginning in 2024, with details on the first ten years per the requirements of Washington State's EIA. The assessment considered a wide range of measures that are reliable and available during the study period.

Compared to Clark Public Utilities' 2021 CPA, the potential has decreased slightly in the near term but increased over the mid- and long-term. Near term savings were aligned with recent program achievements, which decreased in the commercial and industrial sectors.

In the mid to longer term, this assessment found significantly higher amounts of cost-effective potential. This additional potential was driven by higher energy and capacity values in the avoided costs as well as higher projections of customer counts and loads.

Compliance with State Requirements

The methodology used to estimate the cost-effective energy efficiency potential described in this report is consistent with the methodology used by the Council in determining the potential and cost-effectiveness of conservation resources in the 2021 Power Plan. Appendix III provides a list of Washington's EIA requirements and a description of how each was implemented. In addition to using a methodology consistent with the Council's 2021 Power Plan, the assessment used assumptions from the 2021 Power Plan where utility-specific inputs were not used. Utility-specific inputs covering customer characteristics, previous conservation achievements, and economic inputs were used. The assessment included the measures considered in the 2021 Power Plan materials, with additional RTF updates since its publication.

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Appendix I: Acronyms

aMW	Average Megawatt
BPA	Bonneville Power Administration
CEIP	Clean Energy Implementation Plan
CETA	Clean Energy Transformation Act
CPA	Conservation Potential Assessment
EIA	Energy Independence Act
EUI	Energy Use Intensity
HPWH	Heat Pump Water Heater
HVAC	Heating, Ventilation, and Air Conditioning
IRP	Integrated Resource Plan
kW	kilowatt
kWh	kilowatt-hour
LED	Light-Emitting Diode
MW	Megawatt
MWh	Megawatt-hour
NEEA	Northwest Energy Efficiency Alliance
O&M	Operations and Maintenance
RPS	Renewable Portfolio Standard
RTF	Regional Technical Forum
SEM	Strategic Energy Management
TRC	Total Resource Cost

Appendix II: Glossary

Achievable Technical Potential	Conservation potential that includes considerations of market barriers and programmatic constraints, but not cost effectiveness. This is a subset of technical potential.
Average Megawatt (aMW)	An average hourly usage of electricity, measured in megawatts, across the hours of a day, month, or year.
Avoided Cost	The costs avoided through the acquisition of energy efficiency.
Cost Effective	A measure is described as cost effective when the present value of its benefits exceeds the present value of its costs.
Economic Potential	Conservation potential that passes a cost-effectiveness test. This is a subset of achievable potential. Per the EIA, a Total Resource Cost (TRC) test is used.
Levelized Cost	A measure of costs when they are spread over the life of the measure, like a car payment. Levelized costs enable the comparison of resources with different useful lifetimes.
Megawatt (MW)	A unity of demand equal to 1,000 kilowatts (kW).
Renewable Portfolio Standard	A requirement that a certain percentage of a utility's portfolio come from renewable resources. In 2020, Washington utilities with more than 25,000 customers are required to source 15% of their energy from renewable resources.
Technical Potential	The set of possible conservation savings that includes all possible measures, regardless of market or cost barriers.
Total Resource Cost (TRC) Test	A test for cost-effectiveness that considers all costs and benefits, regardless of who they accrue to. A measure passes this test if the present value of all benefits exceeds the present value of all costs. The TRC test is required by Washington's Energy Independence Act and is the predominant cost effectiveness test used throughout the Northwest and U.S.

Appendix III: Compliance with State Requirements

This Appendix details the specific requirements for Conservation Potential Assessments listed in WAC 194-37-080. The table below lists the specific section and corresponding requirement along with a description of how the requirement is implemented in the model and where the implementation can be found.

Table 12: CPA Compliance with EIA Requirements

WAC 194-37-080 Section	Requirement	Implementation
(5)(a)	**Technical potential.** Determine the amount of conservation that is technically feasible, considering measures and the number of these measures that could physically be installed or implemented, without regard to achievability or cost.	The model calculates technical potential by multiplying the quantity of stock (number of homes, building floor area, industrial load) by the number of measures that could be installed per each unit of stock. The model further constrains the potential by the share of measures that have already been completed. See calculations in the "Units" tabs within each of the sector model files.
(5)(b)	**Achievable technical potential**. Determine the amount of the conservation technical potential that is available within the planning period, considering barriers to market penetration and the rate at which savings could be acquired.	The model applies maximum achievability factors based on the Council's 2021 Power Plan assumptions and ramp rates to identify how the potential can be acquired over the 20-year study period. See calculations in the "Units" tabs within each of the sector model files. The complete set of the ramp rates used is on the "Ramp Rates" tab.
(5)(c)	**Economic achievable potential**. Establish the economic achievable potential, which is the conservation potential that is cost-effective, reliable, and feasible, by comparing the total resource cost of conservation measures to the cost of other resources available to meet expected demand for electricity and capacity.	Lighthouse used the Council's ProCost model to calculate TRC benefit-cost ratios for each measure after updating ProCost with utility-specific inputs. The ProCost results are collected through an Excel macro in the "ProCost Measure Results-(scenario).xlsx" files and brought into the CPA models through Excel's Power Query. See Appendix IV for further discussion of the avoided cost assumptions.
(5)(d)	**Total resource cost**. In determining economic achievable potential as provided in (c) of this subsection, perform a life-cycle cost analysis of measures or programs to determine the net levelized cost, as described in this subsection.	A life-cycle cost analysis was performed using the Council's ProCost tool, which Lighthouse configured with utility-specific inputs. Costs and benefits were included consistent with the TRC test. The measure files within each sector folder are used to calculate the ProCost results. These

WAC 194-37-080 Section	Requirement	Implementation
		results are then rolled up into the ProCost Measure Results files, which are linked to each sector model file through Excel's Power Query functionality.
(5)(d)(i)	Conduct a total resource cost analysis that assesses all costs and all benefits of conservation measures regardless of who pays the costs or receives the benefits.	The costs considered in the economic analysis included measure capital costs, O&M costs, periodic replacement costs, and any non-energy costs. Benefits included avoided energy, T&D capacity costs, avoided generation capacity costs, non-energy benefits, O&M savings, and periodic replacement costs. Measure costs and benefits can be found in the individual measure files as well as the "ProCost Measure Results" files.
(5)(d)(ii)	Include the incremental savings and incremental costs of measures and replacement measures where resources or measures have different measure lifetimes.	Assumed savings, cost, and measure lifetimes are based on 2021 Power Plan and subsequent RTF updates, where applicable. Measure costs and benefits can be found in the individual measure files as well as the "ProCost Measure Results" files.
(5)(d)(iii)	Calculate the value of the energy saved based on when it is saved. In performing this calculation, use time differentiated avoided costs to conduct the analysis that determines the financial value of energy saved through conservation.	Lighthouse used a 20-year forecast of monthly on- and off-peak market prices and the load shapes developed for the 2021 Power Plan as part of the economic analysis conducted in ProCost. The "MC and Loadshape" file contains both the market price forecast as well as the library of load shapes. Individual measure files contain the load shape assignments.
(5)(d)(iv)	Include the increase or decrease in annual or periodic operations and maintenance costs due to conservation measures.	Measure analyses include changes to O&M costs as well as periodic replacement costs, where applicable. These assumptions are based on the 2021 Power Plan and/or RTF. Measure assumptions can be found in the individual measure files.
(5)(d)(v)	Include avoided energy costs equal to a forecast of regional market prices, which represents the cost of the next increment of available and reliable power supply available to the utility for the life of the energy	Clark Public Utilities provided a forecast of on- and off-peak market prices at the mid-Columbia trading hub, which Lighthouse extrapolated to cover the 20-year period evaluated by this CPA. Further discussion of this forecast can be found

WAC 194-37-080 Section	Requirement	Implementation
	efficiency measures to which it is compared.	in Appendix IV. See the "MC and Loadshape" file for the market prices. These prices include the value of avoided REC purchases as applicable.
(5)(d)(vi)	Include deferred capacity expansion benefits for transmission and distribution systems.	Deferred transmission and distribution system benefits are based on the values developed by the Council for the 2021 Power Plan. These values can be found on the "ProData" tab of the ProCost files, cells C50 and C54.
(5)(d)(vii)	Include deferred generation benefits consistent with the contribution to system peak capacity of the conservation measure.	Deferred generation capacity expansion benefits are based on BPA's monthly demand charges scaled to reflect a price differential between winter and summer months that Clark Public Utilities was finding for call options. The development of these values is discussed in Appendix IV. These values can be found on the "ProData" tab of the ProCost files, cells C60.
(5)(d)(viii)	Include the social cost of carbon emissions from avoided non-conservation resources.	This assessment uses the social cost of carbon values determined in 2016 by the federal Interagency Workgroup using a 2.5% discount rate, as required by the Clean Energy Transformation Act. The emissions intensity of energy savings is based on a Council analysis of the regional marginal emissions intensity updated subsequent to the 2021 Power Plan. Beginning in 2030, an emissions intensity of 0 lbs./kWh is assumed based on the CETA requirements for GHG neutral energy. The carbon costs and emissions intensities can be found in the MC and Loadshape file.
(5)(d)(ix)	Include a risk mitigation credit to reflect the additional value of conservation, not otherwise accounted for in other inputs, in reducing risk associated with costs of avoided non-conservation resources.	This analysis uses a scenario analysis to consider risk. Avoided cost values with uncertain future values were varied across three different scenarios and the resulting sensitivity and risk were analyzed. The Scenario Results section of this report discusses the inputs used and the implicit risk

WAC 194-37-080 Section	Requirement	Implementation
		adders used in the analysis.
(5)(d)(x)	Include all non-energy impacts that a resource or measure may provide that can be quantified and monetized.	All quantifiable non-energy benefits were included where appropriate, based on values from the Council's 2021 Power Plan materials and RTF. Measure assumptions can be found in the individual measure files.
(5)(d)(xi)	Include an estimate of program administrative costs.	This assessment uses the Council's assumption of administrative costs equal to 20% of measure capital costs. Program admin costs can be found in the "ProData" tab of the ProCost files, cell C29.
(5)(d)(xii)	Include the cost of financing measures using the capital costs of the entity that is expected to pay for the measure.	This assessment utilizes the financing cost assumptions from the 2021 Power Plan materials, including the sector-specific cost shares and cost of capital assumptions. Financing assumptions can be found in the ProData tab of the ProCost files, cells C37:F46.
(5)(d)(xiii)	Discount future costs and benefits at a discount rate equal to the discount rate used by the utility in evaluating non-conservation resources.	This assessment uses a real discount rate of 3.75% to determine the present value of all costs and benefits. This is the value developed for the 2021 Power Plan. The discount rate used in this analysis can be found in the ProCost files, on cell C27 of the ProData tab.
(5)(d)(xiv)	Include a ten percent bonus for the energy and capacity benefits of conservation measures as defined in 16 U.S.C. § 839a of the Pacific Northwest Electric Power Planning and Conservation Act.	A 10% bonus is applied consistent with the Northwest Power Act. The 10% credit used in the measure analyses can be found in the ProCost files, on cell C29 of the ProData tab.

Appendix IV: Avoided Costs

The methodology used to conduct conservation potential assessments for electric utilities in the state of Washington is dictated by the requirements of the Energy Independence Act (EIA) and the Clean Energy Transformation Act (CETA). Specifically, WAC 194-37-070 requires utilities to determine the economic, or cost-effective, potential by "comparing the total resource cost of conservation measures to the total cost of other resources available to meet expected demand for electricity and capacity."[5] This CPA will determine the cost-effectiveness of conservation measures through a benefit-cost ratio approach, which uses avoided costs to represent the costs avoided by acquiring efficiency instead of other resources. The EIA specifies that these avoided costs include the following components:

- Time-differentiated energy costs equal to a forecast of regional market prices
- Deferred capacity expansion costs for the transmission and distribution system
- Deferred generation capacity costs consistent with each measure's contribution to system peak capacity savings
- The social cost of carbon emissions from avoided non-conservation resources
- A risk mitigation credit to reflect the additional value of conservation not accounted for in other inputs
- A 10% bonus for energy and capacity benefits of conservation measures, as defined by the Pacific Northwest Electric Power Planning and Conservation Act

In addition to these requirements, Washington's CETA requires specific values be used for the social cost of carbon. [6] Lighthouse has also included the value of avoided renewable portfolio standard compliance costs in the avoided costs.

Each of these inputs is covered in detail in the following sections.

Avoided Energy Costs

Avoided energy costs are the energy costs avoided by Clark Public Utilities through the acquisition of energy efficiency instead of supply-side resources. For every megawatt-hour of conservation achieved, Clark Public Utilities can either avoid the purchase or sell one additional megawatt-hour of energy.

For this CPA, Clark Public Utilities provided a forecast of avoided on- and off-peak energy prices at the Mid-Columbia trading hub from The Energy Authority (TEA). The forecast was provided on April 25, 2023, and includes prices by month for a seven-year period (2024-2030).

To benchmark this forecast, Lighthouse compared the TEA forecast to prices published by the CME Group[7] that were pulled on April 7, 2023. The comparisons of on- and off-peak prices are shown in Figure 27 and Figure 28 below. While the prices available from the CME Group cover a more limited timeframe, the prices are nearly identical.

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[5] WAC 194-37-070. Accessed January 20, 2021. https://app.leg.wa.gov/wac/default.aspx?cite=194-37-070

[6] WAC 194-40-100. Accessed March 7, 2023. https://app.leg.wa.gov/WAC/default.aspx?cite=194-40-100

[7] See https://www.cmegroup.com/trading/energy/electricity/mid-columbia-day-ahead-peak-calendar-month-5-mw-futures.html and https://www.cmegroup.com/trading/energy/electricity/mid-columbia-day-ahead-off-peak-calendar-month-5-mw-futures.html

Figure 27: Comparison of On-Peak Prices

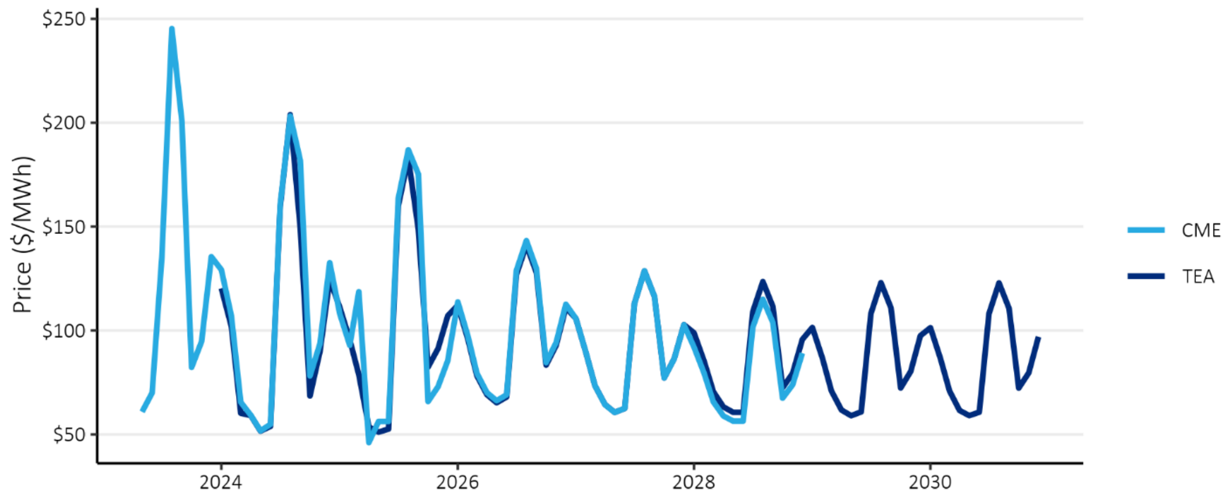
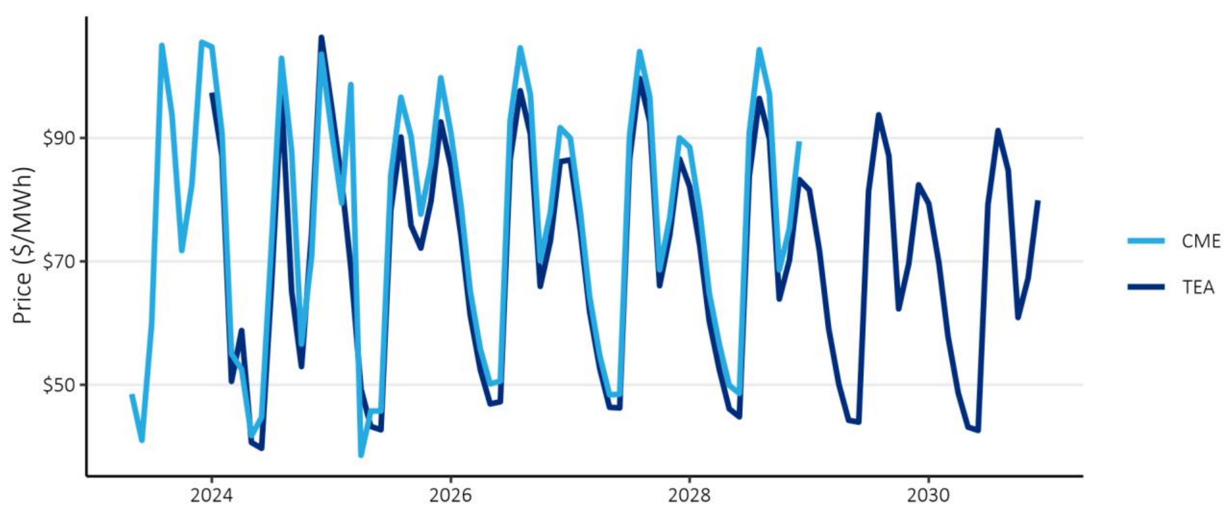


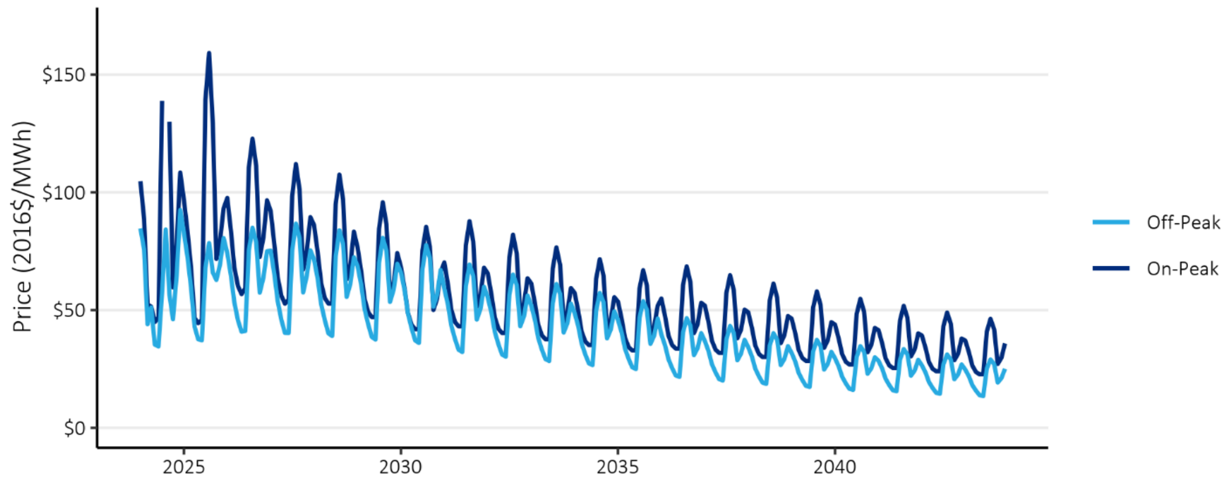
Figure 28: Comparison of Off-Peak Prices



To develop a forecast that covers the full 20-year study period of this CPA, Lighthouse developed a set of multipliers that would transition from the prices in 2028 to the mid-range of longer-term prices expected in the Northwest Power & Conservation Council's most recent market price forecast. [8] Lighthouse identified this approach as a balance that reflected both the near-term high prices and month to month volatility while also including the longer-term forecast based on market fundamentals from the Council. Figure 29 shows the resulting on- and off-peak prices resulting from this process.

[8] https://www.nwcouncil.org/fs/18190/2023_02_p3.pdf. Accessed March 3, 2023.

Figure 29: CPA Price Forecast



The levelized value of the 20-year price forecast is $52/MWh (2016$), a notable increase from the price forecast used in the 2021 CPA, which also had a levelized value of $32/MWh (2016$).

Lighthouse also created high and low variations of this forecast to be used in the avoided cost scenarios, which are described more subsequently. To develop the forecast variations, Lighthouse assumed that the high and low prices would vary by approximately 20% in the near term and 80% in the long term, relative to the base case price forecast. A similar approach was used in Clark Public Utilities' 2021 CPA based on the variation observed in the price forecasts developed for the 2021 Power Plan. Lighthouse applied this variation to the forecast described above to create high and low scenario forecasts. The resulting forecasts for on- and off-peak prices are shown in Figure 30 and Figure 31 below.

Figure 30: Comparison of On-Peak Price Scenarios

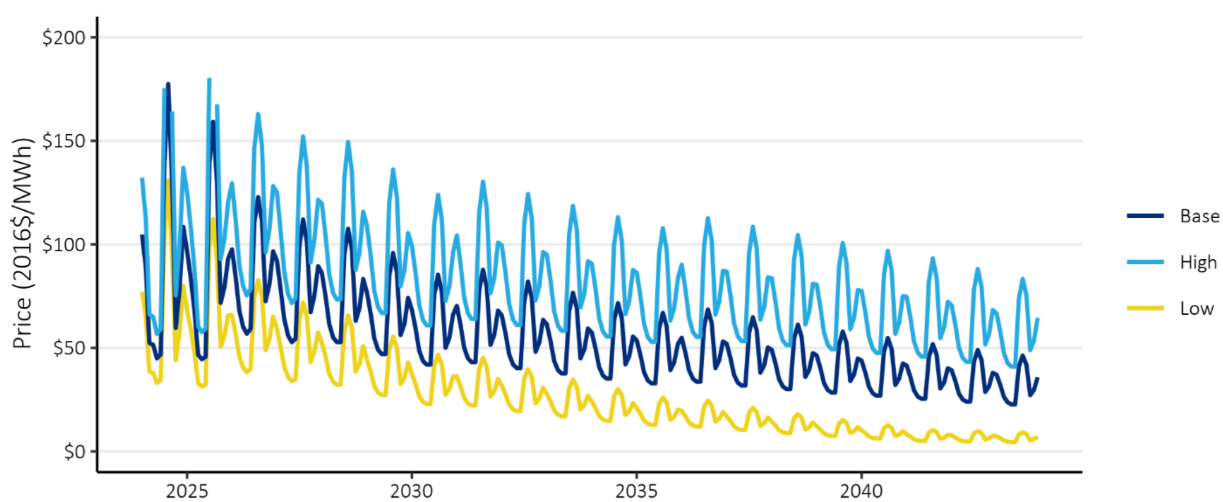
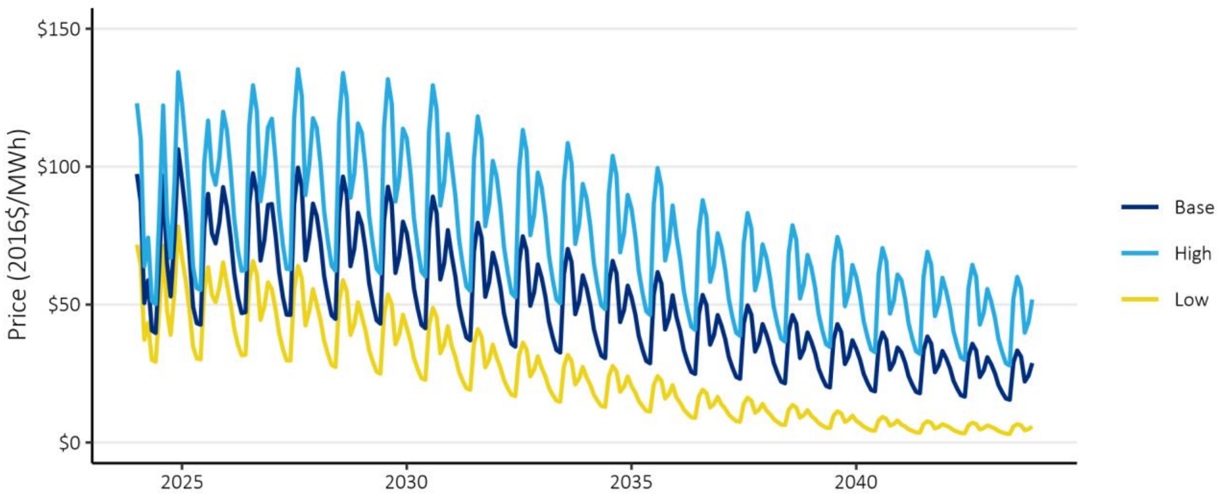


Figure 31: Comparison of Off-Peak Price Scenarios



Deferred Transmission and Distribution Capacity Costs

Unlike supply-side resources, energy efficiency does not require transmission and distribution infrastructure. Instead, it frees up capacity in these systems by reducing the peak demands and over time can help defer future capacity expansions and the associated capital costs.

In the development of the 2021 Power Plan, the Council developed a standardized methodology and surveyed the region to calculate these values. This CPA uses the values developed by the Council through that process: $3.54 and $7.82 per kW-year (in 2016 dollars) for transmission and distribution capacity, respectively. These values are slightly higher than the values used in the Clark Public Utilities' 2021 CPA and reflect small updates to the Council's values as they finalized the 2021 Power Plan.

These values for deferred transmission and distribution capacity are applied to demand savings coincident with the timing of the respective transmission and distribution system peaks. These values were used in all scenarios of the 2023 CPA. These capacity values were also applied to the demand savings quantified in the Demand Response Potential Assessment.

Deferred Generation Capacity Costs

Similar to the transmission and distribution systems discussed above, acquiring energy efficiency resources can also help defer or eliminate the costs of new generation resources built or acquired to meet peak demands for electricity.

For this CPA, Lighthouse and Clark Public Utilities staff collaborated to quantify generation capacity values that would be based on the sum of BPA demand charges across a calendar year, but scaled to reflect a price differential between winter and summer months that Clark Public Utilities was finding for capacity call options. This resulted in winter values of $67/kW-year and summer values of $57/kW-year in current year dollars.

In the base case, Lighthouse assumed that these values would increase by 2% each year and calculated a 20-year levelized cost in 2016 dollars, which is required in ProCost. The resulting base case values were

$69/kW-year for winter and $59/kW-year for summer. Lighthouse used these base cases values to quantify the value of demand savings in the Demand Response potential assessment as well.

For the low case, no price escalation was assumed, resulting in values of $57/kW-year for winter and $49/kW-year for summer. In the high scenario, 4% growth was assumed, resulting in values of $84/kW-year for winter and $72/kW-year for summer.

Social Cost of Carbon

In addition to avoiding purchases of energy, energy efficiency measures avoid emissions of greenhouse gases like carbon dioxide. Washington's EIA requires that CPAs include the social cost of carbon, which the EPA defines as a measure of the long-term damage done by a ton of carbon dioxide emissions in a given year. The EPA describes it as including, among other things, changes in agricultural productivity, human health, property damages from increased flood risk, and changes in energy system costs, including increases in the costs of cooling and decreases in heating costs.[9] In addition to this requirement, Washington's CETA requires that utilities use the social cost of carbon values developed by the federal Interagency workgroup using a 2.5% discount rate.

Washington's recently enacted Climate Commitment Act (CCA) requires all electricity imported into the state, including energy purchased from the Mid-Columbia trading hub, to be carbon-free or include emissions allowances. Based on this, the price forecasts discussed above may already include some cost of carbon embedded in the prices. Electric utilities also receive free emissions allowances under the CCA based on their forecasted emissions. These free allowances could be considered to offset any carbon costs included in the market prices. Because the CCA made no changes to CETA's requirement to include specific social cost of carbon values, this CPA used the CETA-required values in all scenarios.

To implement the cost of carbon emissions, additional assumptions must be made about the intensity of carbon emissions. This assessment uses an updated forecast of marginal emissions rates developed by the Council in 2022. The values from this analysis are used for years before 2030. Beginning in 2030, the marginal emissions rate is set to zero to reflect that CETA requires carbon-free energy. The Council's updated values generally follow those used in the 2021 Power Plan and Clark Public Utilities' 2021 CPA, but are now available on a more granular basis, reflecting variations by month and on- and off-peak periods. Table 13 shows the forecasted marginal emissions rates by month and year.

[9] https://www.epa.gov/sites/production/files/2016-12/documents/social_cost_of_carbon_fact_sheet.pdf. Accessed January 21, 2021.

Table 13: Council Forecast of Marginal Emissions Rates (lbs./kWh)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2023	1.0	1.1	1.0	1.0	1.0	0.9	1.2	1.2	1.2	1.0	1.2	1.1
2024	1.1	1.0	0.8	0.8	0.6	0.9	0.9	1.0	1.0	0.9	1.1	1.1
2025	0.6	0.4	0.6	0.6	0.4	0.6	0.8	1.0	1.0	0.9	0.8	0.8
2026	0.5	0.6	0.4	0.4	0.4	0.5	0.6	0.9	0.9	0.7	0.8	0.6
2027	0.6	0.6	0.4	0.6	0.3	0.5	0.7	0.9	0.9	0.7	0.8	0.7
2028	0.3	0.4	0.4	0.2	0.3	0.5	0.6	0.9	0.8	0.7	0.6	0.6
2029	0.4	0.4	0.3	0.3	0.4	0.4	0.9	0.9	0.8	0.7	0.7	0.8
2030	0.6	0.5	0.5	0.5	0.3	0.4	0.7	0.8	1.0	0.8	0.7	0.8
2031	0.6	0.5	0.4	0.5	0.4	0.5	0.7	0.9	1.1	0.9	0.5	0.9
2032	0.6	0.4	0.3	0.3	0.3	0.4	0.7	1.0	0.9	0.6	0.5	0.7
2033	0.4	0.4	0.5	0.4	0.3	0.5	0.8	1.0	1.0	0.9	0.7	0.9
2034	0.5	0.5	0.4	0.3	0.3	0.8	0.7	1.0	1.1	0.9	0.6	0.7
2035	0.5	0.5	0.4	0.5	0.3	0.5	0.8	1.0	0.8	0.6	0.5	0.7
2036	0.6	0.3	0.5	0.4	0.2	0.6	0.5	0.9	1.1	0.7	0.7	0.7
2037	0.4	0.4	0.5	0.4	0.3	0.5	0.8	0.9	0.9	0.8	0.5	0.8
2038	0.5	0.5	0.4	0.3	0.3	0.4	0.7	0.9	0.9	0.7	0.5	0.8
2039	0.5	0.5	0.5	0.3	0.3	0.5	0.7	0.9	1.0	0.8	0.7	0.8
2040	0.3	0.4	0.3	0.2	0.1	0.3	0.7	0.9	0.8	0.6	0.4	0.7
2041	0.2	0.1	0.1	0.1	0.1	0.1	0.4	0.4	0.4	0.2	0.1	0.2
2042	0.4	0.2	0.2	0.1	0.1	0.1	0.3	0.6	0.5	0.2	0.2	0.2

Renewable Portfolio Standard Compliance Costs

The renewable portfolio standard established under Washington's EIA requires that utilities source 15% of retail sales from renewable resources throughout the study period of this CPA. The subsequently passed CETA furthers these requirements, mandating that 100% of sales be greenhouse gas neutral in 2030, with an allowance that up to 20% of the requirement can be achieved through other options, such as the purchase of RECs.

Energy efficiency can reduce the cost of complying with these requirements by reducing Clark Public Utilities' overall load. In 2024, a reduction in load of 100 MWh through energy efficiency would reduce the number of RECs required for compliance by 15. This equates to a value of 15% of the cost of a REC for every megawatt-hour of energy savings. In 2030, it was assumed that marginal energy purchases would also include the purchase of a REC, thus the full price of a REC was added to the energy price after 2030.

Lighthouse developed a forecast of REC prices based on input from several clients.

Risk Mitigation Credit

Any purchase of a resource involves risk. The decision to invest is based on uncertain forecasts of loads and market conditions. Investing in energy efficiency can reduce the risks that utilities face by the fact that it is made in small increments over time, rather than the large, singular sums required for generation resources. A decision not to invest in energy efficiency could result in exposure to higher market prices than forecast, an unneeded infrastructure investment, or one that cannot economically dispatch due to low market prices. While over-investments in energy efficiency are possible, the small and discrete amounts invested in energy efficiency limit the scale of any exposure to this risk.

In its power planning work, the Council develops a risk mitigation credit to account for this risk. This credit accounts for the value of energy efficiency not explicitly included in the other avoided cost values, ensuring that the level of cost-effective energy efficiency is consistent with the outcomes of the power planning process. The credit is determined by identifying the value that results in a level of cost-effective energy efficiency potential that is equivalent to the regional targets set by the Council.

In the 2021 Power Plan, the Council determined that no risk credit was necessary after including carbon costs and a generation capacity value in its avoided cost.

This CPA follows the process used in Clark Public Utilities' previous CPAs. A scenario analysis is used to account for uncertainty, where present, in avoided cost values. The variation in energy and capacity avoided cost inputs covers a range of possible outcomes and the sensitivity of the cost-effective energy efficiency potential is identified by comparing the outcomes of each scenario. In selecting its biennial target based on this range of outcomes, Clark Public Utilities is selecting its preferred risk strategy and the associated risk credit.

Northwest Power Act Credit

Finally, this CPA includes a 10% cost credit for energy efficiency. This credit is specified in the Pacific Northwest Electric Power Planning and Conservation Act for regional power planning work completed by the Council and by Washington's EIA for CPAs completed for Washington utilities. This credit is applied as a 10% bonus to the energy and capacity benefits described above.

Summary

Table 14 summarizes the avoided cost assumptions used in each of the scenarios in this CPA update.

Table 14: Avoided Cost Assumptions by Scenario

		Low Scenario	Base Scenario	High Scenario
Energy Values	Avoided Energy Costs (20-Year Levelized Price, 2016$)	Market Forecast minus 20%-80% ($27/MWh)	Market Forecast ($52/MWh)	Market Forecast plus 20%-80% ($77/MWh)
	Social Cost CO_2	Federal 2.5% Discount Rate Values	Federal 2.5% Discount Rate Values	Federal 2.5% Discount Rate Values
	RPS Compliance	WA EIA & CETA Requirements	WA EIA & CETA Requirements	WA EIA & CETA Requirements
Capacity Values	Distribution Capacity (2016$)	$7.82/kW-year	$7.82/kW-year	$7.82/kW-year
	Transmission Capacity (2016$)	$3.54/kW-year	$3.54/kW-year	$3.54/kW-year
	Generation Capacity (2016$) Winter Summer	$57/kW-year $49/kW-year	$69/kW-year $59/kW-year	$84/kW-year $72/kW-year
	Implied Risk Adder (2016$)	-$25/MWh -$10-12/kW-year	N/A	25$/MWh $13-15/kW-year
	NW Power Act Credit	10%	10%	10%

Appendix V: Measure List

This appendix provides a list of the measures that were included in this assessment and the data sources that were used for any measure characteristics. The assessment used all measures from the draft 2021 Power Plan that were applicable to Clark Public Utilities. Lighthouse customized these measures to make them specific to Clark Public Utilities' service territory and updated several with new information available from the RTF. The RTF continually updates estimates of measure savings and cost. This assessment used the most up to date information available when the CPA was developed.

This list is high-level and does not reflect the thousands of variations for each individual measure. Instead, it summarizes measures by category. Many measures include variations specific to different home or building types, efficiency level, or other characterization. For example, attic insulation measures are differentiated by home type (e.g., single family, multifamily, manufactured home), heating system (e.g., heat pump or furnace), baseline insulation level (e.g., R0, R11, etc.) and maximum insulation possible (e.g., R22, R30, R38, R49). This differentiation allows for savings and cost estimates to be more precise.

The measure list is grouped by sector and end use. Note that all measures may not be applicable to an individual utility service territory based on the characteristics of individual utilities and their customer sectors.

Table 15: Residential End Uses and Measures

End Use	Measure Category	Data Source(s)
Appliances	Air Cleaner	2021 Power Plan, RTF
	Clothes Washer	2021 Power Plan, RTF
	Clothes Dryer	2021 Power Plan, RTF
	Freezer	2021 Power Plan
	Refrigerator	2021 Power Plan
Cooking	Electric Oven	2021 Power Plan
	Microwave	2021 Power Plan
Electronics	Advanced Power Strips	2021 Power Plan, RTF
	Desktop	2021 Power Plan
	Laptop	2021 Power Plan
	Monitor	2021 Power Plan
	TV	2021 Power Plan
EVSE	EVSE	2021 Power Plan
HVAC	Air Source Heat Pump	2021 Power Plan
	Central Air Conditioner	2021 Power Plan
	Cellular Shades	2021 Power Plan
	Circulator	2021 Power Plan
	Circulator Controls	2021 Power Plan
	Ductless Heat Pump	2021 Power Plan, RTF
	Duct Sealing	2021 Power Plan, RTF
	Ground Source Heat Pump	2021 Power Plan
	Heat Recovery Ventilator	2021 Power Plan
	Room Air Conditioner	2021 Power Plan
	Smart Thermostats	2021 Power Plan, RTF
	Weatherization	2021 Power Plan, RTF
	Whole House Fan	2021 Power Plan
Lighting	Fixtures	2021 Power Plan, RTF
	Lamps	2021 Power Plan, RTF
	Pin Lamps	2021 Power Plan, RTF
Motors	Well Pump	2021 Power Plan
Water Heat	Aerators	2021 Power Plan, RTF
	Circulator	2021 Power Plan
	Circulator Controls	2021 Power Plan
	Dishwasher	2021 Power Plan
	Gravity Film Heat Exchanger	2021 Power Plan
	Heat Pump Water Heater	2021 Power Plan, RTF
	Pipe Insulation	2021 Power Plan
	Showerhead	2021 Power Plan
	Thermostatic Restrictor Valve	2021 Power Plan, RTF
Whole Home	Behavior	2021 Power Plan

Table 16: Commercial End Uses and Measures

End Use	Measure Category	Data Source(s)
Compressed Air	Air Compressor	2021 Power Plan, WA Code
Electronics	Computers	2021 Power Plan
	Power Supplies	2021 Power Plan
	Smart Power Strips	2021 Power Plan, RTF
	Servers	2021 Power Plan
Food Preparation	Combination Ovens	2021 Power Plan, RTF
	Convection Ovens	2021 Power Plan, RTF
	Fryers	2021 Power Plan, RTF
	Griddle	2021 Power Plan, RTF
	Hot Food Holding Cabinet	2021 Power Plan, RTF
	Overwrapper	2021 Power Plan
	Steamer	2021 Power Plan, RTF
HVAC	Advanced Rooftop Controller	2021 Power Plan, RTF
	Chiller	2021 Power Plan
	Circulation Pumps	2021 Power Plan, RTF
	Ductless Heat Pump	2021 Power Plan
	Energy Management	2021 Power Plan
	Fans	2021 Power Plan
	Heat Pumps	2021 Power Plan
	Package Terminal Heat Pumps	2021 Power Plan
	Pumps	2021 Power Plan, RTF
	Smart Thermostats	2021 Power Plan
	Unitary Air Conditioners	2021 Power Plan
	Very High Efficiency Dedicated Outside Air System	2021 Power Plan
	Variable Refrigerant Flow Dedicated Outside Air System	2021 Power Plan
	Windows	2021 Power Plan
Lighting	Exit Signs	2021 Power Plan
	Exterior Lighting	2021 Power Plan
	Garage Lighting	2021 Power Plan
	Interior Lighting	2021 Power Plan
	Stairwell Lighting	2021 Power Plan
	Streetlights	2021 Power Plan
Motors & Drives	Pumps	2021 Power Plan, RTF
Process Loads	Elevators	2021 Power Plan
	Engine Block Heater	2021 Power Plan, RTF
Refrigeration	Freezer	2021 Power Plan
	Grocery Refrigeration	2021 Power Plan, RTF
	Ice Maker	2021 Power Plan, RTF
	Refrigerator	2021 Power Plan, RTF
	Vending Machine	2021 Power Plan, RTF
	Water Cooler Controls	2021 Power Plan
Water Heating	Commercial Clothes Washer	2021 Power Plan, RTF
	Heat Pump Water Heater	2021 Power Plan, RTF
	Pre-Rinse Spray Valve	2021 Power Plan, RTF
	Pumps	2021 Power Plan, RTF
	Showerheads	2021 Power Plan

Table 17: Industrial End Uses and Measures

End Use	Measure Category	Data Source(s)
All Electric	Energy Management	2021 Power Plan
	Forklift Charger	2021 Power Plan
	Water/Wastewater	2021 Power Plan
Compressed Air	Air Compressor	2021 Power Plan, WA Code
	Air Compressors	2021 Power Plan, WA Code
	Compressed Air Demand Reduction	2021 Power Plan
Fans and Blowers	Fan Optimization	2021 Power Plan
	Fans	2021 Power Plan, RTF
HVAC	HVAC	2021 Power Plan
Lighting	High Bay Lighting	2021 Power Plan
	Lighting	2021 Power Plan
	Lighting Controls	2021 Power Plan
Low Temp Refer	Motors	2021 Power Plan
	Refrigeration Retrofit	2021 Power Plan
Material Handling	Motors	2021 Power Plan
	Paper	2021 Power Plan
	Wood Products	2021 Power Plan
Material Processing	Hi-Tech	2021 Power Plan
	Motors	2021 Power Plan
	Paper	2021 Power Plan
	Pulp	2021 Power Plan
	Wood Products	2021 Power Plan
Med Temp Refer	Food Storage	2021 Power Plan
	Motors	2021 Power Plan
	Refrigeration Retrofit	2021 Power Plan
Melting and Casting	Metals	2021 Power Plan
Other	Pulp	2021 Power Plan
Other Motors	Motors	2021 Power Plan
Pollution Control	Motors	2021 Power Plan
Pumps	Pulp	2021 Power Plan
	Pump Optimization	2021 Power Plan
	Pumps	2021 Power Plan, RTF

Table 18: Utility Distribution End Uses and Measures

End Use	Measure Category	Data Source
Distribution	Line Drop Control with no Voltage/VAR Optimization	2021 Power Plan
	Line Drop Control with Voltage Optimization & AMI	2021 Power Plan

Appendix VI: Energy Efficiency Potential by End Use

The tables in this appendix document the cost-effective energy efficiency savings potential by end use for each sector.

Table 19: Residential Potential by End Use (aMW)

End Use	2-Year	4-Year	10-Year	20-Year
Appliances	0.18	0.58	4.21	18.36
Cooking	0.00	0.01	0.06	0.37
Electronics	0.04	0.13	1.13	2.51
EV Supply Equipment	-	-	-	-
HVAC	0.75	1.95	10.91	34.29
Lighting	0.05	0.14	0.86	3.70
Motors	-	-	-	-
Water Heat	0.42	1.20	5.72	13.78
Whole Home	3.12	4.50	4.50	4.50
Total	**4.56**	**8.51**	**27.39**	**77.51**

Table 20: Commercial Potential by End Use (aMW)

End Use	2-Year	4-Year	10-Year	20-Year
Compressed Air	0.00	0.00	0.00	0.00
Electronics	0.01	0.06	0.64	1.46
Food Preparation	0.00	0.02	0.18	0.63
HVAC	0.31	0.99	5.25	13.01
Lighting	1.81	3.61	8.13	12.61
Motors/Drives	0.01	0.04	0.36	1.23
Process Loads	-	-	-	-
Refrigeration	0.08	0.28	2.20	5.81
Water Heat	0.00	0.01	0.13	0.69
Total	**2.24**	**5.01**	**16.90**	**35.44**

Table 21: Industrial Potential by End Use (aMW)

End Use	2-Year	4-Year	10-Year	20-Year
All Electric	0.52	1.32	4.28	5.03
Compressed Air	0.02	0.06	0.18	0.30
Fans and Blowers	0.04	0.14	0.89	2.56
HVAC	0.08	0.14	0.23	0.26
Lighting	0.65	1.39	3.04	3.24
Low Temp Refrigeration	0.01	0.02	0.13	0.31
Material Handling	0.00	0.01	0.09	0.37
Material Processing	0.11	0.26	0.76	1.02
Med Temp Refrigeration	0.02	0.04	0.16	0.36
Melting and Casting	0.00	0.00	0.00	0.00
Other	0.00	0.00	0.00	0.00
Other Motors	0.00	0.00	0.02	0.06
Pollution Control	0.00	0.00	0.01	0.01
Pumps	0.03	0.11	0.93	3.31
Total	**1.48**	**3.49**	**10.70**	**16.83**

Table 22: Utility Distribution System Potential by End Use (aMW)

End Use	2-Year	4-Year	10-Year	20-Year
LDC with no VVO	0.04	0.12	0.78	1.48
LDC with VVO & AMI	0.12	0.39	2.58	4.89
Total	**0.15**	**0.50**	**3.37**	**6.38**

Appendix VII: Ramp Rate Alignment Documentation

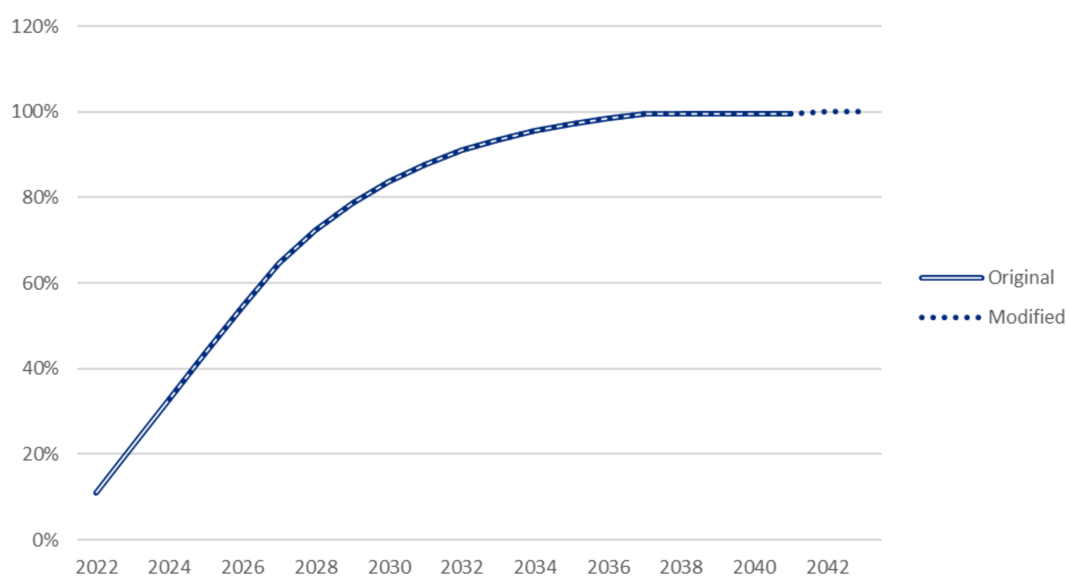
This appendix documents how Lighthouse adjusted the ramp rates from the 2021 Power Plan to be applicable to the 2024-43 time period of this CPA and then selected the appropriate adjusted ramp rate to ensure alignment between the near-term potential quantified in the CPA and the recent achievements of Clark Public Utilities' (Clark Public Utilities) energy efficiency programs. Ramp rates are the annual values that describe the share of technical potential available in a given year that is achievable. Aligning the potential with recent achievements ensures that the near-term potential is feasible for Clark Public Utilities' programs as energy efficiency programs take time to ramp up and are subject to local and dynamic market conditions.

Ramp Rate Adjustments

The CPA model used for this assessment uses the ramp rates developed by the Northwest Power and Conservation Council for the 2021 Power Plan. The 2021 Power Plan, however, covers an earlier time period and so the ramp rates require adjustment to correspond to the 2024-43 time period of this CPA.

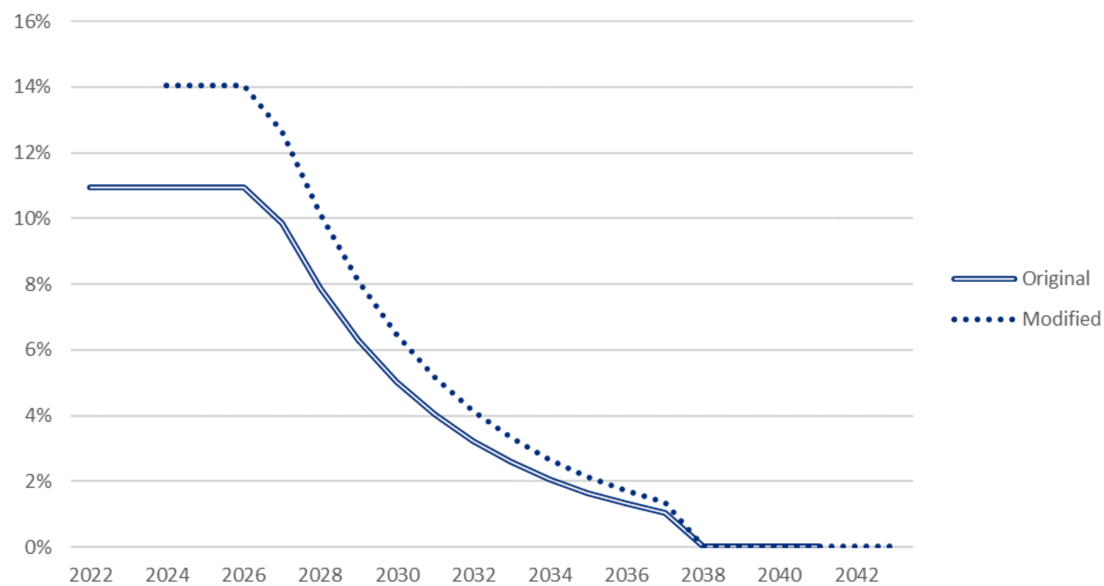
There are two different types of ramp rates, which correspond with the two types of measure under consideration. For lost opportunity measures that are associated with equipment replacement cycles or new construction, the ramp rate values reflect the amount of energy efficiency potential captured among the equipment being purchased in a given year. These ramp rates typically approach 100% in the later years and were adjusted to cover the timeline of the CPA by simply extending the final value of the ramp rate an additional two years. Figure 32 shows how one lost opportunity ramp rate was modified to cover the 2024-43 timeline of this CPA. The original ramp rate reaches 100% at approximately 2037 and the modified ramp rate simply extends this trend for another two years.

Figure 32: Lost Opportunity Ramp Rate Adjustment



For retrofit measures, the ramp rate values reflect the portion of the total available potential that is achieved in a given year. Because retrofit measures can be achieved in any year, the ramp rate values typically sum to 100% over a 20-year time period. To adjust the ramp rates for retrofit measures, Lighthouse assumed that the potential associated with the first two years of the 2021 Power Plan had been achieved and the remaining potential was distributed across the 18 remaining years of the original 2021 Power Plan timeline, in proportion to the original ramp rate projection. This results in higher ramp rate values relative to the original 2021 Power Plan, but equivalent amounts of potential after program achievements have been accounted for. Figure 33 shows the original and modified versions of one retrofit measure ramp rate.

Figure 33: Retrofit Ramp Rate Adjustment



For this ramp rate, nearly 100% of the remaining potential is captured by 2038 in both the original and modified versions of the ramp rate.

Ramp Rate Alignment Process

Clark Public Utilities provided program achievement data for 2021-22, which Lighthouse summarized by sector and end use. Lighthouse also summarized the residential program achievements by high-level measure categories.

Clark Public Utilities also receives credit for savings from market transformation that the Northwest Energy Efficiency Alliance (NEEA) estimates has occurred in Clark Public Utilities' service territory. Measure-level detail provided by Clark Public Utilities allowed Lighthouse to allocate these savings to end uses and measure categories.

Lighthouse compared the recent savings from Clark Public Utilities' programs and NEEA's market transformation initiatives with the cost-effective energy efficiency potential identified in the 2023 CPA. Lighthouse started with the ramp rates that were assigned to each measure in the 2021 Power Plan and compared the resulting cost-effective potential in the first few years of the assessment with Clark Public Utilities' recent programmatic achievements. Lighthouse then made changes to the ramp rate assignments for each measure to accelerate or decelerate the pace of savings acquisition to align with recent programmatic achievements. In areas where there were no recent program achievements, Lighthouse typically assigns a ramp rate that is slower than the applicable 2021 Power Plan ramp rate unless one is already assigned. This accounts for the fact that a program may need to start from scratch and build momentum over several years.

NEEA resets the baseline against which it quantifies its market transformation savings with every new Power Plan. This happened in 2022 with the publication of the 2021 Power Plan. For consistency in projecting future savings, Lighthouse used NEEA's projected 2023 savings for both 2021 and 2022. This level of savings best represents the expected level of savings going forward with the 2021 Power Plan baseline.

The following tables show how Clark Public Utilities' recent achievements compare to the potential after Lighthouse adjusted the ramp rates to align. Color scaling has been applied to highlight the larger values. Discussion follows each table with additional detail.

Residential

The table below shows how residential potential was aligned with recent achievements by measure category.

Table 23: Alignment of Residential Program History and Potential by Measure Category (MWh)

		Program History		CPA Cost-Effective Potential		
End Use	Category	2021	2022	2024	2025	2026
Appliances	Air Cleaner	23	23	13	25	45
Appliances	Clothes Washer	253	253	247	372	510
Appliances	Dryer	111	111	141	274	474
Appliances	Freezer	-	-	6	11	20
Appliances	Refrigerator	193	193	198	298	408
Cooking	Microwave	-	-	4	7	12
Cooking	Oven	-	-	1	1	2
Electronics	Advanced Power Strips	93	18	-	-	-
Electronics	Laptop	-	-	4	7	13
Electronics	TV	129	129	109	196	314
EVSE	EVSE	6	52	-	-	-
HVAC	ASHP	1,687	1,393	27	34	37
HVAC	CAC	-	-	4	8	13
HVAC	Circulator	54	54	44	64	82
HVAC	Circulator Controls	-	-	0	0	1
HVAC	DHP	1,583	1,573	2,087	2,075	2,063
HVAC	Duct Sealing	3	6	225	407	702
HVAC	Room AC	4	4	-	-	-
HVAC	Thermostat	65	48	274	659	1,289
HVAC	Weatherization	349	236	299	372	454
Lighting	Lighting	-	-	201	268	346
Water Heat	Aerators	103	14	-	-	-
Water Heat	Circulator	54	54	25	36	46
Water Heat	Circulator Controls	-	-	2	4	7
Water Heat	Dishwasher	-	-	1	2	3
Water Heat	HPWH	1,886	779	1,399	2,061	2,734
Water Heat	Showerhead	48	-	-	-	-
Water Heat	TSRV	4	-	65	113	181

Whole Home	Behavior	14,690	16,079	13,662	13,627	12,123
NEEA	NEEA	-	-	*n/a*	*n/a*	*n/a*
	Total	**21,340**	**21,019**	**19,037**	**20,923**	**21,879**

Note: For clarity, measure categories with no program achievements and no cost-effective potential have been removed. In addition, note that some measures have savings values that are small and cannot be shown at this level of resolution. These values show as 0 in this and following tables while a true zero value is shown as a dash.

The following sections discuss the alignment within each residential end use.

Appliances & Cooking

While there are no Clark Public Utilities program achievements in these end uses, NEEA's market transformation work includes an initiative for retail products and appliances that contributes savings. The ramp rate assignments for these measures were slowed slightly from the default 2021 Power Plan assignments to align with recent NEEA savings.

Electronics

In this category, Clark Public Utilities has achieved some savings through advanced power strips. However, the Regional Technical Forum (RTF) has recently deactivated the measure due to a lack of data and confidence in the savings, so the measure was removed from this CPA. Additional potential is available through TVs, which is part of NEEA's Retail Product Portfolio, similar to the appliance end use discussed above. Lighthouse slowed the ramp rate for laptops since there is no current program or NEEA initiative that would address this category of measures.

Electric Vehicle Supply Equipment (EVSE)

While Clark Public Utilities has recently started offering an incentive for qualifying EV chargers, after updating this measure with new data from the RTF, it did not pass the cost effectiveness screening. EV chargers may provide additional value as a future demand response resource, however.

HVAC

In the HVAC category, as with Clark Public Utilities' 2021 CPA, only a limited number of applications of air-source heat pumps (ASHP) were cost-effective, limiting the ability to closely match program achievement and potential. However, the tax credits and incentives provided for heat pumps through the federal Inflation Reduction Act have the potential to make these measures cost-effective, especially the more generous incentives provided to income-qualified households. The measures in this category were accelerated to align with recent program activity as much as possible.

The potential with ductless heat pumps (DHP) was accelerated to slightly exceed recent achievements, as there is some crossover with ASHP measures. Some weatherization measures were accelerated while duct sealing measures were slowed from the default 2021 Power Plan ramp rates. The potential with smart thermostats was slowed to be more consistent with current program levels.

Lighting

The lighting end use is now subject to Washington state standards that took effect in 2020 and cover many screw-in lamps. The potential that remains is in fixtures with integrated LEDs and less common bulb types. There is not currently a program to incentivize LED fixtures, so these measures were given a slower ramp rate.

Water Heat

The program history in the water heating category consists mostly of savings from heat pump water heaters. The potential for heat pump water heaters was left at the 2021 Power Plan ramp rates, which resulted in reasonable alignment with recent achievement from Clark Public Utilities programs and NEEA savings.

Washington's recent HB 1444 specifies standards for showerheads and aerators, so there is no potential in these categories. Lighthouse applied slower ramp rates to the initial potential for circulator pumps and controls. Lighthouse also applied a slower ramp rate for thermostatic restrictor valves to match recent program activity more closely.

Whole Home

This category includes a residential behavior program. The ramp rates were adjusted to align with Clark Public Utilities' planned behavior program as much as possible.

Table 24 below summarizes the residential measure category results in Table 23 by end use. In addition, this table incorporates savings from several NEEA initiatives that do not align with categories included in the CPA but could be grouped in the end uses listed below.

Table 24: Alignment of Residential Program History and Potential by End Use (MWh)

	Program History		CPA Cost-Effective Potential		
End Use	**2021**	**2022**	**2024**	**2025**	**2026**
Appliances	581	581	605	981	1,457
Cooking	-	-	4	8	13
Electronics	243	169	113	204	327
EVSE	6	52	-	-	-
HVAC	3,788	3,356	2,960	3,619	4,641
Lighting	-	-	201	268	346
Motors	-	-	-	-	-
Water Heat	2,096	847	1,492	2,216	2,971
Whole Home	14,690	16,079	13,662	13,627	12,123
NEEA	-	-	*n/a*	*n/a*	*n/a*
Total	**21,404**	**21,083**	**19,037**	**20,923**	**21,879**

Commercial

In the commercial sector, most of the potential is in the lighting end use, which was given some of the fastest ramp rates available in the 2021 Power Plan. Lighthouse made no change to these ramp rates, which resulted in near-term potential that is aligned with recent program history.

Potential in the HVAC end use, which includes energy management programs, was slowed slightly.

Lighthouse applied slightly slower ramp rates to measures in the other end uses, including compressed air, electronics, food preparation, refrigeration, and water heating. These end uses have smaller amounts of potential and are not a focus of current programs.

Table 25 below shows the alignment of program history and potential in the commercial sector.

Table 25: Alignment of Commercial Program History and Potential by End Use (MWh)

	Program History		CPA Cost-Effective Potential		
End Use	2021	2022	2024	2025	2026
Compressed Air	-	-	0	0	0
Electronics	54	54	45	85	146
Food Preparation	20	20	13	25	46
HVAC	2,524	1,210	1,020	1,681	2,492
Lighting	7,899	9,329	7,854	8,031	8,029
Motors/Drives	-	-	40	68	109
Process Loads	-	-	-	-	-
Refrigeration	6	501	259	444	707
Water Heat	7	7	9	17	30
NEEA	-	-	-	-	-
Total	**10,511**	**11,122**	**9,239**	**10,352**	**11,557**

Industrial

Most of the Clark Public Utilities' recent savings, as well as the future potential, in the industrial sector are in the lighting and energy management end uses. Lighthouse applied slightly slower ramp rates across the industrial sector end uses to align the future potential with recent program achievements.

Table 26 shows the alignment of industrial potential and recent program history by end use.

Table 26: Alignment of Industrial Program History and Potential by End Use (MWh)

	Program History		CPA Cost-Effective Potential		
End Use	2021	2022	2024	2025	2026
Energy Management	1,337	2,762	1,987	2,526	3,151
Compressed Air	760	35	100	118	139
Fans and Blowers	-	-	119	216	353
HVAC	1,355	565	388	302	265
Lighting	1,998	3,924	2,763	2,965	3,171
Motors	-	-	5	8	10
Refrigeration	-	-	79	100	128
Process	428	1,388	456	544	637
Pumps	480	-	103	175	278
Other	-	-	2	2	3
NEEA	-	-	*n/a*	*n/a*	*n/a*
Total	**6,358**	**8,674**	**6,001**	**6,957**	**8,135**

Utility Distribution System

The amount of potential in the utility distribution system is limited compared to other sectors. The 2021 Power Plan assumes that the potential in this sector will be acquired slowly. No changes were made to the default ramp rate assigned in the 2021 Power Plan.

Table 27: Alignment of Distribution System Program History and Potential by End Use (MWh)

	Program History		CPA Cost-Effective Potential		
End Use	2021	2022	2024	2025	2026
Distribution System	-	-	512	834	1265