CLALLAM COUNTY PUD

2021 Conservation Potential Assessment Results

LIGHTHOUSE ENERGY CONSULTING

Ted Light
August 23, 2021

ABOUT LIGHTHOUSE ENERGY CONSULTING

Ted Light, Principal

- Established Lighthouse Energy Consulting in 2020
- Over a decade of energy planning experience
- Formerly with EES Consulting, Energy Trust of Oregon
- Lead analyst & project manager for Clallam PUD's 2017 & 2019 CPAs
- Part of team that reviewed 2021 Power Plan EE & DR supply curves
- Member of NW Power Council's Conservation Resource Advisory Committee

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AGENDA

- What is a Conservation Potential Assessment (CPA)?
- Background
- Historic Targets & Achievements
- Results

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WHAT IS A CPA?

How can Clallam PUD save energy?

- Sectors
- End Uses

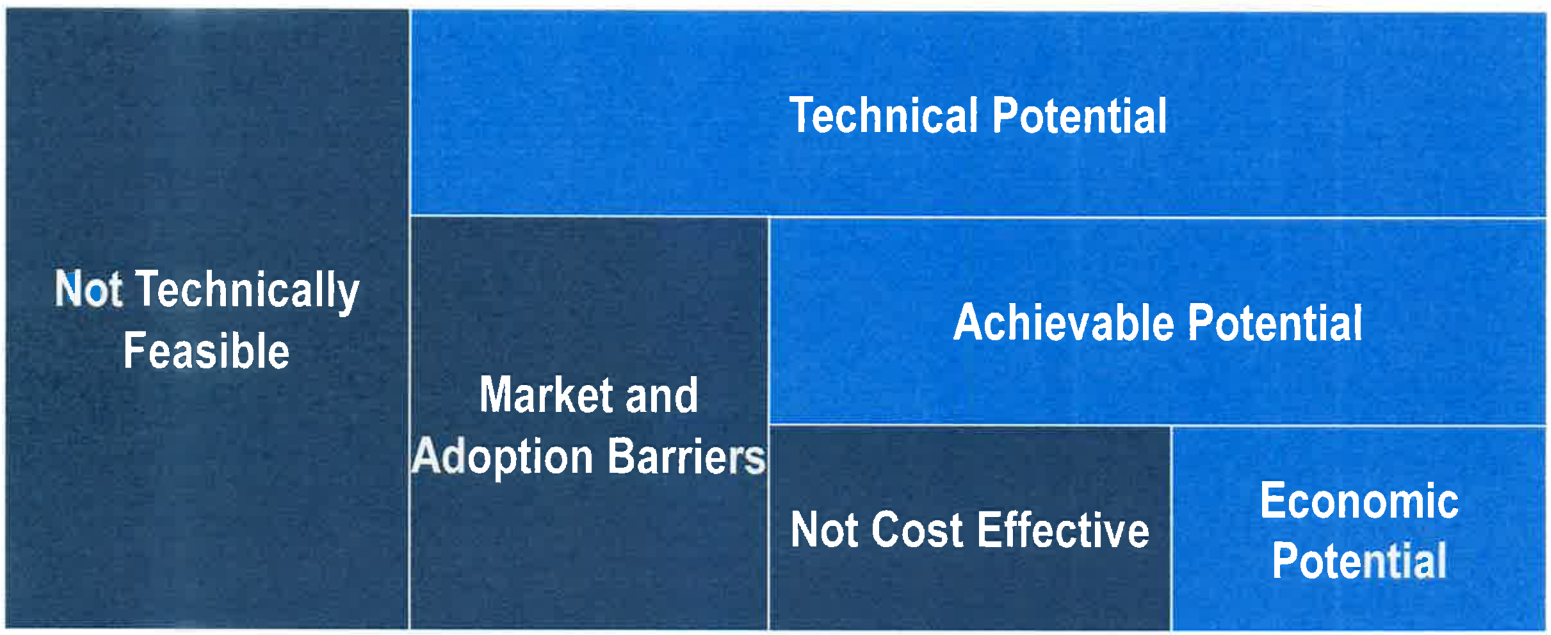
How much is possible?

- Customer Characteristics
- Equipment Saturations
- Past Achievements
- Market Barriers

What is cost-effective?

- Costs and benefits of energy efficiency
- Costs and benefits of alternative resources

WHAT IS A CPA?



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BACKGROUND

Energy Independence Act (19.285 RCW)	Development of two-year targets every two years
	Based on CPA
	Follow methodology of NW Power Council, using utility-specific inputs
Clean Energy Transformation Act (19.405 RCW)	Four-year targets based on CPA in Clean Energy Implementation Plan
	Requires utilities to use specific values for the social cost of carbon

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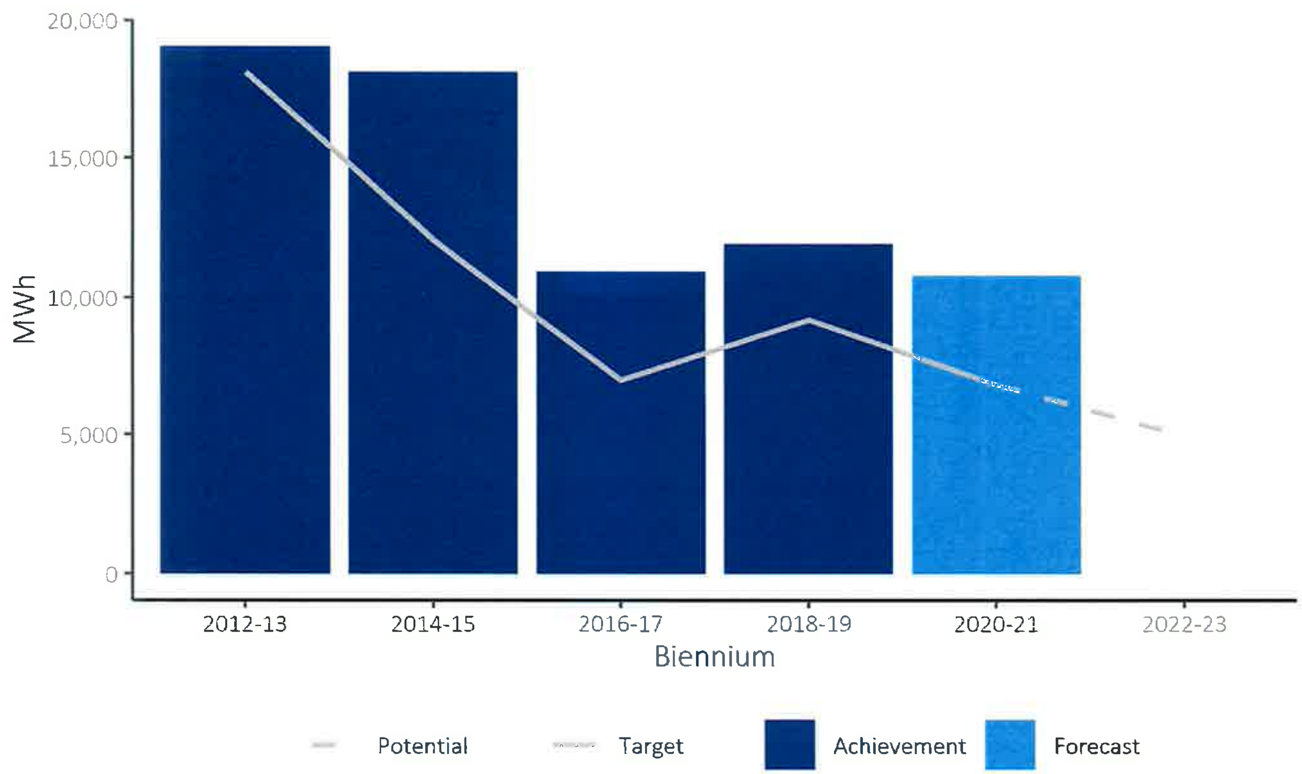
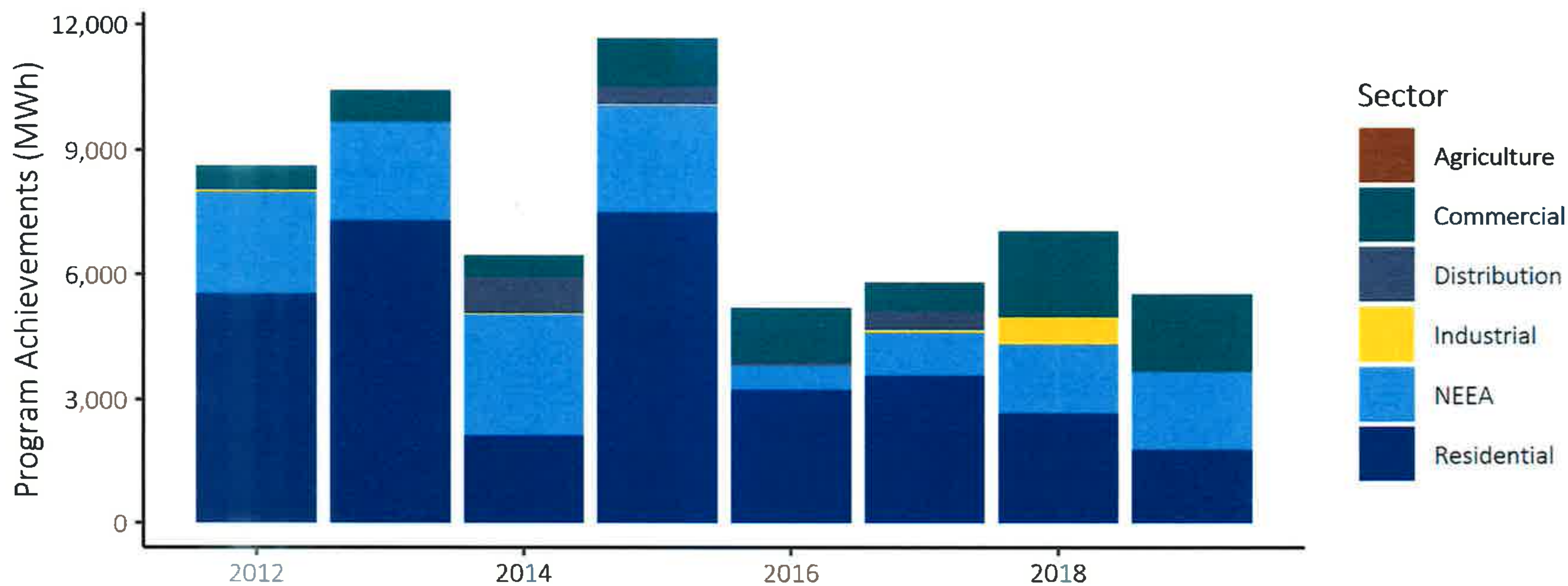
CLALLAM PUD HISTORY



CLALLAM PUD HISTORY



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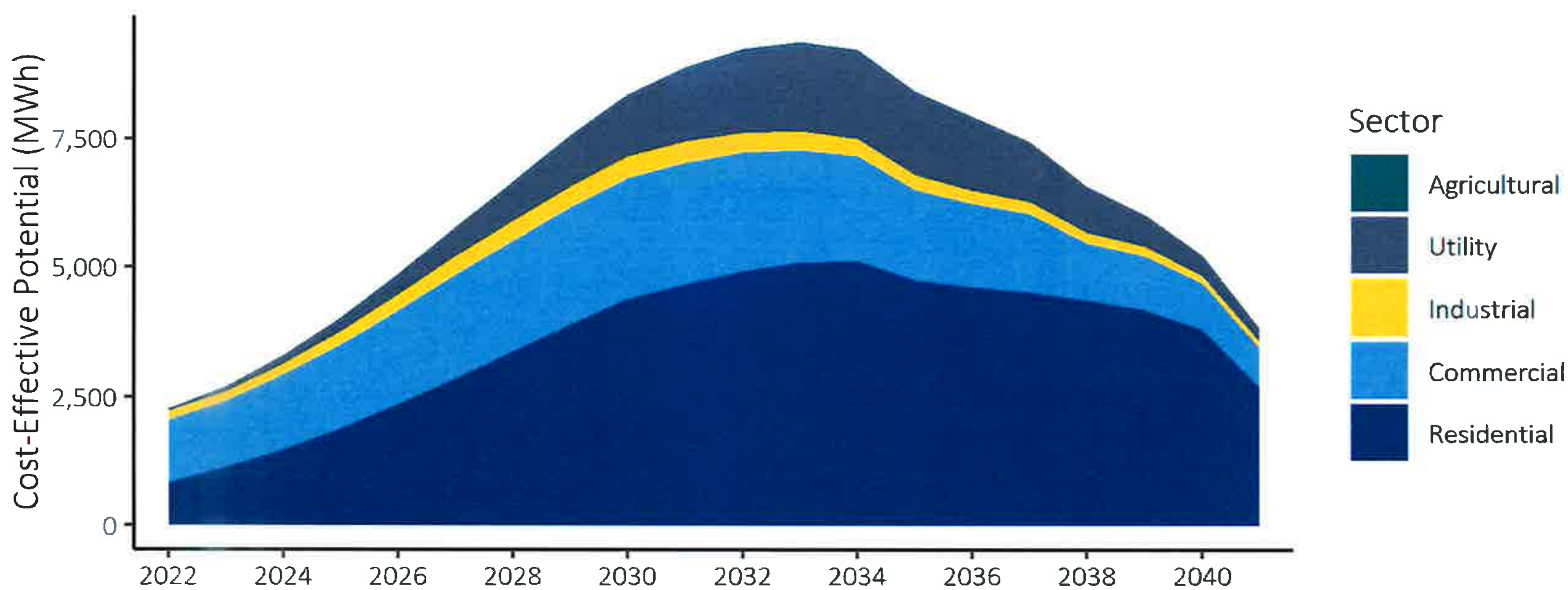
2021 CPA RESULTS



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COMPARISON TO 2019 CPA

	2-Year Potential			10-Year Potential			20-Year Potential		
Sector	2019 CPA	2021 CPA	% Change	2019 CPA	2021 CPA	% Change	2019 CPA	2021 CPA	% Change
Residential	2,891	1,976	-32%	23,652	26,928	14%	39,858	71,057	78%
Commercial	3,504	2,523	-28%	17,345	18,524	7%	26,718	33,834	27%
Industrial	263	330	25%	3,679	3,058	-17%	5,081	5,548	9%
Utility	88	133	52%	1,314	5,895	349%	4,030	17,357	331%
Agricultural	88	16	-82%	526	152	-71%	175	275	57%
Total	**6,833**	**4,978**	**-27%**	**46,516**	**54,557**	**17%**	**75,862**	**128,071**	**69%**

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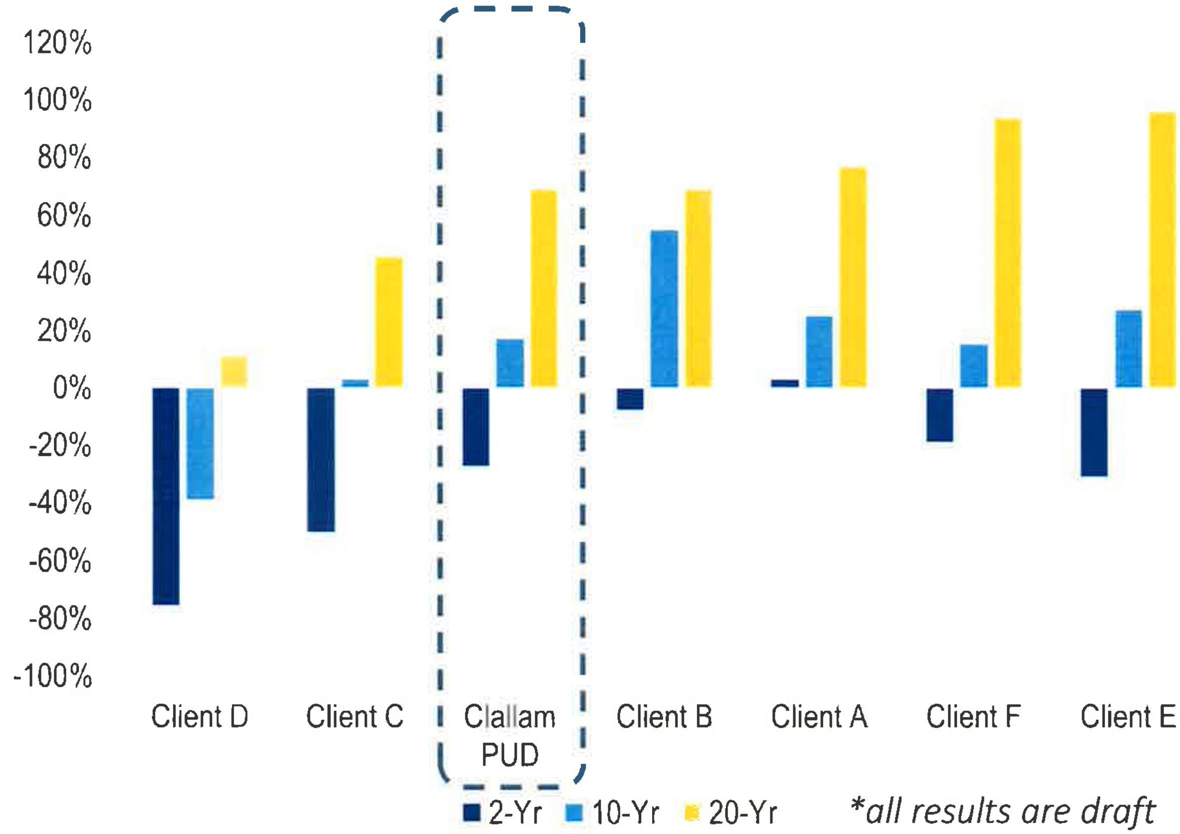
BENCHMARKING: CHANGE IN POTENTIAL



*all results are draft

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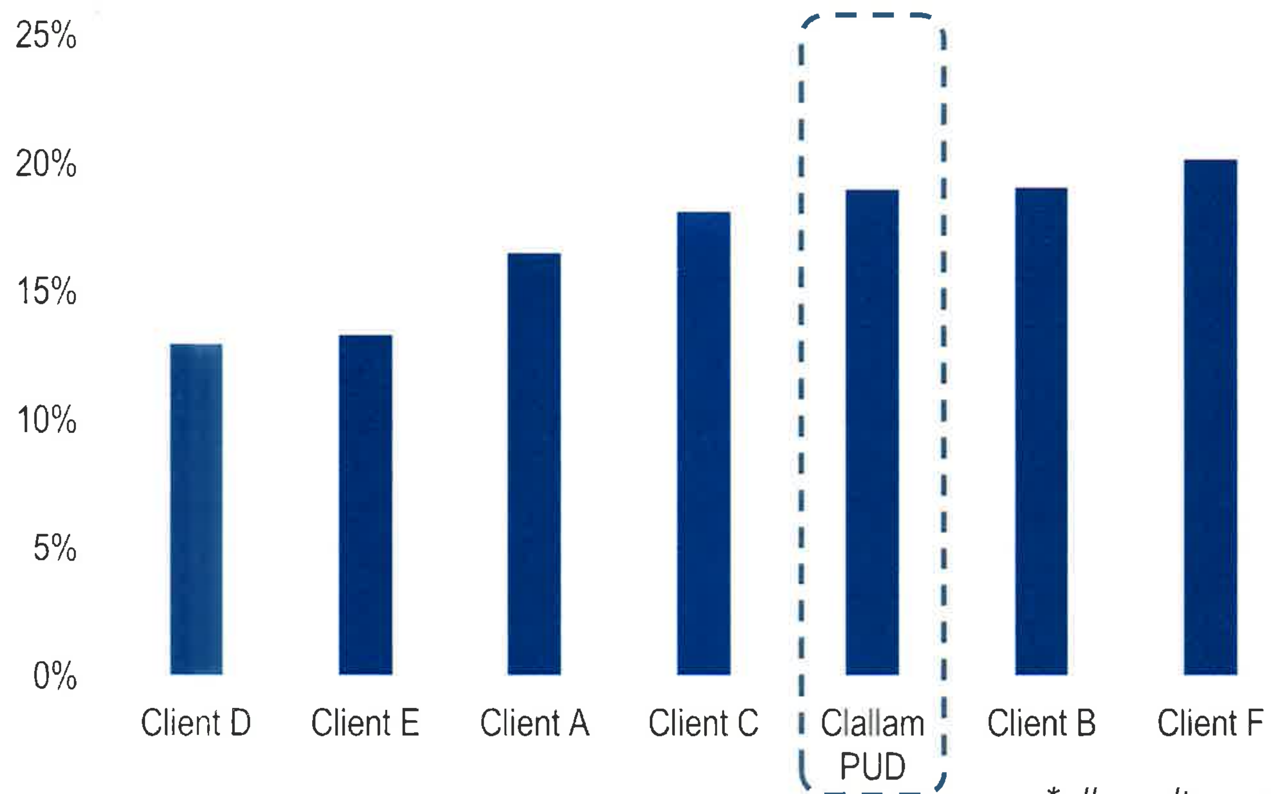
BENCHMARKING



*all results are draft

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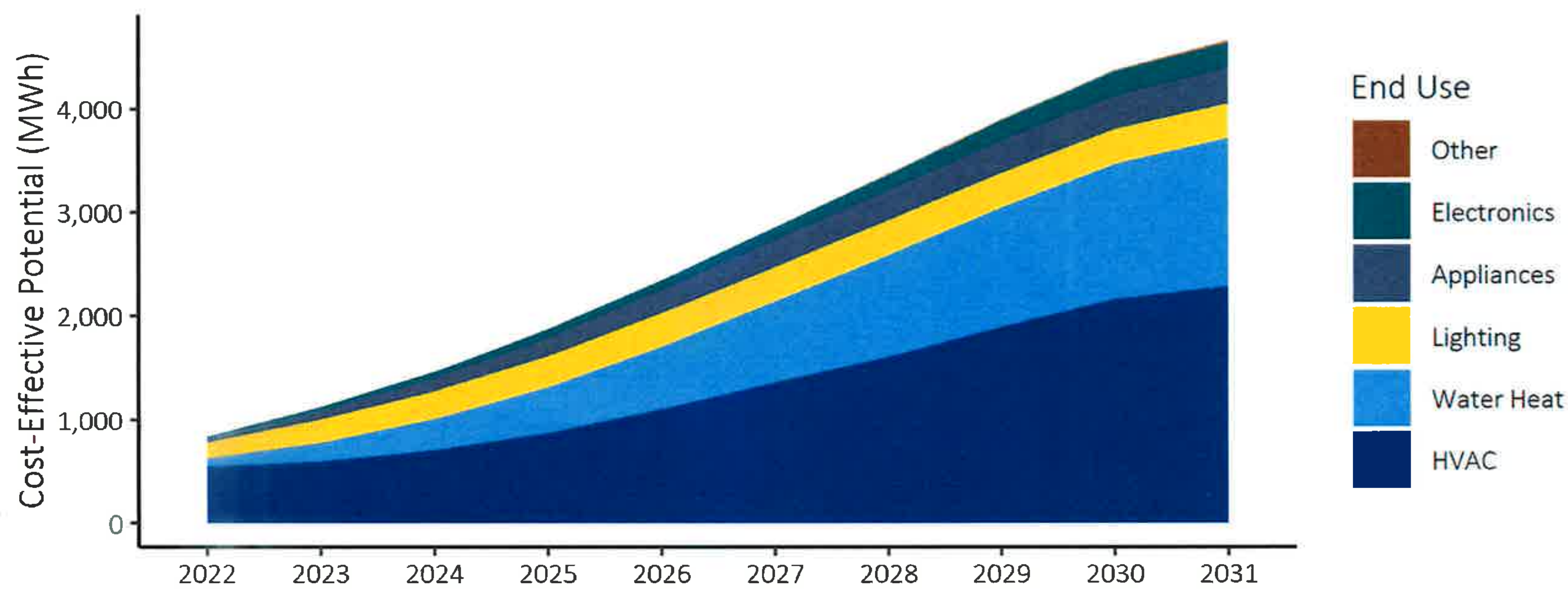
CPA RESULTS: RESIDENTIAL



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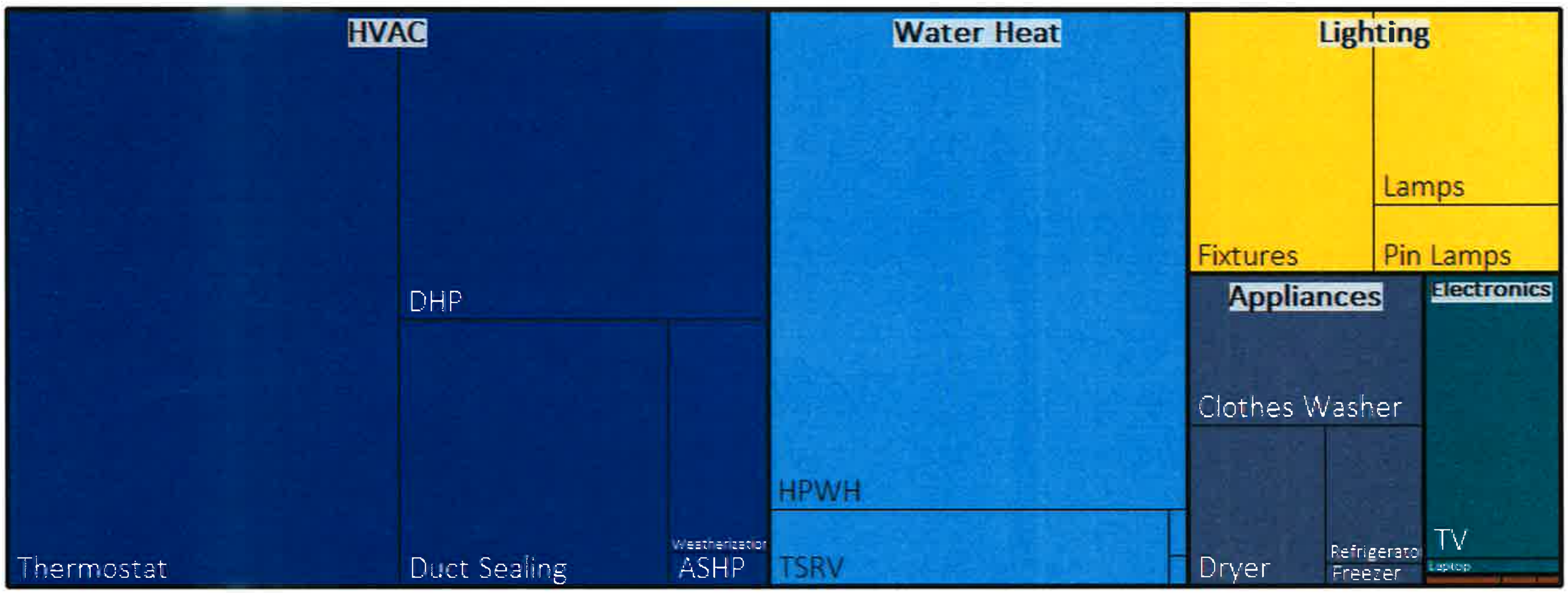
CPA RESULTS: RESIDENTIAL



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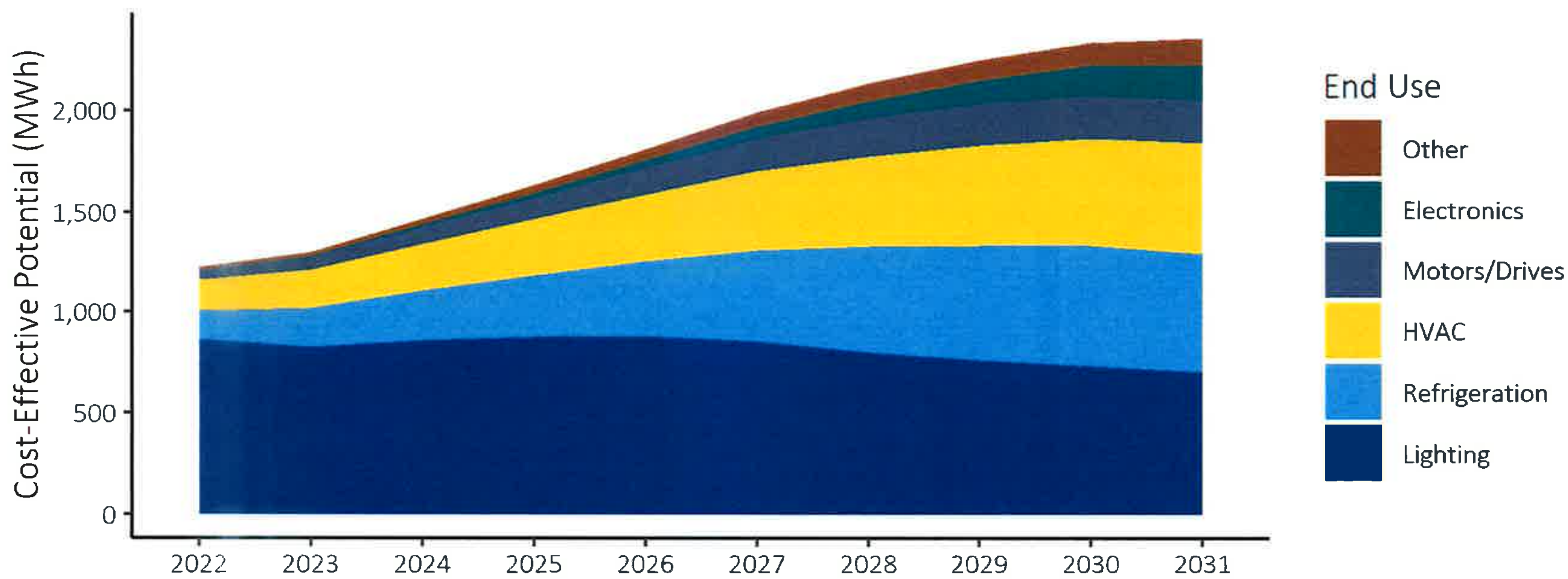
CPA RESULTS: COMMERCIAL



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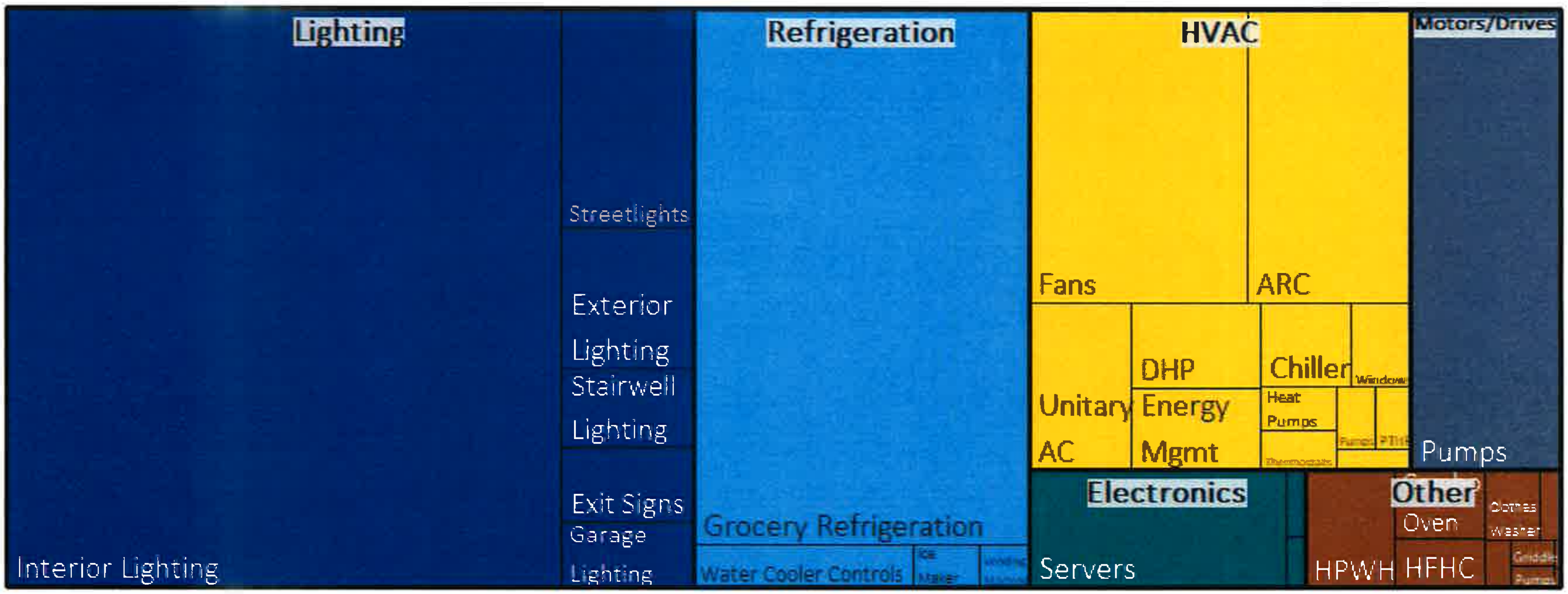
CPA RESULTS: COMMERCIAL



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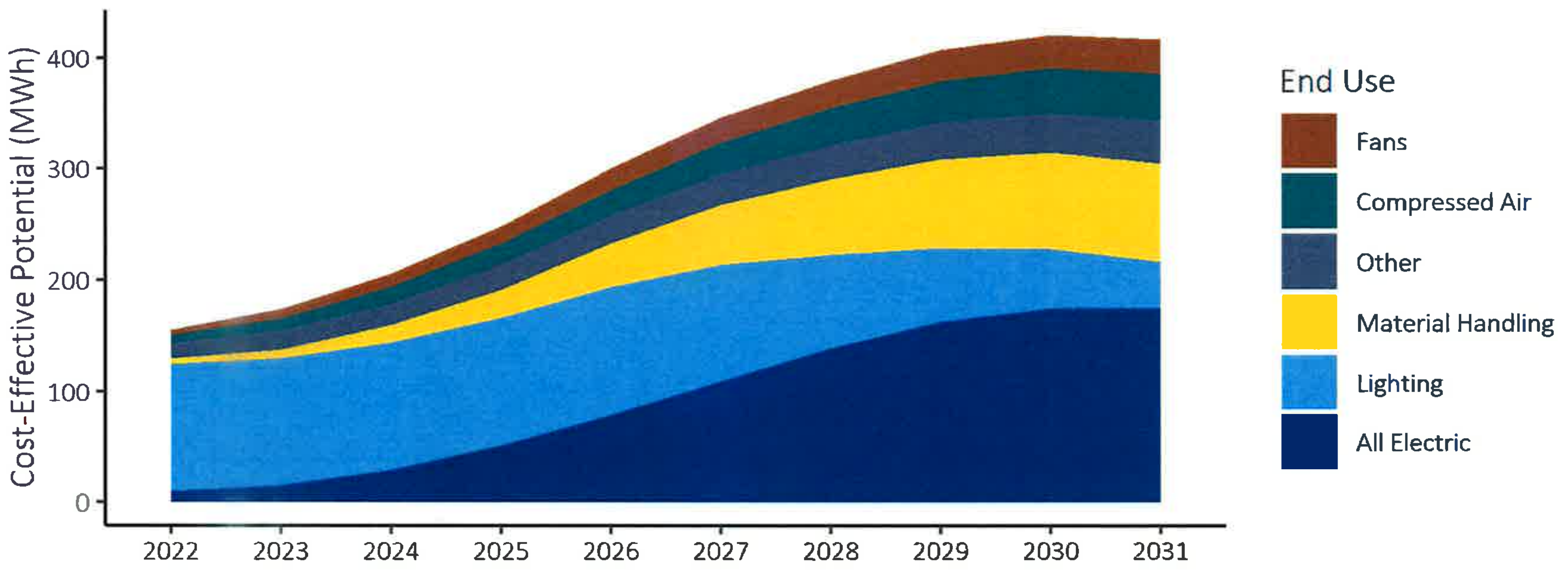
CPA RESULTS: INDUSTRIAL



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CONCLUSION

- 2-Year Target: 4,978 MWh
- 4-Year Target: 12,342 MWh
- Lower near-term potential due to low avoided costs, updated measure costs & savings, WA product standards, impacts of COVID-19
- More potential in long-term from new measures, measures with slower adoption rates

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Thank you!

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2021 CONSERVATION POTENTIAL ASSESSMENT

Public Utility District No. 1 of Clallam County

June 21, 2021

Prepared by:

LIGHTHOUSE ENERGY CONSULTING

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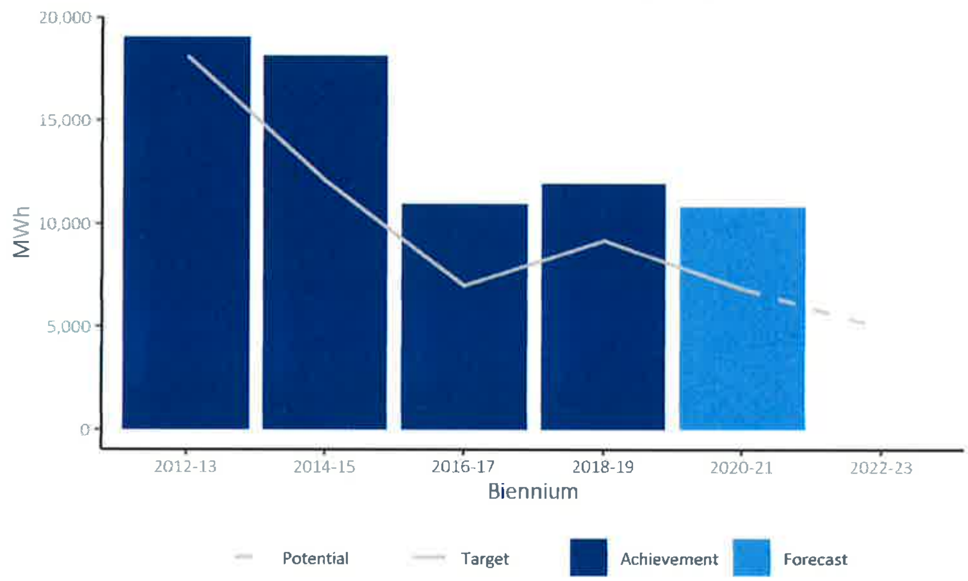
Executive Summary

Overview

This report describes the methodology and results of a conservation potential assessment (CPA) conducted by Lighthouse Energy Consulting (Lighthouse) for Public Utility District No. 1 of Clallam County (Clallam PUD). The assessment estimated the cost-effective energy savings potential for the period of 2022 to 2041. 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), and the four-year period covered by the interim compliance period of the Clean Energy Implementation Plan.

Clallam PUD provides electricity service to over 32,000 customers in Clallam County, excluding portions of the City of Port Angeles. 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. Clallam PUD's history of consistently exceeding its biennium conservation targets is shown in Figure 1.

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 Seventh and draft 2021 Power Plans. 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 draft 2021 Power Plan materials, with customizations to make the results specific to Clallam PUD's service territory and customers. Notable changes in this CPA relative to Clallam PUD's previous assessment include the following:

- Energy Efficiency Measures

- This assessment uses the measures savings, costs, and other characteristics based on the measures included in the draft 2021 Power Plan, with updates from the Regional Technical Forum (RTF) and additional customizations to make the measures specific to Clallam PUD.
    - Several measures included in previous assessments are covered by Washington's HB 1444, a law that specifies efficiency standards for numerous products, including screw-in lighting, showerheads, and aerators.
- Avoided Costs
    - A new market price forecast was incorporated, which has a 20-year levelized cost of \$26/MWh (2016\$), a decrease of 23% from the 2019 CPA.
- Customer Characteristics
    - Updated counts of residential homes.
    - New estimates of commercial floor area using the Mergent Intellect database and the 2019 Commercial Building Stock Assessment.
    - New breakdown of Clallam PUD's industrial sector loads.
    - Updated sector growth rates.
- Program Impacts
    - Consideration of Clallam PUD's recent conservation program achievements and current program forecasts.

Results

Figure 2 and Table 1 show the cost-effective energy efficiency potential by sector over two-, four-, 10-, and 20-year periods. Over the 20-year planning period, Clallam PUD has over 128,000 MWh of cost-effective conservation available, which is approximately 19% of its projected 2041 load. The EIA focuses on the two- and 10-year potential, which are 4,978 MWh and 54,557 MWh, respectively.

Figure 2: Cost-Effective Energy Savings Potential by Sector

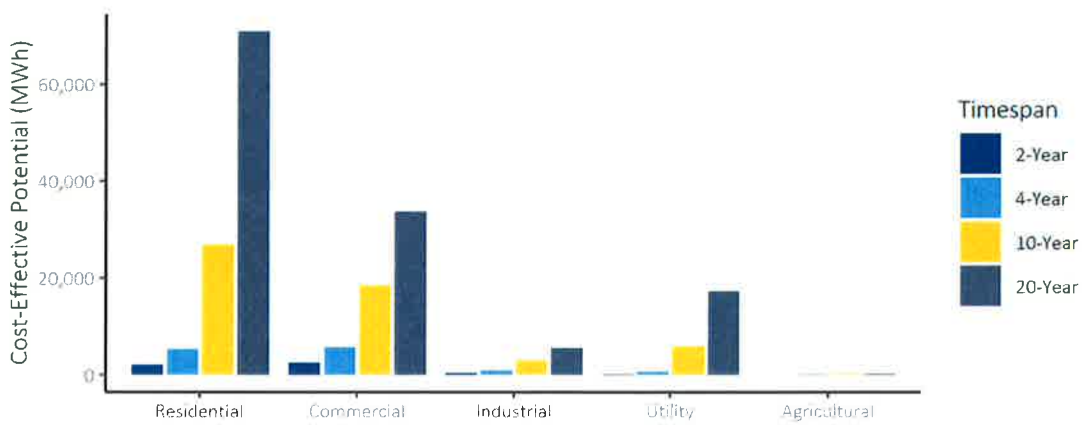


Table 1: Cost-Effective Energy Savings Potential by Sector (MWh)

Sector	2-Year	4-Year	10-Year	20-Year
Residential	1,976	5,343	26,928	71,057
Commercial	2,523	5,628	18,524	33,834
Industrial	330	783	3,058	5,548
Utility	133	548	5,895	17,357
Agricultural	16	39	152	275
Total	**4,978**	**12,342**	**54,557**	**128,071**

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

The residential and commercial sectors are the two largest components of Clallam PUD's overall load, and most of the energy efficiency potential comes from these sectors. There is only a small amount of agriculture in Clallam PUD's service territory, so the potential in this sector is especially small.

This assessment does not specify how the energy efficiency potential will be achieved. Possible mechanisms include Clallam PUD's own energy efficiency programs, market transformation driven by the Northwest Energy Efficiency Alliance (NEEA), state building codes, and 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 profiles developed by the Council to identify the demand savings from each measure that would occur at the time of Clallam PUD's system peak. The energy savings potential identified in this assessment will also result in more than 31 MW of peak demand savings over the 20-year planning period, as shown in Table 2. This represents 15% of Clallam PUD's projected 2041 peak demand.

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

Sector	2-Year	4-Year	10-Year	20-Year
Residential	0.6	1.5	8.3	23.3
Commercial	0.3	0.8	2.6	4.8
Industrial	0.0	0.1	0.4	0.8
Distribution Efficiency	0.0	0.1	0.8	2.4
Agricultural	0.0	0.0	0.0	0.0
Total	**1.0**	**2.5**	**12.2**	**31.3**

The estimates of annual energy efficiency potential are based on ramp rates developed by the Council. Ramp rates are used to reflect the share of available potential that can be acquired in each year. For this CPA, Lighthouse selected ramp rates that would align near-term potential with recent program history. Specifically, program achievements for 2019 and 2020 were provided by Clallam PUD staff. This data showed 2020 savings levels similar to prior years in the residential sector with increases and decreases in the industrial and commercial sectors, respectively. Lighthouse assigned appropriate ramp rates for each measure so that the acquisition of energy efficiency was aligned with recent program history while still allowing for the acquisition of all potential 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 2,300 MWh in 2022 and grows to a maximum of over 9,400 MWh in 2033. After that point, the available potential diminishes through the remaining years of the planning period.

Figure 3: Annual Incremental Energy Efficiency Potential

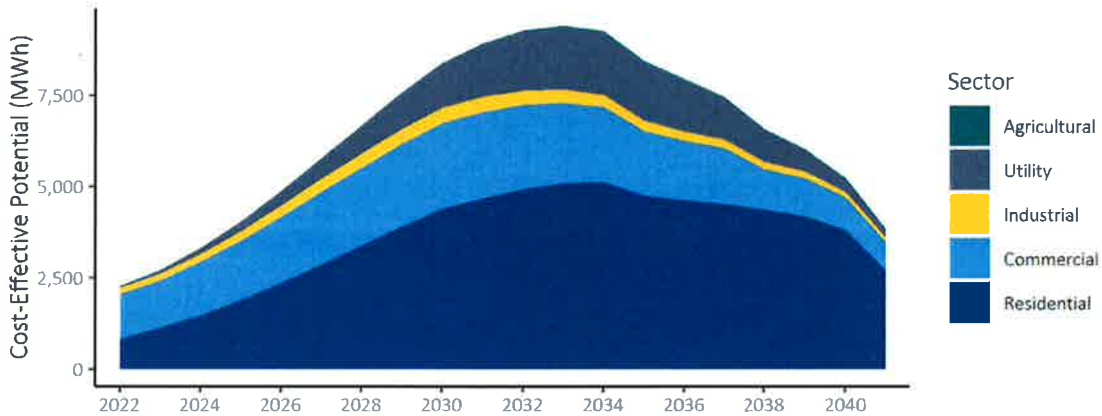
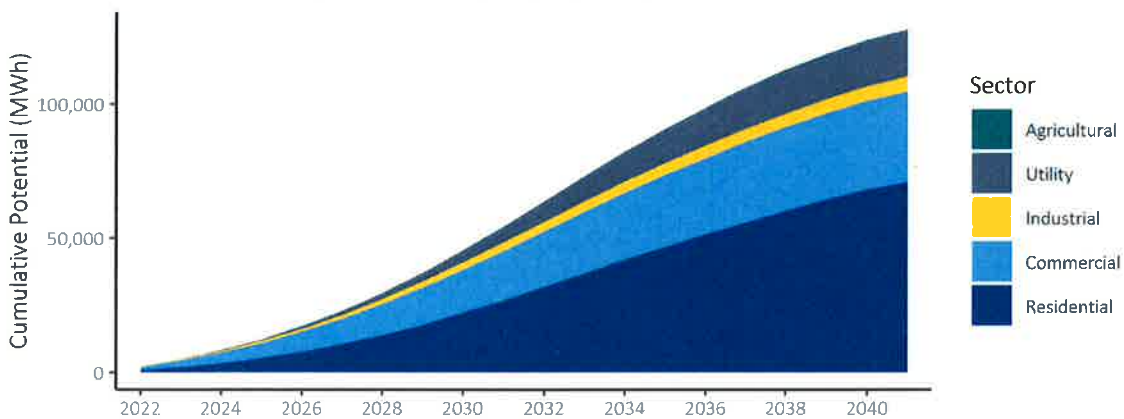


Figure 4 shows how the energy efficiency potential grows on a cumulative basis through the study period, totaling nearly 128,000 MWh over the 20-year planning period.

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 2019 CPA and this 2021 CPA. The two-year comparison shows an overall reduction of 25% while there are increases in potential over the 10- and 20-year period.

Table 3: Comparison of 2019 and 2021 CPA Cost-Effective Potential (MWh)

Sector	2-Year Potential			10-Year Potential			20-Year Potential		
	2019 CPA	2021 CPA	% Change	2019 CPA	2021 CPA	% Change	2019 CPA	2021 CPA	% Change
Residential	2,891	1,976	-32%	23,652	26,928	14%	39,858	71,057	78%
Commercial	3,504	2,523	-28%	17,345	18,524	7%	26,718	33,834	27%
Industrial	263	330	25%	3,679	3,058	-17%	5,081	5,548	9%
Utility	88	133	52%	1,314	5,895	349%	4,030	17,357	331%
Agricultural	88	16	-82%	526	152	-71%	175	275	57%
Total	**6,833**	**4,978**	**-27%**	**46,516**	**54,557**	**17%**	**75,862**	**128,071**	**69%**

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

Avoided Costs

As described above, the lower market prices used in this forecast have put additional pressure on measures with previously marginal cost-effectiveness. This resulted in less cost-effective potential from measures like residential weatherization and air source heat pumps.

Product Standards

A Washington State lighting standard taking effect in 2020 impacts many screw-in bulbs. Lighting measures were included in this assessment, but the potential is limited.

The same law specifies efficiency standards for other products beginning in 2021, including low-flow showerheads and faucet aerators. Measures impacted by these standards were not included in this assessment.

New Measures

New to the 2021 Power Plan is the addition of measures for motor-driven systems, including fans, pumps, air compressors, and other systems applicable to the commercial and industrial sectors. This addition resulted in additional potential in both sectors. However, this potential is driven by equipment replacement cycles, so it is projected to be acquired slowly over time.

In addition, this CPA included new per-unit estimates of savings from several measures, including smart thermostats and heat pump water heaters. This resulted in additional potential for these measures, but at a slower rate of adoption.

Customer Characteristics

This CPA used updated customer forecasts based on data provided by Clallam PUD. Counts of residential homes have increased slightly along with the projected growth rate. In the commercial sector, updated estimates of energy use intensities from the recently published 2019 Commercial Building Stock Assessment have resulted in increased floor area, driving additional potential in that sector. The loads in the industrial sector are consistent with the 2019 CPA. The industrial sector now includes water treatment and wastewater loads that previously were included in the commercial sector. This has added to the industrial sector potential.

Conclusion

This report summarizes the CPA conducted for Clallam PUD for the 2022 to 2041 timeframe. The CPA identified a slightly smaller amount of cost-effective potential in the near-term relative to the 2019 CPA, with larger potential available in the long-term.

There is less near-term potential in the residential sector due to lower avoided costs, continued program achievements, and new product standards taking effect. The remaining potential, including some measures with higher per-unit savings, is driven by equipment replacement cycles, and is expected to be acquired slowly over time.

The potential in the commercial sector was adjusted to align with recent program history, which was impacted by the COVID-19 pandemic. New measures characterized for the commercial and industrial sectors compensate for this decline, but their impact is over the long-term.

Introduction

Objectives

This report describes the methodology and results of a CPA conducted for Clallam PUD by Lighthouse. The CPA estimated the cost-effective energy savings potential for the period of 2022 to 2041. This report describes the results of the full 20-year study period, with additional detail on the two- and 10-year periods that are the focus of Washington's EIA and the four-year period that aligns with the interim compliance period covered by the first Clean Energy Implementation Plan.

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 Clallam PUD's 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. The required values were incorporated in this analysis.

The results of this assessment can be used to assist Clallam PUD in planning its energy efficiency programs by identifying the amount of cost-effective energy savings available in various sectors, end uses, and measures.

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 Clallam PUD serves more than 32,000 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 of the 10-year cost-effective conservation potential for the subsequent 10 years.

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

Recent Legislative Changes

Another new law, Washington HB 1444 of the 2019 legislative session, concerns efficiency standards for a variety of appliances, including lighting, showerheads, and aerators. Except for lighting, the law generally applies to products manufactured after January 1, 2021. Accordingly, measures impacted by these product standards were removed from this assessment.

The law's efficiency standard for lighting took effect in 2020. The standard covers many common screw-in lights common in the residential and commercial sectors and specifies a level of efficiency that is currently only possible with compact fluorescent light (CFL) or light-emitting diode (LED) technologies. Recent studies of lighting market trends have identified that CFLs are rapidly decreasing in market share due to consumer preference for LEDs. Manufacturers are also contributing to this trend, following consumer preferences,

[1] Washington RCW 19.285.040

and shifting production from CFLs to LEDs. As a result, consumers may soon only be able to purchase LED lights for many applications, and utility lighting programs may be unnecessary. Some residential lighting potential remains from integrated LED fixtures, which do not require separate screw-in bulbs. However, the potential is limited from these measures as the savings are relative to efficient LED baselines.

Study Uncertainties

The recent rapid changes in economic conditions from the COVID-19 pandemic illustrate the uncertainties inherent in long-term planning. While this assessment makes use of the latest forecasts of customers and loads, it is still subject to remaining uncertainties and limitations. These uncertainties include, but are not limited to:

- Customer Characteristic Data: This assessment used the best available data to reflect Clallam PUD's customers. In some cases, however, the assessment relied upon data beyond Clallam PUD's service territory due to limitations of adequate sample sizes. There are uncertainties, therefore, related to the extent that this data is reflective of Clallam PUD's customer base.
- Measure Data: Measure savings and cost estimates 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 provided in January of 2021. While this is an up-to-date forecast, market prices and forecasts are continually changing.
- Utility System Assumptions: Measures in this CPA reflect 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 Clallam PUD's 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 based on 20-year forecasts of growth. These forecasts 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 Clallam PUD.

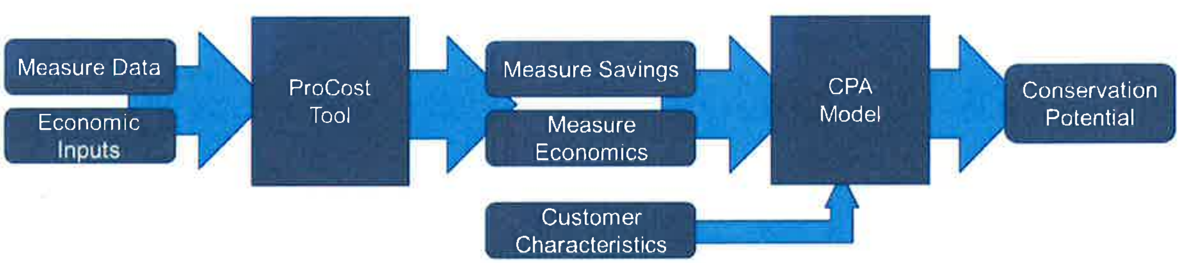
Requirements for this CPA are laid out in RCW 19.285.040 and WAC 194-37-070, Section 5 parts (a) through (d). Additional requirements are specified in the developing rules of Washington's CETA. The methodology used to produce this assessment is consistent with these requirements. The development of the conservation potential follows much of the methodology used by the Council in developing its regional power plans, including the Seventh Power Plan and material developed to date for the draft 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 measure savings and economic results are combined with customer data in Lighthouse's CPA, which quantifies the number of remaining implementation opportunities. The savings associated with each of these opportunities is aggregated in the CPA model to determine the overall potential.

Figure 5: Conservation Potential Assessment Methodology



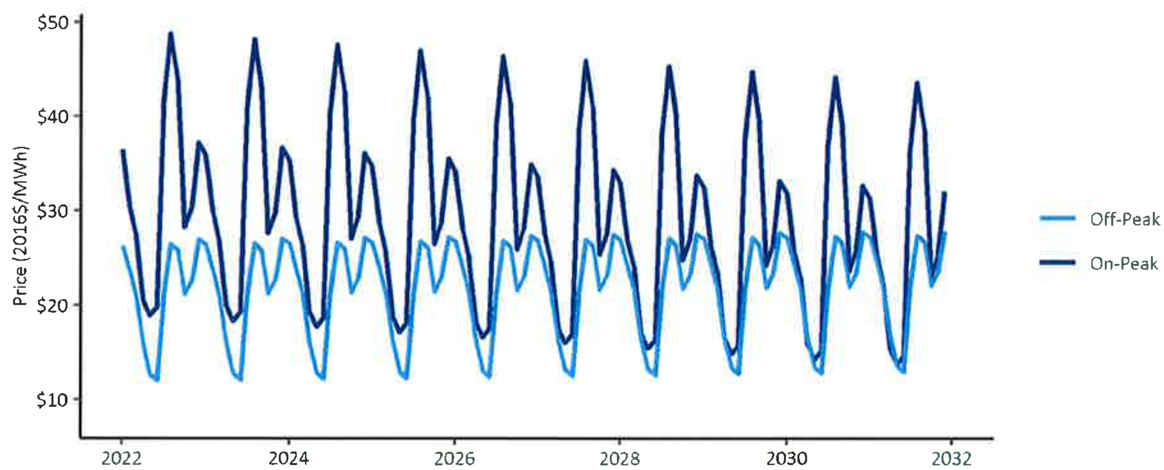
Economic Inputs

Lighthouse worked closely with Clallam PUD staff to define the economic inputs that were used in this CPA. Including 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 cost of energy purchases that are avoided through energy efficiency savings. The EIA requires utilities to "set avoided costs equal to a forecast of market prices." For this CPA, Lighthouse developed a forecast of on- and off-peak market prices at the Mid-Columbia trading hub. Figure 6 below shows the market price forecast that was used for the base case scenario of this assessment. For clarity, the figure only shows the initial 10 years. High and low scenario price forecasts were developed based on this forecast 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 avoid emissions of greenhouse gases like carbon dioxide. The EIA requires that CPAs include the social cost of carbon, which the US 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.[2] 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. These values were used in all scenarios of the CPA.

Renewable Portfolio Standard Compliance Costs

By reducing Clallam PUD's overall load, energy efficiency reduces the cost of complying with Washington's requirements for renewable and carbon-neutral energy. Clallam PUD currently purchases Renewable Energy Credits (RECs) to fulfill the EIA requirement of sourcing 15% of its 2020 sales from renewable energy resources. With a 15% requirement for renewable energy, Clallam PUD can avoid the purchase of 15 RECs by saving 100 MWh of energy. 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. Based on this requirement, it is assumed that after 2030 every unit of energy savings results in an equivalent reduction in REC purchases if the assumed marginal resource is not already carbon-free.

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 draft 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

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

deferrals. This CPA uses values provided by Clallam PUD, which use the methodology developed by the Council with utility-specific costs. The resulting values are $0.45 and $3.53 per kW-year (in 2016 dollars) for transmission and distribution capacity, respectively. 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 Clallam PUD's previous CPA.

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. 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 ultimate exposure to this risk.

This CPA update follows the process used in Clallam PUD's 2017 and 2019 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 based on this range of outcomes, Clallam PUD is selecting its preferred risk strategy and the associated risk credit.

Northwest Power Act Credit

The EIA requires that a 10% cost credit be given to energy efficiency measures. 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%, which is Clallam PUD's long-term cost of capital. This is a decrease from the value used in Clallam PUD's 2019 CPA, which was 4.3%. 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.

Assumptions about finance costs are applied to measures as well. The cost of each measure is assumed to be split across various entities, including Bonneville Power Administration (BPA), Clallam PUD, and end-use customers. For each of these entities, additional assumptions are made about whether the measure costs are financed, and if so, the cost of that financing. This assessment uses the finance cost assumptions that were used in the draft 2021 Power Plan materials.

Measure Characterization

Measure characterization is the process of defining each individual measure, including the savings at the meter as well as the cost, lifetime, non-energy impacts, and a load shape that defines when the savings occur. The Council's draft 2021 Power Plan materials are the primary source for this information, although updates from the RTF have been incorporated where appropriate.

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 double 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 and the corresponding impacts to heating and cooling system energy demands.

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, factoring in line losses, as well as the demand savings that occur coincident with Clallam PUD's system peak. It also determines the levelized-cost and benefit-cost ratios, which are used to determine whether measures are cost-effective.

Customer Characteristics

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

This CPA used baseline measure saturation data from the Council's draft 2021 Power Plan. This data was developed from NEEA's stock assessments, market research and other studies. This data was supplemented with Clallam PUD's 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 the CPA model. The model calculates the economic or cost-effective potential by progressing through the types of energy efficiency potential shown in Figure 7 below. 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 Seventh Power Plan, it was assumed that 85% of all measure opportunities can be achieved. This assumption comes from a pilot study 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 draft 2021 Power Plan, the Council has taken 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, 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 whom they accrue to. 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.

Recent Conservation Achievement

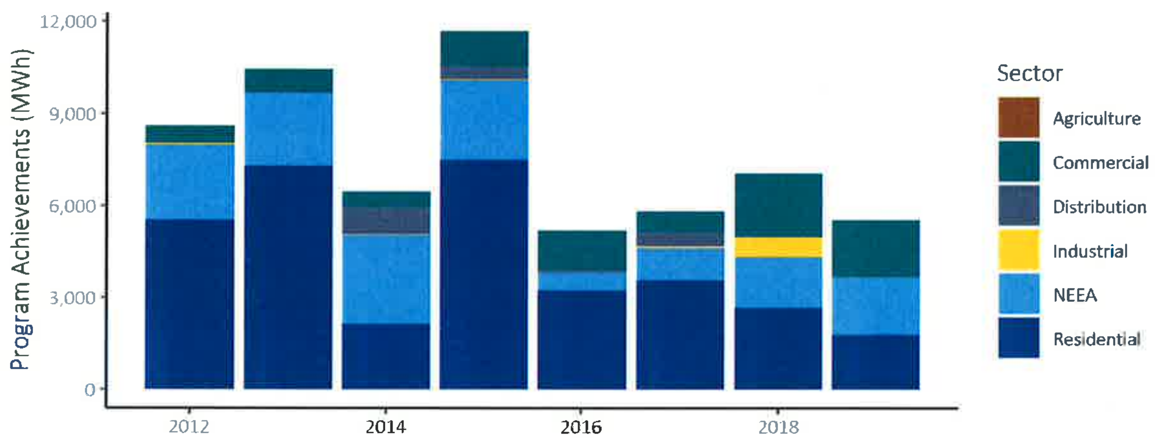
Clallam PUD has a long history of energy efficiency achievement and, according to the RTF's Regional Conservation Progress Report, over 2016-2019 has achieved savings equal to 0.9% of its retail sales, placing it among the highest achievers in the region.

Clallam PUD currently offers programs for its residential, commercial, industrial, and agricultural customers. In addition to these programs, Clallam PUD receives credit for the market transformation initiatives of NEEA that accrue 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 Clallam PUD's recent conservation achievement by sector as well as the savings attributed to NEEA, as reported under Washington's EIA.

Figure 8: Recent Conservation Achievements by Sector



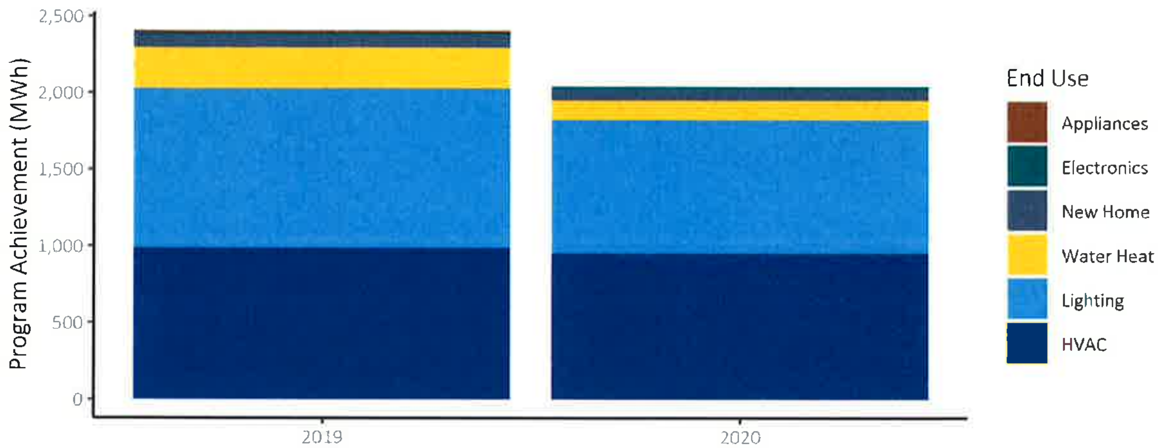
The savings over this five-year period average nearly 6,000 MWh per year. Most of the historical savings are from Clallam PUD's residential sector. Savings from NEEA's market transformation initiatives are also primarily in the residential sector.

Additional detail for each sector is provided below.

Residential

The recent residential program achievements by end use are shown in Figure 9. Savings in the HVAC end use make up the largest category, which includes both weatherization measures as well as heating system equipment. Lighting measures make up the second largest category, but the savings from these measures are expected to diminish in the future based on the state standards discussed above. Smaller amounts of savings come from the water heating, new homes, electronics, and appliance end uses.

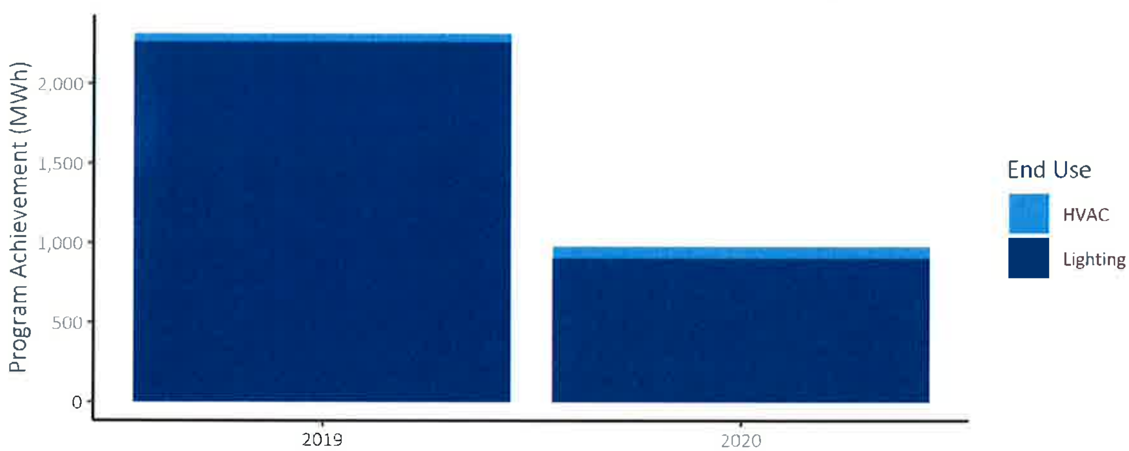
Figure 9: 2019-2020 Residential Program Achievements by End Use



Commercial

Most of Clallam PUD's commercial savings are in the lighting end use, as shown in Figure 10. Smaller amounts of savings come from projects in the HVAC end use. The impact of the COVID-19 pandemic can be seen in the decrease in savings from 2019 to 2020.

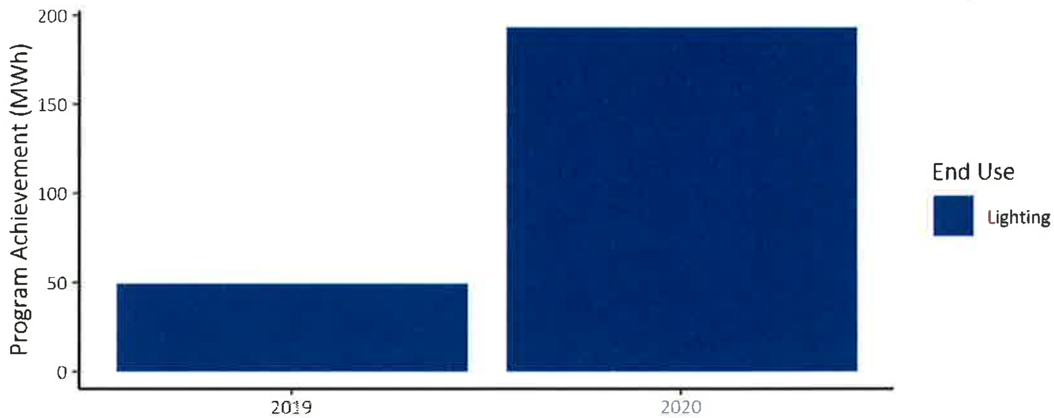
Figure 10: 2019-2020 Commercial Program Achievements by End Use



Industrial

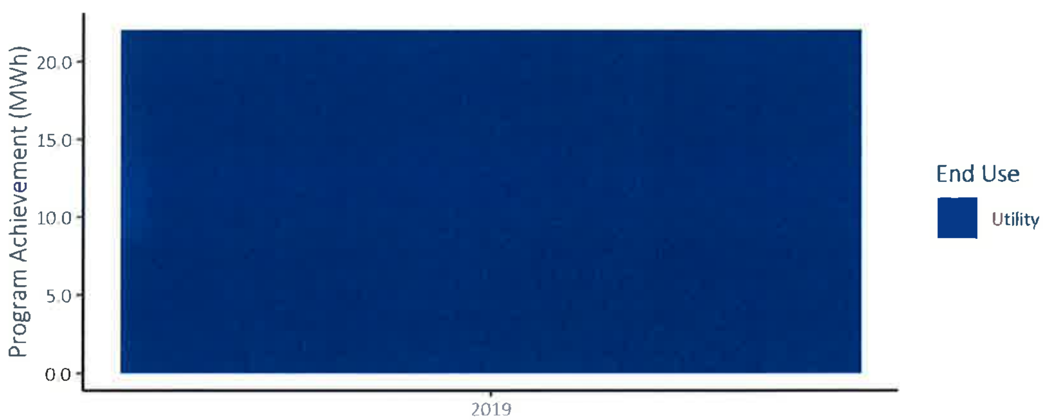
In the industrial sector, all the savings come from the lighting end use, as shown in Figure 11. Clallam PUD's industrial sector is largely comprised of loads in the wood products sector which has had a successful year despite the pandemic due to high demand for its products.

Figure 11: 2019-2020 Industrial Program Achievements by End Use



Clallam PUD has not reported any savings in the agricultural sector over the past three years. But they did report savings from a reconductoring project on their distribution system in 2019.

Figure 12: 2019-20 Utility System Achievements



Customer Characteristics

This section describes the characterization of Clallam PUD's customer base. This characterization 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. Additional information about the local climate and population of the service territory is used to characterize some measures. This information is summarized in Table 4.

Table 4: Service Territory Characteristics

Heating Zone	Cooling Zone	Total Homes (2019)	Total Population (2019)
1	1	28,846	57,102

The count of homes is based on the count of residential customers reported to the US EIA, while the population is based on census estimates for Clallam County, excluding the population of Port Angeles.

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. Additionally, the local climate zones and population are defined. 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	76%	4%	9%	13%
HVAC Equipment				
Electric Forced Air Furnace	5%	0%	0%	67%
Air Source Heat Pump	38%	0%	0%	22%
Ductless Heat Pump	19%	0%	0%	0%
Electric Zonal/Baseboard	24%	95%	95%	0%
Central Air Conditioning	0%	0%	0%	0%
Room Air Conditioning	1%	1%	1%	1%
Other Appliances				
Electric Water Heater	100%	100%	100%	88%
Refrigerator	124%	100%	100%	111%
Freezer	19%	5%	5%	39%
Clothes Washer	95%	16%	16%	89%
Electric Clothes Dryer	90%	5%	5%	89%
Dishwasher	76%	32%	32%	72%
Electric Oven	95%	100%	100%	100%
Desktop	67%	21%	21%	56%
Laptop	52%	16%	16%	39%
Monitor	81%	26%	26%	50%

Table 6: Residential New Home Characteristics

	Single Family	Low Rise Multifamily	High Rise Multifamily	Manufactured
Share of Homes	76%	4%	9%	13%
HVAC Equipment				
Electric Forced Air Furnace	23%	23%	23%	23%
Air Source Heat Pump	25%	25%	25%	25%
Ductless Heat Pump	26%	26%	26%	26%
Electric Zonal/Baseboard	26%	26%	26%	26%
Central Air Conditioning	0%	0%	0%	0%
Room Air Conditioning	1%	1%	1%	1%
Other Appliances				
Electric Water Heater	100%	100%	100%	88%
Refrigerator	124%	100%	100%	111%
Freezer	19%	5%	5%	39%
Clothes Washer	95%	16%	16%	89%
Electric Clothes Dryer	90%	5%	5%	89%
Dishwasher	76%	32%	32%	72%
Electric Oven	95%	100%	100%	100%
Desktop	67%	21%	21%	56%
Laptop	52%	16%	16%	39%
Monitor	81%	26%	26%	50%

The shares of home types are based on data for Clallam County from the American Community Survey. This assessment mainly used the same HVAC equipment and appliance saturations as the 2019 CPA, since no new information is available. The only adjustment made was to scale HVAC equipment saturations such that the total for electric heating did not exceed 100%. The 2019 CPA largely used the 2019 Residential Building Stock Assessment (RBSA), which was developed by NEEA, except for air conditioning equipment, where instead the professional judgement of Clallam PUD staff was used to better reflect their service territory.

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 124% means that single family homes average slightly more than 1.2 refrigerators per home.

The count of homes was estimated to grow at 1.1%, based on the compound average growth rate of customers reported to the US EIA from 2013-19. An additional demolition rate, based on assumptions for Washington State from the Council's 2021 Power Plan, was also used. The demolition rate is used to quantify the number of existing homes that are converted to new homes without adding to the overall count of homes.

Commercial

In the commercial sector, building floor area is the key variable in determining the number of conservation opportunities, as many of the commercial measures are quantified based on the applicable square feet of floor area. To determine the commercial floor area in Clallam PUD's service territory, Lighthouse used the Mergent Intellect database of commercial businesses. Lighthouse used this database to come up with a preliminary distribution of floor area, which was scaled to match Clallam PUD's pre-pandemic commercial loads using energy use intensities from NEEA's 2019 Commercial Building Stock Assessment (CBSA). The

2019 CBSA found that energy use intensities had decreased relative to the previous (2012) study by more than 20% across many building types, largely due to more efficient lighting. The net result of this is an increase in the estimated commercial floor area by approximately 35% relative to the 2019 CPA.

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	2019 Floor Area (square feet)
Large Office	0
Medium Office	795,900
Small Office	1,317,100
Extra Large Retail	815,995
Large Retail	152,303
Medium Retail	945,437
Small Retail	2,153,207
School (K-12)	1,267,446
University	7,401
Warehouse	564,881
Supermarket	151,348
Mini Mart	224,757
Restaurant	503,387
Lodging	822,942
Hospital	351,385
Residential Care	707,396
Assembly	1,584,897
Other Commercial	803,367
Total	**13,169,149**

The commercial floor area was assigned a growth rate of 0% based on US EIA commercial sales data, which is essentially flat between 2013 and 2019.

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 assumptions on the percent of savings to the applicable end-use consumption within each industrial segment.

To quantify the industrial segment loads, Clallam PUD provided 2020 energy consumption data for its industrial customers categorized by industry. The resulting industrial consumption totals 27,591 MWh, as summarized in Table 8. This represents an increase of approximately 5,000 MWh over the 2019 CPA and is largely due to the inclusion of water supply and wastewater treatment in the industrial sector, which were previously included in the commercial sector.

No growth rate was applied to the industrial sector, except for indoor agriculture, where a growth rate of approximately 12% was assumed for the first five years.

Table 8: Industrial Sector Sales by Segment

Segment	2019 Sales (MWh)
Water Supply	2,147
Sewage Treatment	3,183
Wood - Other	19,512
Indoor Agriculture	2,749
Total	**27,591**

Agricultural

The agricultural sector was characterized using data from the US Department of Agriculture's Census of Agriculture, which is conducted every five years. This assessment used data from the 2017 Census of Agriculture, published in 2019.[3] This version of the census was not available at the time of the 2019 CPA, so it reflects new information for the 2021 CPA.

In addition, Council staff characterized several additional measures for the draft 2021 Power Plan, resulting in a wider array of agricultural inputs. The primary inputs for this sector are summarized in Table 9 below.

Table 9: Agricultural Sector Inputs

Characteristic	Count	2017 Census Data Point
Number of Farms	325	Total number of farms
Irrigated Acres	1,727	Acres of irrigated land
Dairy Production	0%	Share of statewide dairy production

Overall, the agricultural sector load represents a very small portion of Clallam PUD's customer base.

Distribution System Efficiency

The draft 2021 Power Plan materials include 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 based on an estimate of the number of distribution substations and feeders for each utility, as well as the 2018 sales within each sector as reported to the US EIA. Table 10 summarizes the assumptions used for this sector.

Table 10: Utility Distribution System Efficiency Assumptions

Characteristic	Count
Distribution Substations	13
Residential/Commercial Substations	13
Urban Feeders	18
Rural Feeders	10
2018 Residential Sales (MWh)	439,440
2018 Commercial Sales (MWh)	172,619
2018 Industrial/Other Sales (MWh)	20,161

[3] United States Department of Agriculture. (2019). 2017 Census of Agriculture. Retrieved from: http://www.agcensus.usda.gov/Publications/2017/

Results

This section discusses the results of the 2021 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 that can be saved without considering the cost-effectiveness of measures. It considers market barriers and the practical limits of acquiring energy savings by efficiency programs, but not cost.

Figure 13 shows the supply curve of achievable potential over the 20-year study period. A supply curve depicts the cumulative potential 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 IRPs. The costs include credits for deferred transmission and distribution system costs, 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 the credits exceed the measure costs.

Figure 13: 20-Year Supply Curve

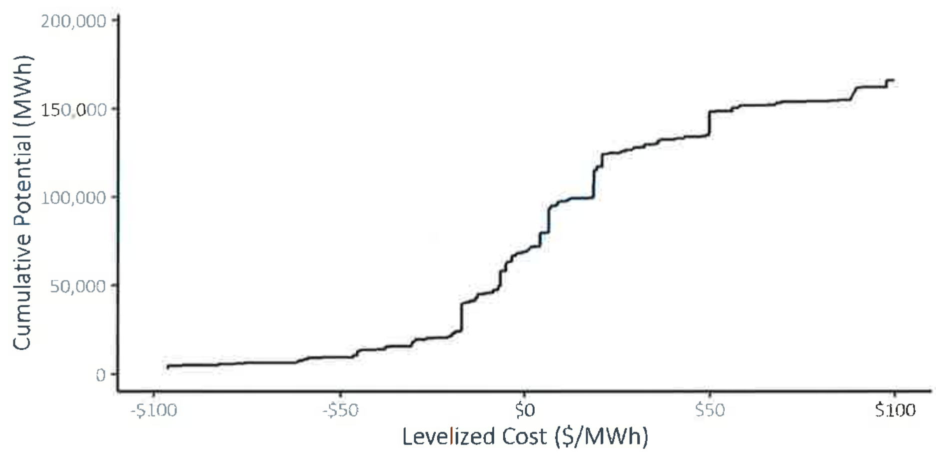


Figure 13 shows that approximately 70,000 MWh of potential are available at a cost at or below $0/MWh. These are measures where benefits such as the deferral of capacity costs and non-energy benefits exceed the measure costs. Approximately 150,000 MWh of achievable potential are available for costs below $50/MWh. A total of more than 193,000 MWh are available in Clallam PUD's service territory over the 20-year period, but only potential below $100/MWh is shown in the supply curve. After approximately $60/MWh, any increases in potential comes 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 14.

Figure 14: 20-Year Benefit-Cost Ratio Supply Curve

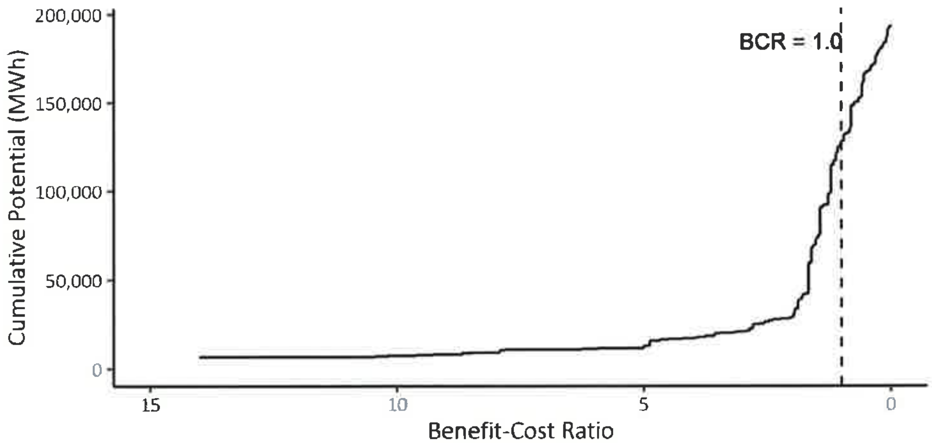
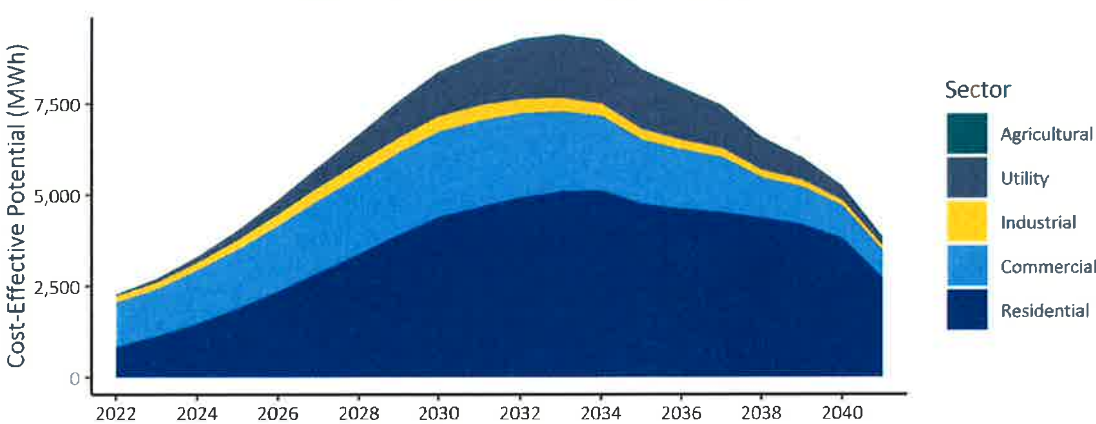


Figure 14 includes a dashed line where the benefit-cost ratio is equal to one. There are approximately 130,000 MWh of savings potential to the left of this line, with higher benefit cost ratios. The supply curve line becomes less steep as you move to the right of this line, suggesting a higher sensitivity to lower avoided costs. The economic or cost-effective potential is described below.

Cost-Effective Conservation Potential

Figure 15 shows the cost-effective potential by sector on an annual basis. Most of the potential is in Clallam PUD's residential and commercial sectors, with less available in the industrial, utility, and agricultural sectors.

Figure 15: Annual Cost-Effective Potential by Sector



Ramp rates from the 2021 Power Plan were used to establish reasonable rates of acquisition for all sectors. Lighthouse made modifications to the ramp rates for some measures to align the near-term potential with recent and expected savings in each sector given the current economic conditions. 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 2019 CPA, the cost-effective potential in the residential sector has decreased in near term but increased in the long term. State product standards for lighting, showerheads, and aerators have resulted in reductions in potential from these measures, while additional savings are now available in measures with slower adoption rates.

Figure 16 shows the cost-effective potential by end use for the first 10 years of the study period. Measures in the HVAC (which includes weatherization) and water heating end uses make up the largest share of potential in the sector in the near term.

The potential for these end uses grows during the initial 10 years of the study as the expected market share of heat pump water heaters increases and adoption of HVAC measures increase. Potential in the appliances (including clothes washers, dryers, refrigerators, and freezers), lighting, and electronics end uses have smaller amounts of potential in the initial 10 years.

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.

In Figure 16, the other end use category includes measures in the cooking and electric vehicle supply equipment end uses.

Figure 16: Annual Residential Potential by End Use

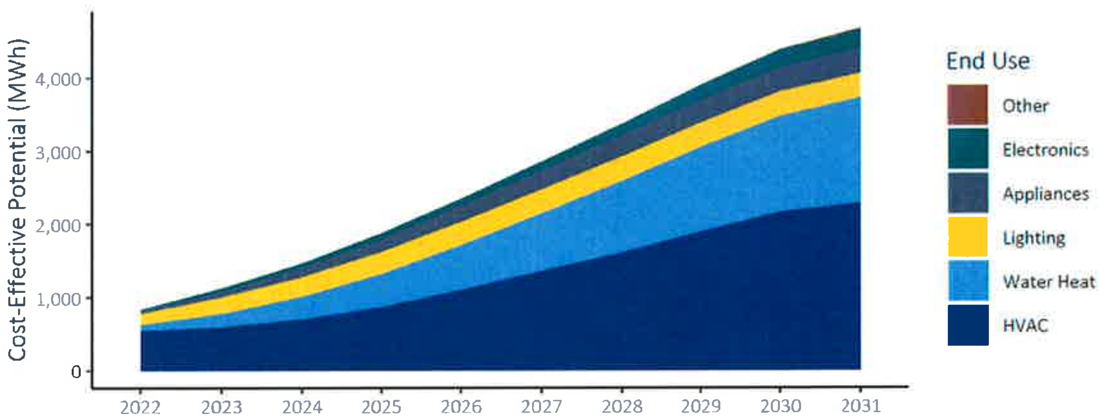
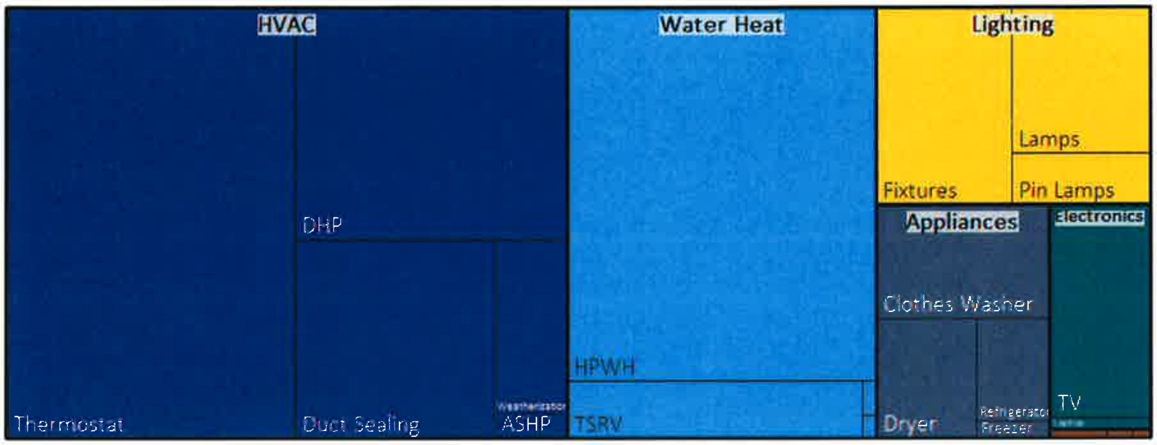


Figure 17 shows how the 10-year potential breaks down into end uses and measure categories. The area of each block represents the share of the total 10-year residential potential. Smart thermostats, ductless heat pumps (DHP), and duct sealing make up most of the potential in the HVAC end use, while heat pump water heaters (HPWH) and thermostatic restriction valves (TSRV) are the key measures within the water heating end use.

Figure 17: Residential Potential by End Use and Measure Category

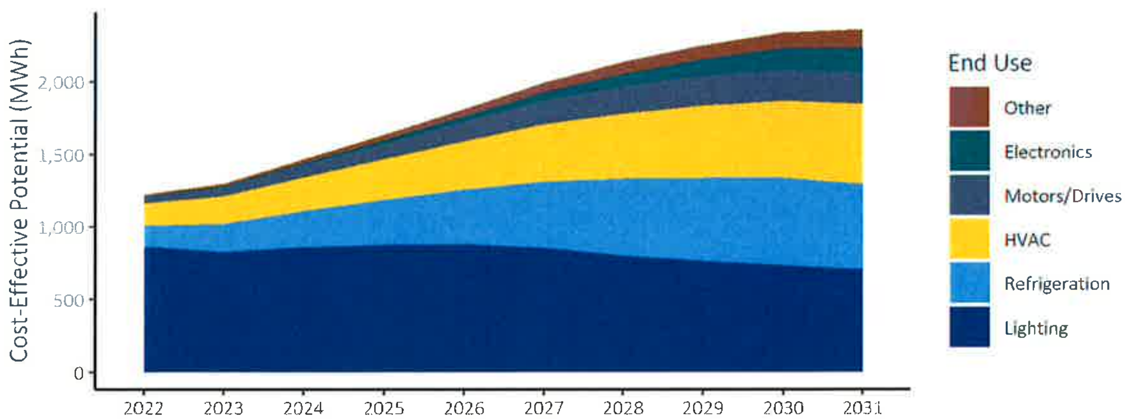


Commercial

In the commercial sector, lighting, HVAC, and refrigeration measures are the end uses with the highest potential. The lighting end use includes measures applicable to both interior and exterior lighting. Within the HVAC end use, the top measures include fans and advanced rooftop controllers (ARC).

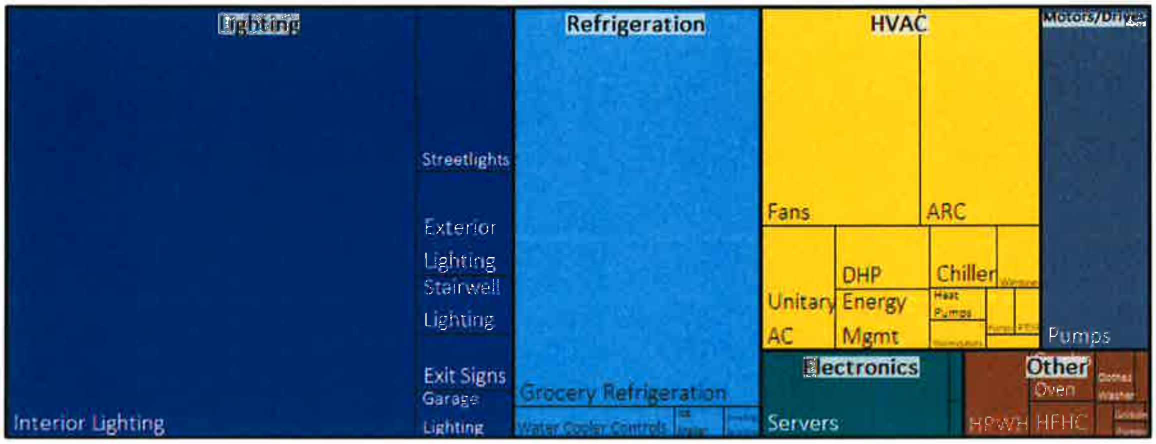
In Figure 18, the other category includes measures in the compressed air, food preparation, process loads, and water heating end uses.

Figure 18: Annual Commercial Potential by End Use



Key end uses and measure categories within the commercial sector are shown in Figure 19. The area of each block is proportional to its share of the 10-year commercial potential. The commercial sector includes a variety of building types with different end uses. This is apparent in the range of measures included in Figure 19.

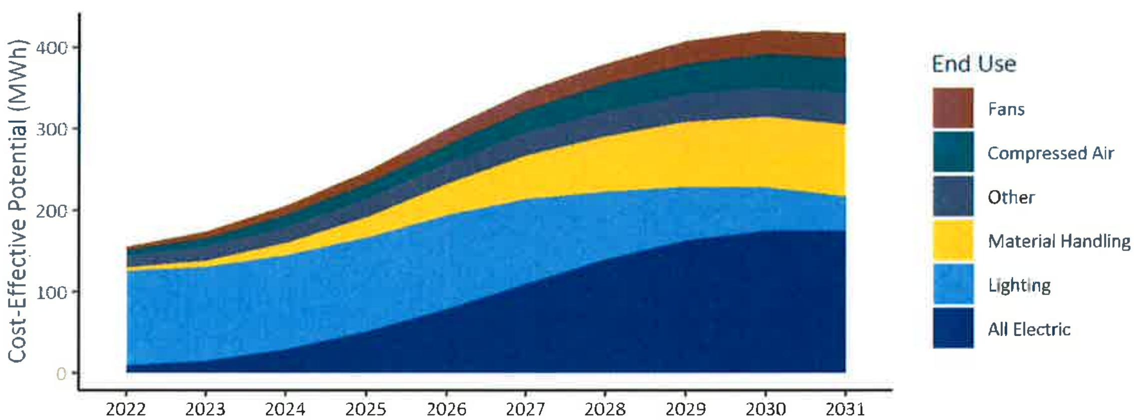
Figure 19: Commercial Potential by End Use and Measure Category



Industrial

The annual industrial sector potential is shown in Figure 20, the majority of which is in the all electric and other end uses. The all electric end use category includes measures applicable to all end uses, such as strategic energy management programs. The other category in Figure 20 includes a variety of end uses, including lighting, material processing, and several other small end uses. The diminishing remaining potential of lighting savings in the industrial sector is reflected in Figure 20.

Figure 20: Annual Industrial Potential by End Use



The breakdown of 10-year industrial potential into end uses and measure categories is shown in Figure 21.

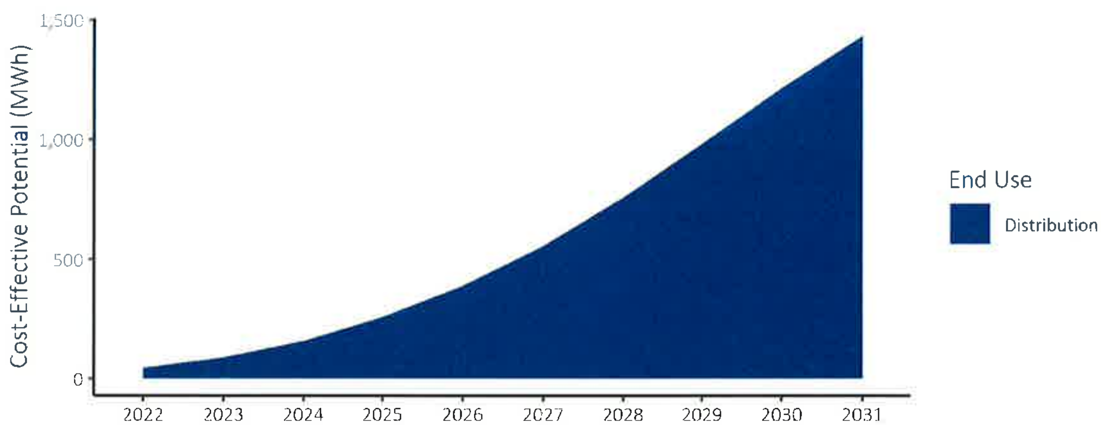
Figure 21: Industrial Potential by End Use and Measure Category

Distribution Efficiency

Measures in the distribution efficiency sector involve the regulation of voltage to improve the efficiency of utility distribution systems. This analysis includes the measures characterized for the draft 2021 Power Plan, which are based on an estimate of the number of distribution substations and feeders for Clallam PUD.

The annual distribution system potential is shown in Figure 22. The Council characterized three measures in the draft 2021 Power Plan, which use increasing sophisticated control systems.

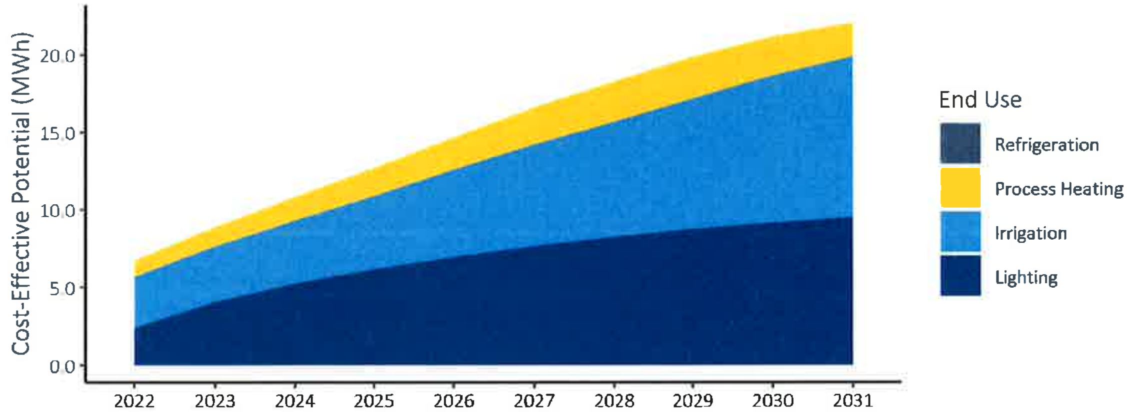
Figure 22: Annual Distribution System Potential



Agricultural

The potential in the agricultural sector is driven by the irrigated acreage, number of pumps, annual dairy production, and number of farms in Clallam PUD's service territory. This CPA used the agricultural measure characterizations developed for the draft 2021 Power Plan and new agricultural data available from the 2017 US Census of Agriculture. Note, the scale used in Figure 23 has changed significantly from what was used in other figures above.

Figure 23: Annual Agricultural Potential by End Use



Savings Shape

This section provides further details on the shape of the identified cost-effective potential, including breakdowns by on- and off-peak 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 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 corresponding to the ratio of the total measure savings corresponding to that 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. The load shapes used in this analysis were the ones developed by the Council for the draft 2021 Power Plan.

Results

Figure 24 shows the monthly savings profiles for on- and off-peak 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 24: On- and Off-Peak Savings by Month and Sector

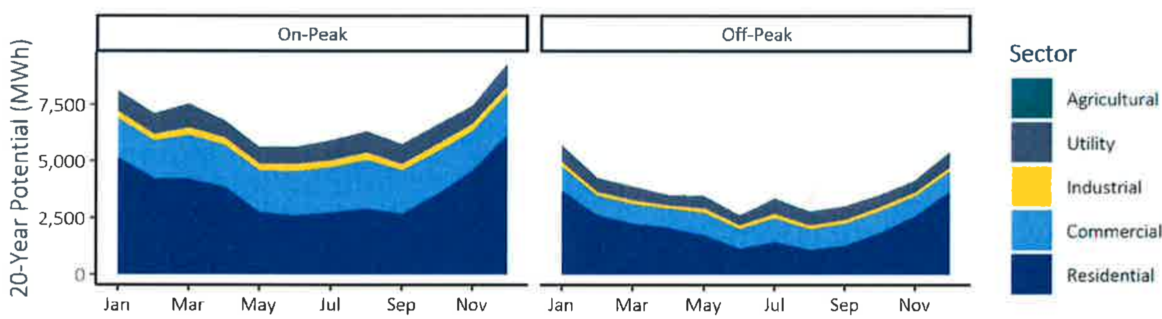


Figure 25 shows a similar breakdown as above, only by end use instead of sector. This figure shows that HVAC and water heating end uses are the two key end uses for on-peak savings. As would be expected, the HVAC savings are more focused in the winter months while water heating savings are more evenly spread across the year.

Figure 25: On- and Off-Peak Savings by Month and End Use

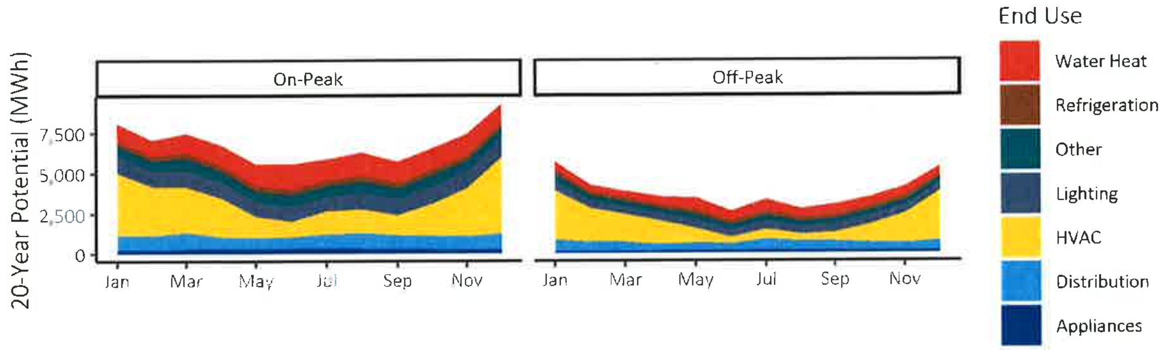


Figure 26 and Figure 27 show the peak demand savings by month and sector or end use. Again, the residential sector and HVAC end use contribute the most to reductions in peak demand. For this breakdown, Lighthouse used the same timing of monthly peak demand as was used in the 2019 CPA, which assumed morning peaks in the winter and shoulder season months with evening peaks in the summer.

Figure 26: Monthly Peak Savings by Sector

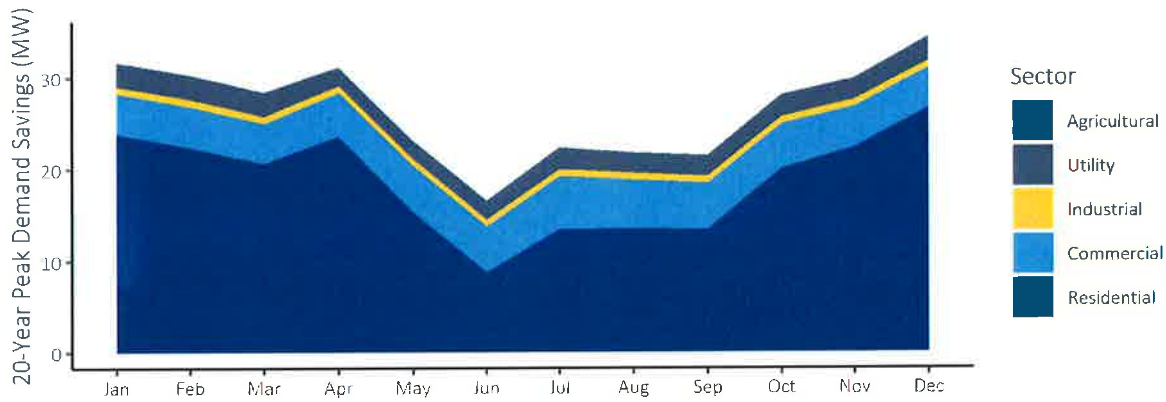
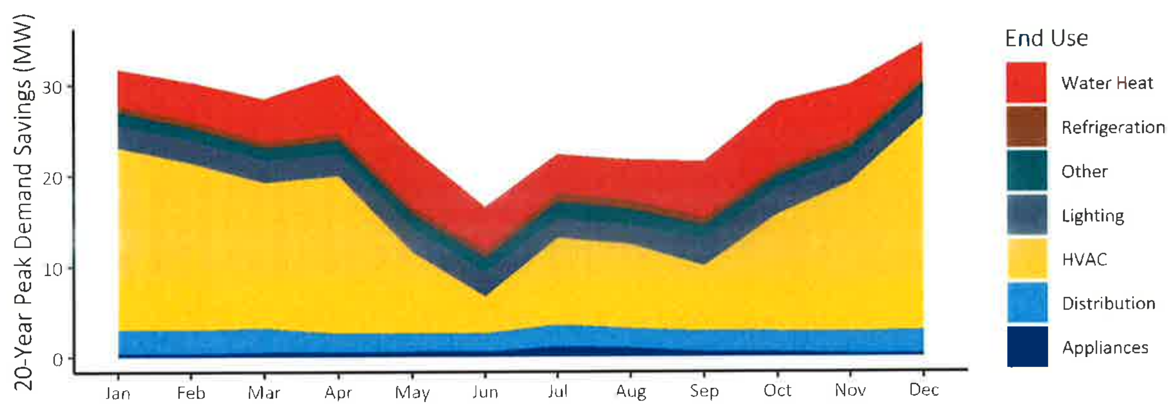


Figure 27: Monthly Peak Savings by End Use



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 Clallam PUD to understand the sensitivity of the cost-effective potential to variations in avoided cost. All other inputs were held constant.

Table 11 summarizes the avoided cost assumptions used in each scenario, which are discussed further in Appendix IV.

Table 11: 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% ($14)	Market Forecast ($26)	Market Forecast plus 20%-80% ($37)
	Social Cost CO_2	Federal 2.5% Discount Rate Values	Federal 2.5% Discount Rate Values	Federal 2.5% Discount Rate Values
	RPS Compliance	WA EIA & CETA Requirements	WA EIA & CETA Requirements	WA EIA & CETA Requirements
Capacity Values	Distribution Capacity (2016$)	$6.85/kW-year	$6.85/kW-year	$6.85/kW-year
	Transmission Capacity (2016$)	$3.08/kW-year	$3.08/kW-year	$3.08/kW-year
	Generation Capacity (2016$)	$74/kW-year	$88/kW-year	$124/kW-year
	Implied Risk Adder (2016$)	-$12/MWh -$13/kW-year	N/A	$11/MWh $37/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 both the cost of energy and capacity. The final row calculates the implied risk adders for the low and high scenarios by totaling the differences in both energy and capacity-based values. Further discussion of these values is provided in Appendix IV.

Table 12 summarizes the cost-effective potential across each avoided cost scenario. These results show a slightly higher sensitivity to the low scenario. This echoes the observation made regarding the benefit-cost ratio supply curve in Figure 14, which featured a steeper line and more sensitivity to the left of the line where the benefit-cost ratio equaled 1.0, and less sensitivity to the right.

Table 12: Cost Effective Potential (MWh) by Avoided Cost Scenario

Scenario	2-Year	4-Year	10-Year	20-Year
Low Scenario	3,461	8,862	41,021	98,585
Base Case	4,978	12,342	54,557	128,071
High Scenario	5,622	13,803	59,373	136,488

These results should be considered with the relative likelihood of each scenario and the associated scale of risk as well. For example, given that we are already in an environment with low market prices, further declines in market prices and the low capacity value reflected in the low scenario may be less likely. In addition, pursuing only the energy efficiency quantified in the low scenario could lead to long-term contracts for other resources that, over the long term, may prove to be unneeded or uneconomic.

Overall, energy efficiency remains a low-risk resource for Clallam PUD since it is purchased in small increments over time, making it unlikely that too much will be purchased.

Summary

This report has summarized the results of the 2021 CPA conducted for Clallam PUD. The assessment provided estimates of the cost-effective energy savings potential for the 20-year period beginning in 2022, with detail 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 Clallam PUD's 2019 CPA, the potential has decreased in the short term. Factors driving the potential downward in the short term include the recent adoption of state product standards for lighting and water-saving measures, as well as the continued decline in avoided costs. Ramp rates were also adjusted to reflect recent program achievements, which have been affected by the COVID-19 pandemic.

In the longer term, this assessment found higher amounts of cost-effective potential. This additional potential is in measures that currently see lower adoption rates, like heat pump water heaters and smart thermostats, but can gain traction in the future. In the commercial and industrial sectors, new measures for pumps and fans also add to the potential. New data from the 2019 CBSA has also resulted in an increase in the estimate of commercial floor area in Clallam PUD's service territory.

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 for determining the potential and cost-effectiveness of conservation resources in the draft 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 draft 2021 Power Plan, the assessment used assumptions from the draft 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 draft 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
CETA	Clean Energy Transformation Act
CFL	Compact Fluorescent Light
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 US.

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 13: CPA Compliance

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 contain the ProCost results. These results are then rolled up into the ProCost Measure Results files, which are

WAC 194-37-080 Section	Requirement	Implementation
		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 draft 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 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 efficiency measures to which it is compared.	Lighthouse developed a 20-year forecast of on- and off-peak market prices at the mid-Columbia trading hub based on available forward prices. Further discussion of this forecast can be found in Appendix IV.

WAC 194-37-080 Section	Requirement	Implementation
		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 Clallam PUD, using the methodology 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 Clallam PUD's monthly demand costs, which represents their cost of capacity. 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 by the federal Interagency Workgroup using a 2.5% discount rate, as required by the Clean Energy Transformation Act. The carbon costs 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 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 draft 2021 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.

WAC 194-37-080 Section	Requirement	Implementation
		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 draft 2021 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% to determine the present value of all costs and benefits. This represents Clallam PUD's long-term cost of capital. 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 NW 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."[4] 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 in item four above. Lighthouse has also included the value of avoided renewable portfolio standard compliance costs in the avoided costs.

This appendix discusses each of these input in detail in the following sections.

Avoided Energy Costs

Avoided energy costs are the energy costs avoided by Clallam PUD through the acquisition of energy efficiency instead of supply-side resources. For every megawatt-hour of conservation achieved, Clallam PUD avoids the purchase of one megawatt-hour of energy.

For this CPA, Lighthouse has developed a forecast of avoided on- and off-peak energy prices at the Mid-Columbia trading hub. The forecast is based on forward on- and off-peak prices reported by the CME Group[5,6] on January 11, 2021. These include monthly prices for roughly a six-year period. To develop a forecast that would cover the 20-year study period of this CPA, Lighthouse developed linear regression models fitted to these prices and then used those models to forecast prices over the full study period.

Figure 28 and Figure 29 show how the forward prices from the CME Group compare to the fitted model developed by Lighthouse for on- and off-peak prices, respectively. Both models provide a very close fit to

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

[5] https://www.cmegroup.com/trading/energy/electricity/mid-columbia-day-ahead-peak-calendar-month-5-mw-futures.html. Accessed January 11, 2021.

[6] https://www.cmegroup.com/trading/energy/electricity/mid-columbia-day-ahead-off-peak-calendar-month-5-mw-futures.html. Accessed January 11, 2021.

the forward prices, although the unusual shape to the off-peak forward prices in 2023 is not reflected in the modeled prices.

Figure 28: On-Peak Price Comparison

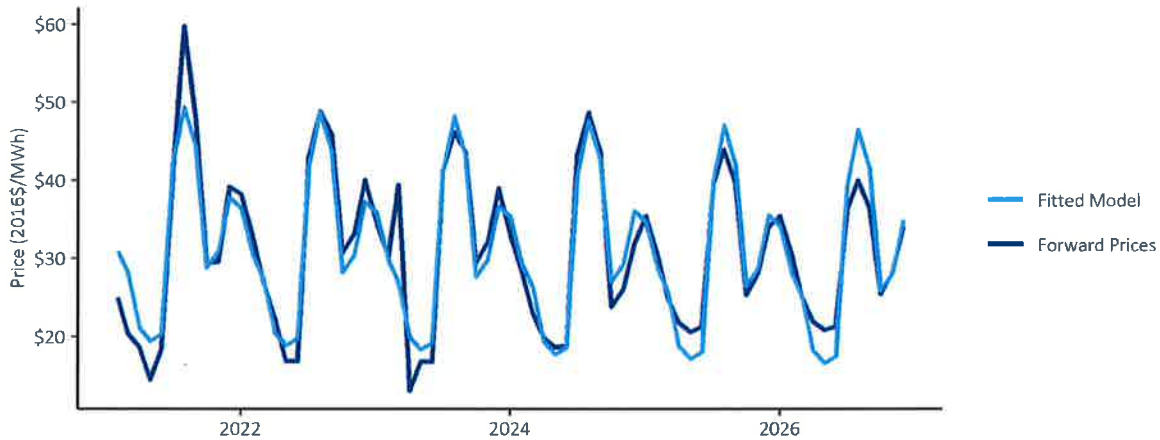
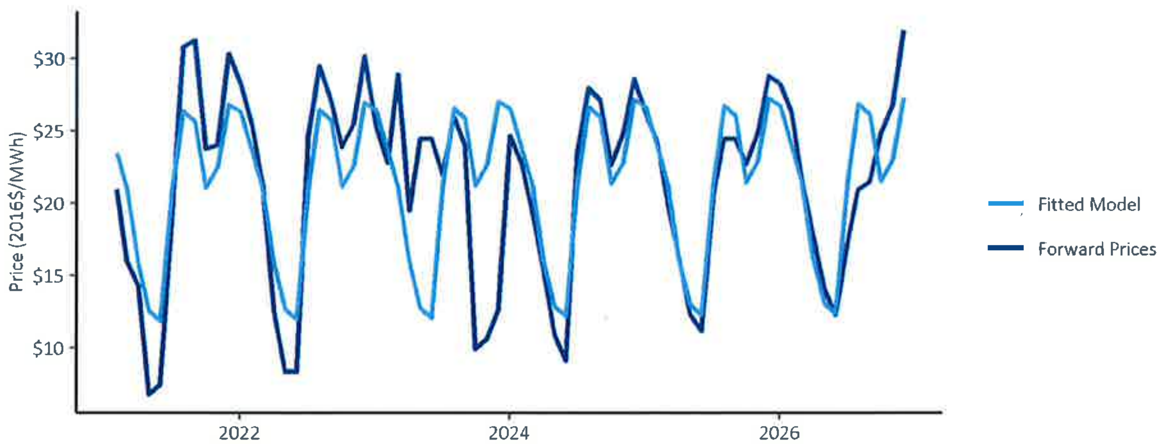
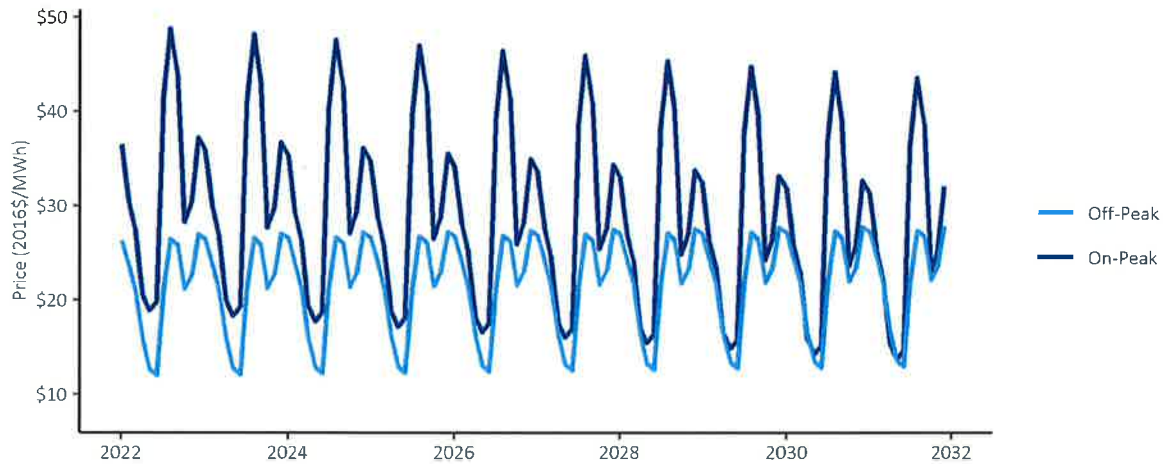


Figure 29: Off-Peak Price Comparison



The modeled forecast of on- and off-peak prices is shown in Figure 30 below. For clarity, only the first 10 years are shown. The levelized value of the 20-year price forecast is $26/MWh (2016$). This represents a 23% decrease from the price forecast used in the 2019 CPA, which had a levelized value of $34/MWh.

Figure 30: 20-Year On- and Off-Peak Price Forecast



Lighthouse also created high and low variations of this forecast to be used in the avoided cost scenarios, which are described subsequently. To develop the forecast, Lighthouse examined the variation in the forecast developed by the Northwest Power and Conservation Council (Council) for the 2021 Plan and found that the highest and lowest forecasted prices varied by approximately 20% in the near term and 80% in the long term, relative to the average price forecast. Lighthouse applied this trend to forecast described above to create the high and low scenario forecasts. The resulting forecasts for on- and off-peak prices are shown in Figure 31 and

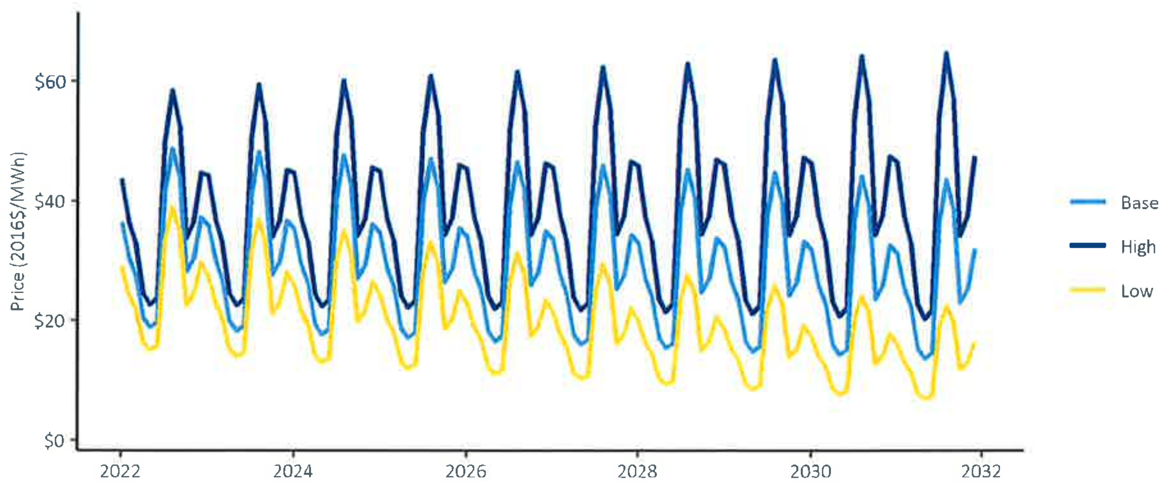


Figure 32 below.

Figure 31: Comparison of On-Peak Price Scenarios

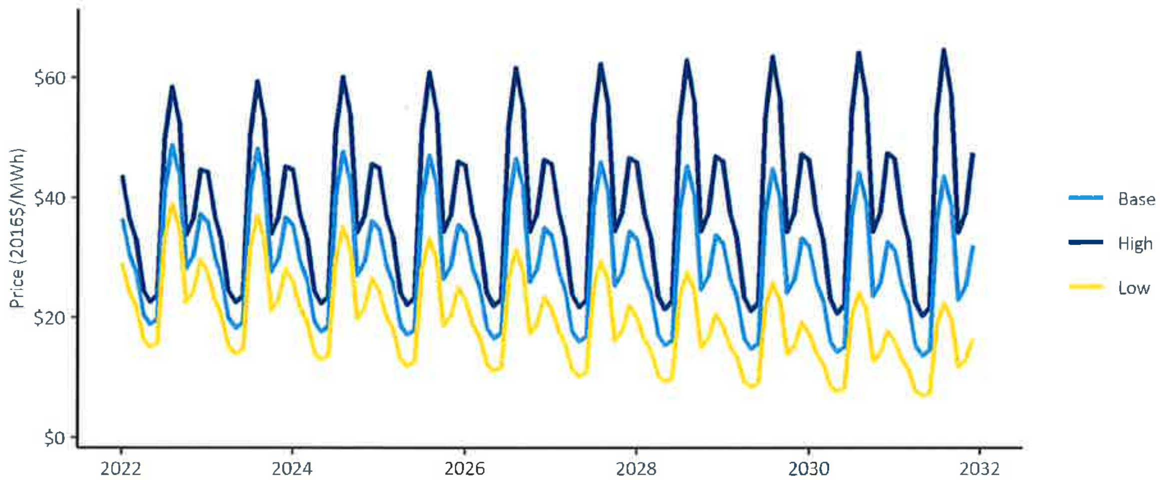
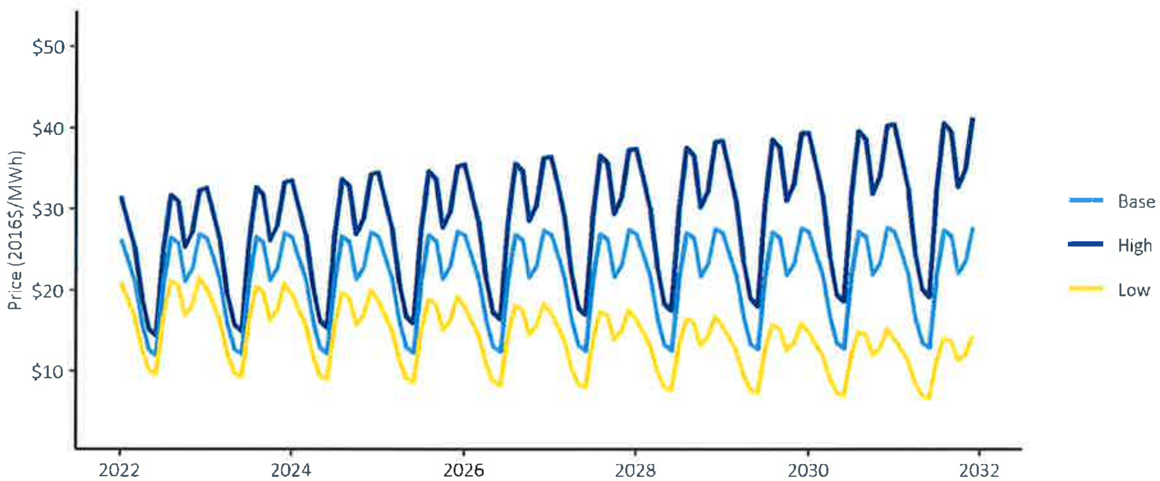


Figure 32: Comparison of Off-Peak Price Scenarios



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 draft 2021 Power Plan, the Council developed a standardized methodology to calculate these values. As part of the 2019 CPA, Clallam PUD used the Council's methodology to calculate values of $0.31/kW-year and $4.85/kW-year (2016$) for transmission and distribution, respectively. These values are comparable to what the Council developed based on a survey of Northwest utilities using the new methodology, which were $3.08/kW-year for transmission capacity and $6.85/kW-year for distribution capacity (2016$). Both sets of values are a significant decrease from the values in the Seventh Plan, which were $26/kW-year and $31/kW-year (2012$) for transmission and distribution systems, respectively.

Clallam PUD's 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 2021 CPA.

Deferred Generation Capacity Costs

Like 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. While there is currently no organized capacity market in the Northwest, Clallam PUD does pay a demand charge to BPA based on its monthly peak demand. These charges effectively function as a generation capacity value for Clallam PUD.

Lighthouse followed a similar methodology as what was used in Clallam PUD's previous CPAs to convert the monthly BPA demand charges to an annual generation capacity value. Using assumptions about energy efficiency capacity contributions by month, BPA's 2020 monthly demand charges were scaled and added to calculate an annual value. Lighthouse reviewed historic trends in demand charges and found that, on average, the demand charges increased by approximately 2% each year, consistent with common assumptions about inflation. Lighthouse used this trend to calculate a 20-year series of annual generation capacity values and then levelized them to provide a single input required for the Council's ProCost model. This resulted in a base case value of $87/kW-year. For the low case, no price escalation was assumed, resulting in a value of $74/kW-year. In the high scenario, the Council's Seventh Plan value will be used, which is $124/kW-year when converted to 2016 dollars. Any updates from the 2021 Plan regarding this value will not be available until after the completion of the draft Power Plan, currently scheduled for July 2021.

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 US EPA defines as a measure of the long-term damage done by a ton of carbon dioxide emissions each 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.[7] 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. These values were used in all scenarios of the CPA.

To implement a cost of carbon emissions, additional assumptions must be made about the intensity of carbon emissions. This assessment uses the market rate emissions factors developed for the 2021 Plan with modifications to reflect that CETA requires carbon-free energy beginning in 2030.

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

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

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 Renewable Energy Credits (RECs).

Energy efficiency can reduce the cost of complying with these requirements by reducing Clallam PUD's overall load. In 2022, 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 Sixth Power Plan, the value of the risk adder varied by measure type and included values as large as $50/MWh for some measures. In the Seventh Plan, the Council determined that no risk credit was necessary after including carbon costs and a generation capacity value in its avoided cost. Any determination of a risk credit based on the 2021 Plan will not be available until the draft Plan is released.

This CPA follows the process used in Clallam PUD's 2017 and 2019 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, Clallam PUD 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% ($14)	Market Forecast ($26)	Market Forecast plus 20%-80% ($37)
	Social Cost CO_2	Federal 2.5% Discount Rate Values	Federal 2.5% Discount Rate Values	Federal 2.5% Discount Rate Values
	RPS Compliance	WA EIA & CETA Requirements	WA EIA & CETA Requirements	WA EIA & CETA Requirements
Capacity Values	**Distribution Capacity (2016$)**	$6.85/kW-year	$6.85/kW-year	$6.85/kW-year
	Transmission Capacity (2016$)	$3.08/kW-year	$3.08/kW-year	$3.08/kW-year
	Generation Capacity (2016$)	$74/kW-year	$88/kW-year	$124/kW-year
	Implied Risk Adder (2016$)	-$12/MWh -$13/kW-year	N/A	$11/MWh $37/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 Clallam PUD. Lighthouse customized these measures to make them specific to Clallam PUD's service territory and updated several with new information available from the Regional Technical Forum. 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
Appliances	Air Cleaner	Draft 2021 Plan
	Clothes Washer	Draft 2021 Plan
	Clothes Dryer	Draft 2021 Plan
	Freezer	Draft 2021 Plan
	Refrigerator	Draft 2021 Plan
Cooking	Electric Oven	Draft 2021 Plan
	Microwave	Draft 2021 Plan
Electronics	Advanced Power Strips	Draft 2021 Plan
	Desktop	Draft 2021 Plan
	Laptop	Draft 2021 Plan
	Monitor	Draft 2021 Plan
	TV	Draft 2021 Plan
EVSE	EVSE	Draft 2021 Plan
HVAC	Air Source Heat Pump	Draft 2021 Plan
	Central Air Conditioner	Draft 2021 Plan
	Cellular Shades	Draft 2021 Plan
	Circulator	Draft 2021 Plan
	Circulator Controls	Draft 2021 Plan
	Ductless Heat Pump	Draft 2021 Plan
	Duct Sealing	Draft 2021 Plan
	Ground Source Heat Pump	Draft 2021 Plan
	Heat Recovery Ventilator	Draft 2021 Plan
	Room Air Conditioner	Draft 2021 Plan
	Smart Thermostats	Draft 2021 Plan
	Weatherization	Draft 2021 Plan
	Whole House Fan	Draft 2021 Plan
Lighting	Fixtures	Draft 2021 Plan
	Lamps	Draft 2021 Plan
	Pin Lamps	Draft 2021 Plan
Motors	Well Pump	Draft 2021 Plan
Water Heat	Aerators	Draft 2021 Plan
	Circulator	Draft 2021 Plan
	Circulator Controls	Draft 2021 Plan
	Dishwasher	Draft 2021 Plan
	Gravity Film Heat Exchanger	Draft 2021 Plan
	Heat Pump Water Heater	Draft 2021 Plan, RTF
	Pipe Insulation	Draft 2021 Plan
	Showerhead	Draft 2021 Plan
	Thermostatic Restrictor Valve	Draft 2021 Plan, RTF
Whole Home	Behavior	Draft 2021 Plan

Table 16: Commercial End Uses and Measures

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

Table 17: Industrial End Uses and Measures

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

Table 18: Utility Distribution End Uses and Measures

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

Table 19: Agricultural End Uses and Measures

End Use	Measure Category	Data Source
Irrigation	Irrigation Hardware	Draft 2021 Plan
	Motor Rewind	Draft 2021 Plan
	Pumps	Draft 2021 Plan
	Variable Rate Irrigation	Draft 2021 Plan
Lighting	Dairy Lighting	Draft 2021 Plan
	Exterior Lights	Draft 2021 Plan
Process Heating	Block Heater	Draft 2021 Plan
	Stock Tanks	Draft 2021 Plan
Refrigeration	Dairy Refrigeration	Draft 2021 Plan
Ventilation	Fans	Draft 2021 Plan

Appendix VI: Energy Efficiency Potential by End Use

Table 20: Residential Potential by End Use (MWh)

End Use	2-Year	4-Year	10-Year	20-Year
Appliances	131	440	2,210	5,564
Cooking	0	2	37	301
Electronics	59	202	1,235	2,287
EV Supply Equipment	0	1	13	16
HVAC	1,143	2,727	13,190	36,378
Lighting	374	948	2,946	5,150
Motors	-	-	-	-
Water Heat	268	1,021	7,296	21,361
Whole Home	-	-	-	-
Total	**1,976**	**5,343**	**26,928**	**71,057**

Table 21: Commercial Potential by End Use (MWh)

End Use	2-Year	4-Year	10-Year	20-Year
Compressed Air	0	1	3	11
Electronics	8	43	670	1,469
Food Preparation	9	34	271	681
HVAC	343	856	3,616	8,994
Lighting	1,693	3,431	8,185	12,041
Motors/Drives	114	309	1,418	2,600
Process Loads	-	-	-	-
Refrigeration	336	897	4,015	7,054
Water Heating	18	57	346	984
Total	**2,523**	**5,628**	**18,524**	**33,834**

Table 22: Industrial Potential by End Use (MWh)

End Use	2-Year	4-Year	10-Year	20-Year
All Electric	25	105	946	1,644
Compressed Air	18	52	259	598
Fans and Blowers	11	23	46	52
HVAC	-	-	-	-
Lighting	231	462	927	1,053
Low Temp Refrigeration	-	-	-	-
Material Handling	12	52	466	914
Material Processing	2	6	46	159
Med Temp Refrigeration	-	-	-	-
Melting and Casting	-	-	-	-
Other	-	-	-	-
Other Motors	0	1	5	17
Pollution Control	0	0	2	7
Pumps	18	44	169	535
Total	**318**	**745**	**2,866**	**4,979**

Table 23: Distribution Efficiency by End Use (MWh)

End Use	2-Year	4-Year	10-Year	20-Year
LDC with no VVO	16	66	708	2,083
LDC with VVO & AMI	117	482	5,187	15,274
Total	**133**	**548**	**5,895**	**17,357**

Table 24: Agricultural Potential by End Use (MWh)

End Use	2-Year	4-Year	10-Year	20-Year
Irrigation	7	16	64	130
Lighting	7	18	68	120
Process Heating	2	6	20	24
Refrigeration	-	-	-	-
Ventilation	-	-	-	-
Total	**16**	**39**	**152**	**275**

Appendix VII: Ramp Rate Alignment Documentation

This appendix documents how ramp rates were selected to ensure alignment between the near-term potential and the recent achievements of Clallam PUD's energy efficiency programs. Aligning the potential with recent achievements provides the best way to ensure that the near-term potential is feasible for Clallam PUD's programs as energy efficiency programs take time to ramp up and are subject to local market conditions, including the impacts of the COVID-19 pandemic.

Process

Achievement data for 2019-20 was provided by Clallam PUD and summarized by sector and end use. Residential program achievements were also summarized by high-level measure categories.

Savings from NEEA's market transformation initiatives were allocated to customer sectors based on the historical makeup of these savings but could not be allocated within end uses or measure categories. Lighthouse has a general sense of NEEA's initiatives and can identify the end uses or measures where NEEA's market transformation initiatives may contribute additional savings. That said, NEEA's market transformation savings are quantified relative to a baseline that is set to the baseline used in the most recent regional power plan. Accordingly, NEEA's baseline will reset in 2022 with the new 2021 Power Plan (2021 Plan), and it is currently unknown what level of savings will be achieved at this point. To account for this uncertainty, Lighthouse was conservative in the projecting the level of NEEA savings that may continue relative to past years.

Similarly, Clallam PUD has a small amount of savings from new homes. The savings from these cannot be allocated to a single measure or end use as they span space and water heating, as well as other end uses.

These recent achievements were compared with the cost-effective energy efficiency potential identified in the 2021 CPA.

Lighthouse started with the default ramp rates assigned to each measure in the draft 2021 Plan and compared the resulting cost-effective potential in the first few years of the assessment with Clallam PUD's recent program achievements. Changes to ramp rates were made to accelerate or decelerate the acquisition of potential to align with recent programmatic achievements.

The following tables show how Clallam PUD's previous and forecasted achievements compare to the potential *after* ramp rates were adjusted. Color scaling has been applied to highlight the larger values. Discussion follows each table with additional detail.

Note that NEEA savings are called out explicitly in the historical columns tallying past programmatic achievements, but NEEA savings are not differentiated from other Clallam PUD program savings in columns detailing future savings potential. As described above, it is difficult to determine how savings will be achieved. For some measures, achievements will be a mix of both Clallam PUD programs and NEEA's market transformation initiatives.

Residential

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

Table 25: Alignment of Residential Program History and Potential by Measure Category (MWh)

		Program History		CPA Cost-Effective Potential		
End Use	Category	2019	2020	2022	2023	2024
Appliances	Clothes Washer	8	1	21	43	65
Appliances	Dryer	5	0	13	26	39
Appliances	Freezer	-	-	1	3	4
Appliances	Refrigerator	-	-	8	16	24
Cooking	Oven	-	-	0	0	0
Electronics	Advanced Power Strips	18	18	-	-	-
Electronics	Laptop	-	-	8	12	15
Electronics	TV	-	-	12	27	45
EVSE	EVSE	-	-	0	0	0
HVAC	ASHP	394	417	5	8	10
HVAC	Circulator Controls	-	-	0	0	0
HVAC	DHP	522	436	458	454	450
HVAC	Duct Sealing	3	4	10	21	39
HVAC	Thermostat	17	6	37	68	154
HVAC	Weatherization	51	89	37	45	55
Lighting	Lighting	1,040	871	149	225	272
Water Heat	Circulator	-	-	0	1	2
Water Heat	Circulator Controls	-	-	0	0	0
Water Heat	HPWH	256	118	74	171	277
Water Heat	Showerhead	9	7	-	-	-
Water Heat	TSRV	-	-	8	13	27
NEEA	NEEA	1,495	1,495	*n/a*	*n/a*	*n/a*
	Total	**3,819**	**3,462**	**842**	**1,135**	**1,479**

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

In these end uses, the potential for each measure category is well aligned with program achievements. While there are some measure categories with slightly higher potential than program achievements, this is one end use where NEEA's initiative may contribute additional savings. NEEA has a Retail Product Portfolio initiative that includes appliances and electronics.

Electronics

In this category, Clallam PUD has been providing incentives for advanced power strips. These measures, however, did not pass the cost-effectiveness test for this CPA. Additional potential is available through TVs and computers, which could be achieved through NEEA's Retail Product Portfolio, like the appliance category discussed above.

Electric Vehicle Supply Equipment (EVSE)

There is a small amount of potential here, but too small to show up in the resolution provided by the table. This is an area for Clallam to consider adding incentives.

HVAC

In the HVAC category, only certain applications of air-source heat pumps (ASHP) and ductless heat pumps (DHP) were cost-effective, limiting the ability to closely match program achievement and potential. The measures in this category were accelerated. The potential with ductless heat pumps (DHP) was also accelerated to match program potential. The potential with duct sealing measures was given slightly slower ramp rates as the recent program activity in this category has been limited. The potential with smart thermostats was slowed slightly but left slightly higher than recent program achievement, as this continues to be an area for growth and Clallam could accelerate here, especially if ASHPs are not cost-effective in the future.

Lighting

Measures in the lighting category were given faster ramp rates, but program potential is limited in this area due to Washington state standards that took effect in 2020 covering many screw-in lamps. There is potential that remains in fixtures and less common bulb types.

Water Heat

The program history in the water heating category consists mostly of savings from heat pump water heaters and showerheads. The potential for heat pump water heaters was left with the default 2021 Plan ramp rates. While this results in potential that is slightly higher than recent program achievement, this is an area where NEEA has a market transformation initiative which contributes additional savings. Washington's HB 1444 specifies standards for showerheads and aerators, so there is no potential in these categories. The initial potential for circulator pumps and controls was left at the default ramp rates, which results in limited early potential for these measures, which are new to the 2021 Power Plan and Clallam PUD's CPA. Similarly, no changes were made to the default 2021 Plan ramp rate for thermostatic restrictor valves.

Table 26 below summarizes the residential measure category results in Table 25 by end use.

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

	Program History		CPA Cost-Effective Potential		
End Use	2019	2020	2022	2023	2024
Appliances	13	1	43	89	133
Cooking	-	1	0	0	1
Electronics	18	18	20	39	60
EVSE	-	1	0	0	0
HVAC	987	951	547	596	707
Lighting	1,040	871	149	225	272
Motors	-	1	-	-	-
Water Heat	265	125	83	185	306
Whole Home	84	74	-	-	-
NEEA	1,495	1,495	*n/a*	*n/a*	*n/a*
Total	**3,903**	**3,539**	**842**	**1,135**	**1,479**

Commercial

In the commercial sector, most of the potential is in the lighting end use which was given the fastest ramp rates available in the draft 2021 Plan. Using these default ramp rates resulted in potential that is well-aligned with recent program history in this end use, which declined in 2020.

Lighthouse applied slightly slower ramp rates to measures in the electronics and motors/drives categories but made no other changes. These end uses have smaller amounts of potential that ramp more slowly. Potential in the HVAC category was left somewhat higher than program history as this is a category where NEEA's market transformation efforts may contribute additional savings.

Table 27 below shows the alignment of program history and potential in the commercial sector.

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

	Program History		CPA Cost-Effective Potential		
End Use	2019	2020	2022	2023	2024
Compressed Air			0	0	0
Electronics			2	6	12
Food Preparation			3	6	10
HVAC	52	73	154	190	233
Lighting	2,262	903	864	829	861
Motors/Drives			49	66	87
Process Loads			-	-	-
Refrigeration			144	192	251
Water Heating			7	11	17
NEEA	370	370	*n/a*	*n/a*	*n/a*
Total	**2,684**	**1,346**	**1,222**	**1,300**	**1,470**

Industrial

Most of the potential in the industrial sector is in the lighting and energy management categories. Faster ramp rates were applied to lighting measures to align with Clallam PUD's recent program history. The ramp rates for energy management measures were slowed from the default 2021 Plan ramp rates as Clallam PUD's industrial base is primarily comprised of one wood products facility. Achieving potential here would rely on the participation of this one facility, which in the past has been resistant to participating in energy efficiency programs. Similar adjustments were made to other industrial end uses to reflect the lack of program traction in these end uses.

Table 28 shows the alignment of industrial potential and recent program history by end use.

Table 28: Alignment of Industrial Program History and Potential by End Use (MWh)

MWh	Program History		CPA Cost-Effective Potential		
End Use	**2019**	**2020**	**2022**	**2023**	**2024**
Energy Management	-	-	10	15	29
Compressed Air	-	-	8	11	15
Fans and Blowers	-	-	10	14	17
HVAC	-	-	-	-	-
Lighting	49	193	116	116	116
Motors	-	-	0	0	0
Refrigeration	-	-	-	-	-
Process	-	-	5	9	17
Pumps	-	-	8	10	12
Other	-	-	0	0	0
NEEA	14	14	*n/a*	*n/a*	*n/a*
Total	**63**	**208**	**156**	**174**	**206**

Agricultural

The amount of potential is very limited in the agricultural sector, as Clallam PUD has limited agricultural activity in its service territory. There is a small amount of dairy production, but the potential in this category was slowed as it is not currently an area of focus for Clallam PUD's programs.

Table 29: Alignment of Agricultural Program History and Potential by End Use (MWh)

	Program History		CPA Cost-Effective Potential		
End Use	**2019**	**2020**	**2022**	**2023**	**2024**
Irrigation	-	-	3	4	4
Lighting	-	-	2	4	5
Process Heating	-	-	1	1	2
Refrigeration	-	-	-	-	-
Ventilation	-	-	-	-	-
Total	**-**	**-**	**7**	**9**	**11**

Utility Distribution System

As with the agricultural sector, the amount of potential in this category is limited compared to other sectors. No changes were made to the default ramp rate assigned in the draft 2021 Plan.

Table 30: Alignment of Distribution System Program History and Potential by End Use (MWh)

	Program History		CPA Cost-Effective Potential		
End Use	2019	2020	2022	2023	2024
Distribution System	22	0	44	89	158

RESOLUTION NO. 2209-21

A RESOLUTION Establishing the District's
2022 - 2031 Achievable Cost-Effective Conservation Potential and
2022 - 2023 Biennial Conservation Target

WHEREAS, under the Washington State Energy Independence Act, Chapter 19.285 RCW, PUD No. 1 of Clallam County (the "District") is required to pursue all available conservation that is cost-effective, reliable and feasible; and

WHEREAS, the Energy Independence Act is implemented by the Washington State Department of Commerce, through regulations published at Chapter 194-37 WAC; and

WHEREAS, WAC 194-37-070(1) provides that, by January 1 of each even-numbered year, the District shall identify its achievable cost-effective conservation potential for the upcoming ten years; and

WHEREAS, WAC 194-37-070(2) provides that, by January 1 of each even-numbered year, the District shall establish and make public a biennial conservation target that shall be no less than the target's *pro rata* share of the ten-year conservation potential identified by the District; and

WHEREAS, the District has developed its ten-year potential and its biennial target; and

WHEREAS, notice was given of a public meeting to be held August 23, 2021, to take public comment on, and to establish, the District's ten-year potential and its biennial target.

NOW, THEREFORE, BE IT RESOLVED, that the District's achievable cost-effective conservation potential for the next ten-year period is 54,557 MWh, and the District's biennial conservation target is 4,978 MWh, both of which are in compliance with requirements of the Energy Independence Act.

PASSED, by the Board of Commissioners of Public Utility District No. 1 of Clallam County, this 23rd day of August, 2021.

____

President

ATTEST:

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Vice President

____

Secretary