2021 CLEAN ENERGY IMPLEMENTATION PLAN

City of Richland Energy Services

November 9, 2021

Prepared by:

LIGHTHOUSE ENERGY CONSULTING

with

Efficiency for Everyone & empower dataworks

Adopted by City Council on
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Revised November 9, 2021

Introduction

Objectives

This report describes the development and results of a Clean Energy Implementation Plan (CEIP) prepared for and with the close collaboration of the City of Richland Energy Services (RES) by Lighthouse Energy Consulting, Efficiency for Everyone, and Empower Dataworks. This is the first CEIP required under Washington's new Clean Energy Transformation Act (CETA) and covers the first four-year interim compliance period beginning in 2022 and ending in 2025.

Background

CETA requires electric utilities to prepare a CEIP by January 1, 2022, and every four years thereafter. According to Washington RCW 19.405.060, the CEIP must:

- Propose interim targets for meeting CETA's standards for greenhouse gas neutral electricity in 2030 and clean energy in 2045
- Identify specific targets for energy efficiency, demand response, and renewable energy
- Identify specific actions for meeting the interim targets and specific actions described above
- Ensure that all customers benefit from the transition to clean energy

Further requirements for the development of CEIPs are specified in Chapter 194-40 of the Washington Administrative Code. This report summarizes the CEIP prepared based on the requirements of the CETA.

Uncertainties

The recent rapid changes in economic conditions illustrate the uncertainties inherent in long-term utility planning. This CEIP uses the best available information at the time of its development. Nonetheless, it is still subject to remaining uncertainties and limitations. These uncertainties include, but are not limited to:

- <u>Load Forecasts</u>: This CEIP projects future customer load growth based on forecasts of future growth. These forecasts inherently include a significant level of uncertainty. The forecast is an econometric forecast that "bakes in" future energy efficiency achievements based on historical achievements. Future energy efficiency achievements that vary significantly from past achievements, may lead to deviations from the load forecast.

- <u>BPA Contracts</u>: RES's current contract with BPA expires in 2028. While this analysis assumes that RES will have similar products available after 2028, this is not certain.

Due to these uncertainties and the continually changing planning environment, the CETA requires utilities to update their CEIP every four years to reflect the best available data.

Report Organization

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

- **Utility Targets & Actions**: Discusses the development of targets and actions for clean and renewable energy, energy efficiency, and demand response
- **Actions to Ensure an Equitable Transition**: Discusses the public process conducted, outcomes, and actions to ensure equity in RES's transition to clean energy

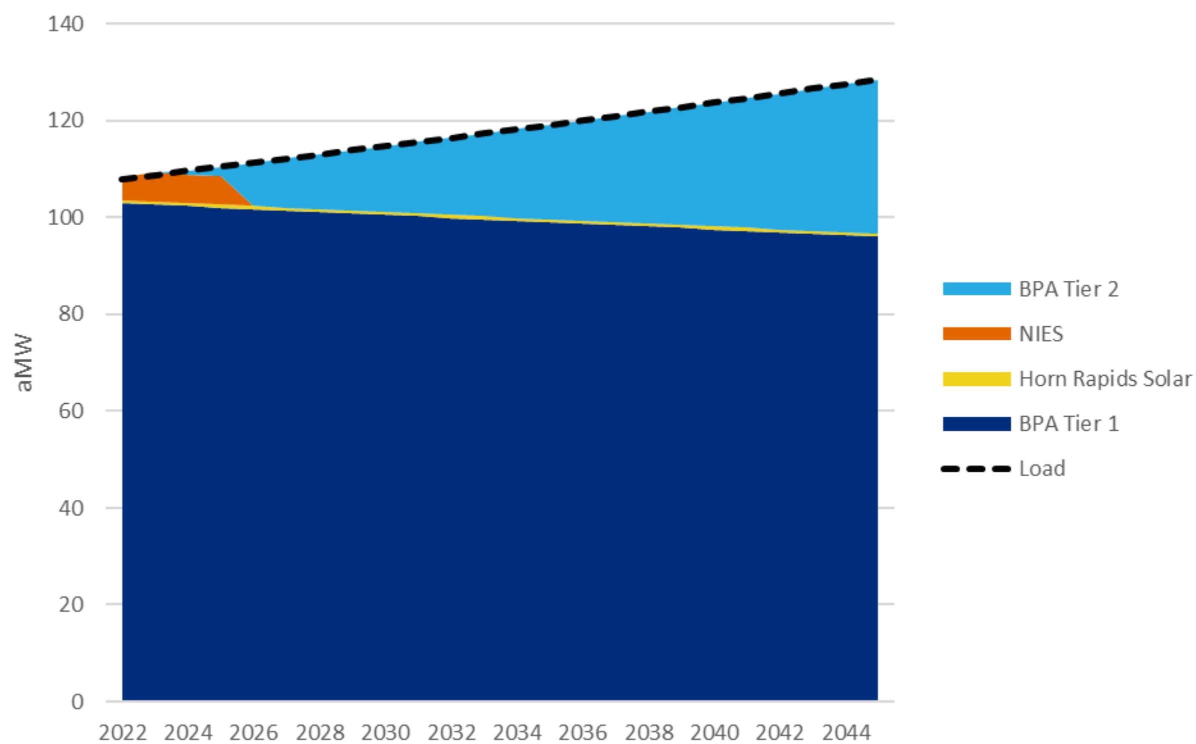
Utility Targets and Actions

While CETA has no targets for clean energy in the four-year interim compliance period covered by this CEIP, Lighthouse worked with RES staff to project future loads and resources and compare them against CETA's 2030 and 2045 requirements. Lighthouse and RES also considered the requirements of Washington's Energy Independence Act (EIA), which RES must now comply with, having recently passed the qualifying threshold of 25,000 customers.

Loads and Resources

Lighthouse worked with RES to quantify future loads and resources through 2045. These are shown in Figure 1. Details on the sources and assumption for each resource follow below.

Figure 1: Projected Loads and Resources



Load Forecast

For the purposes of this CEIP, RES staff provided the official 2021 BPA load forecast, which is dated November 13, 2020. The forecast covers 2021-2031 and assumes an annual growth rate of 0.76 percent. This growth rate was used to extrapolate the forecast through 2045. This forecast is an econometric forecast and includes embedded energy efficiency. If RES continues to pursue energy efficiency at similar levels, no adjustment to this forecast is necessary. Increasing the rate of acquisition, however, could reduce the future load growth below these projections.

BPA Tier 1 and Tier 2 Power

Lighthouse used RES's 2020-2021 rate period high water mark (RHWM) and assumed an annual decline of 0.3 percent to estimate future Tier 1 power purchases from BPA. Any remaining load not served by Tier 1 power or RES's other resources was assumed to be served through Tier 2 purchases from BPA. Based on

RES's projected future load growth, as well as the assumed decline in available Tier 1 power, the need for Tier 2 purchases increases over time.

Lighthouse assumed that both Tier 1 and Tier 2 purchases were approximately 96 percent renewable per the CETA definition based on the average of BPA's reported fuel mix from 2016-2019.

RES also receives a share of Renewable Energy Certificates (RECs) as part of its Tier 1 purchases, based on past incremental improvements to the federal hydroelectric system. RES provided recent allocations of RECs covering 2018-2020. Lighthouse assumed that RES would continue to receive RECs at a rate equal to the average of these three years, with the same 0.6 percent annual degradation rate used for Tier 1 power. These RECs are counted towards the renewable energy requirement of the EIA, which does not count existing hydro as a renewable resource.

While RES's current contract with BPA expires in 2028, Lighthouse assumed that similar Tier 1 and Tier 2 products will be available beyond 2028.

Horn Rapids Solar, Storage, and Training Project (HRSST)

HRSST is a utility-scale solar and storage facility located with RES's service territory. Consistent with RES's 2020 Integrated Resource Plan (IRP), Lighthouse assumed an annual output of 0.582 aMW. RES provided an annual degradation rate of 0.0043 percent, based on the annual degradation of the solar photovoltaic panels. RES's contract with HRSST ends in 2045, the last year considered in this analysis.

RES receives additional credit for the output of HRSST that can be counted against the EIA requirements because it is distributed generation and was constructed using labor from apprentice programs. Together, these factors result in RECs and additional credit that RES can count at a rate of 2.2 times the actual power production. For compliance with CETA's requirements, the additional credit cannot be applied. Only RECs associated with actual generation can be counted towards CETA's requirements.

Northwest Intergovernmental Energy Supply (NIES)

RES procures some of its needs for power through NIES, a subsidiary of Northwest Requirements Utilities. RES provided planned power purchases for NIES through 2025. Lighthouse assumed that planned NIES purchases are not clean.

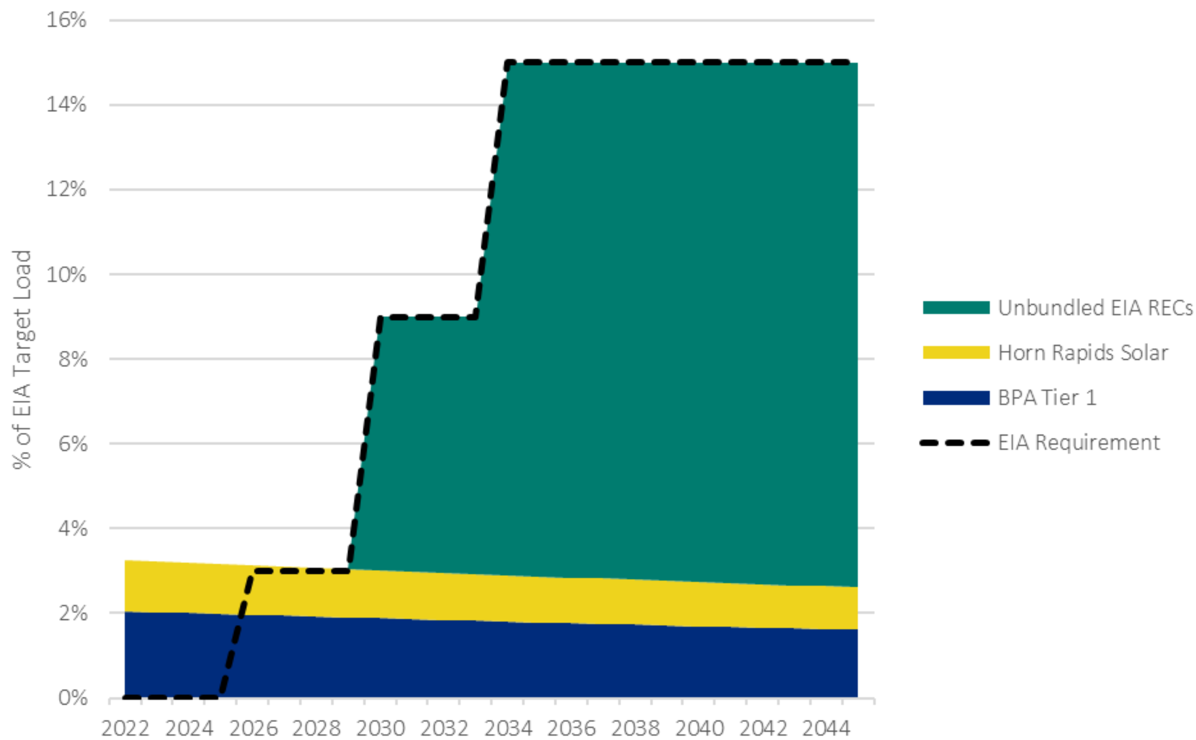
EIA Compliance

The EIA has requirements for renewable energy that are phased in over time. Beginning in 2026, RES must supply three percent of its power from renewable resources. This requirement steps up to nine percent in 2030 and 15 percent in 2034, but CETA's requirements for clean and renewable energy may effectively supersede these requirements as it requires 100 percent carbon neutral energy beginning in 2030. There are still some unresolved questions regarding the interaction between the EIA and CETA, so to be conservative, Lighthouse has assumed that the requirements for EIA continue. Ultimately RECs or other renewable energy resources purchased for compliance with the EIA can be counted towards compliance with CETA's requirements.

Figure 2 shows the projected compliance with EIA requirements for renewable energy. Based on these projections, RES can comply with RECs received through its Tier 1 purchases and HRSST project through 2028. Beginning in 2029, RES may need to purchase a small number of RECs or otherwise procure renewable resources. This need grows as the EIA requirement steps up to 9 percent in 2030 and to 15 percent in 2034. Lighthouse assumed these needs would be met with unbundled REC purchases. In the

2022-2025 interim compliance period covered by this CEIP, no action is needed to comply with the requirements of the EIA.

Figure 2: Projected EIA Compliance



CETA Compliance

CETA has two primary requirements for clean energy:

1. In 2030, 80 percent of retail sales must be clean or non-emitting, and the remaining 20 percent can be made greenhouse gas neutral through several alternative compliance mechanisms, including the purchase of RECs.
2. Beginning in 2045, all retail sales must come from non-emitting or renewable resources. No alternative compliance mechanisms are allowed.

Lighthouse reframed these requirements as the following:

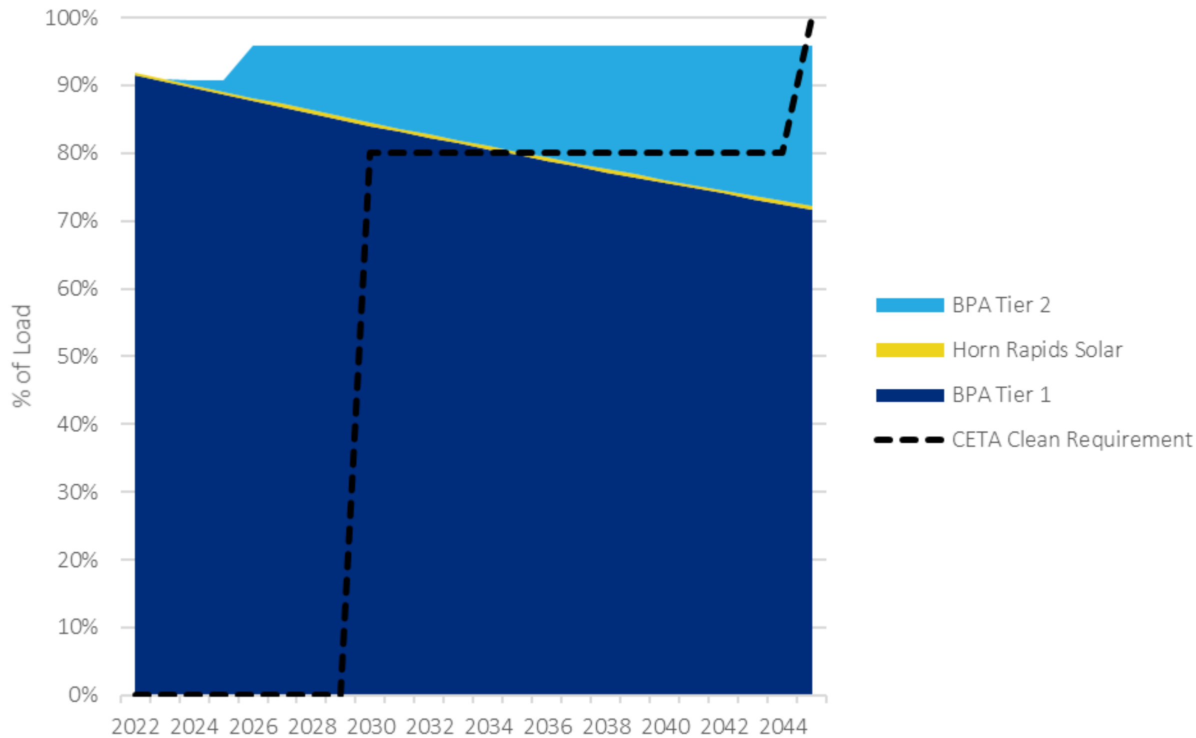
1. A requirement for clean and renewable energy that begins at 80 percent in 2030 and steps up to 100 percent in 2045.
2. A requirement for 100 percent greenhouse gas neutral energy from 2030 to 2044, counting the requirements for clean and renewable energy as well as any alternative compliance mechanisms.

The following discussion uses these reframed requirements to examine RES's future CETA compliance.

Figure 3 shows RES's projected compliance with the requirement for 80% clean energy beginning in 2030 and stepping up to 100% in 2045. This figure shows that RES can likely achieve compliance with its existing resources until the 2045 requirement for 100% clean energy.

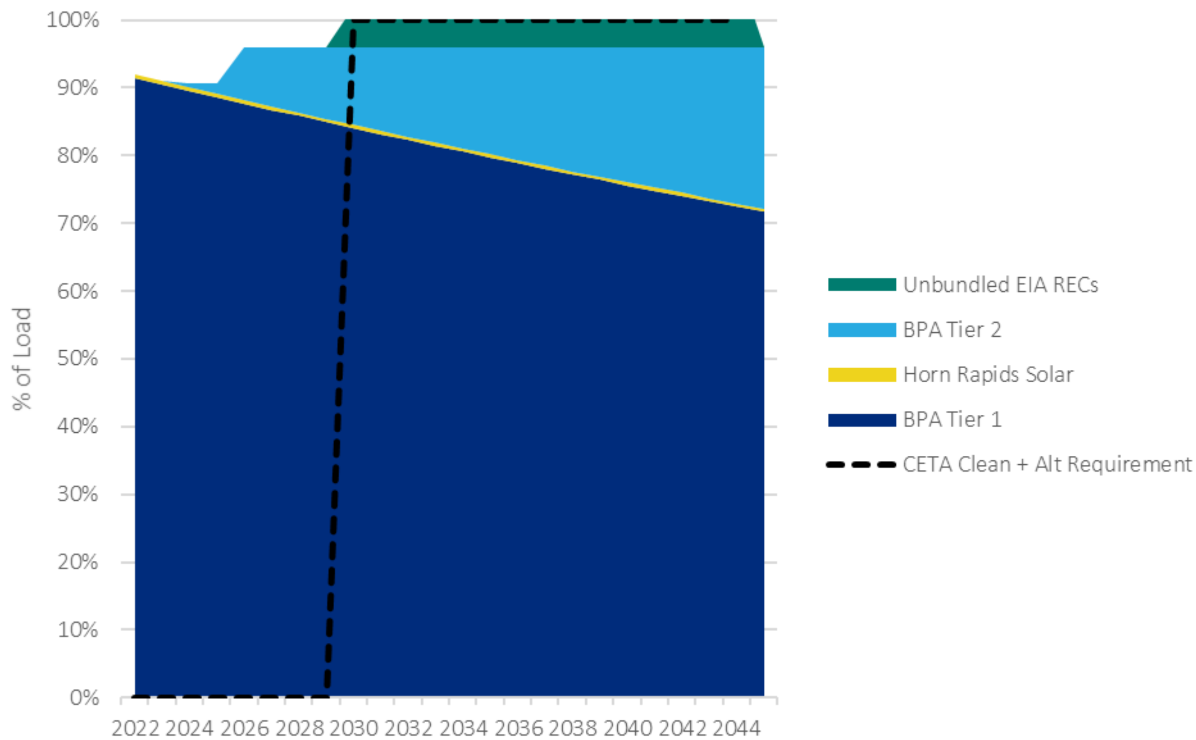
In the interim compliance period covered by this CEIP, there are no requirements for clean energy. Similarly, based on current projections, RES appears to have sufficient clean energy resources for the second interim compliance period.

Figure 3: CETA Clean Energy Compliance



RES's future compliance with respect to the 100 percent greenhouse gas neutral requirement is shown in Figure 4 below. This requirement begins in 2030 and ends after 2044. RECs purchased for EIA compliance are shown in green, similar to Figure 2 above. Based on the combination of clean energy resources and RECs purchased for EIA compliance, RES will likely be in compliance with this requirement throughout the 2030-2044 time period when it is in effect.

Figure 4: CETA Greenhouse Gas Neutral Compliance



Based on these projections, RES has identified a target of serving approximately 89% of its retail load with renewable and non-emitting resources over the first four-year interim compliance period from 2022-2025. This reflects average hydro conditions while adding in a small buffer to reflect uncertainty in year-to-year variations of hydro conditions and BPA's fuel mix. In the interim compliance period covered by this CEIP, there are no requirements for clean energy, so no action is needed at this time.

Renewable Energy

Based on the calculations above, RES does not have a need to procure renewable energy for this interim compliance period. **Lighthouse estimates that RES will use approximately 3,030,454 MWh of renewable energy based on the expected output of the federal hydro system and HRSST project.** This is based on the contributions of the renewable energy resources described above while also adding in the small buffer included in the estimate of the share of retail load served by non-emitting and renewable resources described above.

Energy Efficiency

Lighthouse, with support from Empower Dataworks, completed a conservation potential assessment for RES. This assessment is included as Attachment A with this report. Based on this report, **a four-year energy efficiency target of 21,412 MWh was identified**. Based on discussions in the CETA rulemaking, this target can be updated when RES completes its 2023 CPA.

Demand Response

Lighthouse also completed a demand response potential assessment (DRPA) for RES. The assessment identified demand voltage reduction (DVR) as cost-effective demand response resource. Lighthouse also identified smart thermostats used for summer peak demand reductions as cost-effective, and smart thermostats used for winter demand reductions were just below the cost-effectiveness threshold.

RES currently implements DVR in its system, and recently used it to reduce demand by approximately 400 kW during the heat wave in late June of 2021.

For smart thermostats, Lighthouse recommends that RES further investigate the costs and benefits of a smart thermostat program with its customers. RES does not currently offer a smart thermostat incentive as part of its energy efficiency programs, but customers may be installing them without utility incentives. RES could explore the following topics to further evaluate whether smart thermostats were a good fit for the utility:

- Current customer adoption of smart thermostats
- Customer willingness to participate in summer & winter demand response programs at various incentive levels
- Costs to implement a demand response program

In the DRPA, Lighthouse used estimates of these values based on regional assumptions and projected future adoption of smart thermostats. With refined estimates, RES could refine the estimate of cost effectiveness and proceed with a pilot program if warranted.

The CEIP form developed by the Department of Commerce requests the quantity of DR resources to be *acquired* over the interim performance period. **Since RES already has DVR resources in place and will be further exploring whether to implement a smart thermostat DR program, a target of 0 MW is recommended.**

Specific Actions

Based on the targets identified above, the following specific actions are recommended for RES:

1. **Implement EE programs to meet identified target.** RES should continue to implement EE programs, considering new measures where appropriate, to meet the energy efficiency target identified for this CEIP. Pursuing energy efficiency will help minimize load growth and reduce the need for new clean energy resources to comply with CETA's future clean energy standards.

2. **Investigate smart thermostat DR program.** Further investigating whether smart thermostat programs can be a cost-effective resource will help RES reduce peak demands which may reduce the need for new resources.

Consistency With Long-Term Plans

As RES has only recently become a qualifying utility, it has not yet submitted a resource plan or clean energy action plan per RCW 19.280. RES did, however, complete an integrated resource plan in 2020. The recommendations included in the IRP are summarized below, along with explanations of how this CEIP is consistent with those recommendations.

BPA Tier 1 Power: The IRP recommended that RES not take any actions that would result in decreases to the Tier 1 allocation rights in its current and future BPA power contracts. This CEIP assumes that RES will continue to receive the same allocation Tier 1 power and adds a factor that accounts for the output capability of the federal system declining slightly over time.

Energy Efficiency: The IRP identified that the cost-effective energy efficiency measures identified in RES's 2019 CPA are the least expensive resources available to RES. The 2021 CPA, which was conducted in parallel with this CEIP, updates the assessment of cost-effective energy efficiency measures that can be part of a least-cost portfolio for RES.

Demand Response: The IRP recommended RES gage customer interest in demand response programs. This CEIP builds upon that recommendation by identifying RES's current DVR program as a cost-effective DR resource and residential smart thermostat DR programs as another potential cost-effective resource for RES to investigate further.

Renewable Energy Purchase Requirements: The IRP identified the upcoming need to comply with the renewable energy requirements of the EIA. This CEIP uses updated load and resource forecasts to estimate the required amount of renewable energy. While the CEIP assumed RES would purchase unbundled RECs for simplicity, the renewable energy could come from any resource.

Renewable Energy & CETA Compliance: The IRP recommends that RES investigate renewable resources (including local renewables and distributed solar) and offset some of the carbon in its portfolio with RECs. This CEIP identifies that REC purchases can help RES comply with CETA clean energy requirements through 2032 and that additional renewable energy resources are needed beyond that point.

Actions to Ensure an Equitable Transition

Energy Equity is the distribution of costs and benefits of an energy system (e.g. an electric grid) and the accessibility to affordable energy across customers in a region or utility service territory. Low income households pay a larger proportion of their incomes for energy than other customers and addressing their energy burden is beneficial for society as a whole.

In its requirements to ensure the transition to clean energy is equitable, CETA asks utilities to:

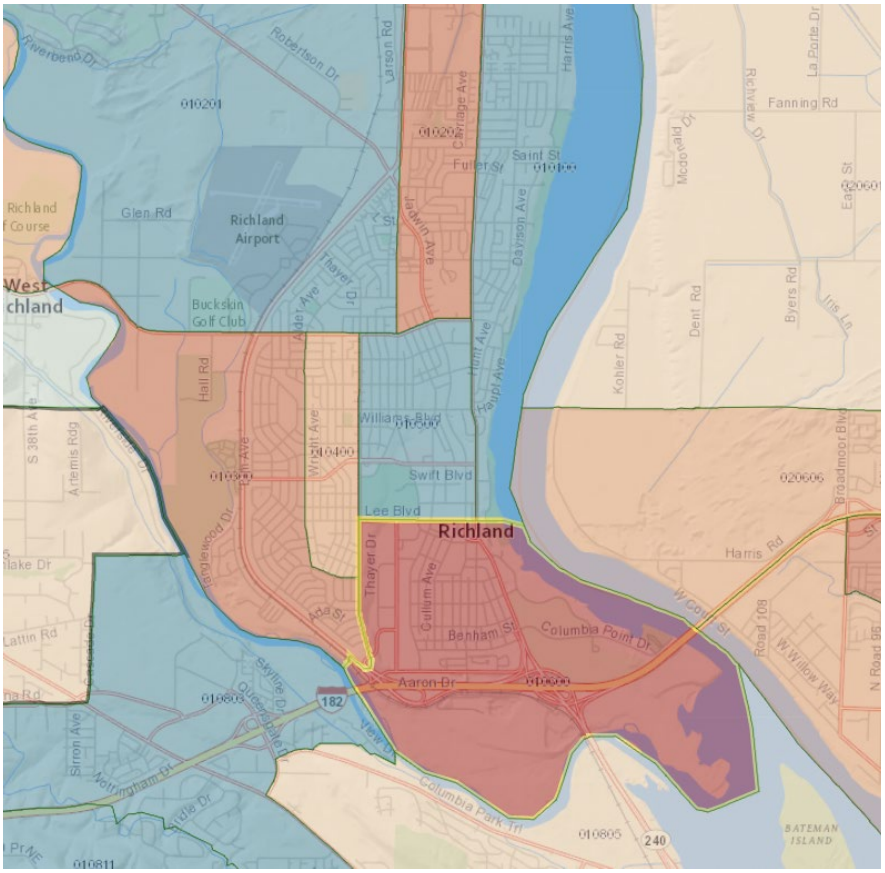
- Identify highly impacted communities within the utility service territory
- Identify vulnerable populations based on indicators developed through a public process
- Report on the forecasted distribution of energy and non-energy costs and benefits of the utility's specific actions (described above) using one or more indicators developed through a public process.
- Identify the expected effect of specific actions on highly impacted communities and vulnerable populations, including the location (if applicable)
- Describe how the utility intends to reduce risks to highly impacted communities and vulnerable populations

Each of these items is discussed below, including the public process RES used where necessary.

Highly Impacted Communities

A highly impacted community is a geographic location characterized by degraded air quality, whose residents face economic or historic barriers to participation in clean air decisions and solutions. For example, a predominantly low income neighborhood or a neighborhood with a high population of people of color located near a major roadway would meet this definition. RES has one community that was identified as a highly impacted community. This community corresponds to the area shaded in red in the lower-right corner in the map below. This community corresponds with Census Tract 53005010600 and was assigned a ranking of 9 out of 10 on the environmental health disparities map.

Figure 5: RES Highly Impacted Community

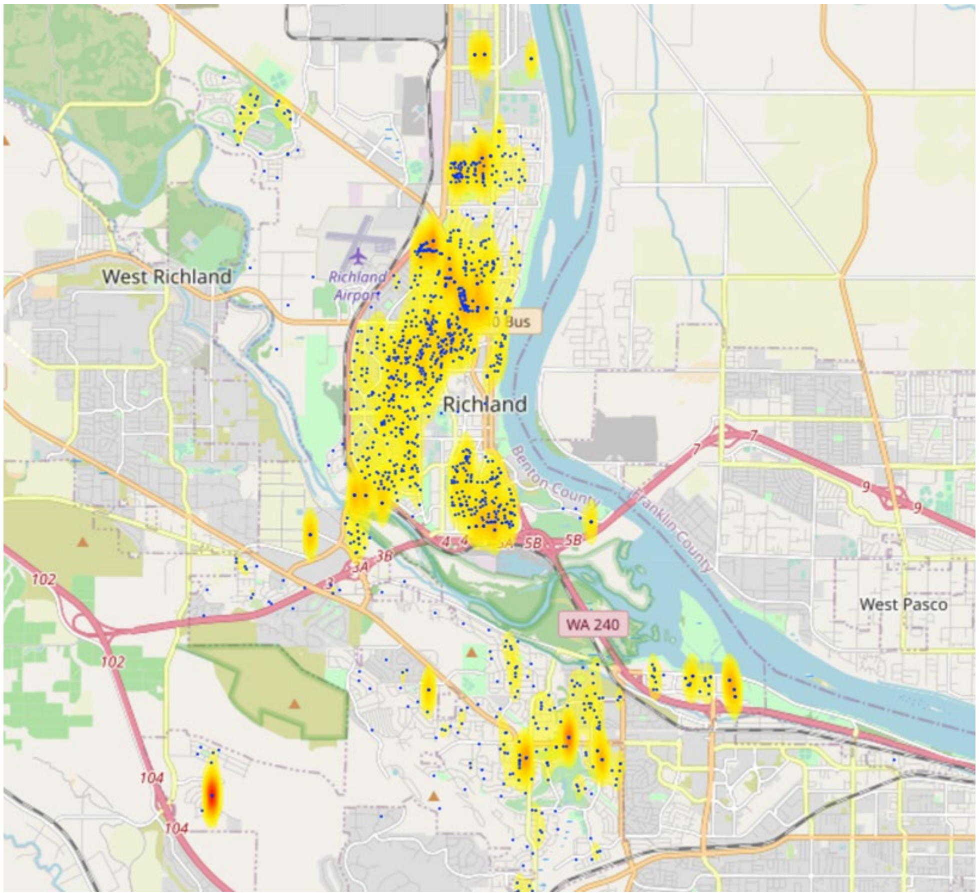


Source: https://fortress.wa.gov/doh/wtn/WTNIBL/

As part of a separate analysis, RES provided detail for approximately 1,600 accounts[1] with arrearages that under normal, non-COVID-19 conditions would be disconnected for non-payment. These accounts were mapped, as shown in Figure 6 below. The cluster of accounts near the center of the map aligns with highly impacted community shown above in red.

[1] The large number of accounts is due to the March 18, 2020, Washington State Proclamation 20-23 prohibiting utilities from disconnecting customers due to non-payment. Under normal conditions RES' disconnect list ranges from 100 to 300 weekly.

Figure 6: RES Accounts in Arrears



Public Process

In order to identify vulnerable populations, assess the risks to them during the clean energy transition, identify specific actions RES could take to address those risks, and develop indicators to measure the distribution of costs and benefits of RES's planned actions for clean energy, RES chose to engage directly and deeply with community organizations serving vulnerable populations in the service territory.

RES chose this approach after considering other possible engagement strategies for three reasons. First, engaging with organizations rather than individual community members allowed for breadth (across different populations) and depth (detailed understanding of each population). There were several longstanding community organizations active in RES's service territory that were willing to participate in the engagement process on the short timeline and through virtual (rather than in-person) meetings. Finally, an emerging best practice for serving vulnerable populations involves working with trusted community partners. RES viewed this engagement as an important first step in expanding their relationships with community partners to better serve priority populations in the years ahead.

To identify participants for the engagement, RES created a spreadsheet that listed local community organizations serving populations commonly identified in the equity literature as "vulnerable"—these included households with low and moderate incomes, people of color, non-English speakers, renters, people with disabilities, and those living in multifamily or mobile/manufactured homes. RES then crossreferenced the populations served by the organizations on their list to ensure there were no gaps. In total, RES identified 14 organizations with potential to contribute to the engagement process and reached out to those organizations by phone and email to describe the process and invite them to participate.

RES chose to engage with community organizations through two virtual meetings, each lasting approximately one hour. The sessions were kept short in order to respect participants' time. The first meeting, held on July 27, 2021, was attended by seven individuals representing five organizations. The second meeting, held on August 17, 2021, was attended by six individuals from six organizations. Four individuals attended both meetings.

The community organizations that RES engaged with during its two input sessions were:

- Arc of Tri-Cities
- Benton & Franklin Community Action Connection
- City of Richland (CDBG/HOME Administration)
- Kennewick Housing Authority
- Senior Life Resources (Mid-Columbia Meals on Wheels)
- United Way
- Women of Wisdom

Both meetings were structured to allow participants to share their expertise and knowledge on the topics specified in the CETA rulemaking. The first meeting focused on identifying vulnerable populations in RES territory and understanding their current priorities and challenges. Through a structured, facilitated discussion, RES learned that there are multiple intersections between the priorities of vulnerable populations, the potential benefits of a clean energy transition, and the areas in which RES can take action.

In the second meeting, RES built on the discussion and learnings from the first engagement to present a list of potential actions RES could take that could address the priorities and risks identified in the first meeting. Participants discussed what would be required to make those actions successful, provided their sense of how to prioritize possible actions, and made suggestions about indicators RES could use to measure its progress toward an equitable clean energy transition.

After each meeting, RES provided participants the slides from the meeting and invited participants to follow up by email with any further ideas or questions.

Identification of Vulnerable Populations

Vulnerable populations are those facing higher risks due to adverse socioeconomic factors, including unemployment, high housing and transportation costs, access to food and health care, and language barriers as well as sensitivity factors, such as low birth weight and higher rates of hospitalization.

CETA requires each utility to identify vulnerable populations based on adverse socioeconomic factors and sensitivity factors developed through a public process.

Through its engagement with community organizations, RES identified multiple populations at risk during the clean energy transition. Community organizations used many identifiers to describe vulnerable populations including income, age, ability, language spoken, race/ethnicity, gender, and circumstances (for example: experiencing homelessness).

In discussion with community organizations, RES was able to ascertain four characteristics that it can use to identify and reach many, if not most, of these vulnerable populations. These include three housing characteristics and one bill payment characteristic. For example, community organizations noted that many of the people they work with are renters. Thus, RES identified renters as a target population.

The table below summarizes the way participants in RES's engagement process described vulnerable populations, the adverse socio-economic factors (i.e., the reasons the population is vulnerable), and the cross-cutting characteristics that RES will use to identify and develop specific actions to reach these populations. It is notable that each vulnerable population identified by the community organizations will be reached by RES in at least two ways. For example, community organizations noted that families in transition as a result of domestic violence often have low/moderate incomes and may lack employment, are likely to be renters and potentially have late payments or be in arrears on their utility bills.

Table 1: Identification of Vulnerable Populations

		Populations RES will target			
Description of vulnerable population provided by engaged community organizations	Adverse socio-economic and sensitivity factors	Single-family homeowners experiencing generational poverty	Single-family and multi-family renters	Mobile/ manufactured home residents	Customers with a history of late payments, in arrears, or have received a shut-off notice
Seniors, retirees living on fixed income	Low/moderate income, lack of internet access or ability to access information online, poor health, lack of mobility, lack of trust in "free" offers or unknown service providers	x	x	x	x
Families in transition as a result of domestic violence, substance abuse, criminal justice system	Low/moderate income, lack of employment		x		x
Disabled	Low/moderate income	x	x	x	x
Limited English proficiency	Low/moderate income, difficulty accessing information if it is English-only, lack of understand or trust in utility communications	x	x	x	x
Seasonal workers, refugees, immigrants	Low/very low income, difficulty accessing information if it is English-only, lack of understand or trust in utility communications		x	x	x

Description of vulnerable population provided by engaged community organizations	Adverse socio-economic and sensitivity factors	Populations RES will target			
		Single-family homeowners experiencing generational poverty	Single-family and multi-family renters	Mobile/ manufactured home residents	Customers with a history of late payments, in arrears, or have received a shut-off notice
BIPOC[2] women	Low/moderate income, lack of employment	x	x	x	x
At risk of homelessness	Low/very low income	x	x	x	x

The following table shows the factors and sources that will be used to identify customers in each of the above four categories, whom RES will target in efforts to design specific actions to reach vulnerable populations.

Targeted population	Factor & Source	Date last updated	Approximate number of households in service territory
Single-family homeowners experiencing generational poverty	Single-family homeowners who have received a disconnect notice	2021	893
Renters of single-family and multifamily buildings	Account type in RES customer information system Multi-family buildings already qualified as low-income properties as noted by community partners	2021	~9,000 renter households (35% of all households)
Mobile/manufactured home residents	County data, Google and other online records, community partners *Note: mobile/manufactured homes cannot be identified in the RES customer information system	2021	~700 customers
Customers with a history of late payments, in arrears, or have received a shut-off notice	RES customer information system	2021	~1,650 customers

In the analysis of customers with arrearages, it was noted that 77 percent of these customers were renters. This confirms the selection of renters as a vulnerable population. The customers with arrearages were

[2] Black, indigenous, people of color

distributed across single family, multifamily, and manufactured homes, validating the need to consider vulnerable populations across a range of home types.

Identification of Indicators and Forecasting the Distribution of Costs and Benefits

CETA stipulates that utilities identify one or more indicators, developed through a public process, to forecast the distribution of costs and benefits from the utility specific actions—the utility's planned actions on energy efficiency, demand response, and clean or renewable energy.

During the public process, RES shared how its actions would primarily be in the area of energy efficiency and proposed that the distribution of energy efficiency program costs and benefits would best be measured by identifying the distribution of program participation and program incentive dollars across its program participants. Participants agreed with these suggestions and had no other alternatives to suggest.

While all RES customers benefit from the acquisition of energy efficiency as a low-cost resource, benefits such as bill savings, incentives, and home improvements often go only to those who can afford the cost of purchasing energy efficient equipment. RES's planned actions to reduce risks to these populations will help the highly impacted community members and vulnerable populations receive more of these benefits.

If a smart thermostat program is found to be cost effective, it could enable broader participation in RES programs, including the highly impacted communities and vulnerable populations, as smart thermostats require a lower level of investment than other programs and could be offered to participants at little to know cost when the combined benefits of EE and DR are considered.

Actions to Reduce Risks

RES identified several potential risks to vulnerable populations during its engagement with community organizations. These included risks associated with the clean energy transition and those that are tangential to it:

- Unstable housing – This includes the risk of becoming homeless due to rising housing costs and tenuous employment/low wages and people living in "unofficial" housing including converted garages and RVs.
- Unhealthy rentals – This includes renters who are living in unsafe conditions but cannot move because of the high costs of moving and lack of other affordable options. It may also include landlords that cannot afford to or choose not to improve their properties.
- Unhealthy single-family homes – This includes homeowners whose generational poverty prevents them from maintaining their homes
- High utility costs – This includes the challenges people in all types of housing encounter paying utility bills and the compounding debt associated with late/non-payment of utility bills.
- Unhealthy mobile/manufactured homes – This includes people living in homes they rent or own that are unhealthy, uncomfortable, and expensive to heat/cool. These homes are often unimproved because of the high cost of the retrofits compounded by the inability of owners to obtain financing and their low incomes.

Two strategies to address the identified risks are energy efficiency measures and bill payment options. Efficiency measures can improve a home's health and comfort while reducing utility costs. Bill payment options, including levelized monthly billing, autopay, and pre-payment may help households control utility costs by providing more information about energy use and cost, preventing unexpectedly large bills, and preventing customers from incurring fees associated with unpaid bills.

Bill payment options - RES already offers levelized billing and autopay and is in process of developing a pre-payment option. In order to expand participation in these billing options to populations who could benefit from them, RES will explore opportunities to:

- Conduct targeted outreach to vulnerable populations based on their bill payment history (i.e., customers with late payments) to offer alternative bill payment options
- Default customers with late payments/in arrears/with disconnect notices to levelized billing
- Offer incentives to customers to adopt alternative bill payment options
- Partner with community organizations to offer financial and/or efficiency education

Energy efficiency - RES has energy efficiency programs for single family and multi-family building owners. Community organizations raised important considerations regarding how to provide efficiency to vulnerable populations. RES intends to explore these cross-cutting strategies into its existing and future programs as they apply to many, if not most, vulnerable populations:

- Use a trusted source to bring information about efficiency opportunities: these include community organizations, schools, faith organizations, and individuals within the community.
- Seek out ways to qualify participants for income-limited offers without asking for income and address verification.
- Design offers such that the benefits to the participant outweigh the costs (both dollars and time) and perceived risks (for example: providing address or identification).
    - Evaluate both the benefits and costs from the participants perspective.
    - Simplify the demands of program participation, for example by reducing the complexity of applying, the time required, and by clearly and simply communicating what is being offered.
    - Keep in mind that poverty creates a short-term mindset. Develop offers in which the benefits are felt immediately and any payback is as short as possible (ideally one year or less).
- Partner with community organizations in design and delivery of efficiency offers.
- Conduct outreach about offers through multiple channels, meeting potential participants where they are (for example, at the farmer's market WIC booth). Keep in mind that many populations have limited access to the internet.
- Communicate all offers in the language in which people are most comfortable.

In order to expand efficiency benefits to the three targeted populations noted above (single-family homeowners in generational poverty, renters, and residents of mobile/manufactured homes), RES recognizes that it needs to better understand the needs of these populations and the reasons they have not participated in existing efficiency programs. To that end, RES intends to:

- Conduct targeted outreach to raise awareness of current offers and learn what these populations would require in order to undertake efficiency improvements.
- Explore opportunities to adapt existing or develop new offers to better meet the needs of the targeted populations.

The following table summarizes RES's planned actions.

<table>
<tr><th>Targeted population</th><th>RES planned actions</th></tr>
<tr><td>Single- and multi-family rental property owners</td><td rowspan="3">Targeted outreach to:
1) raise awareness of current offers
2) understand what is required to increase efficiency in their buildings
3) amend existing offers to better meet the identified needs</td></tr>
<tr><td>Single-family homeowners experiencing generational poverty</td></tr>
<tr><td>Mobile/manufactured home residents</td></tr>
</table>

Attachment A

2021 CONSERVATION POTENTIAL ASSESSMENT

Richland Energy Services

September 8, 2021

Prepared by:

LIGHTHOUSE ENERGY CONSULTING

with

empower dataworks

Adopted by City Council on
October 19, 2021, through Resolution 123-21

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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), with support from Empower Dataworks, for Richland Energy Services (RES). The assessment estimated the cost-effective energy efficiency 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 first Clean Energy Implementation Plan (CEIP).

RES provides electricity service to over 25,000 customers across a service territory that covers 48-square miles. 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. Since RES recently crossed this threshold, they will need to begin complying with these requirements, completing a CPA every two years and reporting two-year conservation targets and annual achievements to Washington's Department of Commerce. Although not required by the EIA, RES completed a CPA in 2019 to begin understanding the process and using the assessment to assist with conservation planning.

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 RES's service territory and customers. Notable changes in this CPA relative to RES'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 RES.
  - Several measures included in previous CPAs 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
- Customer Characteristics
  - Updated counts of residential homes.
  - Updated equipment saturations based on a customer usage analysis and other data
  - Updated estimates of commercial floor area using the 2019 Commercial Building Stock Assessment.

- Updated breakdowns of RES's industrial sector loads
- Exclusion of the agricultural sector, based on commercial development of previously agricultural land
- Updated sector growth rates.

- Program Impacts
  - Consideration of RES's recent conservation program achievements, including impacts from the COVID-19 pandemic

Results

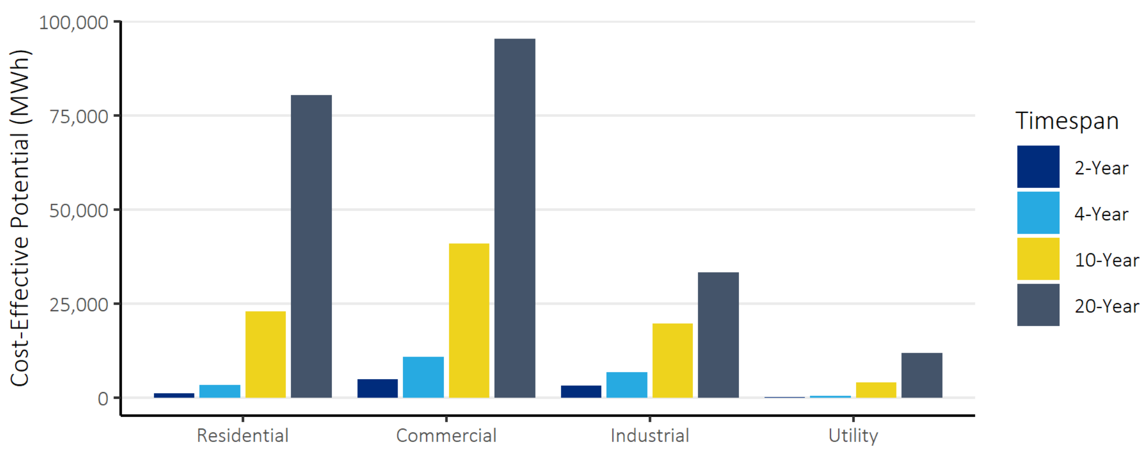
Table 1 and Figure 1 show the cost-effective energy efficiency potential by sector over two-, four-, 10-, and 20-year periods. Over the 20-year planning period, RES has nearly 221,000 MWh of cost-effective conservation available, which is approximately 20% of its projected 2041 load. The EIA focuses on the two- and 10-year potential, which are 9,186 MWh and 87,422 MWh, respectively. There is 21,412 MWh of cost-effective potential available in the four-year period covered by the upcoming CEIP.

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

Sector	2-Year	4-Year	10-Year	20-Year
Residential	1,126	3,366	22,859	80,369
Commercial	4,808	10,841	40,894	95,334
Industrial	3,161	6,831	19,647	33,273
Utility	91	374	4,022	11,844
Total	**9,186**	**21,412**	**87,422**	**220,819**

Note: In this and all subsequent tables, totals may not match due to rounding. Appendix VIII provides tables and figures in unites of aMW.

Figure 1: Cost-Effective Energy Savings Potential by Sector



Over the long term, the residential and commercial sectors have the largest potential. In the near term, however, more cost-effective potential is available in the commercial and industrial sectors. A much smaller amount of potential is available in the utility sector.

This assessment does not specify how the energy efficiency potential will be achieved. Possible mechanisms include RES'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 RES's system peak. The cost-effective energy savings potential identified in this assessment will result in nearly 47 MW of peak demand savings over the 20-year planning period, as shown in Table 2. This represents 21% of RES's estimated 2041 peak demand.

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

Sector	2-Year	4-Year	10-Year	20-Year
Residential	0.3	0.9	6.4	23.9
Commercial	1.0	2.2	8.1	16.7
Industrial	0.4	1.0	2.7	4.6
Utility	0.0	0.1	0.6	1.7
Total	**1.8**	**4.1**	**17.8**	**46.9**

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 RES's recent program history. Specifically, program achievements for 2019 and 2020 were provided by RES staff. Based on this data, 2020 savings levels exceeded 2019 in the residential sector but experienced notable declines in the commercial and industrial sectors due to the COVID-19 pandemic. Lighthouse assigned 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 2. The available cost-effective potential starts at 4,389 MWh in 2022 and grows to a maximum of over 15,000 MWh in 2034. After that point, the available potential diminishes as the remaining available potential diminishes.

Figure 2: Annual Incremental Energy Efficiency Potential

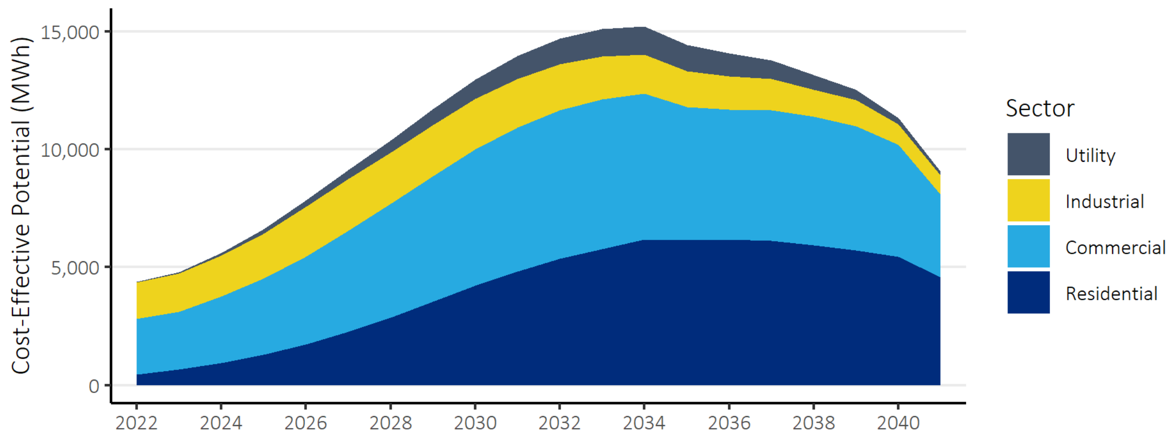
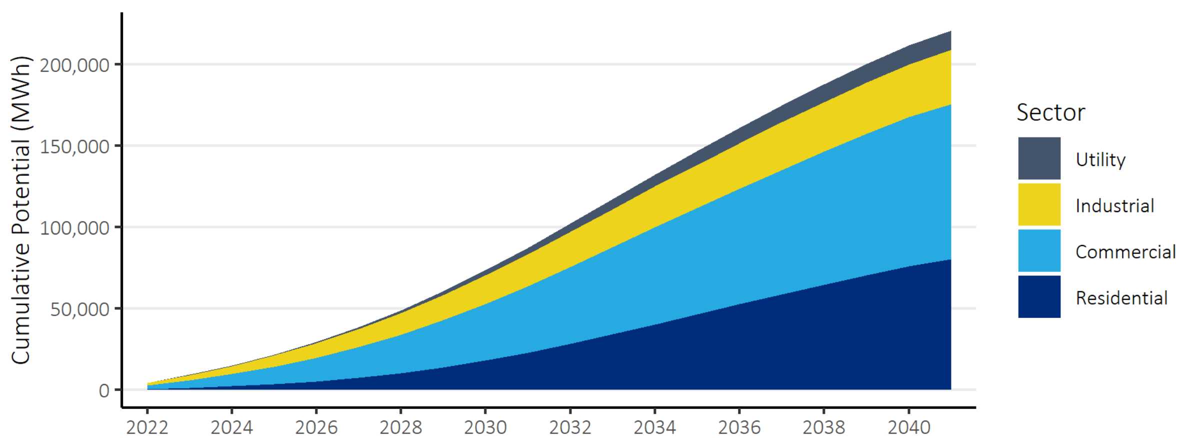


Figure 3 shows how the energy efficiency potential grows on a cumulative basis through the study period, totaling nearly 221,000 MWh over the 20-year planning period.

Figure 3: 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 a significant overall reduction across all sectors. Over the longer-term, the 10-year potential has increased slightly, with even more potential over the 20-year period. These differences reflect a shift in the makeup of the overall potential. Many measures that have been drivers of savings in the past are now covered by product standards while what remains will take longer to acquire, as programs shift focus to new measures, some of which are only available during end-of-life replacement cycles.

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	3,416	1,126	-67%	22,250	22,859	3%	37,931	80,369	112%
Commercial	5,606	4,808	-14%	47,479	40,894	-14%	78,227	95,334	22%
Industrial	3,592	3,161	-12%	13,490	19,647	46%	15,943	33,273	109%
Utility	175	91	-48%	2,190	4,022	84%	6,132	11,844	93%
Total	**12,790**	**9,186**	**-28%**	**85,410**	**87,422**	**2%**	**138,320**	**220,819**	**60%**

Additional discussion of the factors leading to these changes is provided below.

Avoided Costs

The low market prices used in this CPA put pressure on measures with previously marginal cost-effectiveness. These avoided costs, along with updated measure costs and savings, have resulted in less cost-effective potential from measures like residential weatherization and air source heat pumps.

Product Standards

A Washington State lighting standard that took effect in 2020 impacted the potential for many screw-in bulbs, requiring levels of efficiency that are only currently available with compact fluorescent light (CFL) or light-emitting diode (LED) technology. Further, lighting market studies have found that CFL lights are quickly losing market share due to consumer preference for LEDs and shifting manufacturing production. Consequently, consumers in Washington will now likely only be able to purchase LED bulbs for many bulb types, and utility programs may no longer be necessary to encourage the purchase of more efficient lighting. 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.

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 resulted in significant 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 slow rate of adoption.

Customer Characteristics

This CPA used updated customer data for each sector. Counts of residential homes have increased slightly relative to the 2019 CPA.

In the commercial sector, RES provided load data by commercial building type that RES staff had previously developed for the 2019 CPA with some refinements. This data was thought to be the best reflection of commercial loads since it did not include impacts from the COVID-19 pandemic. Lighthouse translated these loads to estimates of floor area with new estimates of energy use intensities (EUI) from the recently published 2019 Commercial Building Stock Assessment (CBSA). The new data resulted in a slight decrease in the estimated floor area.

The industrial sector now includes water treatment and wastewater loads that previously were included in the commercial sector. Excluding this change, the loads in the industrial sector have increased slightly relative to the 2019 CPA. This change and the new measures described above have added potential to the industrial sector.

Conclusion

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

Less near-term potential in the residential sector is due to low avoided costs, updated measure costs and savings, 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 all sectors was adjusted to align with recent program history, which in the commercial and industrial sectors was impacted by the COVID-19 pandemic. New measures characterized for the commercial and industrial sectors add potential, but their impact is over the long-term.

Introduction

Objectives

This report describes the methodology and results of a CPA conducted for RES by Lighthouse, with support from Empower Dataworks. 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 CEIP.

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 RES'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 RES in planning its energy efficiency programs by identifying the amount of cost-effective energy savings available in various sectors, end uses, and measures. It can also inform RES resource planning.

Background

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

- Identify the achievable cost-effective conservation potential for the upcoming 10 years using methodologies consistent with the Council's latest power plan.
- Establish a biennial acquisition target for cost-effective conservation that is no lower than the utility's pro rata share 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 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, and shifting production from CFLs to LEDs. As a result, consumers may only be able to purchase LED lights

[1] Washington RCW 19.285.040

for many applications, and utility lighting programs may be unnecessary. Lighting measures were included in this assessment, but the potential is limited.

Study Uncertainties

The recent rapid changes in economic conditions because of 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 RES's customers. In some cases, however, the assessment relied upon data beyond RES's service territory due to limitations of adequate sample sizes. There are uncertainties, therefore, related to the extent that this data is reflective of RES'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 that was based on prices in May of 2021. 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 RES'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 RES.

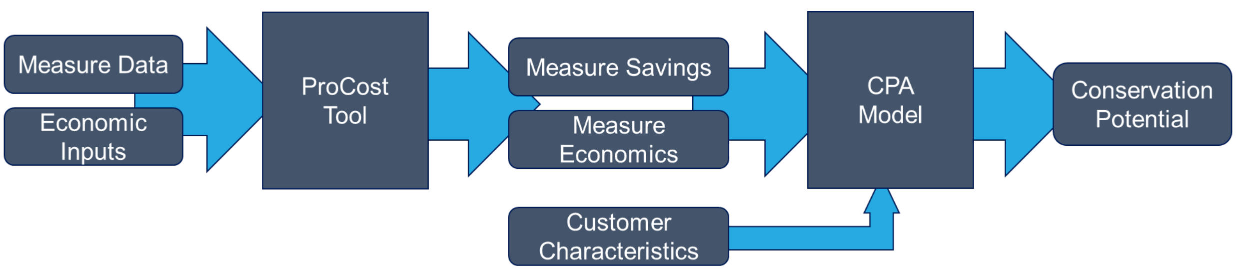
Requirements for this CPA are laid out in RCW 19.285.040 and WAC 194-37-070, Section 5 parts (a) through (d). Additional requirements are specified in the CETA. The methodology used to produce this assessment is consistent with these requirements. The development of the conservation potential follows much of the methodology used by the Council in developing its regional power plans, including the Seventh Power Plan and material from the draft 2021 Power Plan that was available during the development of this CPA.

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 4. 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 model, 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 4: Conservation Potential Assessment Methodology



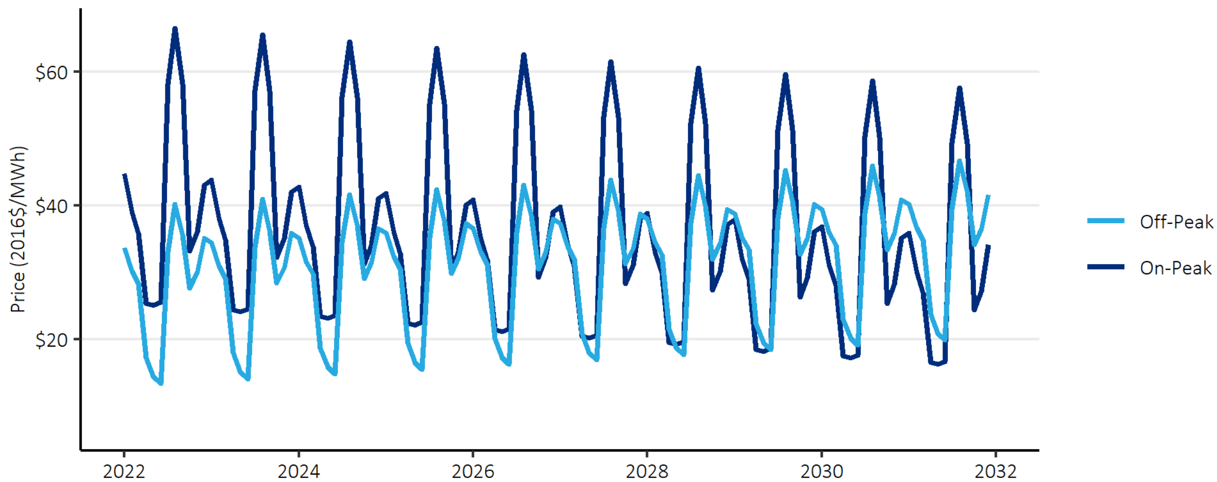
Economic Inputs

Lighthouse worked closely with RES staff to define the economic inputs that were used in this CPA. Inputs included 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 5 below shows the market price forecast that was used for the base case scenario of this assessment. For clarity, the figure does not show the full 20-year forecast. High and low scenario price forecasts were developed based on this forecast and are discussed in Appendix IV.

Figure 5: Avoided Energy Costs



Social Cost of Carbon

In addition to avoiding purchases of energy, energy efficiency measures have the potential to avoid emissions of greenhouse gases like carbon dioxide. The EIA requires that CPAs include the social cost of carbon, which the U.S. EPA defines as “a measure of the long-term damage done by a ton of carbon dioxide emissions in a given year.” It includes, among other things, changes in agricultural productivity, human health, property damages from increased flood risk, and changes in energy system costs, including increases in the costs of cooling and decreases in heating costs.[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.

To implement a cost of carbon emissions, additional assumptions must be made about the intensity of carbon emissions associated with a marginal unit of energy. This assessment uses the marginal emissions factors developed for the 2021 Plan, which start at approximately 1 lb CO_{2e}/kWh in 2022 and decline to 0.4 lb CO_{2e}/kWh over the 20-year study period.

Renewable Portfolio Standard Compliance Costs

By reducing RES’s overall load, energy efficiency reduces the cost of complying with Washington’s requirements for renewable and carbon-neutral energy. Beginning in 2026, RES will need to purchase Renewable Energy Credits (RECs) to fulfill the EIA requirement of sourcing 3% of its sales from renewable energy resources. With a 3% requirement for renewable energy, RES can avoid the purchase of 3 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.

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

Deferred Transmission and Distribution System Costs

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

In the development of the 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 deferrals. This CPA uses the values developed by the Council through that process. The resulting values are $3.08 and $6.85 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 RES'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 over time limit the ultimate exposure to this risk.

This CPA follows the process used in RES's 2019 CPA. 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, RES 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 3.75%, which reflects RES's cost of capital. This is the same value used in RES's 2019 CPA. 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), RES, 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 available.

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 RES'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

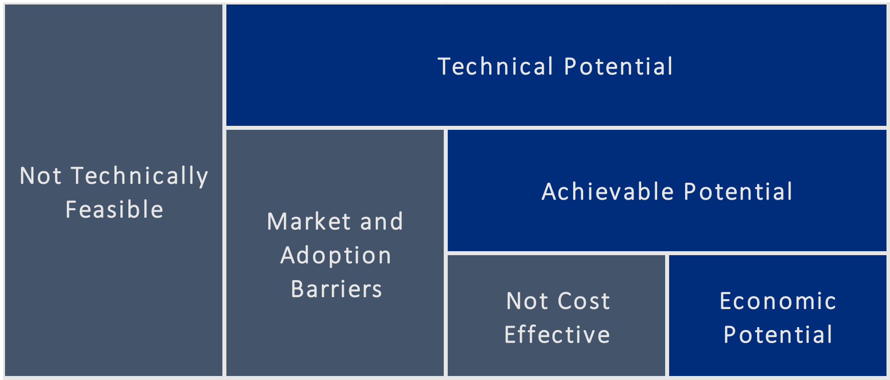
The assessment of customer characteristics is used to determine the number of available measure installation opportunities for each measure. This includes both the number of opportunities overall, as well as the share, or saturation, that have already been completed. The characterization of RES's customer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

This CPA used baseline measure saturation data from the Council's draft 2021 Power Plan. This data was developed from NEEA's stock assessments, market research and other studies. This data was supplemented with RES'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 6 below. Each is discussed in further detail below.

Figure 6: 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 came 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

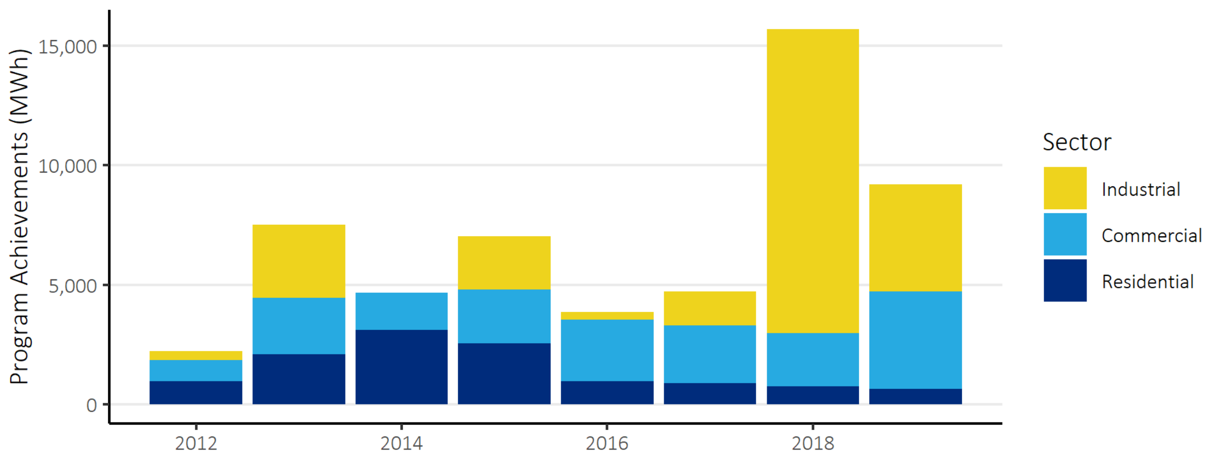
RES has a long history of energy efficiency achievement and, according to the RTF's 2019 Regional Conservation Progress Report, has averaged savings equal to 0.9% of its retail sales in each year over the 2016-2019 time period.

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

Overall

Figure 7 summarizes RES's conservation achievements from 2012-2019 by sector, as reported by the RTF's Regional Conservation Progress Report.

Figure 7: Recent Conservation Achievements by Sector



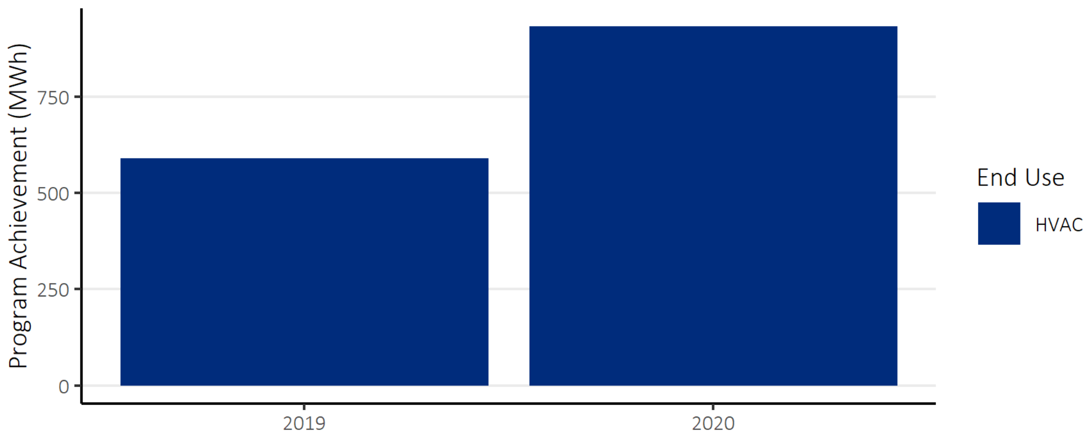
The average savings over this eight-year period is nearly 7,000 MWh per year. Savings from NEEA's market transformation initiatives contribute additional savings that are not included in this figure. In recent years, these savings have totaled between 2,000 and 3,000 MWh per year. The savings from NEEA's initiatives are primarily in the residential sector.

RES provided additional detail on savings for 2019 and 2020 for each sector, which is discussed below.

Residential

The recent residential program achievements by end use are shown in Figure 8. All of the savings are in the HVAC end use, which includes both weatherization measures as well as heating system equipment. In 2021, RES plans to add program offerings for heat pump water heaters and electric vehicle supply equipment (EVSE).

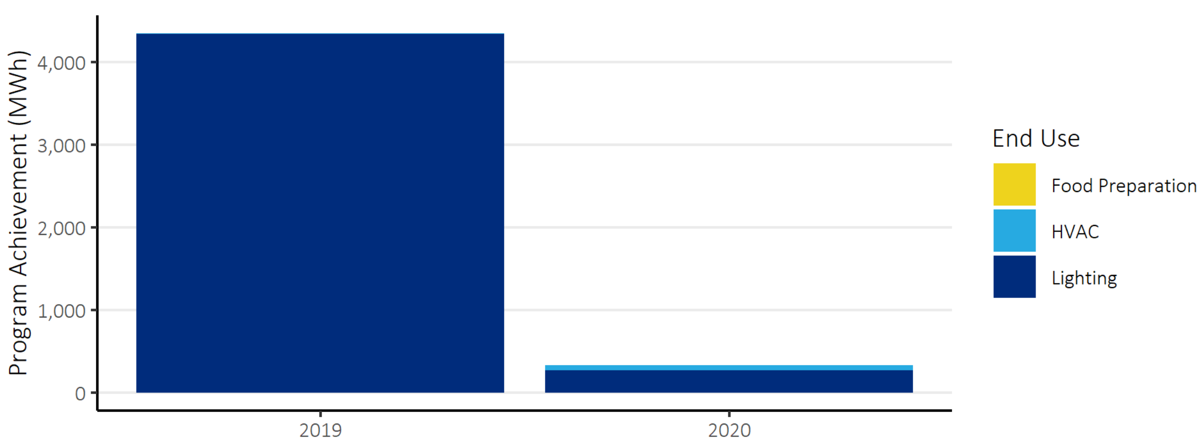
Figure 8: 2019-2020 Residential Program Achievements by End Use



Commercial

Nearly all of RES's commercial savings are in the lighting end use, as shown in Figure 9. Smaller amounts of savings come from projects in the HVAC and food preparation end uses. The impact of the COVID-19 pandemic can be seen in the significant decrease in savings from 2019 to 2020.

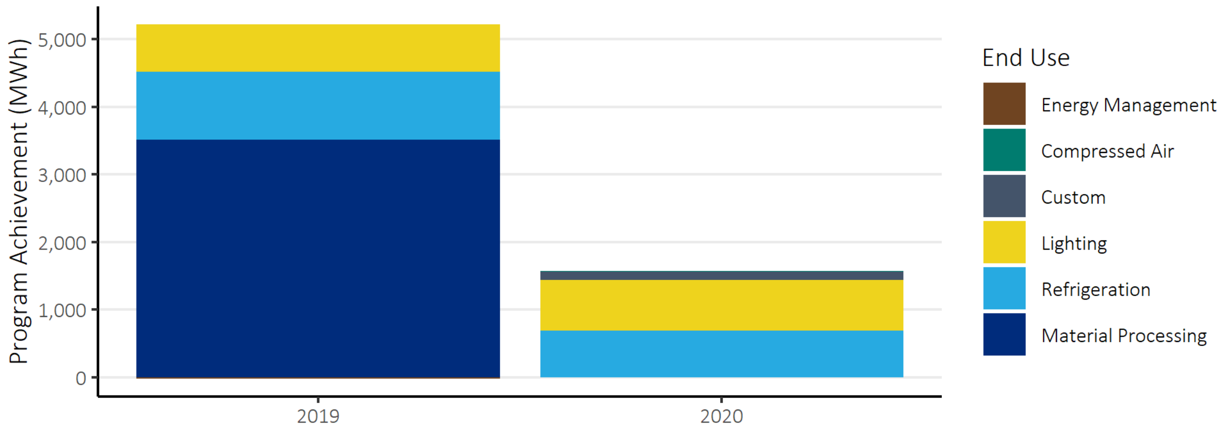
Figure 9: 2019-2020 Commercial Program Achievements by End Use



Industrial

In the industrial sector, a large project involving the treatment of wastewater from an industrial facility contributed large savings in 2019. Lighting, refrigeration, and other end uses contributed additional savings. Savings from the industrial sector are often lumpy with savings varying from year to year, depending on the projects identified and chosen for capital investment by industrial facilities. These savings are summarized in Figure 10 below.

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



Customer Characteristics

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

Table 4: Service Territory Characteristics

Heating Zone	Cooling Zone	Total Homes (2020)	Total Population (2019)
1	3	25,197	56,400

The count of homes is based on residential account data provided by RES. This count is a slight increase from the 2019 CPA. The estimated future growth in the number of homes is based on Benton County Assessor data and was calculated by tracking newly constructed buildings over the period from 2016-2020 and dividing the annual new construction count by the existing building stock. The annual growth rates were then averaged over the 5-year period for each building type to yield the overall growth rate used in the analysis.

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.

The population is based on census data for the City of Richland.

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.

The distribution of home types was updated based on Benton County Assessor data. Homes were classified into one of four building types: single family, manufactured homes, and low-rise multifamily apartments. According to the Benton County Assessor, no buildings were identified as high-rise multifamily dwellings and all residential buildings within the City of Richland appeared to be 3 stories or less.

To perform this classification, meters that showed minimal energy consumption (less than 1200 kWh/year in energy use) were flagged as potentially unoccupied (approximately 70 meters). Of the remaining meters, mobile homes were labelled as such using the county assessor data. Land parcels and buildings with multiple units were flagged as multifamily properties. Some meters were associated with addresses that didn't have a match in the county assessor data. These phantom addresses belong mostly to accessory dwelling units (ADUs) or duplexes - they were geocoded using the Google Maps API to obtain the latitude and longitude, then they were matched to specific land parcels using the assessor's GIS data.

HVAC and other appliance saturation data was based on analysis of customer usage data in combination with NEEA's 2016 Residential Building Stock Assessment and input from RES staff. 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	Manufactured
Share of Homes	68%	28%	4%
HVAC Equipment			
Electric Forced Air Furnace	7%	10%	61%
Air Source Heat Pump	52%	4%	30%
Ductless Heat Pump	2%	0%	0%
Electric Zonal/Baseboard	7%	72%	3%
Central Air Conditioning	27%	9%	42%
Room Air Conditioning	16%	64%	16%
Other Appliances			
Electric Water Heater	79%	77%	94%
Refrigerator	136%	105%	119%
Freezer	45%	16%	50%
Clothes Washer	96%	53%	100%
Electric Clothes Dryer	91%	49%	100%
Dishwasher	87%	67%	88%
Electric Oven	96%	100%	100%
Desktop	49%	40%	56%
Laptop	53%	35%	38%
Monitor	51%	44%	56%

Table 6: Residential New Home Characteristics

	Single Family	Low Rise Multifamily	Manufactured
Growth Rate	1.58%	1.97%	0.53%
HVAC Equipment			
Electric Forced Air Furnace	5%	0%	50%
Air Source Heat Pump	49%	10%	50%
Ductless Heat Pump	2%	0%	0%
Electric Zonal/Baseboard	0%	90%	0%
Central Air Conditioning	48%	10%	40%
Room Air Conditioning	0%	80%	10%
Other Appliances			
Electric Water Heater	79%	77%	94%
Refrigerator	136%	105%	119%
Freezer	45%	16%	50%
Clothes Washer	96%	53%	100%
Electric Clothes Dryer	91%	49%	100%
Dishwasher	87%	67%	88%
Electric Oven	96%	100%	100%
Desktop	49%	40%	56%
Laptop	53%	35%	38%
Monitor	51%	44%	56%

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 136% means that single family homes average approximately 1.4 refrigerators per home.

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 estimate the commercial floor area in RES's service territory, RES provided an update to the 2019 loads by commercial building types that was developed for the 2019 CPA. This data was thought to best reflect typical commercial loads without the impacts of the COVID-19 pandemic. RES staff refined the categorizations of buildings included this data, resulting in a decrease in the overall loads included. The loads were combined with energy use intensities (EUIs) from the 2019 CBSA, which found that EUIs had decreased relative to the previous (2012) study by 24-45% across many building types, largely due to more efficient lighting. The net result of this is a 10 percent decrease in the estimated commercial floor area 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	2018 Floor Area (square feet)
Large Office	6,848,566
Medium Office	5,044,930
Small Office	3,336,676
Extra Large Retail	629,341
Large Retail	430,952
Medium Retail	1,160,408
Small Retail	824,593
School (K-12)	2,306,652
University	747,298
Warehouse	498,291
Supermarket	396,413
Mini Mart	70,289
Restaurant	510,751
Lodging	582,198
Hospital	486,528
Residential Care	245,658
Assembly	2,288,002
Other Commercial	1,788,062
Total	**28,195,609**

The commercial floor area was assigned a growth rate of 0.9% based on the growth in commercial and industrial sales reported to the EIA since 2015.

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, RES provided 2018 energy consumption data for its industrial customers categorized by industry. The overall industrial consumption totals 166,432 MWh, as summarized in Table 8. This represents an increase over the 2019 CPA, even though loads for wastewater treatment were moved to the industrial sector, which were previously included in the commercial sector.

Lighthouse based the growth rate based on the compound annual growth of commercial and industrial sales reported to the EIA, which was 0.9 percent.

Table 8: Industrial Sector Sales by Segment

Segment	2020 Sales (MWh)
Water Supply	12,741
Sewage Treatment	4,025
Frozen Food	57,487
Other Food	9,328
Chemical Manufacturing	189
Cement/Concrete Products	2,019
Primary Metal Manufacturing	25,355
Fabricated Metal Manufacturing	37,715
Misc. Manufacturing	14,261
Refrigerated Warehouse	3,311
Total	**166,432**

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 U.S. EIA. Table 9 summarizes the assumptions used for this sector.

Table 9: Utility Distribution System Efficiency Assumptions

Characteristic	Count
Distribution Substations*	14
Residential/Commercial Substations*	12
Urban Feeders*	10
Rural Feeders*	10
2018 Residential Sales (MWh)	338,631
2018 Commercial Sales (MWh)	435,831
2018 Industrial/Other Sales (MWh)	157,422

**Note that these are estimates from the Council and may not reflect RES's actual system*

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 11 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 integrated resource plans. The costs include credits for deferred transmission and distribution system costs, avoided generation capacity, avoided periodic replacements, and non-energy impacts. With these credits, some of the lowest-cost measures have a net levelized cost that is negative, meaning that the credits exceed the measure costs.

Figure 11: 20-Year Supply Curve

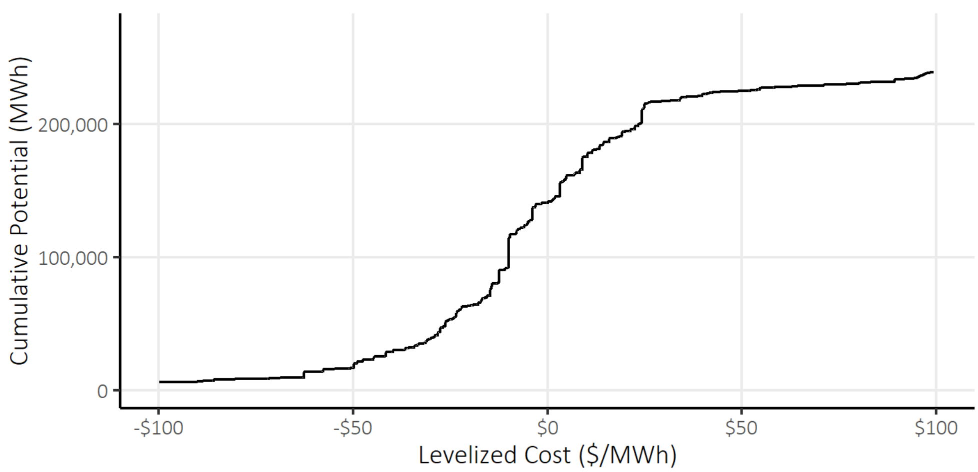


Figure 11 shows that approximately 140,000 MWh of potential are available at a cost at or below $0/MWh. These are measures where benefits such as the deferral of capacity costs and non-energy benefits exceed the measure costs. More than 200,000 MWh of achievable potential is available at costs at or below approximately $25/MWh. A total of nearly 270,000 MWh is available in RES's service territory over the 20-year period, but only potential below $100/MWh is shown in the supply curve. After approximately $25/MWh, the supply curve flattens and any increases in potential come at increasingly higher costs.

Supply curves based on levelized cost are limited in that not all energy savings are equally valued. For example, two measures could have the same levelized cost but provide different reductions in peak demand. An alternative to the supply curve based on levelized cost is one based on the benefit-cost ratio. This is shown below in Figure 12.

Figure 12: 20-Year Benefit-Cost Ratio Supply Curve

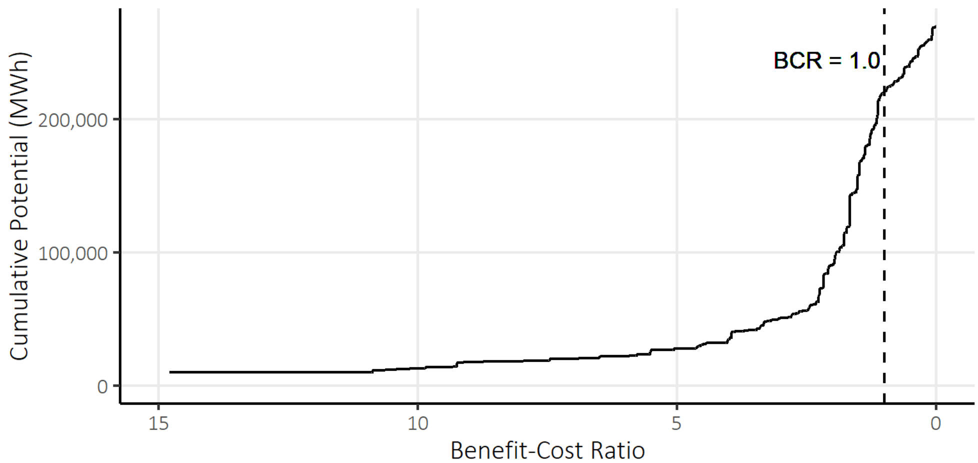
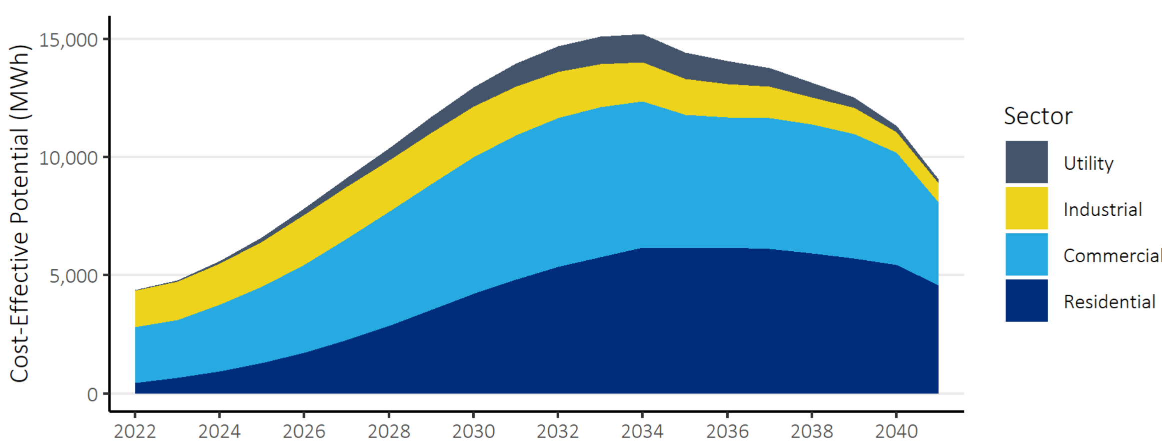


Figure 12 includes a dashed line where the benefit-cost ratio is equal to one. There are approximately 220,000 MWh of cost-effective savings potential to the left of this line, with benefit-cost ratios greater than one. The slope of the line is steep to the left of the point where the benefit-cost ratio equals one. This suggests higher sensitivities to lower avoided costs, which would effectively shift the dashed line to the left. The cost-effective potential is described further below.

Cost-Effective Conservation Potential

Figure 13 shows the cost-effective potential by sector on an annual basis. Most of the potential is in RES's residential and commercial sectors, followed by the industrial sector, with smaller amounts available in the utility sector.

Figure 13: 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 assigned 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 14 shows the cost-effective potential by end use for the first 10 years of the study period. Measures in the HVAC (which includes both equipment and 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 and adoption of HVAC measures increases. 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. Lighthouse assessed the demand response potential of these measures in RES's *2021 Demand Response Potential Assessment*.

In Figure 14, the other end use category includes measures in the cooking and electric vehicle supply equipment end uses. The cost-effective potential in these categories is very small in the initial 10 years of the study period.

Figure 14: Annual Residential Potential by End Use

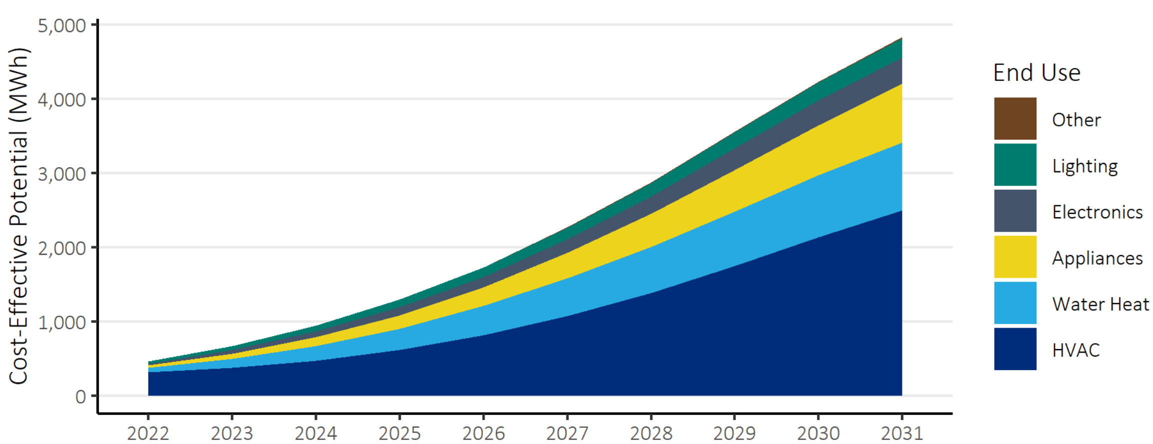
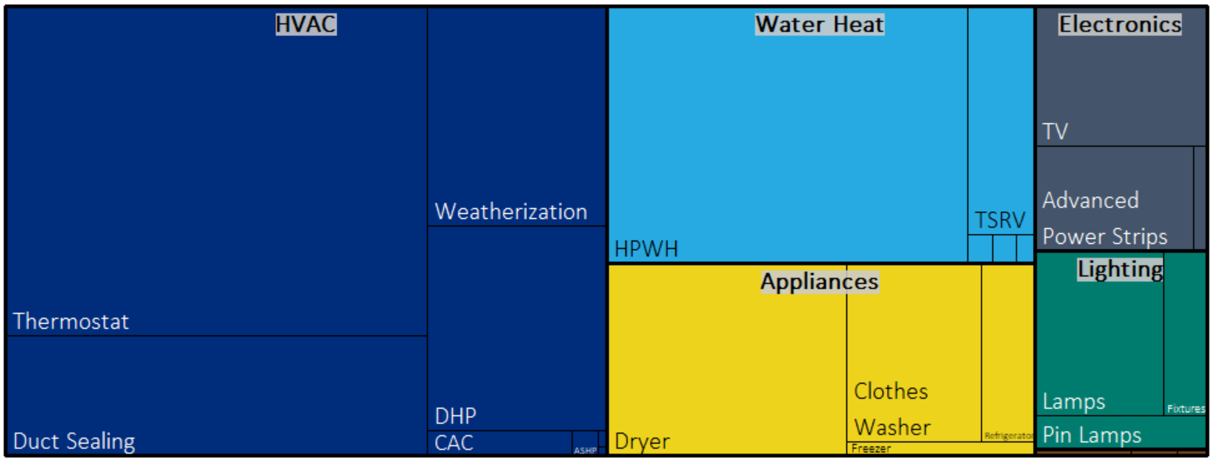


Figure 15 shows how the 10-year potential breaks down into end uses and measure categories. The area of each block represents the share of the total 10-year residential potential. Smart thermostats and duct sealing make up most of the potential in the HVAC end use, while heat pump water heaters (HPWH) and thermostatic restriction valves (TSRV) are the key measures within the water heating end use.

Figure 15: Residential Potential by End Use and Measure Category

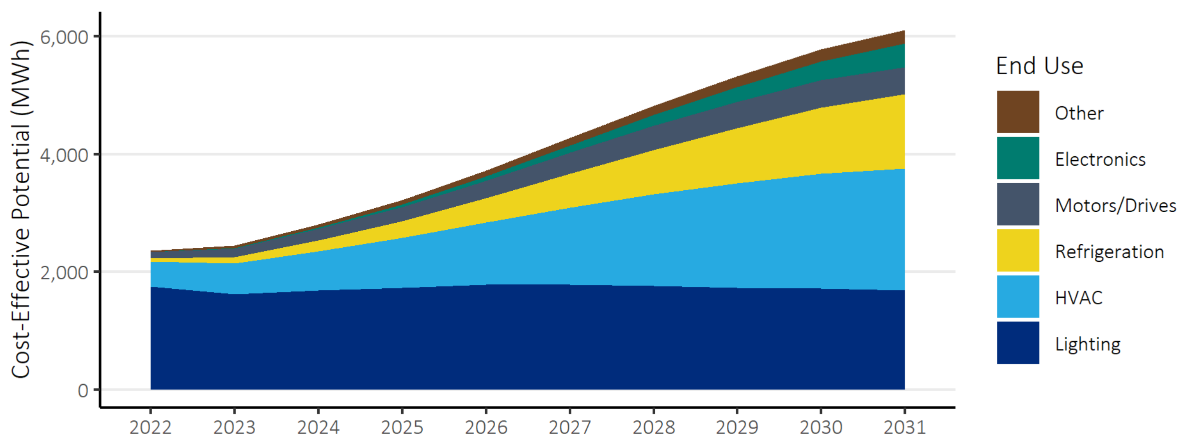


Commercial

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. The electronics category includes energy efficient computers and equipment for embedded data centers.

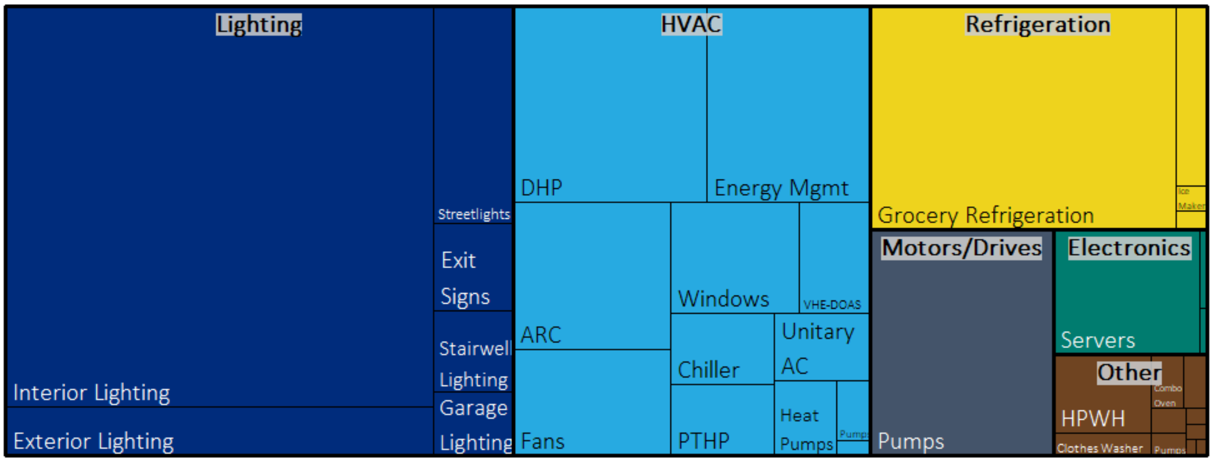
In Figure 16, the other category includes measures in the compressed air, food preparation, and water heating end uses.

Figure 16: Annual Commercial Potential by End Use



The key end uses and measure categories within the commercial sector are shown in Figure 17. The area of each block is proportional to its share of the 10-year commercial potential. Most of the potential in the lighting end use is in interior lighting, while the potential in the HVAC end use is more evenly distributed across a range of equipment types. The commercial sector includes a variety of building types with different end uses and system types. This is apparent in the range of measures included in Figure 17.

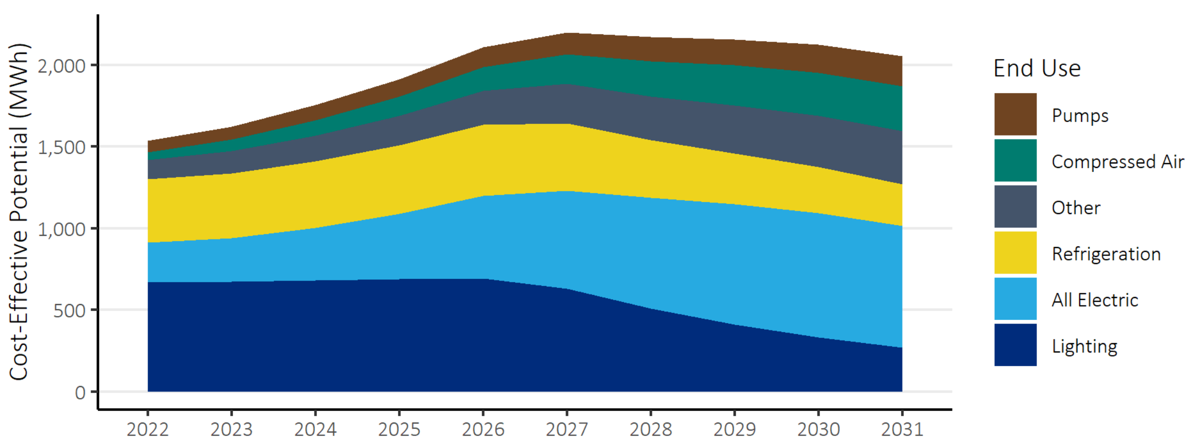
Figure 17: Commercial Potential by End Use and Measure Category



Industrial

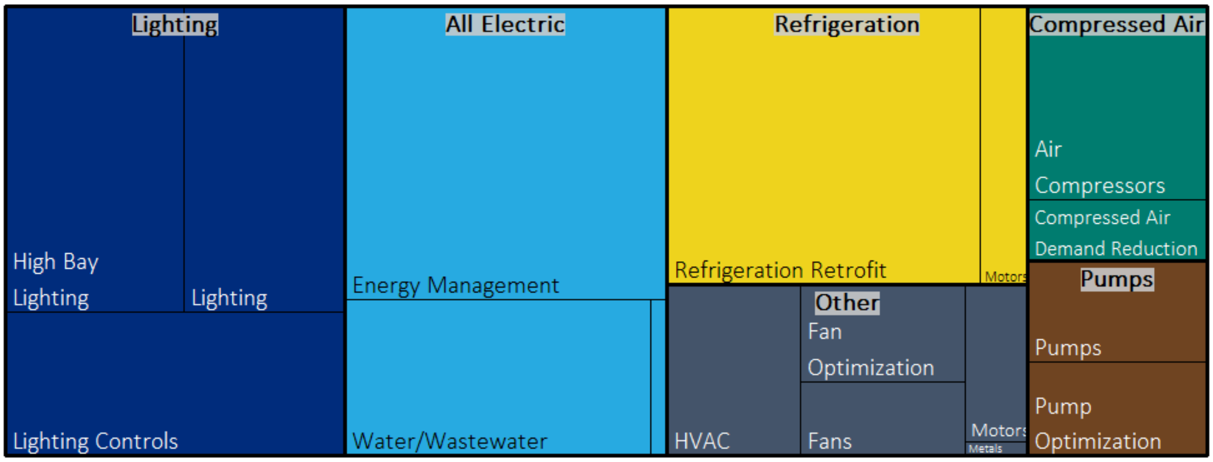
The annual industrial sector potential is shown in Figure 18. Significant amounts of potential are spread across the all electric and lighting end uses. The all electric end use includes measures applicable to all end uses, such as strategic energy management programs. Smaller amounts of potential are available through measures in the refrigeration, compressed air, and pumps end uses. The other category in Figure 18 includes a variety of end uses, including material handling and processing, HVAC, fan systems, and several other small end uses.

Figure 18: Annual Industrial Potential by End Use



The breakdown of 10-year industrial potential into end uses and measure categories is shown in Figure 19.

Figure 19: Industrial Potential by End Use and Measure Category

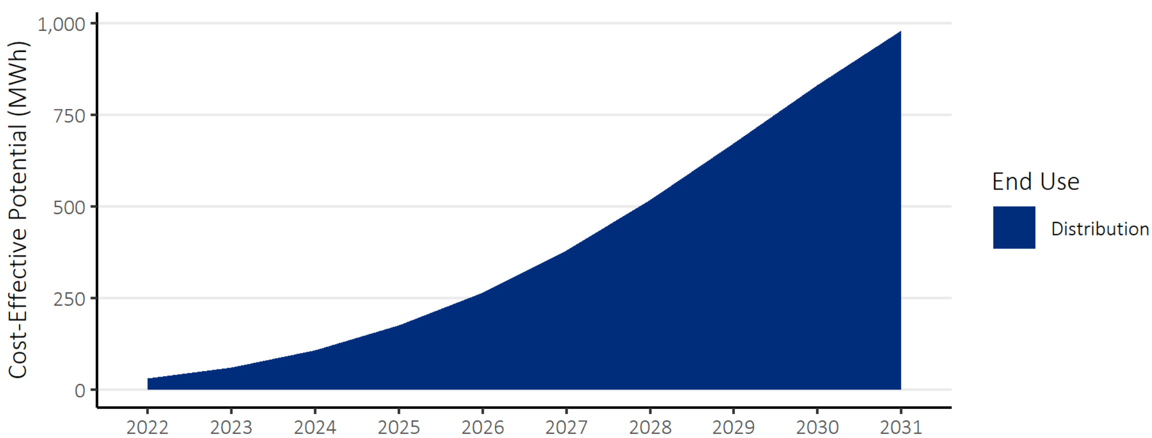


Utility

Measures in the utility sector involve the regulation of voltage to improve the efficiency of the distribution system. This 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 RES.

The annual distribution system potential is shown in Figure 20. The Council characterized three measures in the draft 2021 Power Plan, which use increasingly sophisticated control systems. Note that the scale for this figure has changed relative to the figures above, as the potential in this sector is much smaller than those sectors.

Figure 20: Annual Distribution System Potential



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

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

Table 10: Avoided Cost Assumptions by Scenario

		Low Scenario	Base Scenario	High Scenario
Energy Values	Avoided Energy Costs (20-Year Levelized Price, 2016$)	Market Forecast minus 20%-80% ($18)	Market Forecast ($34)	Market Forecast plus 20%-80% ($50)
	Social Cost CO_2	Federal 2.5% Discount Rate Values	Federal 2.5% Discount Rate Values	Federal 2.5% Discount Rate Values
	RPS Compliance	WA EIA & CETA Requirements	WA EIA & CETA Requirements	WA EIA & CETA Requirements
Capacity Values	Distribution Capacity (2016$)	$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	$124/kW-year
	Implied Risk Adder (2016$)	-$16/MWh -$14/kW-year	N/A	$16/MWh $36/kW-year
	Northwest Power Act Credit	10%	10%	10%

Instead of using a single risk adder applied to each unit of energy, the two alternate scenarios consider potential futures with higher and lower values for the avoided cost inputs where some degree of uncertainty exists, including variations in the value of both energy and capacity. The 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 11 summarizes the cost-effective potential across each avoided cost scenario. As discussed above, the results show higher sensitivities to the low avoided cost scenario. This suggests a higher risk in over-valuing energy efficiency. However, these results should also 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.

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

Scenario	2-Year	4-Year	10-Year	20-Year
Low Scenario	7,952	18,575	76,125	187,521
Base Case	9,186	21,412	87,422	220,819
High Scenario	9,225	21,552	88,354	223,618

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

Summary

This report has summarized the results of the 2021 CPA conducted for RES. The assessment provided estimates of the cost-effective energy savings potential for the 20-year period beginning in 2022, with details on the first ten years per the requirements of Washington State's EIA. The assessment considered a wide range of measures that are reliable and available during the study period.

Compared to RES's 2019 CPA, the potential has decreased in the near term. Factors driving the potential downward 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 significantly higher amounts of cost-effective potential. This additional potential is in measures that currently see slower 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.

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
CEIP	Clean Energy Implementation Plan
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 U.S.

Appendix III: Compliance with State Requirements

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

Table 12: CPA Compliance with EIA Requirements

WAC 194-37-080 Section	Requirement	Implementation
(5)(a)	**Technical potential.** Determine the amount of conservation that is technically feasible, considering measures and the number of these measures that could physically be installed or implemented, without regard to achievability or cost.	The model calculates technical potential by multiplying the quantity of stock (number of homes, building floor area, industrial load) by the number of measures that could be installed per each unit of stock. The model further constrains the potential by the share of measures that have already been completed. See calculations in the “Units” tabs within each of the sector model files.
(5)(b)	**Achievable technical potential**. Determine the amount of the conservation technical potential that is available within the planning period, considering barriers to market penetration and the rate at which savings could be acquired.	The model applies maximum achievability factors based on the Council’s 2021 Power Plan assumptions and ramp rates to identify how the potential can be acquired over the 20-year study period. See calculations in the “Units” tabs within each of the sector model files. The complete set of the ramp rates used is on the “Ramp Rates” tab.
(5)(c)	**Economic achievable potential**. Establish the economic achievable potential, which is the conservation potential that is cost-effective, reliable, and feasible, by comparing the total resource cost of conservation measures to the cost of other resources available to meet expected demand for electricity and capacity.	Lighthouse used the Council’s ProCost model to calculate TRC benefit-cost ratios for each measure after updating ProCost with utility-specific inputs. The ProCost results are collected through an Excel macro in the “ProCost Measure Results-(scenario).xlsx” files and brought into the CPA models through Excel’s Power Query. See Appendix IV for further discussion of the avoided cost assumptions.
(5)(d)	**Total resource cost**. In determining economic achievable potential as provided in (c) of this subsection, perform a life-cycle cost analysis of measures or programs to determine the net levelized cost, as described in this subsection.	A life-cycle cost analysis was performed using the Council’s ProCost tool, which Lighthouse configured with utility-specific inputs. Costs and benefits were included consistent with the TRC test. The measure files within each sector 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 forecast of on- and off-peak market prices at the mid-Columbia trading hub. 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 the Council for the 2021 Power Plan. These values can be found on the "ProData" tab of the ProCost files, cells C50 and C54.
(5)(d)(vii)	Include deferred generation benefits consistent with the contribution to system peak capacity of the conservation measure.	Deferred generation capacity expansion benefits are based on BPA's monthly demand charges, which are used as a proxy for the 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 emissions intensity of energy savings is based on a Council analysis of the regional marginal emissions intensity developed for the 2021 Plan. The carbon costs and emissions intensities can be found in the MC and Loadshape file.
(5)(d)(ix)	Include a risk mitigation credit to reflect the additional value of conservation, not otherwise accounted for in other inputs, in reducing risk associated with costs of avoided non-conservation resources.	This analysis uses a scenario analysis to consider risk. Avoided cost values with uncertain future values were varied across three different scenarios and the resulting sensitivity and risk were analyzed. The Scenario Results section of this report discusses the inputs used and the implicit risk 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.

WAC 194-37-080 Section	Requirement	Implementation
(5)(d)(xi)	Include an estimate of program administrative costs.	This assessment uses the Council's assumption of administrative costs equal to 20% of measure capital costs. Program admin costs can be found in the "ProData" tab of the ProCost files, cell C29.
(5)(d)(xii)	Include the cost of financing measures using the capital costs of the entity that is expected to pay for the measure.	This assessment utilizes the financing cost assumptions from the 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 3.75% to determine the present value of all costs and benefits. This represents RES'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 Northwest Power Act. The 10% credit used in the measure analyses can be found in the ProCost files, on cell C29 of the ProData tab.

Appendix IV: Avoided Costs

The methodology used to conduct conservation potential assessments for electric utilities in the State of Washington is dictated by the requirements of the Energy Independence Act (EIA) and the Clean Energy Transformation Act (CETA). Specifically, WAC 194-37-070 requires utilities to determine the economic, or cost-effective, potential by "comparing the total resource cost of conservation measures to the total cost of other resources available to meet expected demand for electricity and capacity."[3] This CPA determined 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 inputs in detail in the following sections.

Avoided Energy Costs

Avoided energy costs are the energy costs avoided by RES through the acquisition of energy efficiency instead of supply-side resources. For every megawatt-hour of conservation achieved, RES avoids the purchase of one megawatt-hour of energy or can sell one megawatt-hour of excess 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[4,5] on May 12, 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 remaining years of the study period. Figure 21 and Figure 22 show how the forward prices from the CME Group compare to the fitted model developed by Lighthouse for the on- and off-peak prices, respectively. Both models provide a very close fit to the forward prices.

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

[4] https://www.cmegroup.com/trading/energy/electricity/mid-columbia-day-ahead-peak-calendar-month-5-mw-futures.html. Accessed May 12, 2021.

[5] https://www.cmegroup.com/trading/energy/electricity/mid-columbia-day-ahead-off-peak-calendar-month-5-mw-futures.html. Accessed May 12, 2021.

Figure 21: Model Fit of On-Peak Prices

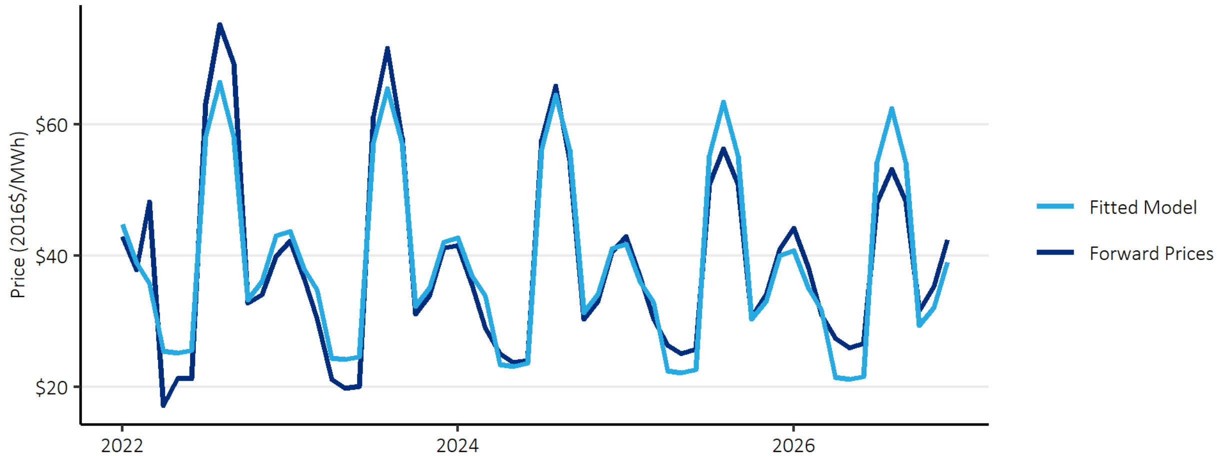
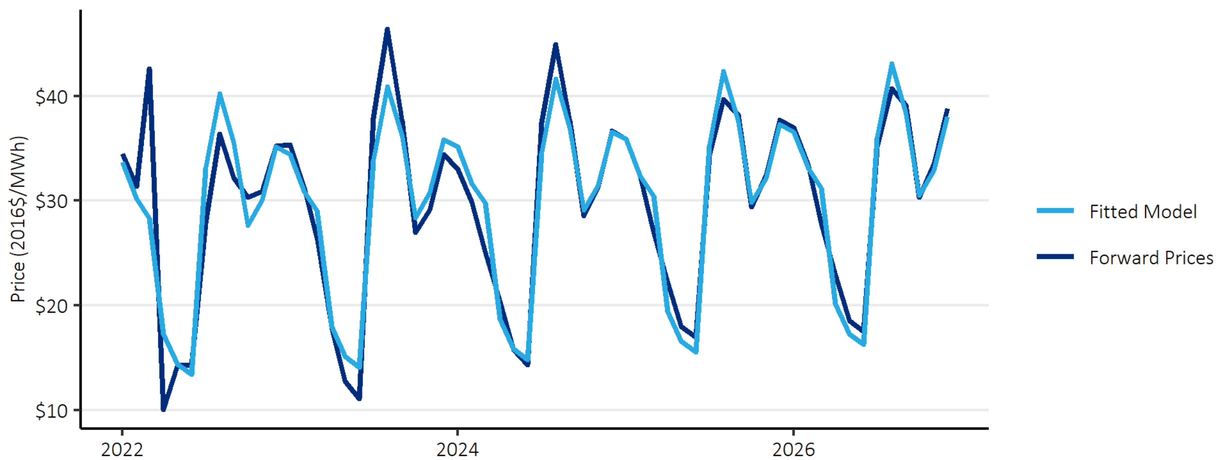
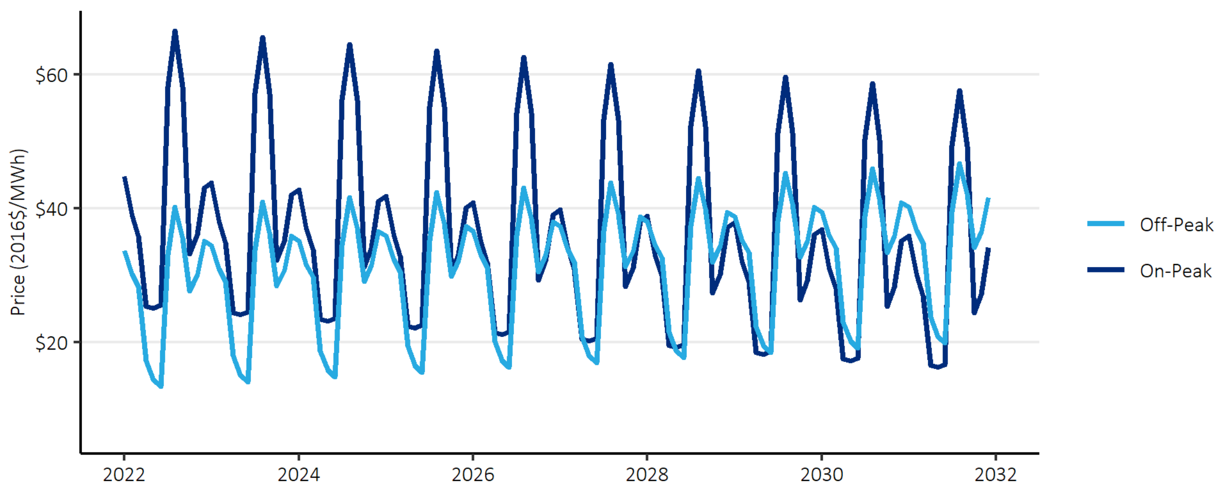


Figure 22: Model Fit of Off-Peak Prices



The modeled forecast of on- and off-peak prices is shown in Figure 23, which excludes some of the final years of the study period for clarity. The levelized value of the 20-year price forecast is approximately $35/MWh (2016$). This is very close to the price forecast used in the 2019 CPA, which had a levelized value of $34/MWh (2016$).

Figure 23: 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 more subsequently. To develop the forecast, Lighthouse examined the variation in the forecasts 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 the base case forecast described above to create the high and low scenario forecasts. The resulting forecasts for on- and off-peak prices are shown in Figure 24 and Figure 25 below.

Figure 24: Comparison of On-Peak Price Scenarios

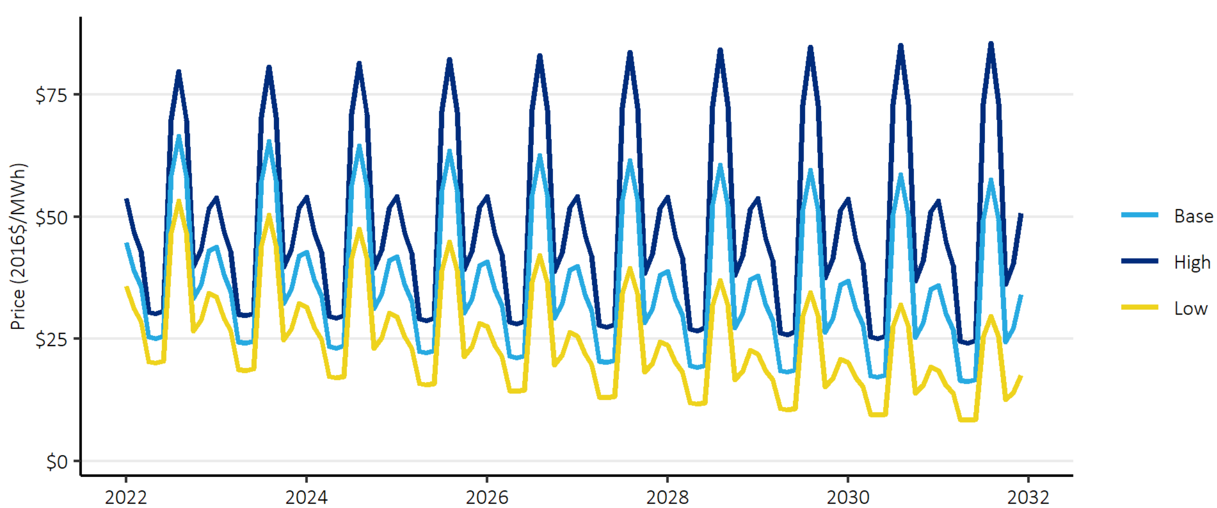
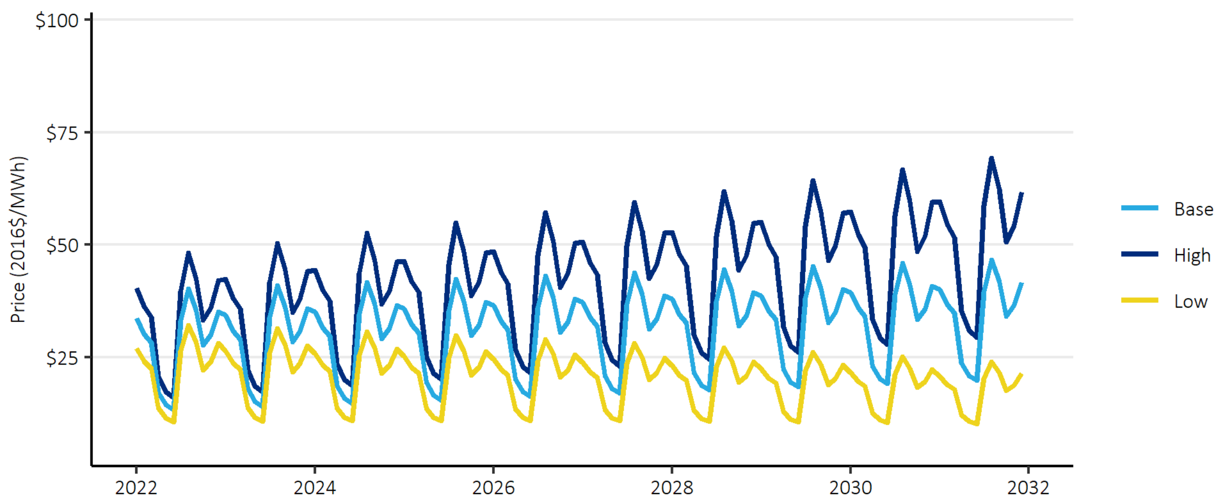


Figure 25: Comparison of Off-Peak Price Scenarios



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 surveyed Northwest utilities to update the values associated with these cost deferrals. The resulting values were $3.08/kW-year for transmission capacity and $6.85/kW-year for distribution capacity. These values were also used in RES's 2019 CPA.

The 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

Similar to the transmission and distribution systems discussed above, acquiring energy efficiency resources can also help defer or eliminate the costs of new generation resources built or acquired to meet peak demands for electricity. While there is currently no organized capacity market in the Northwest, RES does pay a demand charge to BPA based on its monthly peak demand. These charges effectively function as a generation capacity value for RES.

Lighthouse followed a similar methodology as what was used in RES's previous CPA 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 $88/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 in regard to this value will not be available until after the completion of the draft Power Plan, currently scheduled for August 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 in a given year. The EPA describes it as including, among other things, changes in agricultural productivity, human health, property damages from increased flood risk, and changes in energy system costs, including increases in the costs of cooling and decreases in heating costs.[6] 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 associated with a marginal unit of energy. This assessment uses the marginal emissions factors developed for the 2021 Plan, which start at approximately 1 lb CO_{2e}/kWh in 2022 and decline to 0.4 lb CO_{2e}/kWh over the 20-year study period.

Renewable Portfolio Standard Compliance Costs

The renewable portfolio standard established under Washington's EIA requires that utilities source a portion of retail sales from renewable resources throughout the study period of this CPA. For RES, the requirement begins at 3% for the years 2026 through 2029. The subsequently passed CETA furthers these requirements, mandating that 100% of sales be greenhouse gas neutral in 2030, with an allowance that up to 20% of the requirement can be achieved through other options, such as the purchase of Renewable Energy Credits (RECs).

Energy efficiency can reduce the cost of complying with these requirements by reducing RES's overall load. In 2026, a reduction in load of 100 MWh through energy efficiency would reduce the number of RECs required for compliance by 3. This equates to a value of 3% 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.

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

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 RES's 2019 CPA. 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, RES 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 13 summarizes the avoided cost assumptions used in each of the scenarios in this CPA update.

Table 13: 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% ($18)	Market Forecast ($34)	Market Forecast plus 20%-80% ($50)
	Social Cost CO_2	Federal 2.5% Discount Rate Values	Federal 2.5% Discount Rate Values	Federal 2.5% Discount Rate Values
	RPS Compliance	WA EIA & CETA Requirements	WA EIA & CETA Requirements	WA EIA & CETA Requirements
Capacity Values	**Distribution Capacity (2016$)**	$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	$124/kW-year
Implied Risk Adder (2016$)	-$16/MWh -$14/kW-year	N/A	$16/MWh $36/kW-year
Northwest 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 RES. Lighthouse customized these measures to make them specific to RES's service territory and updated several with new information available from the RTF. The RTF continually updates estimates of measure savings and cost. This assessment used the most up to date information available when the CPA was developed.

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

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

Table 14: 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 15: 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 16: 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 17: 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

Appendix VI: Energy Efficiency Potential by End Use

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

Table 18: Residential Potential by End Use (MWh)

End Use	2-Year	4-Year	10-Year	20-Year
Appliances	109	409	3,479	15,816
Cooking	0	2	34	288
Electronics	67	246	1,780	3,485
EV Supply Equipment	0	1	13	16
HVAC	695	1,788	11,440	42,851
Lighting	81	262	1,445	4,038
Motors	-	-	-	-
Water Heat	174	658	4,667	13,875
Whole Home	-	-	-	-
Total	**1,126**	**3,366**	**22,859**	**80,369**

Table 19: Commercial Potential by End Use (MWh)

End Use	2-Year	4-Year	10-Year	20-Year
Compressed Air	1	3	13	53
Electronics	16	86	1,446	3,211
Food Preparation	9	34	274	704
HVAC	950	2,463	12,176	35,946
Lighting	3,379	6,797	17,273	31,284
Motors/Drives	252	682	3,130	5,738
Process Loads	-	-	-	-
Refrigeration	155	627	5,693	15,790
Water Heating	46	148	889	2,606
Total	**4,808**	**10,841**	**40,894**	**95,334**

Table 20: Industrial Potential by End Use (MWh)

End Use	2-Year	4-Year	10-Year	20-Year
All Electric	511	1,232	5,263	8,242
Compressed Air	118	330	1,657	3,789
Fans and Blowers	141	284	581	666
HVAC	90	224	826	998
Lighting	1,343	2,712	5,556	6,369
Low Temp Refrigeration	605	1,243	2,810	4,107
Material Handling	2	7	52	191
Material Processing	7	27	211	767
Med Temp Refrigeration	179	369	848	1,282
Melting and Casting	6	12	32	67
Other	-	-	-	-
Other Motors	3	11	89	323
Pollution Control	0	1	9	33
Pumps	152	353	1,267	3,826
Total	**3,157**	**6,806**	**19,202**	**30,660**

Table 21: Utility Distribution System Potential by End Use (MWh)

End Use	2-Year	4-Year	10-Year	20-Year
LDC with no VVO	21	86	924	2,721
LDC with VVO & AMI	70	288	3,098	9,123
Total	**91**	**374**	**4,022**	**11,844**

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 RES's energy efficiency programs. Aligning the potential with recent achievements provides the best way to ensure that the near-term potential is achievable and feasible for RES'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 RES 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, however, and can therefore 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 release of the new 2021 Power Plan (2021 Plan), and NEEA's savings for future years is uncertain at this point. To account for this uncertainty, Lighthouse was conservative in projecting the level of NEEA savings that may continue relative to past years.

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 Power Plan and compared the resulting cost-effective potential in the first few years of the assessment with RES's recent and forecasted 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 RES's previous 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 program savings in columns detailing future savings potential as it is difficult to determine how savings will be achieved. For some measures, achievements will be a mix of both RES programs and NEEA's market transformation initiatives.

Residential

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

Table 22: 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	-	-	19	40	60
Appliances	Dryer	-	-	5	14	30
Appliances	Freezer	-	-	2	5	7
Appliances	Refrigerator	-	-	8	16	24
Cooking	Microwave	-	-	0	0	0
Cooking	Oven	-	-	0	0	0
Electronics	Advanced Power Strips	-	-	6	10	20
Electronics	Laptop	-	-	7	11	14
Electronics	TV	-	-	10	23	38
EVSE	EVSE	-	-	0	0	0
HVAC	ASHP	427	688	1	2	2
HVAC	CAC	-	-	0	1	2
HVAC	Circulator	-	-	0	0	0
HVAC	Circulator Controls	-	-	0	0	0
HVAC	DHP	46	80	200	199	198
HVAC	Duct Sealing	8	3	9	19	36
HVAC	Thermostat	-	-	17	45	103
HVAC	Weatherization	109	162	91	110	133
Lighting	Lighting	-	-	28	53	78
Water Heat	Circulator	-	-	1	1	2
Water Heat	Circulator Controls	-	-	0	0	0
Water Heat	Dishwasher	-	-	1	1	2
Water Heat	HPWH	-	-	47	108	175
Water Heat	TSRV	-	-	5	9	18
NEEA	NEEA	2,505	2,162	*n/a*	*n/a*	*n/a*
	Total	**3,096**	**3,094**	**459**	**667**	**943**

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, while RES does not currently offer any incentives, NEEA does have initiatives that contribute additional savings. NEEA's Retail Product Portfolio initiative includes appliances and electronics. Overall, the savings in these end uses are small and the ramp rates were generally left at the default 2021 Plan ramp rates. Only the ramp rates for dryers was slowed, as this category includes heat pump dryers, a fairly new measure with low market adoption.

Electronics

In this category, the potential is in advanced power strips, laptops, and televisions. While RES does not offer incentives for any measures in this end use, savings from TVs and computers could be achieved through NEEA's Retail Product Portfolio, similar to the appliance and cooking categories discussed above. Like the categories above, the savings potential in this end use is fairly small and ramp rates were left at the default 2021 Plan ramp rates.

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. RES is adding an efficient EV charger program in 2021. No changes were made to the default 2021 Plan ramp rates in this end use.

HVAC

In the HVAC category, only certain applications of air-source heat pumps (ASHP), ductless heat pumps (DHP), and weatherization measures were cost-effective, limiting the ability to closely match program achievement and potential. The measures in this category were accelerated somewhat, but with ASHPs, future cost-effective potential could not be aligned with recent program history. The potential with ductless heat pumps (DHP) was accelerated to exceed recent program history, as this is another area where NEEA's initiatives contribute savings. 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 as this is an area where RES has no recent program achievement. RES could accelerate efforts with smart thermostats, especially if ASHPs are not cost-effective in the future.

A new measure for efficient central air conditioning systems was found to be cost-effective, but this measure was given a slow ramp rate since there is no current program.

Lighting

Measures in the lighting category were left at the default 2021 Plan ramp rates, program potential in this end use 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 cost-effective potential in the water heating category consists mostly of savings from heat pump water heaters. While RES did not record any savings in this end use in 2019-20, they are launching a program in 2021 through BPA's Comfort Ready Home program. This is also an area where NEEA has a market transformation initiative which contributes additional savings and the potential for heat pump water heaters was left with the default 2021 Plan ramp rates.

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 RES's CPA. Similarly, no changes were made to the default 2021 Plan ramp rate for thermostatic restrictor valves.

Table 23 below summarizes the residential measure category results in Table 22 by end use.

Table 23: 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	-	-	35	74	121
Cooking	-	-	0	0	1
Electronics	-	-	23	44	72
EVSE	-	-	0	0	0
HVAC	591	933	319	377	475
Lighting	-	-	28	53	78
Water Heat	-	-	54	120	197
NEEA	2,505	2,162	*n/a*	*n/a*	*n/a*
Total	**3,096**	**3,094**	**459**	**667**	**943**

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. This is also the area where RES gets most of its commercial sector savings. The savings in this area declined significantly in 2020, a likely impact of the COVID-19 pandemic. Lighthouse slightly slowed the ramp rates for some lighting measures, while still using fast ramp rates.

Lighthouse applied slightly slower ramp rates to measures in the electronics, HVAC, refrigeration, and motors/drives end uses. NEEA's savings in the commercial sector are generally in the HVAC end use, so the potential in this end use was aligned with recent NEEA savings. The other end uses have smaller amounts of potential that ramp more slowly.

Overall, the near-term potential was roughly aligned with RES's average achievement in this sector while also considering savings from NEEA's initiatives.

Table 24 below shows the alignment of program history and potential in the commercial sector.

Table 24: 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	1	1
Electronics	-	-	5	11	24
Food Preparation	-	2	3	6	10
HVAC	7	62	426	523	671
Lighting	4,338	265	1,755	1,624	1,683
Motors/Drives	-	-	107	145	191
Process Loads	-	-	-	-	-
Refrigeration	-	-	51	105	184
Water Heating	-	-	-	-	-
NEEA	620	535	*n/a*	*n/a*	*n/a*
Total	**4,965**	**864**	**2,347**	**2,415**	**2,764**

Industrial

RES's program achievement in the industrial sector also shows significant declines in 2020. While the COVID-19 pandemic may be a contributor, energy efficiency programs in the industrial sector are subject to ups and downs depending on the projects that complete in a given year.

Most of the potential in RES's industrial sector is in the lighting, refrigeration, and energy management end uses. Lighthouse used the default 2021 Plan ramp rates for most end uses, while slowing the potential for the energy management, compressed air, fans and blowers, and HVAC end uses. Lighthouse sought to align the near-term program potential with RES's recent achievement in the industrial sector. This results in in future annual cost-effective potential similar to RES's 2020 achievement or slightly higher.

Table 25 shows the alignment of industrial potential and recent program history by end use.

Table 25: Alignment of Industrial Program History and Potential by End Use (aMW)

	Program History		CPA Cost-Effective Potential		
End Use	**2019**	**2020**	**2022**	**2023**	**2024**
Energy Management	(22)	-	245	266	320
Compressed Air	-	5	48	70	97
Fans and Blowers	-	-	70	71	71
HVAC	-	-	40	50	62
Lighting	705	753	668	675	681
Motors	-	-	1	2	3
Refrigeration	1,001	810	387	397	408
Process	3,512	-	6	9	13
Pumps	-	-	70	82	94
Other	-	-	0	0	0
NEEA	24	21	-	-	-
Total	**5,221**	**1,589**	**1,535**	**1,621**	**1,750**

Utility Distribution System

The amount of potential in the utility distribution system is limited compared to other sectors. No changes were made to the default ramp rate assigned in the draft 2021 Plan.

Table 26: 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	-	-	30	61	108

Appendix VIII: Tables and Figures in aMW

TO: Sandi Edgemon, Elena Manzo, Dawn Senger, Greg Sullivan; City of Richland

FROM: Ted Light, Lighthouse Energy Consulting

SUBJECT: Richland 2021 CPA Results in aMW

DATE: August 31, 2021

This memo provides the results tables and figures from the 2021 CPA report in units of aMW for comparison with Richland's previous 2019 CPA.

Overall Results

Table 1 - Cost-Effective Energy Savings Potential (aMW)

Sector	2-Year	4-Year	10-Year	20-Year
Residential	0.13	0.38	2.61	9.17
Commercial	0.55	1.24	4.67	10.88
Industrial	0.36	0.78	2.24	3.80
Utility	0.01	0.04	0.46	1.35
Total	**1.05**	**2.44**	**9.98**	**25.21**

Figure 26: Cost-Effective Energy Savings Potential by Sector

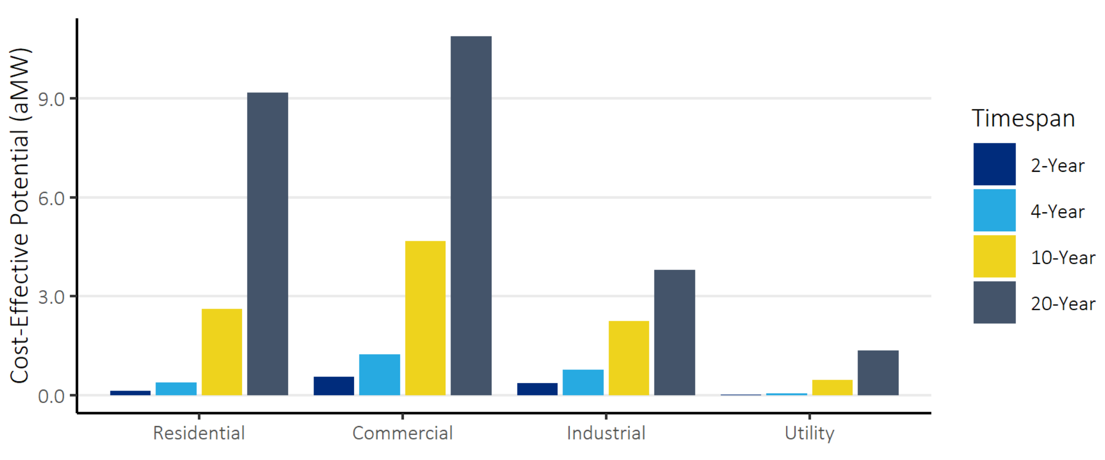


Figure 27: Annual Incremental Energy Efficiency Potential

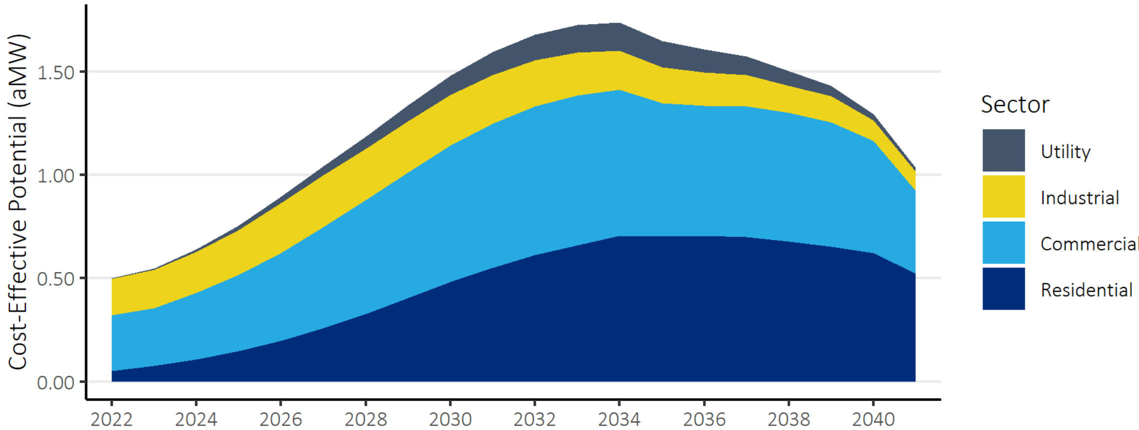


Figure 28: Annual Cumulative Energy Efficiency Potential

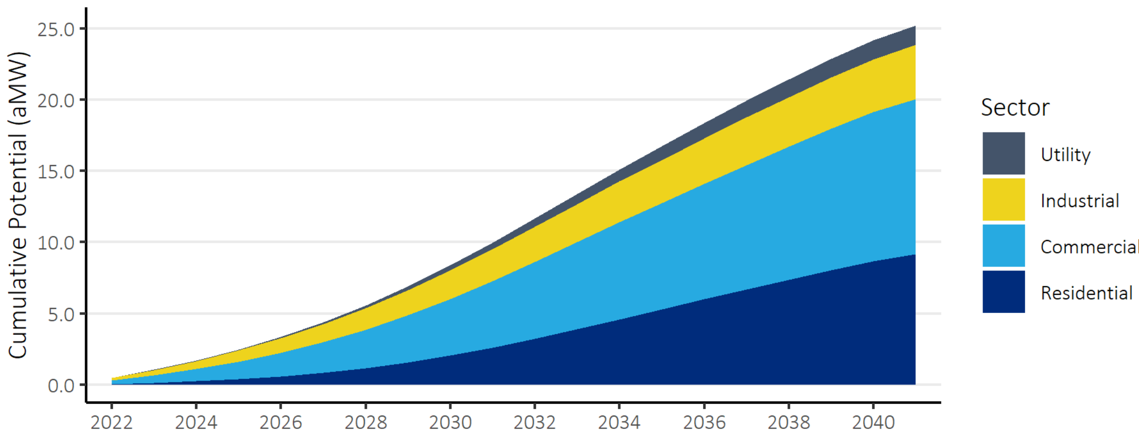


Table 3: Comparison to Previous Assessment (aMW)

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	0.39	0.13	-67%	2.54	2.61	3%	4.33	9.17	112%
Commercial	0.64	0.55	-14%	5.42	4.67	-14%	8.93	10.88	22%
Industrial	0.41	0.36	-12%	1.54	2.24	46%	1.82	3.80	109%
Utility	0.02	0.01	-48%	0.25	0.46	84%	0.70	1.35	93%
Total	1.46	1.05	-28%	9.75	9.98	2%	15.79	25.21	60%

Figure 29: 20-Year Supply Curve

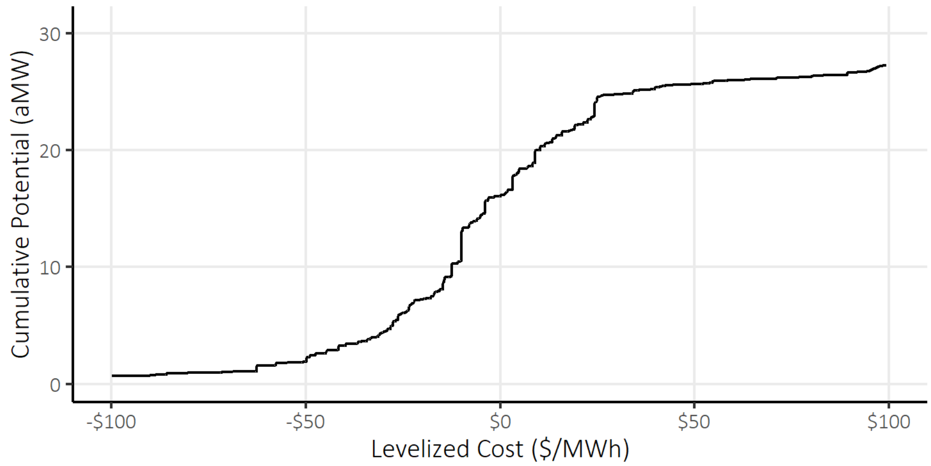
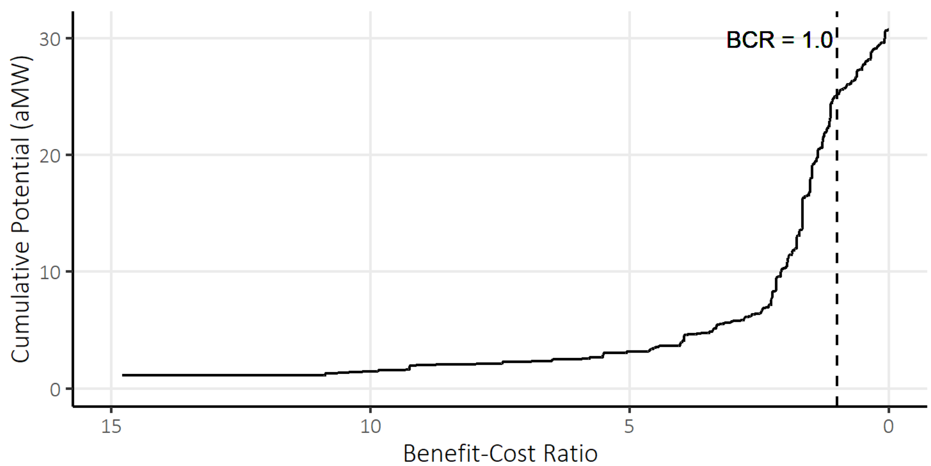


Figure 30: 20-Year Benefit-Cost Ratio Supply Curve



Sector Results

Figure 31: Annual Residential Potential by End Use

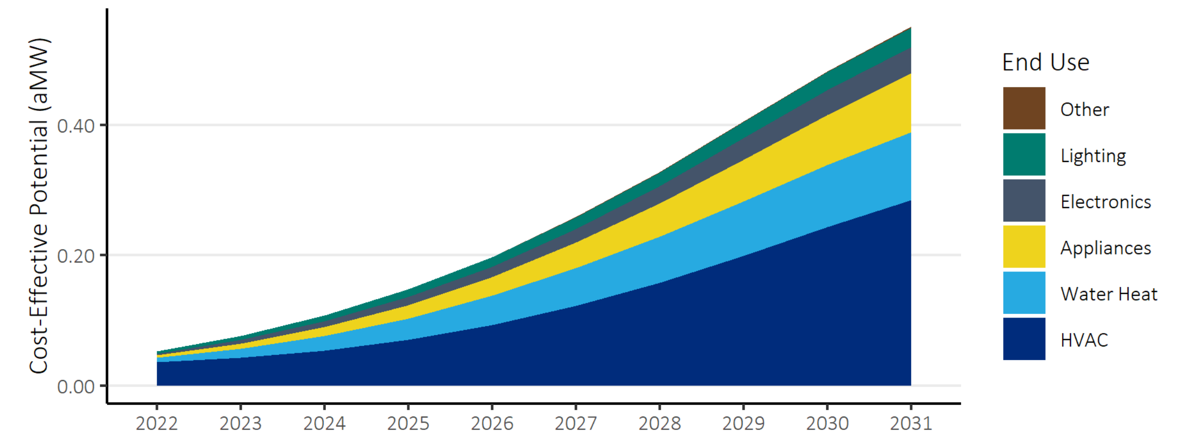


Figure 32: Annual Commercial Potential by End Use

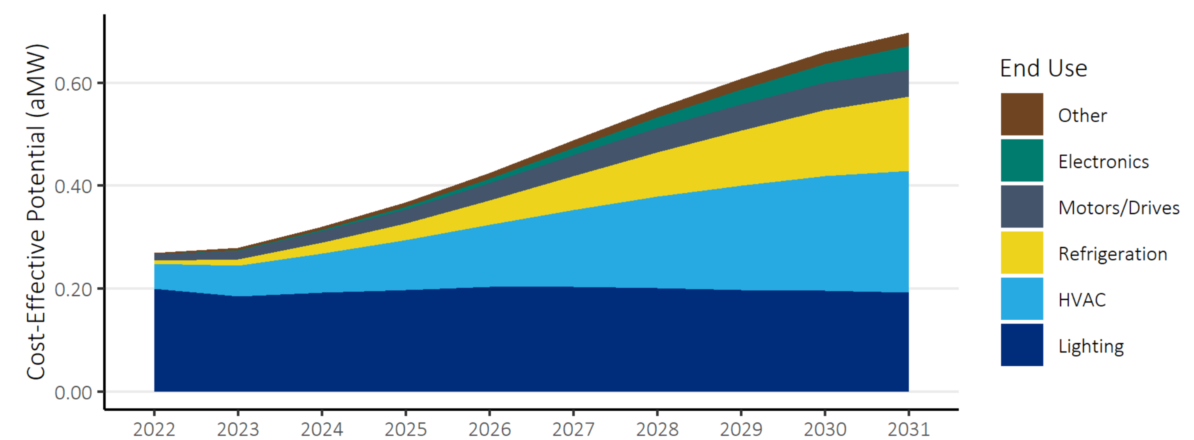


Figure 33: Annual Industrial Potential by End Use

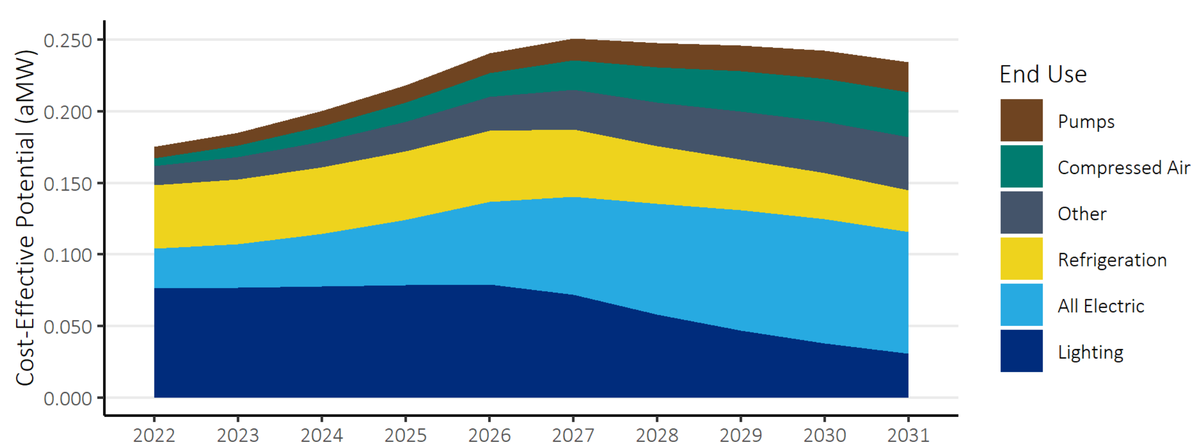
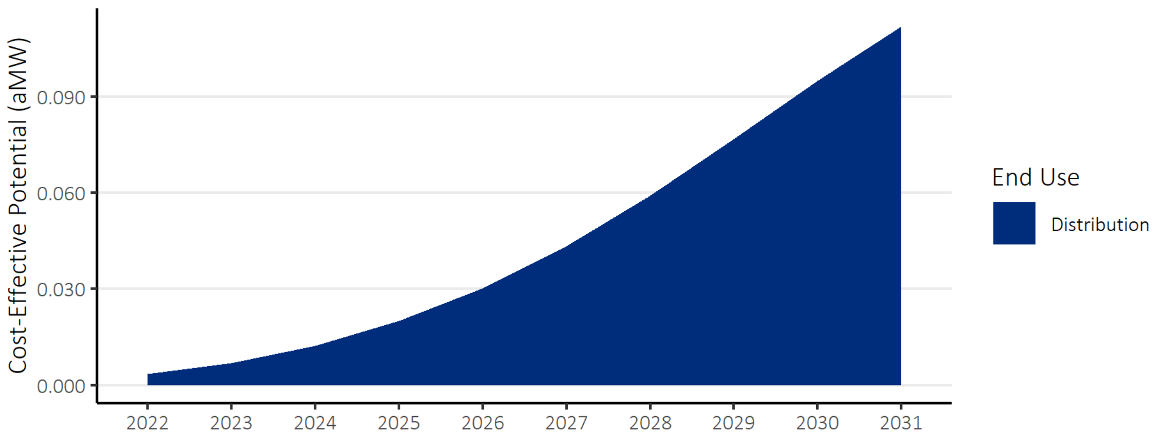


Figure 34: Annual Distribution System Potential



Scenario Results

Table 27: Cost Effective Potential (MWh) by Avoided Cost Scenario

Scenario	2-Year	4-Year	10-Year	20-Year
Low Scenario	0.91	2.12	8.69	21.41
Base Case	1.05	2.44	9.98	25.21
High Scenario	1.05	2.46	10.09	25.53

Potential By Sector & End Use

Table 28: Residential Potential by End Use (aMW)

End Use	2-Year	4-Year	10-Year	20-Year
Appliances	0.01	0.05	0.40	1.81
Cooking	0.00	0.00	0.00	0.03
Electronics	0.01	0.03	0.20	0.40
EVSE	0.00	0.00	0.00	0.00
HVAC	0.08	0.20	1.31	4.89
Lighting	0.01	0.03	0.16	0.46
Motors	-	-	-	-
Water Heat	0.02	0.08	0.53	1.58
Whole Home	-	-	-	-
Total	**0.13**	**0.38**	**2.61**	**9.17**

Table 29: Commercial Potential by End Use (aMW)

End Use	2-Year	4-Year	10-Year	20-Year
Compressed Air	0.00	0.00	0.00	0.01
Electronics	0.00	0.01	0.17	0.37
Food Preparation	0.00	0.00	0.03	0.08
HVAC	0.11	0.28	1.39	4.10
Lighting	0.39	0.78	1.97	3.57
Motors/Drives	0.03	0.08	0.36	0.66
Process Loads	-	-	-	-
Refrigeration	0.02	0.07	0.65	1.80
Water Heat	0.01	0.02	0.10	0.30
Total	**0.55**	**1.24**	**4.67**	**10.88**

Table 30: Industrial Potential by End Use (aMW)

End Use	2-Year	4-Year	10-Year	20-Year
All Electric	0.06	0.14	0.60	0.94
Compressed Air	0.01	0.04	0.19	0.43
Fans and Blowers	0.02	0.03	0.07	0.08
HVAC	0.01	0.03	0.09	0.11
Lighting	0.15	0.31	0.63	0.73
Low Temp Refer	0.07	0.14	0.32	0.47
Material Handling	0.00	0.00	0.01	0.02
Material Processing	0.00	0.00	0.02	0.09
Med Temp Refer	0.02	0.04	0.10	0.15
Melting and Casting	0.00	0.00	0.00	0.01
Other	-	-	-	-
Other Motors	0.00	0.00	0.01	0.04
Pollution Control	0.00	0.00	0.00	0.00
Pumps	0.02	0.04	0.14	0.44
Total	**0.36**	**0.78**	**2.19**	**3.50**

Table 31: Utility Distribution System Potential by End Use (aMW)

End Use	2-Year	4-Year	10-Year	20-Year
EMC-1 LDC with no VVO	0.00	0.01	0.11	0.31
ECM-2 & ECM-3 LDC with VVO & AMI	0.01	0.03	0.35	1.04
Total	**0.01**	**0.04**	**0.46**	**1.35**

Attachment B

2021 DEMAND RESPONSE POTENTIAL ASSESSMENT

Richland Energy Services

September 8, 2021

Prepared by:

LIGHTHOUSE ENERGY CONSULTING

Adopted by City Council on
October 19, 2021, through Resolution 123-21

Table of Contents

Introduction

This report summarizes the 2021 Demand Response Potential Assessment (DRPA) conducted by Lighthouse Energy Consulting (Lighthouse) for Richland Energy Services (RES). The assessment generally followed the methodology used by the Northwest Power and Conservation Council (Council) for the draft 2021 Power Plan (2021 Plan) and included many of the same demand response (DR) products. The DR products included are applicable to the residential, commercial, and industrial sectors and utilize a range of strategies, including direct load control, customer-initiated demand curtailment, and time-varying prices to effect reductions in peak demand. The assessment included DR products addressing both winter and summer demand, as RES is primarily a winter-peaking utility but also experiences high demand in the summer.

DR has not been widely used in the Northwest but has received increased interest in recent years. DR is defined in the Council's Seventh Power Plan (Seventh Plan) as "voluntary reductions in customer electricity use during periods of high demand and limited resource availability."[1] Growing capacity constraints associated with the closure of regional coal-fired power plants, increases in policies requiring the use of carbon-neutral or renewable energy, and operational limitations placed on the region's hydropower system are all driving a need for cost-effective generation capacity. DR offers a solution to reduce peak demands, help integrate renewable resources, and alleviate some congestion on transmission and distribution systems.

In addition, the State of Washington recently passed the Clean Energy Transformation Act (CETA), which requires utilities to assess the amount of DR resource potential that is cost-effective, reliable, and feasible, and use that assessment to identify a target for DR in each Clean Energy Implementation Plan (CEIP). The first CEIP is due January 1, 2022, and every subsequent four years.

Like many utilities in the Northwest, RES does not currently have active customer-facing DR programs. RES does, however, currently make use of voltage regulation during times of peak demand. This is known as demand voltage regulation, or DVR. Regional utilities have been conducting pilots of different DR program types to learn what types of programs would work well in the Northwest. RES has participated in past pilots offered by Bonneville Power Administration (BPA), including a regional pilot conducted from 2013 to 2017. RES also plans to begin offering an incentive for electric vehicle charging equipment and require that customers document that the chargers have been set to charge during off-peak hours.

[1] Northwest Power and Conservation Council, 'Seventh Northwest Conservation and Electric Power Plan', 2016, https://www.nwcouncil.org/sites/default/files/7thplanfinal_allchapters_1.pdf.

Methodology

The methodology began by identifying the DR products to be included in the assessment and quantifying RES's customer base that could adopt them. With these inputs developed, Lighthouse quantified the DR potential.

Like a conservation potential assessment, the DR potential calculation process began with the quantification of technical potential, which is the maximum amount of DR possible without regard to cost or market barriers. The assessment then considered market barriers, program participation rates, and other factors to quantify the achievable potential. Finally, the economic potential is quantified by applying an economic screen to the achievable potential. The methodology used to calculate technical and achievable potential is discussed in further detail below.

Demand Response Products

To determine the products that would be included in this DRPA, Lighthouse reviewed the DR products developed for the 2021 Plan and discussed their applicability to RES with staff. Lighthouse also reviewed RES's monthly forecast and demand, as forecasted in BPA's Tiered Rate Methodology materials. Based on this information, Lighthouse included products targeting both the summer and winter seasons while excluding the agricultural sector as RES has limited customer load in this area.

DR products that rely on pricing strategies to influence customer behavior typically require advanced metering infrastructure (AMI) to record the time-based impacts. RES has plans to deploy AMI across the service territory with completion expected at the end of 2022. This schedule was incorporated into the products that rely on AMI.

The high-level categories of DR products included in this assessment are summarized in Table 1 below, which organizes the products by sector and implementation strategy.

Direct load control (DLC) products are those in which the utility has direct control of the operation of applicable equipment. This category includes switches installed on equipment or other equipment with integrated controls such as smart thermostats or grid-enabled hot water heaters. DLC products typically achieve high event participation rates as the participation is only limited by the success of the controlled equipment receiving and implementing any instructions to change its operation. Demand curtailment is like DLC but requires the intervention of customers to implement reductions in load. These products usually involve contracts between the customer and utility that detail the amount, duration, and frequency of load reductions. Time-varying price products rely on a variety of strategies to encourage customers to respond to higher energy or demand prices.

Table 1: Demand Response Products

	Residential	Commercial	Industrial	Utility
Direct Load Control	EV Charging Grid-Enabled Water Heater Water Heater Switch Space Heating Switch Smart Thermostat	Space Heating Switch Smart Thermostat		Demand Voltage Reduction
Demand Curtailment		Demand Curtailment	Demand Curtailment	
Time-Varying Prices	Time of Use Pricing Critical Peak Pricing	Critical Peak Pricing	Critical Peak Pricing Real Time Pricing	

A complete list of the products used in this assessment is included in the Appendix of this report.

Customer and Sales Forecasts

With the products identified, Lighthouse then quantified the customer base over which the products could be installed. Lighthouse used data provided by RES and other publicly available data to develop forecasts of sales and customer counts for each sector. These forecasts are shown in Figure 1 and Figure 2. The majority of RES's customers are residential customers but sales to the residential and commercial sectors are approximately equal in the near term.

Figure 1: Sales Forecast by Sector

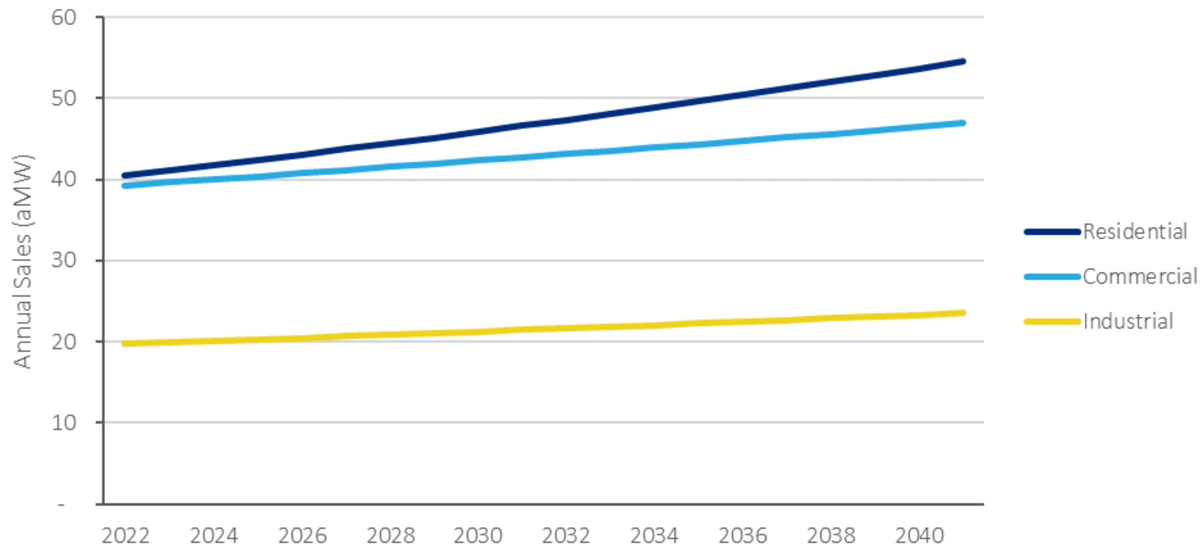
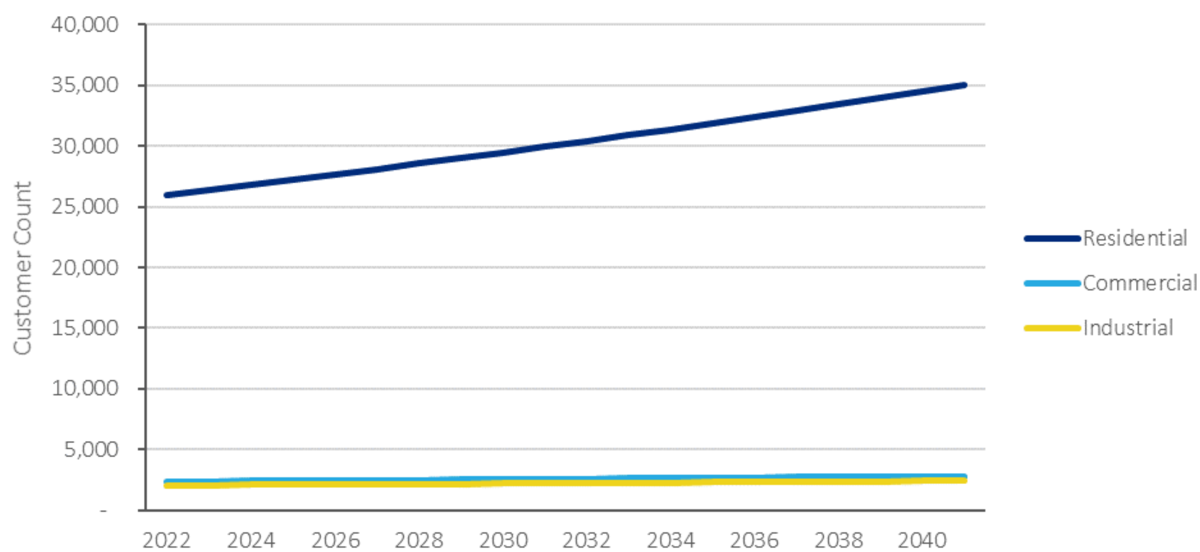


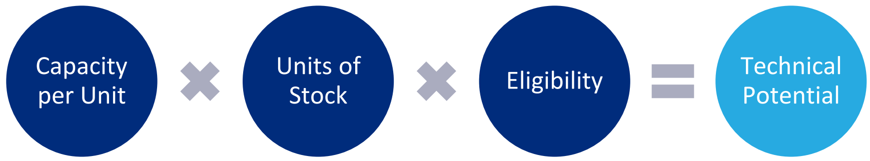
Figure 2: Customer Count Forecast by Sector



Technical Potential

The technical DR potential was quantified by a combination of bottom-up and top-down methodologies. In the bottom-up method, illustrated in Figure 3, the per-unit DR capacity reduction of each product was multiplied by the number of technically possible opportunities. The number of opportunities was determined by multiplying the units of stock, such as the number of homes, by an eligibility factor. This factor quantifies the share of units that are eligible to install the DR product or participate in a program. For example, in quantifying the potential associated with electric resistance water heaters, the eligibility factor would be the share of homes with electric resistance water heaters in RES's service territory.

Figure 3: Bottom-Up Technical Potential Calculation



This analysis used the capacity values determined by Council staff in the development of the 2021 Plan. Stock unit counts were developed from data provided by RES and additional public data. Finally, the eligibility factors were determined by a combination of data from RES's 2021 CPA and the 2021 Plan. Specifically, Lighthouse used projections of future adoption of smart thermostats and heat pump water heaters to inform the future potential identified this DRPA.

In the top-down method, the technical potential was determined by multiplying an assumption of the DR product's impact on load by an applicable load basis. The impact is expressed as a percentage, and the load basis is measured in units of demand. The load basis was determined by multiplying the load of a given customer segment by the share of load within the impacted end use. For example, with products controlling HVAC equipment, the customer segment's load used for HVAC was the starting point and was determined by multiplying an annual energy consumption value by an assumption of what percent of the load is consumed by HVAC equipment. Finally, a peak demand factor converted annual energy consumption values into an average peak demand, based on the expected number and duration of DR events. This calculation is shown in Figure 4.

Figure 4: Top-Down Technical Potential Calculation

In this equation, the load impact assumptions and end use shares were taken from the 2021 Plan. The segment loads within each sector were developed from updated sector-level forecasts developed as part of RES's 2021 Conservation Potential Assessment (CPA). Peak demand factors were calculated by Lighthouse based on 2021 Plan load shapes.

Achievable Potential

The achievable potential was quantified by incorporating additional considerations for program and event participation rates as well as program ramp up periods to the technical potential. Program participation is the proportion of eligible customers who participate in a DR program while event participation quantifies the share of program participants that participate in any given event. For DR products enabled through DLC, the event participation rate is based on the success of the controlled equipment responding to the control signal and reducing demand while for other types of programs this factor considers the likelihood of human intervention.

The annual acquisition of DR programs was determined by ramp rates. Ramp rates consider whether a program is starting from scratch or already has traction in the market and how long it will take to reach its maximum participation levels. This assessment used the ramp rates used in the draft 2021 Plan, where most products were given a ramp rate that reflects a 5- or 10-year ramp up period.

The calculation of achievable potential is the same for both bottom-up and top-down methods and is shown in Figure 5.

Figure 5: Achievable Potential Calculation

Economic Potential

The economic potential was determined by applying a cost-effectiveness screening to the achievable potential described above. To perform this screening, Lighthouse estimated the costs of capacity avoided through demand response for RES. As part of the CPA, Lighthouse identified the following avoided costs related to reductions in peak demand:

- Avoided capital costs related to the deferral or avoidance of capacity expansions on the transmission and distribution systems that deliver power to RES's customers
- Avoided generation capacity costs associated with reductions in peak demand

As discussed in the CPA, RES's avoided generation capacity costs are currently best reflected in the monthly demand charges paid to BPA. Lighthouse used these charges as well as estimates of the months in which each DR product could be used to estimate the avoided generation capacity costs for each DR product. These avoided generation capacity costs were combined with the avoided transmission and distribution system costs and compared with the costs of each product.

Results

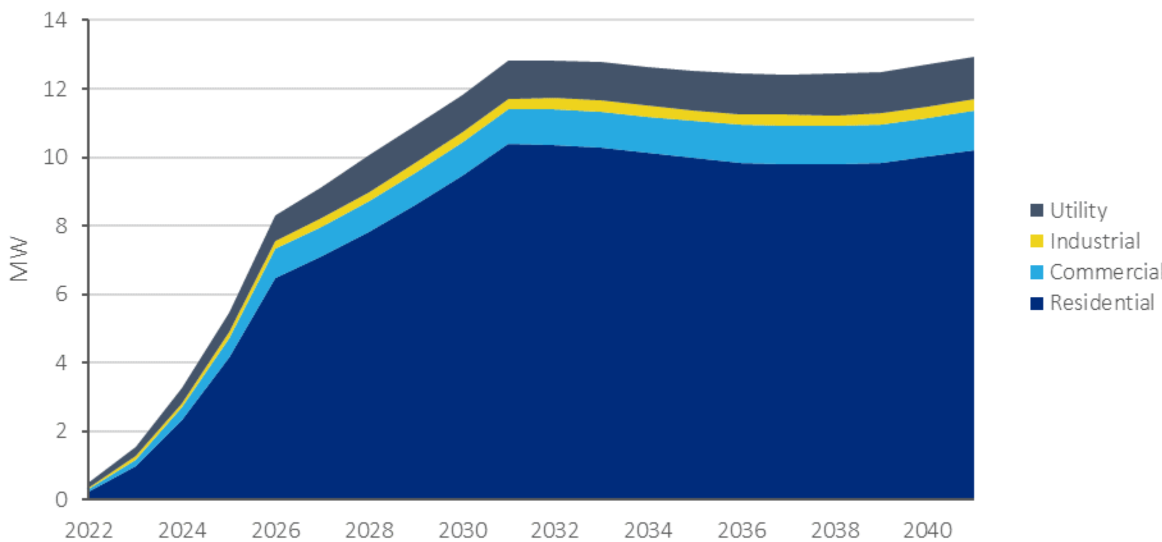
This section documents the results of the DRPA. It begins with the achievable potential available to RES and then discusses the costs and results of the economic screening used to identify the cost-effective potential.

Winter Achievable Potential

The estimated achievable winter DR potential is summarized by sector and year in Figure 6. The total winter potential is 12.9 MW, which is approximately 5.8% of RES's estimated 2041 winter peak demand. The potential reaches a high point in 2031 but then declines slightly afterwards due to the forecasted adoption of heat pump water heaters, which provide less load reduction for demand response. Additional potential is added at the very end due to the continued adoption of smart thermostats.

Most of the potential is in the residential sector, which totals 10.2 MW in the last year of the study period. The remaining potential is primarily in the commercial and utility sectors, with a small amount in the industrial sector. Together, the potential in these three sectors totals approximately 2.7 MW.

Figure 6: Annual Achievable Winter DR Potential by Sector



Most of the winter potential is spread across the categories of space heating and water heating, with pricing and curtailment and EV charging contributing smaller amounts. The pricing and curtailment categories are assumed to impact all customer end uses.

Figure 7 In Figure 7, potential for DVR is included in the pricing and curtailment category.

Figure 7shows how this potential breaks down by end use. In Figure 7, potential for DVR is included in the pricing and curtailment category.

Figure 7: Annual Achievable Winter DR Potential by End Use

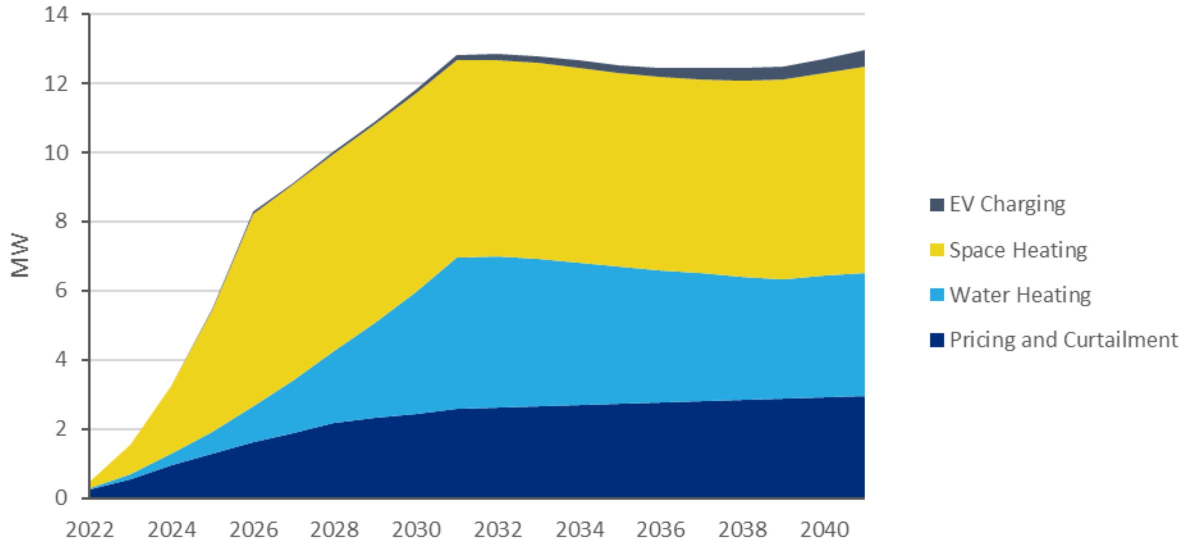
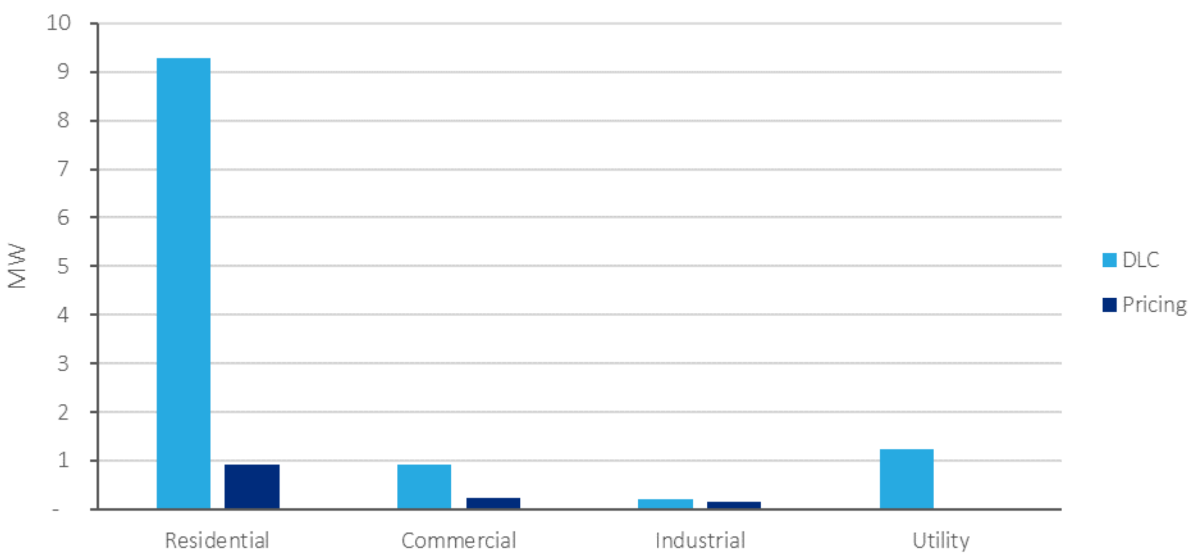


Figure 8 shows how this potential breaks down across the various product types within each sector. In this figure, the commercial and industrial curtailment products are classified as DLC products. Most of the potential is from DLC products, with smaller amounts coming from the pricing and demand curtailment strategies that require AMI.

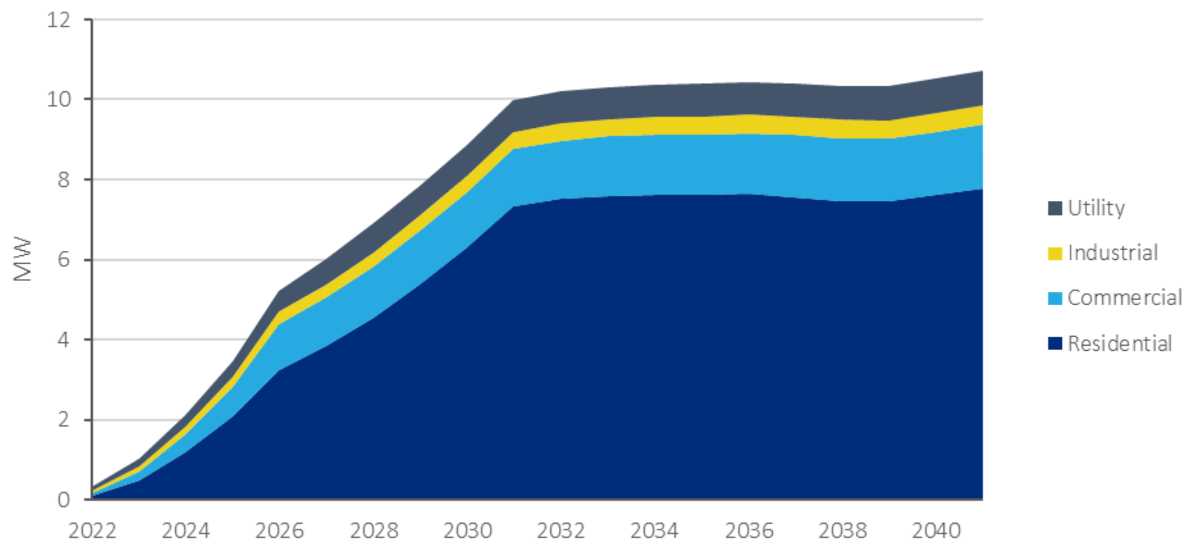
Figure 8: Achievable Winter DR Potential by Sector and Type



Summer Achievable Potential

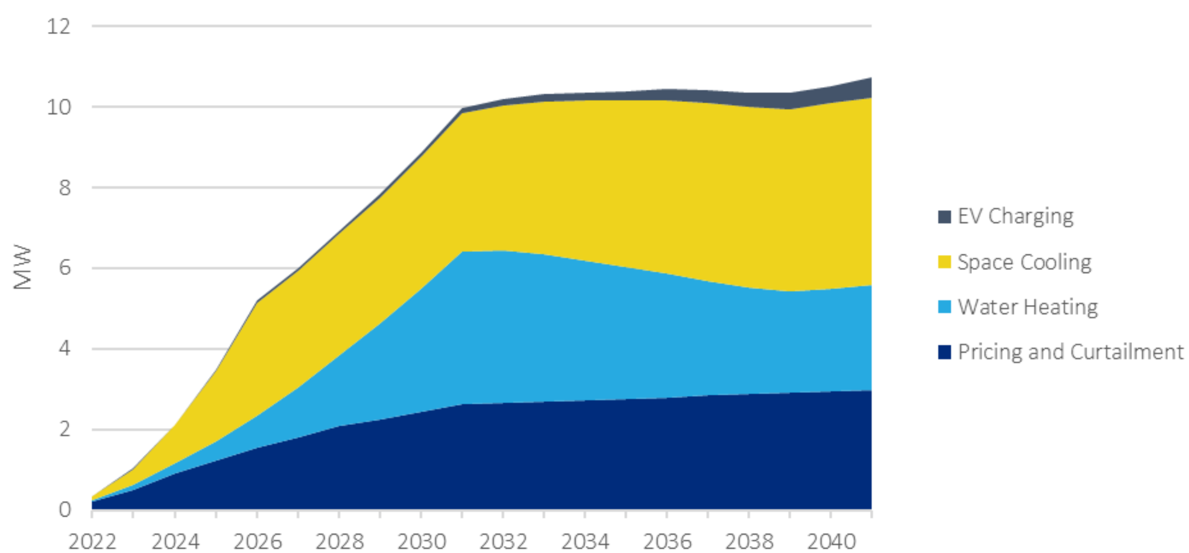
In the summer, RES has approximately 10.7 MW of achievable demand response available. Figure 9, below, shows the annual achievable summer potential by sector. The distribution of summer potential across sectors is similar to the winter potential, with slightly more potential available in the commercial sector due to higher air conditioning loads. Altogether, the achievable summer potential represents approximately 5% of RES's projected peak summer demand.

Figure 9: Annual Achievable Summer DR Potential by Sector



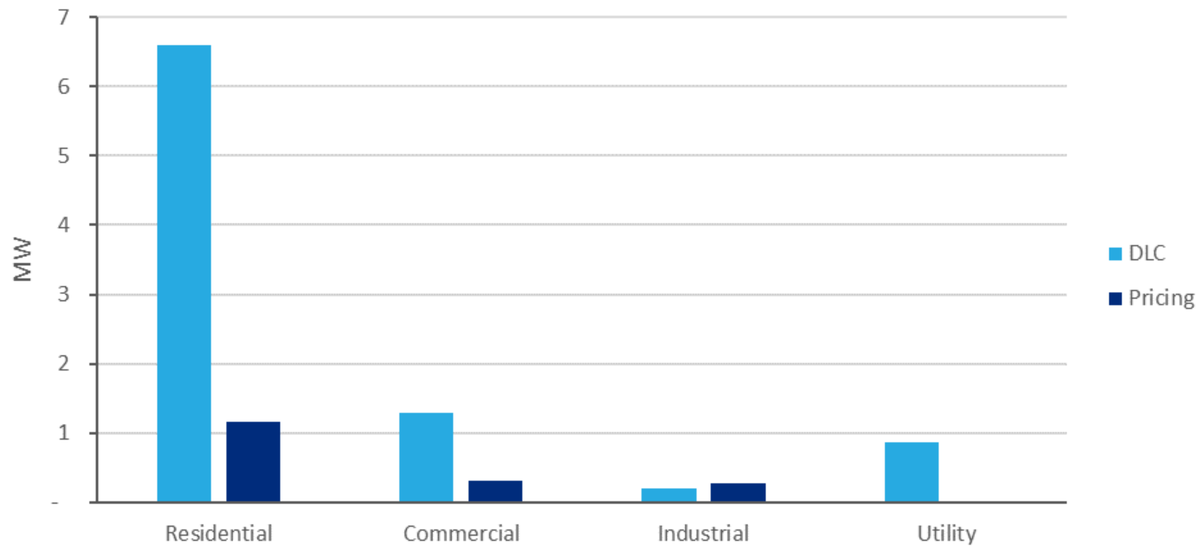
As shown in Figure 10, space cooling is the end use with the largest summer potential, followed by the pricing and curtailment and water heating end uses. As with the winter season, the potential for DVR is included in the pricing and curtailment end use, since it also impacts all customer end uses.

Figure 10: Annual Achievable Summer DR Potential by End Use



The breakdown of the 20-year potential by sector and product type is shown in Figure 11. Similar to the winter season, most of the summer potential is in residential DLC products.

Figure 11: Achievable Summer DR Potential by Sector and Type



Costs

A supply curve detailing the quantity of capacity and cost for each winter DR product is shown in Figure 12. The products are ranked by levelized cost in $/kW-year, with the lowest cost product at the bottom. As you move up the supply curve, the incremental DR potential for each product is shown in dark blue, with the cumulative potential from all previous products shown in lighter blue. The horizontal axis reflects the DR capacity available and the value at the end of each bar is the levelized cost of each product. The levelized cost calculations include the credits for deferred distribution and transmission system capacity costs, which result in a negative cost for DVR. These credits are the same credits that were used in RES's 2021 CPA.

Figure 12 shows that the individual products with the lowest costs include DVR and smart thermostats, both of which have a significant quantity of potential. DR from grid ready water heaters, including both electric resistance (ERWH) and heat pump (HPWH) also have high amounts potential, but at higher costs. The costs of the HPWH products are especially high at $127/kW-year as any program costs are spread over fewer megawatts since heat pump water heaters are more efficient and offer less in terms of available load reductions.

Figure 12: Winter DR Supply Curve (MW and $/kW-year)

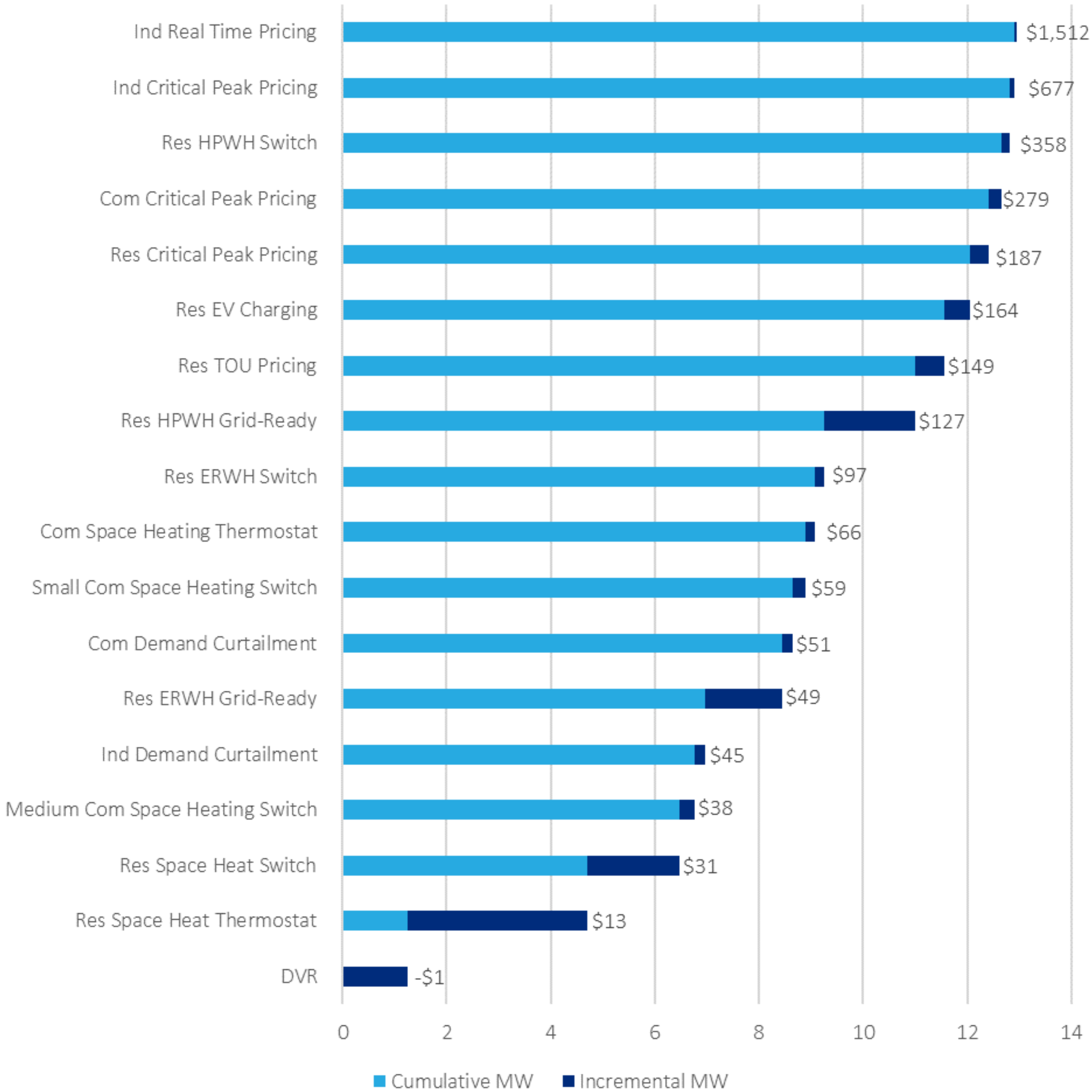
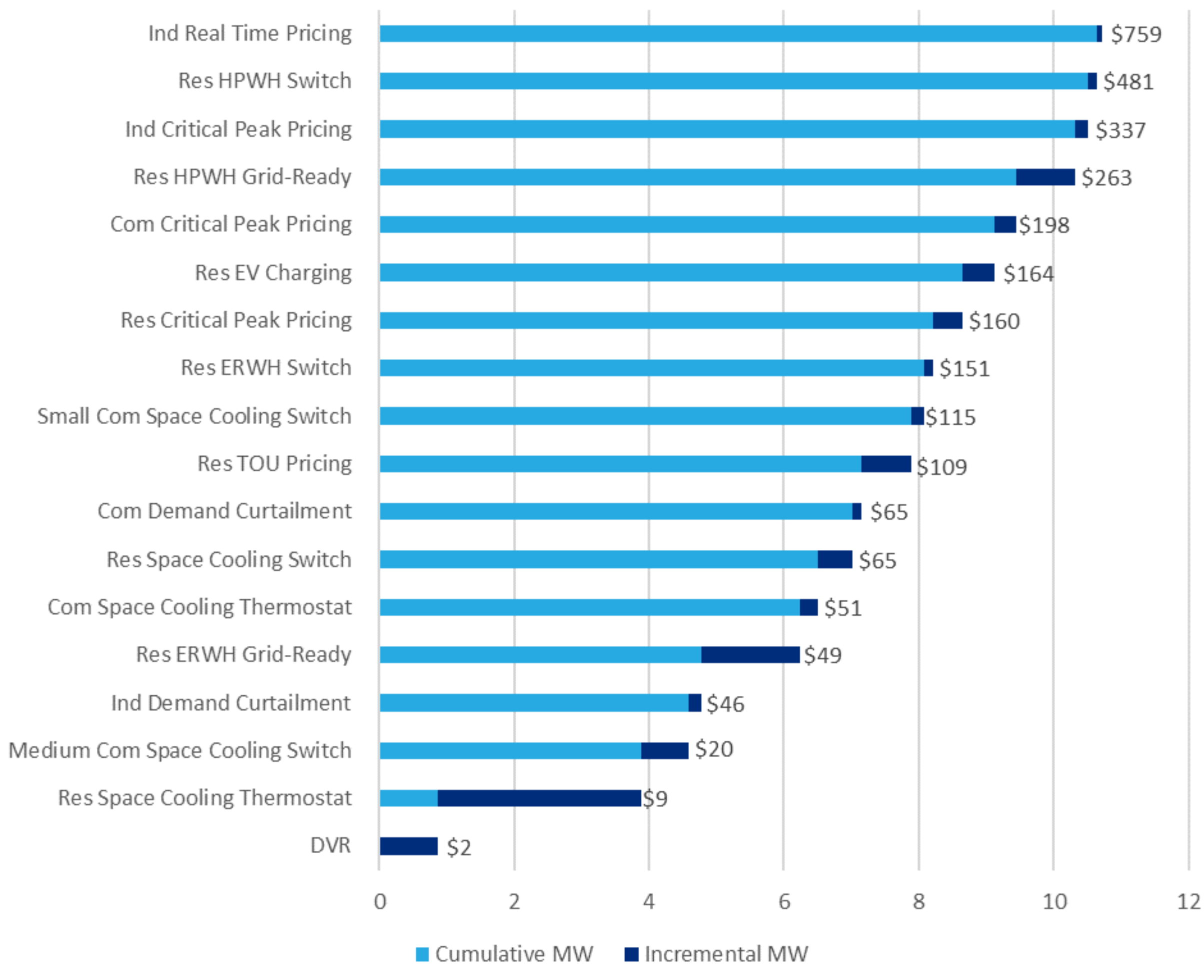


Figure 13 shows a similar supply curve for the summer DR products. The overall characteristics of the summer supply curve are similar to the winter supply curve discussed above. DVR and smart thermostats offer significant amounts of potential at low costs while water heating offers additional potential at higher costs.

Figure 13: Summer DR Supply Curve (MW and $/kW-year)



Cost Effectiveness

Table 2 shows the result of the cost-effectiveness screening for each winter DR product. Products are ranked in descending order by benefit-cost ratio. The 20-year DR potential for each product is also shown. DVR was the only winter product identified as cost effective, with residential smart thermostats falling just below the cost-effectiveness threshold of 1.0.

Table 2: Winter Benefit-Cost Ratio Results by Product

Product Name	Benefit-Cost Ratio	Cumulative MW
DVR	2.4	1.2
Res Space Heat Thermostat	0.9	3.4
Res ERWH Grid-Ready	0.8	1.5
Res Space Heat Switch	0.5	1.8
Medium Com Space Heating Switch	0.5	0.3
Res ERWH Switch	0.4	0.2
Ind Demand Curtailment	0.4	0.2
Com Demand Curtailment	0.4	0.2
Res HPWH Grid-Ready	0.3	1.8
Small Com Space Heating Switch	0.3	0.2
Res TOU Pricing	0.3	0.6
Com Space Heating Thermostat	0.3	0.2
Res HPWH Switch	0.1	0.2
Res EV Charging	0.1	0.5
Res Critical Peak Pricing	0.1	0.4
Com Critical Peak Pricing	0.1	0.2
Ind Critical Peak Pricing	0.0	0.1

In the summer season, both DVR and smart thermostats were identified as cost effective, as shown in Table 3 below. When considered across both summer and winter seasons, the smart thermostat product may be a cost-effective resource for RES as some of the same participants could participate across both seasons.

With a relatively small customer base, RES has a limited population to distribute the fixed costs associated with setting up and implementing demand response programs. In addition, RES can purchase capacity only in the months needed through BPA's monthly demand charges instead of procuring physical resources like power plants that are available all year round but may only be needed part of the year. This results in a low avoided generation capacity cost. Both factors make the economics of demand response difficult for RES. Accordingly the cost-effective demand response potential identified in this assessment was limited to two products.

Table 3: Summer Benefit-Cost Ratio Results by Product

Product Name	Benefit-Cost Ratio	Cumulative MW
DVR	1.9	0.9
Res Space Cooling Thermostat	1.2	3.0
Medium Com Space Cooling Switch	0.7	0.7
Res ERWH Grid-Ready	0.6	1.5
Ind Demand Curtailment	0.4	0.2
Com Space Cooling Thermostat	0.4	0.3
Res Space Cooling Switch	0.3	0.5
Com Demand Curtailment	0.3	0.1
Res TOU Pricing	0.3	0.7
Res ERWH Switch	0.2	0.1
Small Com Space Cooling Switch	0.2	0.2
Res Critical Peak Pricing	0.1	0.4
Res EV Charging	0.1	0.5
Res HPWH Grid-Ready	0.1	0.9
Com Critical Peak Pricing	0.1	0.3
Res HPWH Switch	0.1	0.1
Ind Critical Peak Pricing	0.1	0.2

Summary

This assessment summarizes the results of the 2021 DRPA conducted for RES. The products included and the methodology used were based on those used by the Council in the 2021 Plan, customized to RES's service territory, and aligned with the projections of RES's 2021 CPA. It included products applicable to the winter and summer seasons across the residential, commercial, industrial, and utility sectors using a variety of DLC, demand curtailment, and price-based strategies and targeting a variety of end uses.

Overall, the assessment quantified 12.9 MW of achievable winter DR potential and 10.7 MW in the summer. Most of the DR potential identified is in the residential sector, which is consistent with the makeup of RES's customer base. Utility DVR was cost-effective across both seasons and has already been implemented by RES. Smart thermostats used to control residential space heating and cooling equipment was the product with the highest potential across both seasons but was marginally cost-effective in the summer and just below the cost-effectiveness threshold in the winter. Lighthouse recommends that RES evaluate this product further to refine the program participation, cost, and impact assumptions to see if a DR program using this technology across both seasons could be a cost-effective capacity resource.

Appendix

DR Product Info					
Sector	End Use	Product	Type	Impact	Methodology
Residential	EV Charging	Res EV Charging - Winter	DLC	Winter	Bottom Up
Residential	EV Charging	Res EV Charging - Summer	DLC	Summer	Bottom Up
Residential	Water Heating	Res ERWH Switch - Winter	DLC	Winter	Bottom Up
Residential	Water Heating	Res ERWH Switch - Summer	DLC	Summer	Bottom Up
Residential	Water Heating	Res ERWH Grid-Ready - Winter	DLC	Winter	Bottom Up
Residential	Water Heating	Res ERWH Grid-Ready - Summer	DLC	Summer	Bottom Up
Residential	Water Heating	Res HPWH Switch - Winter	DLC	Winter	Bottom Up
Residential	Water Heating	Res HPWH Switch - Summer	DLC	Summer	Bottom Up
Residential	Water Heating	Res HPWH Grid-Ready - Winter	DLC	Winter	Bottom Up
Residential	Water Heating	Res HPWH Grid-Ready - Summer	DLC	Summer	Bottom Up
Residential	Space Heating	Res Space Heat Switch - East	DLC	Winter	Bottom Up
Residential	Space Cooling	Res Space Cooling Switch - East	DLC	Summer	Bottom Up
Residential	Space Heating	Res Space Heat Thermostat - East	DLC	Winter	Bottom Up
Residential	Space Cooling	Res Space Cooling Thermostat - East	DLC	Summer	Bottom Up
Commercial	Space Heating	Com Space Heating Switch - Small/East	DLC	Winter	Bottom Up
Commercial	Space Cooling	Com Space Cooling Switch - Small/East	DLC	Summer	Bottom Up
Commercial	Space Heating	Com Space Heating Thermostat - East	DLC	Winter	Bottom Up
Commercial	Space Cooling	Com Space Cooling Thermostat - East	DLC	Summer	Bottom Up
Commercial	Space Heating	Com Space Heating Switch - Medium/East	DLC	Winter	Bottom Up
Commercial	Space Cooling	Com Space Cooling Switch - Medium/East	DLC	Summer	Bottom Up
Commercial	All	Com Demand Curtailment - Winter	DLC	Winter	Top Down
Commercial	All	Com Demand Curtailment - Summer	DLC	Summer	Top Down
Industrial	All	Ind Demand Curtailment - Winter	DLC	Winter	Top Down
Industrial	All	Ind Demand Curtailment - Summer	DLC	Summer	Top Down
Residential	All	Res TOU Pricing - Winter	Pricing	Winter	Top Down
Residential	All	Res TOU Pricing - Summer	Pricing	Summer	Top Down
Residential	All	Res Critical Peak Pricing - Winter	Pricing	Winter	Top Down
Residential	All	Res Critical Peak Pricing - Summer	Pricing	Summer	Top Down
Commercial	All	Com Critical Peak Pricing - Winter	Pricing	Winter	Top Down
Commercial	All	Com Critical Peak Pricing - Summer	Pricing	Summer	Top Down
Industrial	All	Ind Critical Peak Pricing - Winter	Pricing	Winter	Top Down
Industrial	All	Ind Critical Peak Pricing - Summer	Pricing	Summer	Top Down
Industrial	All	Ind Real Time Pricing - Winter	Pricing	Winter	Top Down
Industrial	All	Ind Real Time Pricing - Summer	Pricing	Summer	Top Down