MEMORANDUM

EUGENE WATER & ELECTRIC BOARD

Rely on us.

TO:	Commissioners Barofsky, Schlossberg, Brown, Carlson, and Morris
FROM:	Brian Booth, Chief Energy Resources Officer; Ben Ulrich, Lead Energy Resource Analyst; Juan Serpa Muñoz, Business Line Manager
DATE:	March 7, 2025
SUBJECT:	Demand Side Potential Study – Phase 1 Draft and Initial Results
OBJECTIVE:	Information

Issue

EWEB hired Lighthouse Energy Consulting (LEC) to assess demand-side potential in EWEB service territory, including energy conservation, demand response, customer-owned solar, and electrification. The consultant has delivered draft reports for Phase 1 (focusing on energy conservation and demand response), which are included as Attachments A and B. Staff will provide context and insights to the Phase 1 study findings at the March 18th EWEB Board work session.

Background

EWEB's 2023 Integrated Resource Plan projected that, by 2028, electricity consumption could outpace our current energy conservation efforts due to electrification trends and population growth. To better understand the potential to offset future load growth, the 2023 IRP action plan directed staff to conduct a Demand Side Potential Assessment (DSPA) to estimate the cost and potential for demand-side measures to offset anticipated growth in customer energy and peak capacity consumption. Furthermore, staff wanted to understand the potential impacts of customer-owned solar as well as electrification on EWEB's loads in the future.

In early 2024, Lighthouse Energy Consulting (LEC) was selected to conduct a Demand Side Potential Assessment (DSPA). The DSPA was separated into two phases:

- **Phase 1** - Conservation Potential Assessment (CPA) and Demand Response Potential Assessment (DRPA) with initial deliverables in Q1 2025 and final deliverables in Q2 2025.
- **Phase 2** - Electrification Potential Assessment (EPA) and Customer-Owned Solar Photovoltaic Potential Assessment (COSPPA) with initial and final deliverables in Q2 2025.

The Phase 1 DSPA study provides essential input assumptions for EWEB's Integrated Resource Planning (IRP) model, enabling direct cost-effectiveness comparisons between demand-side options (energy conservation and demand response) and supply-side options (wind, solar, utility-scale batteries, etc.). The study forecasted potential annual energy and peak impacts from energy conservation and demand response over the 2024-2045 period, categorized into eight levelized cost bins ranging from under $45/MWh to over $120/MWh. LEC delivered these IRP input assumptions in early 2025, and staff are currently reviewing the methodology and initial data deliverables behind these inputs. Staff continue to review the study results to ensure a comprehensive understanding of the underlying assumptions and their implications for long-term resource planning. Draft reports for both the CPA and DRPA are included with this memo.

Discussion

One component of the DSPA is to assist in determining how customer programs could meet EWEB's long-term energy needs over the next 20 years. The study utilized the best available EWEB-specific customer, building and demographic data. The assessment also relied on regional data to fill any gaps where EWEB-specific information was lacking. Staff now have more accurate demand-side resource inputs which can be used in future IRP efforts. Phase 1 results indicate that there is achievable, cost-effective energy savings potential to keep pace with approximately half of EWEB's forecasted annual load growth. However, further evaluation of study results will be required to assess for cost-effectiveness of program delivery and feasibility.

Feasibility considerations include staffing, program design, customer willingness and ability to participate, contractor capacity and interest, and equipment availability. As staff evaluate the specific, cost-effective conservation measures identified in the study, they will develop the context needed to inform EWEB's implementation strategy. Initial review of the study results suggests that a shift in EWEB's conservation approach will be necessary to achieve these potential energy savings. This will likely include reevaluating how we assess program cost-effectiveness and exploring customer social equity considerations. The DSPA is the first step in the process, and staff look forward to working with commissioners to make informed strategic decisions regarding investment in energy conservation and demand response programs over the next 20 years.

TBL Assessment

No Triple Bottom Line Assessment is required at this time. DSPA results are being presented for information purposes only.

Recommendation & Requested Board Action

No action or direction needed. Initial Phase 1 study results are being shared with commissioners to provide information and context which will be useful in future discussions around energy conservation, demand response and power supply decisions.

APPENDIX A

2024 CONSERVATION POTENTIAL ASSESSMENT

Eugene Water & Electric Board

March 6, 2025

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Prepared by:

LIGHTHOUSE ENERGY CONSULTING

Nauvoo Solutions

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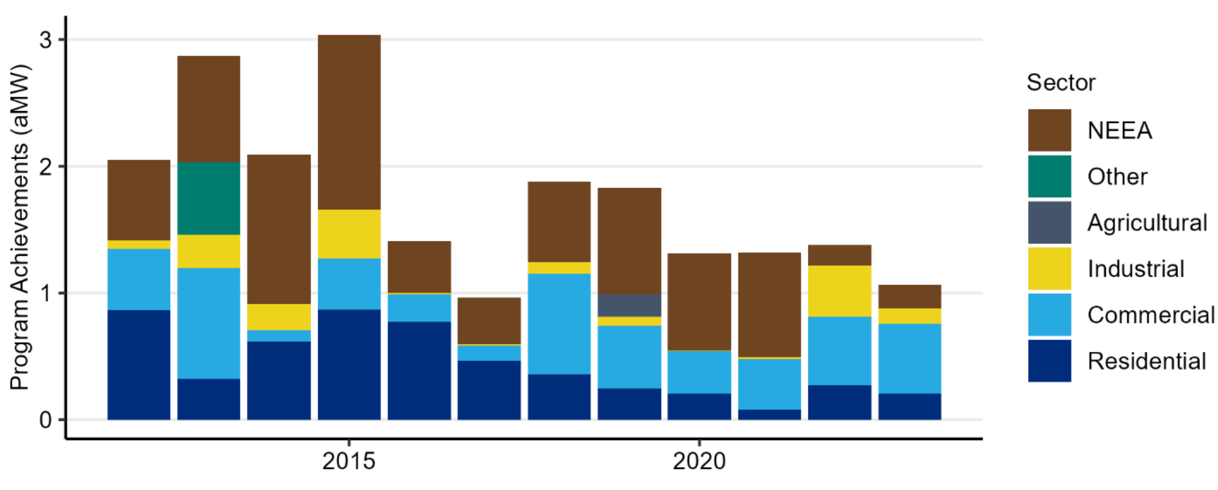
Executive Summary

Overview

This report describes the methodology and results of a conservation potential assessment (CPA) conducted by Lighthouse Energy Consulting and Nauvoo Solutions (the project team) for Eugene Water & Electric Board (EWEB). The CPA estimated the achievable energy efficiency savings potential for 2024 to 2045, the results of which were provided as an input to EWEB's integrated resource planning (IRP) process, where the cost-effective potential was determined through EWEB's optimization modeling. In addition to the IRP inputs, the project team provided complete detailed results data for EWEB staff to review and analyze. This report is one component of a broader Demand Side Potential Assessment that includes demand response, customer-owned rooftop solar, and electrification. The results of these other assessments are not covered here but are reported separately.

By customer count, EWEB is the largest publicly owned utility in Oregon, providing electricity service to nearly 100,000 customers. By sales, EWEB is second only to the Umatilla Electric Cooperative, which serves large data centers. EWEB has a long history of conservation achievement. Its program history since 2012 is shown in Figure 1, which is based on the Regional Technical Forum's (RTF) Regional Conservation Progress report. Over this period, EWEB's programs have averaged nearly 1.1 aMW or 9,500 MWh per year. EWEB also benefits from the market transformation work of the Northwest Energy Efficiency Alliance (NEEA). NEEA works to bring new technologies like heat pump water heaters and ductless heat pumps to the Northwest and advance building codes and product standards. Savings from NEEA have provided 0.7 aMW per year on average across this period in addition to the savings from EWEB's own programs.

Figure 1: Historic Program Achievements (aMW)



This CPA used much of the final 2021 Power Plan materials, with customizations to make the results specific to EWEB's service territory and customers. It also extends the typical 20-year timeline to cover the 22-year period EWEB required. Notable customizations in this CPA to make it specific to EWEB include the following:

- Energy Efficiency Measures
  - This assessment uses the measure savings, costs, and other characteristics based on the measures included in the final 2021 Power Plan, with updates to many measures based on new information from the RTF and additional customizations to make the measures specific to EWEB.
  - Tax credits and incentives available through the Inflation Reduction Act were added to some Air Source Heat Pump measures, which have historically struggled with cost-effectiveness. The tax credits and incentives were deducted from the costs of these measures, similar to how tax credits are deducted from utility-scale wind and solar projects. This reduced the cost for a portion of the potential associated with these measures, based on estimates of the number of homes that would qualify and participate.
- Customer Characteristics
  - The residential customer characteristics for building type, rental status, new construction heating fuel, and income designations were developed based on census data for EWEB service area zip codes.
  - The saturations of electric equipment for residential customers were determined using data from the 2022 Residential Building Stock Assessment (RBSA) that reflected EWEB customers to the greatest extent possible.
  - EWEB provided a customer database populated with information from the Regional Land Information Database (RLID) that the project team was able to leverage to disaggregate commercial and industrial customers into building segments consistent with the Northwest Power and Conservation Council (Council) definitions.
- Program Impacts
  - Incorporation of EWEB's recent conservation program achievements to account for what was already accomplished and estimate what may be possible in the near future.

Results

Figure 2 and Table 1 show the achievable energy efficiency potential identified by this study, by sector, over 2-, 4-, 10-, and 22-year periods. Over the 22-year planning period, EWEB has nearly 85 aMW of achievable conservation available, which is approximately 23% of its projected 2045 load.

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Figure 2: Achievable Potential by Sector (aMW)

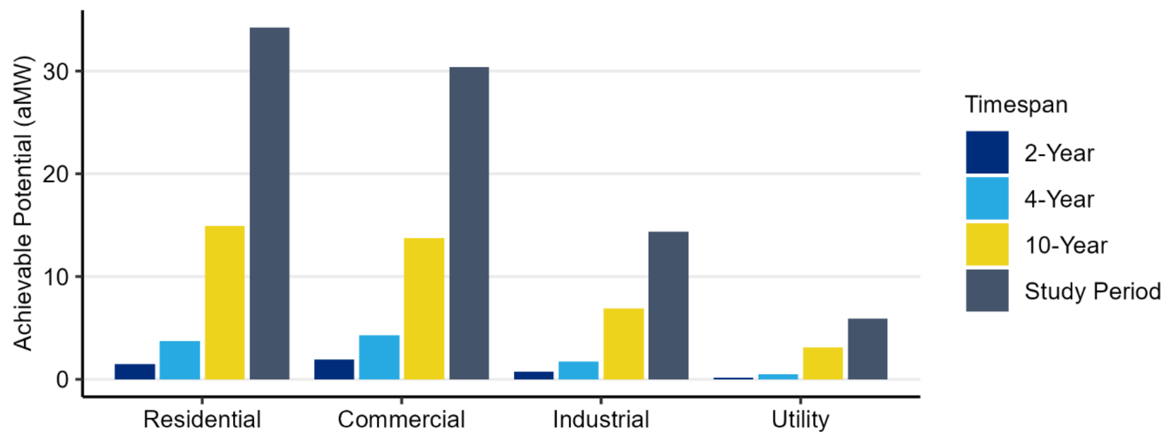


Table 1: Achievable Potential by Sector (aMW)

Sector	2-Year	4-Year	10-Year	22-Year
Residential	1.5	3.7	14.9	34.2
Commercial	1.9	4.3	13.8	30.4
Industrial	0.7	1.7	6.9	14.4
Utility[1]	0.1	0.5	3.1	5.9
Total	**4.2**	**10.2**	**38.7**	**84.9**

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

The residential and commercial sectors are the two largest components of EWEB's overall load, and most of the energy efficiency potential comes from these sectors.

This assessment does not specify how the energy efficiency potential will be achieved. Possible mechanisms include EWEB'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 achieved through several of these mechanisms over the course of its technological maturity. For example, heat pump water heaters started as one of NEEA's market transformation initiatives. They subsequently became a regular offering in utility programs across the Northwest and have recently been included in federal product standards that take effect in 2029. Achieving the full conservation potential may require changes in program design, incentive levels, staffing, or other changes. The assessment considered the full cost of measures in the levelized cost calculations and therefore EWEB could pay up to this cost in order to achieve the potential without changes to the cost effectiveness.

Energy efficiency also contributes to reductions in peak demand. This assessment used hourly load and savings profiles developed by the Council to identify the demand savings from each measure that would occur during EWEB's system peak. The energy savings potential identified through this assessment will result in 150 MW of peak demand savings over the 22-year planning period, as shown in Table 2. This represents approximately 23% of EWEB's projected 2045 peak demand and

[1] Savings in the utility sector come from utility regulation of distribution system voltage levels. See the Utility Distribution System section for further details.

is nearly double the energy savings potential identified above. Energy efficiency savings tend to occur when energy demands are the greatest, significantly contributing to reductions in peak demand.

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

Sector	2-Year	4-Year	10-Year	22-Year
Residential	3.2	8.3	35.6	86.5
Commercial	2.6	5.8	18.0	38.5
Industrial	0.8	2.1	8.3	17.1
Utility	0.2	0.6	4.2	7.9
Total	**6.8**	**16.8**	**66.1**	**150.0**

The annual achievable energy efficiency potential by sector is shown in Figure 3. The available potential starts just below 2 aMW in 2024 and grows to a maximum of approximately 5.5 aMW in 2034. After that point, the available potential diminishes through the remaining years of the planning period.

Figure 3: Annual Incremental Achievable Energy Efficiency Potential (aMW)

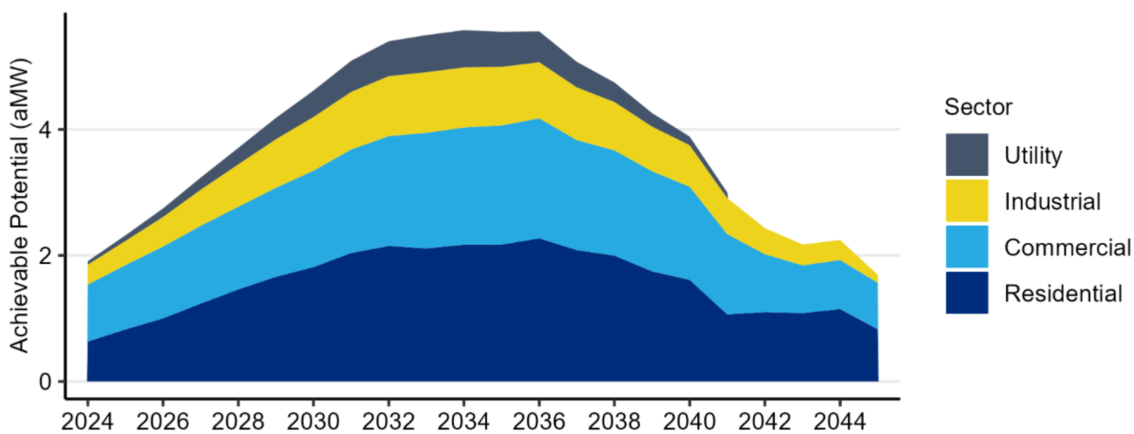
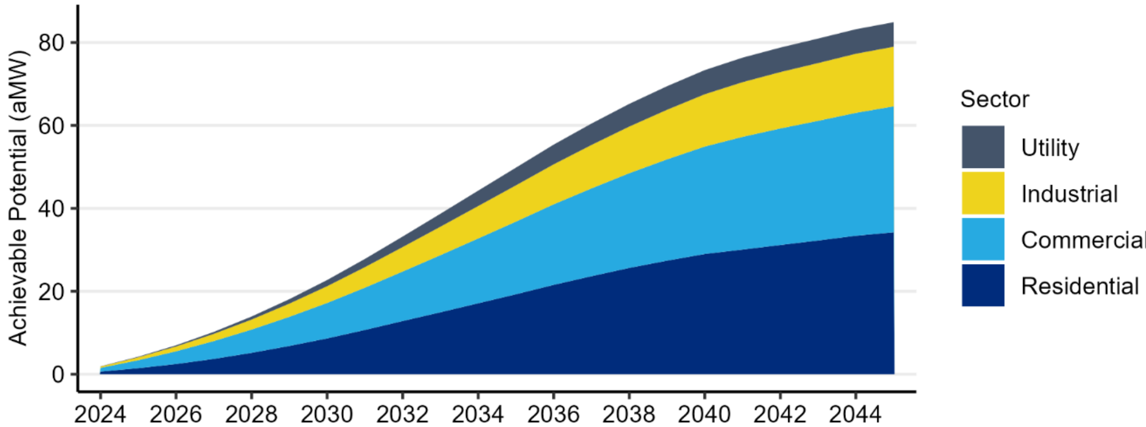


Figure 4 shows how the achievable energy efficiency potential grows on a cumulative basis through the study period, totaling nearly 85 aMW over the 22-year planning period.

Figure 4: Annual Cumulative Achievable Energy Efficiency Potential (aMW)



The year-by-year estimates of energy efficiency potential are based on ramp rates developed by the Council. Ramp rates identify the share of available potential that can be acquired in each year and reflect the market and program maturity of each measure. For each measure, the project team applied a ramp rate that would align the near-term potential with EWEB's recent program achievements and the savings from NEEA's market transformation initiatives estimated to occur in EWEB's service territory. Program achievement data for 2022 through the first half of 2024 were provided by EWEB staff, and the project team assigned appropriate ramp rates for each measure so that the future acquisition of energy efficiency was aligned with recent program history while ensuring the acquisition of all energy efficiency potential over the 22-year planning period. Since this assessment did not evaluate the cost-effectiveness of measures, the project team assumed that measures with levelized costs below $65 per megawatt-hour would be identified as cost-effective in the current IRP and adjusted ramp rates to ensure that future measures below this cost threshold aligned with EWEB's recent accomplishments.

Conclusion

This report summarizes the CPA conducted for EWEB for the 2024 to 2045 timeframe. The CPA identified the achievable potential available in EWEB's service territory and provided it to EWEB for inclusion in their IRP modeling process. While all of the potential will not be cost-effective to acquire, in total, the achievable potential could reduce both EWEB's annual energy and peak demand needs by 23%.

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Introduction

Objectives

This report describes the methodology and results of a CPA conducted for EWEB. The CPA estimated the achievable potential energy savings for the period of 2024 to 2045, the results of which were provided for use in EWEB's IRP process, where the cost-effective energy efficiency potential was determined through EWEB's optimization modeling.

The results of this assessment, combined with the results of EWEB's IRP modeling, can assist EWEB in planning its energy efficiency programs by identifying the amount of cost-effective energy savings available in various sectors, end uses, and measures. This report is one component of a broader Demand Side Potential Assessment that also includes demand response, customer-owned rooftop solar, and electrification. The results of these other assessments are not covered here but are reported separately.

Study Uncertainties

There are uncertainties inherent in any long-term planning effort. While this assessment uses 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 EWEB's customers. In some cases, however, the assessment relied upon data beyond EWEB's service territory due to limitations of adequate sample sizes. Therefore, there are uncertainties related to how much this data reflects EWEB'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 judgment.
- Utility System Assumptions: Measures in this CPA reflect cost credits based on their ability to free up transmission and distribution system capacity. The actual value of these credits is dependent on local conditions, which vary across EWEB's service territory.
- Load and Customer Growth Forecasts: This CPA uses projections of future customer and load growth over a 22-year period. Any forecast over a similar period will include a significant level of uncertainty.
- Policy Changes: The assessment is based on policies in place at the time of its development. Future changes to the policy environment are difficult to predict and could lead to significant changes to loads, cost effectiveness of measures, or other study outcomes.

Due to these uncertainties and the continually changing planning environment, many utilities update their CPAs regularly to reflect the best available data and the latest market conditions.

Report Organization

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

- Methodology
- Customer Characteristics

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- Recent Conservation Achievement
- Achievable Potential Results
- References & Appendices

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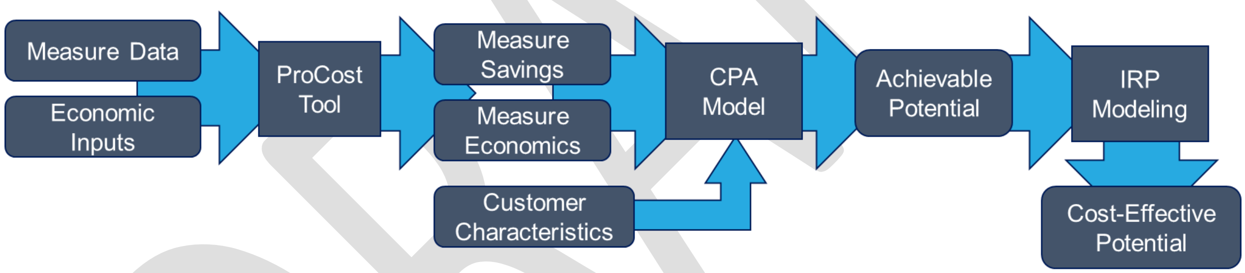
Methodology

This section provides an overview of the methodology used to develop the estimate of achievable conservation potential for EWEB. The development of the conservation potential follows much of the methodology used by the Council in developing its regional power plans, including the 2021 Power Plan.

High-level Methodology

The high-level methodology used for this assessment is illustrated in Figure 5. The process combines data on individual energy efficiency measures and economic assumptions using the Council's ProCost tool. This tool calculates detailed data on the costs and benefits of each measure, which are used to calculate a levelized cost. The measure savings and economics are combined with customer data in Lighthouse's CPA model, quantifying the number of remaining implementation opportunities. The savings associated with each of these opportunities are then aggregated in the CPA model to determine the overall potential. Measures with a similar cost and seasonality of their savings are bundled and provided to EWEB for use in its IRP modeling. The IRP modeling determines the amount of energy efficiency potential that is cost-effective through its optimization process, developing a resource portfolio that balances cost and risk.

Figure 5: Conservation Potential Assessment Methodology



Economic Inputs

As stated above, EWEB's IRP modeling is used to determine the amount of energy efficiency potential that is cost-effective. However, the CPA relied on some economic assumptions to develop the levelized costs that were provided with the savings potential as inputs to the IRP. The project team coordinated with EWEB's staff to determine which economic values would be included in the CPA and those that would be included as part of the IRP analysis. Some values, such as the discount rate, are used in both analyses.

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Table 3 summarizes the typical costs and benefits of energy efficiency measures and where each component was considered as part of this CPA.

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Table 3: Inclusion of Energy Efficiency Costs and Benefits

Category	Cost or Benefit	CPA	IRP
Costs	Measure Capital Costs	✓	
	Operations & Maintenance	✓	
	Program Administration	✓	
	Other Fuel	✓	
Benefits	Avoided Energy		✓
	Non-Energy Impacts	✓	
	Deferred T&D Capacity	✓	
	Deferred Generation Capacity		✓
	NW Power Act Credit	✓	
	Risk Mitigation		✓

Many cost assumptions and some of the benefits included in the CPA are specific to each measure. However, there are several global assumptions that were applied across all measures. This includes the program administrative cost assumption, deferred transmission and distribution capacity, and the Northwest Power Act Credit. The sections below discuss these avoided cost assumptions.

Program Administration Costs

This assessment assumes that program administration costs are equal to 27% of the cost of each measure. In the past three power plans, the Council has assumed that program administrative costs are equal to 20% of measure costs. Based on data from EWEB, we adjusted the Council's assumption upward to better reflect EWEB's actual costs.

Deferred Transmission and Distribution System Costs

Unlike supply-side resources, energy efficiency does not require transmission and distribution infrastructure capacity. 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 9th Power Plan, Council staff surveyed regional utilities to collect values for deferred transmission and distribution system costs. Council staff reported on these values, differentiating the results between the east and west sides of the Cascades. This assessment uses the west values of $22 and $33 per kW-year for transmission and distribution, respectively. These values are applied to each measure based on the degree to which they reduce demand during system peaks.

Northwest Power Act Credit

The Northwest Electric Power Planning and Conservation Act specifies that energy efficiency be given a 10% cost credit in the Council's regional power planning work. Utilities throughout the Northwest follow this practice in their own CPAs, and it was similarly included in this work. Because the treatment of measure benefits is spread across both the CPA and IRP, but all costs are considered in the CPA, the 10% cost credit is applied in the CPA as a 10% reduction to the measure costs.

Other Financial Assumptions

In addition, this assessment uses an assumed discount rate to convert future costs and benefits to present values so that values occurring in different years can be compared. This assessment uses a

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real discount rate of 3.75%, which was the value used in the 2021 Power Plan. Energy efficiency's 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), EWEB, 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 2021 Power Plan.

Measure Characterization

Measure characterization is the process of defining each individual measure, including the savings at the meter and the cost, lifetime, non-energy impacts, and a load or savings shape that defines when the savings occur. The Council's 2021 Power Plan materials are the primary source for this information, although the project team incorporated updated information from the RTF for many measures. Appendix IV contains the full list of energy efficiency measures and the source(s) of information used for each.

Measure savings are typically defined via a "last in" approach. With this methodology, each measure's savings is determined as if it was the last measure installed. Under this approach, savings from home weatherization measures would be determined based on the assumption that the home's heating system has already been upgraded. Similarly, the heating system measure saving would be 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 systems results in less wasted energy released as heat, which impacts the demands on heating and cooling systems.

These measure characteristics and the economic assumptions described above 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 at the same time as EWEB's system peak. The outputs of ProCost are used to calculate a levelized cost that is passed through to EWEB's IRP modeling.

Customer Characteristics

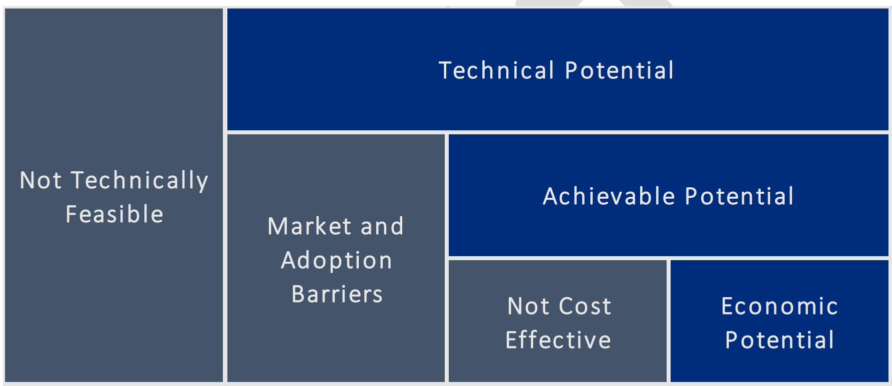
Customer characteristics are assessed to determine the number of remaining measure installation opportunities for each measure and extend the savings of a single measure to an estimate of energy savings potential across the entire utility service territory. These estimates are based on the applicability of a measure given the distribution of customers and equipment, which requires identifying the number of opportunities overall and the share that has already been completed. The characterization of EWEB's customer base was completed using Regional Land Information Database (RLID) data provided by EWEB, NEEA's commercial and residential building stock assessments, US Census data, and Council data. Details for each sector are described subsequently in this report.

This CPA used baseline measure saturation data from the Council's 2021 Power Plan. This data was developed from NEEA's stock assessments, market research, and other studies. This data was supplemented with EWEB'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 Lighthouse's CPA model. The model calculated two types of energy efficiency potential: technical and achievable potential. A third category of potential, called economic or cost-effective potential, was determined by EWEB's IRP modeling. The three types of potential are depicted in Figure 6 and described further 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 individual measure savings by the number of remaining feasible installation opportunities.

The model then applies several filters, incorporating market and adoption barriers to estimate the achievable potential. These filters include assumptions about the maximum potential adoption and the pace of annual achievements. Energy efficiency planners generally assume that not all measure opportunities will be installed; some portion of the technically possible measure opportunities will remain unavailable due to unsurmountable barriers. In the Northwest, planners typically assume that 85% of all measure opportunities can be achieved. This assumption comes from a pilot study conducted in Hood River, Oregon, where home weatherization measures were offered at no cost. The pilot reached over 90% of homes and completed 85% of identified measure opportunities. In the 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 program and market maturity levels and the practical constraints of what utility programs can accomplish in a given year.

Finally, economic potential is determined by limiting the achievable potential to those measures that pass an economic screen. In utility resource planning, utilities typically use the total resource cost (TRC) perspective, which was used for this assessment. The TRC perspective considers all costs and benefits, regardless of who pays the cost or receives the benefit. The costs and benefits included in the TRC test are summarized in

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Table 3 above.

For this CPA, the economic screening was completed through EWEB's IRP modeling, which compared the costs of energy efficiency measures with other supply-side resources. The project team provided EWEB with estimates of the hourly achievable potential for groups of measures with similar costs and seasonal savings shapes. EWEB's IRP model then compared different resource portfolios to find the combination of demand and supply side resources that provided the optimal balance of least cost and risk. The energy efficiency resources in this optimal portfolio are, therefore, cost-effective.

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Customer Characteristics

Overall

This section describes the characterization of EWEB's customers, which is an essential component of the 2024 DSPA. It includes defining the makeup and characteristics of each sector, which determines the type and quantity of opportunities to implement energy efficiency measures, demand response programs, and other distributed energy resources.[2] In this process, the study team relied on data specific to EWEB's service area to the greatest extent possible. Table 4 provides a summary of the data sources used to characterize each customer sector.

Table 4. Primary Customer Characterization Data Sources by Sector

Item	Residential	Commercial	Industrial
Customer Forecast	EWEB Customer Forecast	EWEB Customer Forecast & EWEB Customer Database	EWEB Customer Forecast & EWEB Customer Database
Sales Forecast	EWEB Load Forecast	EWEB Load Forecast & EWEB Customer Database	EWEB Load Forecast & EWEB Customer Database
Segmentation	2022 American Community Survey (ACS)	EWEB Customer Database	EWEB Customer Database
Equipment Saturations	2022 ACS 2022 RBSA	N/A	N/A

Note: The EWEB Customer Database was provided by EWEB with supplemental data from the Lane County Regional Land Information Database (RLID)

EWEB's 2024 estimated customers and their corresponding sales can be divided among the three primary sectors[3] as shown in Table 5.

Table 5. 2024 Customer Counts and Sales by Sector

Sector	2024 Customers	2024 Sales (MWh)	MWh/Customer
Residential	88,500	987,380	11.16
Commercial	9,493	689,671	72.65
Industrial	837	631,271	753.78
Total	**92,806**	**2,308,323**	**24.87**

The distribution of sales is such that the majority (43%) is residential, followed by commercial (30%) and industrial (27%).

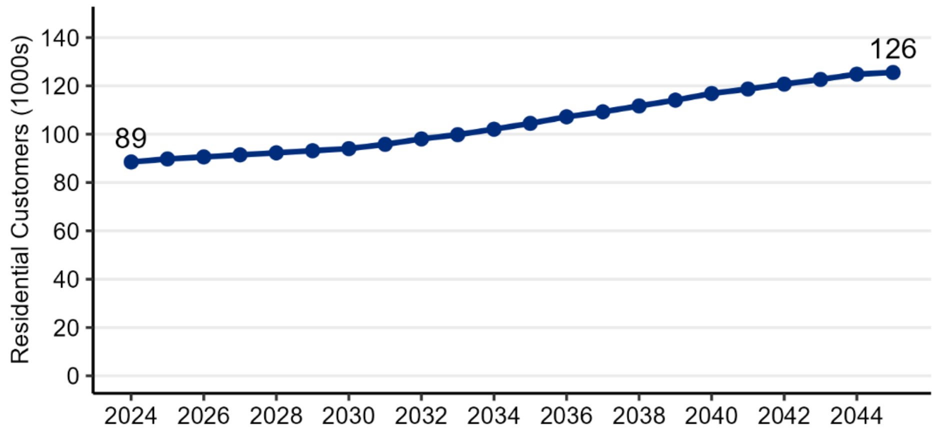
[2] All customer characterization data in this report serves as input to the distributed energy resource modeling, but the segment and sector distributions are not directly equivalent to the distribution of resource potential. This is a result of the differing distributed energy resource measures and programs being viable within the unique customer segments.

[3] Sector definitions are based on the Council's sector definitions for evaluating energy efficiency and demand response measures. These definitions may vary from utility rate class definitions.

Residential

The residential sector is EWEB's largest sector in terms of customers and sales. To align with EWEB's forecast data, the study team based its forecasts of residential customers and sales on forecast data provided by EWEB in June of 2024. Figure 7[4] shows the residential customer forecast over the study horizon, which indicates a compound annual growth rate of 1.68% between 2024 and 2045.

Figure 7. Residential Customer Forecast

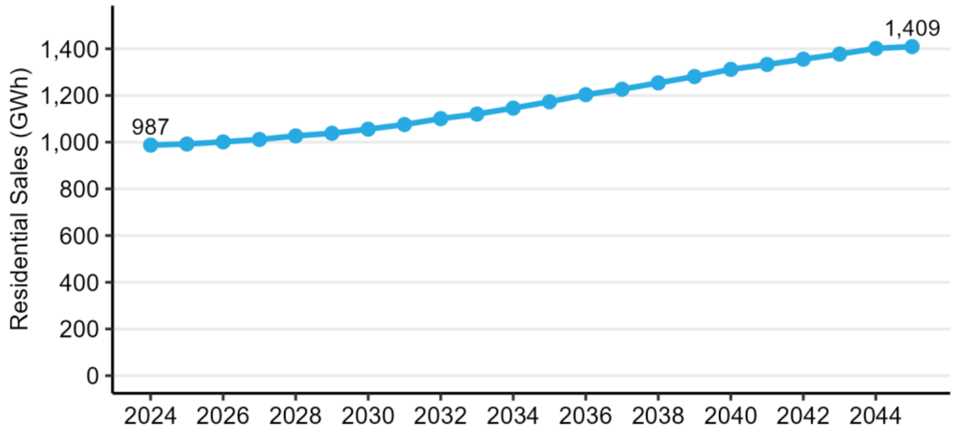


The study team used the 2024-2030 residential customer forecast provided by EWEB and extrapolated to the end of the study period (2045) using EWEB's residential sales forecast and the 2030 average residential MWh/customer (11.23). A demolition rate, based on assumptions for Oregon from the Council's 2021 Power Plan, was also used. The demolition rate specifies the rate at which existing homes are converted into new ones without changing the overall total number of homes. For single-family and multifamily homes, the demolition rate is 0.23% of building stock each year. For manufactured homes, the demolition rate is 1.07% of building stock each year.

Figure 8 displays the sales forecast for residential customers that EWEB provided.

[4] Throughout this report section, all figures containing forecast data display a label for the value in the first year of the study and the final year of the study. For example, in 2024 the estimated number of residential customers is approximately 89,000 and grows over the study period to be approximately 126,000 in 2045.

Figure 8. Residential Sales Forecast (GWh)



The sales forecast indicates a compound annual growth rate of 1.71% between 2024 and 2045 for residential customers when assuming no upgrades for energy efficiency.

Residential Segmentation

The study team further delineated the residential customer forecast based on characteristics of interest identified during scoping sessions with EWEB's staff. The primary division of customers is based on the following:

1. Building Type
2. Occupancy Status (rental versus owner)
3. Income definition

The building types considered in this DSPA are shown in Figure 9 with the occupancy status distribution identified for each building type. The type and number of measures applicable to each home is dependent on the type of home. In addition, occupancy status can impact the installation of measures, as discussed further below. Occupancy status and building type were determined based on applicable zip codes from the 2022 ACS for Lane County[5].

Note. To maintain consistency with the Council, the study team includes duplexes, triplexes, and quadplexes in the single-family segment.

[5] The study team weighted the 2022 ACS data based on the proportion of EWEB customers present in each of the Lane County zip codes

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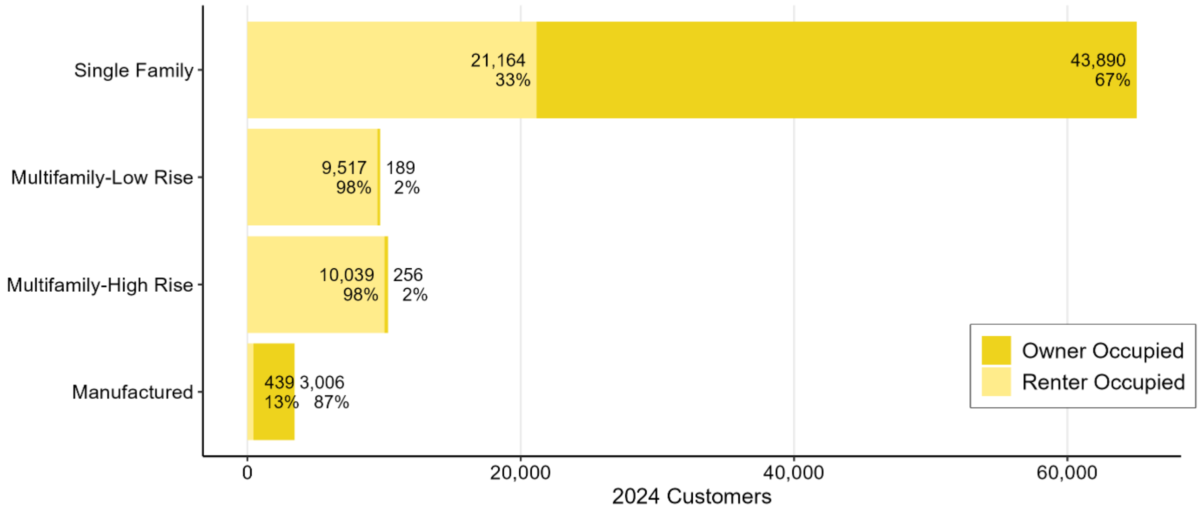
Figure 9. 2024 Residential Customer Distribution by Building Type and Occupancy Status



EWEB's residential customers are eligible for various income-qualified incentives and tax credits. Due to the varying qualification thresholds for these programs, the study team split the residential sector based on multiple income qualification thresholds:

- The Inflation Reduction Act (IRA) bases tax credits and incentives on the household's income relative to the area median income (AMI).
- EWEB's low-income program definition uses a threshold of 60% of the Oregon Median Income (OMI) or 200% of the Federal Poverty Level (FPL), whichever is greater.
- The portion of residential homes that have household incomes that meet the Asset Limited, Income Constrained, Employed (ALICE)[6] income criteria for Lane County. This is a group of households with incomes above 100% of the FPL, but that struggles to afford basic living essentials. The income criteria for the ALICE qualification are based on the county and age of the head of the household.

Income and household data for residential customers were developed based on the 2022 ACS. The resulting income-qualified distributions are described in Table 6 and Table 7.

Table 6. Residential Building Type Distributions by Income Group

Building Type	IRA AMI Group			EWEB Program Designation Group		Renters (Ineligible)
	0% - 80% of AMI	80% - 150% of AMI	Over 150% of AMI	Income Eligible	Income Ineligible	
Single Family	19%	22%	26%	12%	55%	33%
Multifamily-Low Rise	2%	0%	0%	1%	1%	98%
Multifamily-High Rise	0%	1%	1%	0%	2%	98%
Manufactured	67%	18%	3%	43%	44%	13%

[6] https://www.unitedforalice.org/meet-alice

Overall, 11% of all residential homes are considered income-qualified for EWEB programs and owner-occupied, with single-family homes making up most of that group. Note that renters were considered ineligible for the IRA programs because they cannot make the equipment upgrades themselves and landlords are unlikely to make the improvements due to the split incentive problem.[7] This has a large impact on the eligibility status of multifamily homes because most multifamily properties are inhabited by renters.

Table 7. Residential Building Distributions by ALICE Status

Building Type	Below FPL	ALICE	Above ALICE
Single Family	12%	26%	62%
Multifamily-Low Rise	18%	56%	26%
Multifamily-High Rise	37%	42%	21%
Manufactured	18%	54%	27%
Overall	**16%**	**32%**	**52%**

Under the ALICE criteria, 48% of all residential households are considered at or below the ALICE income threshold, with the multifamily segments having the lowest ratio of homes above the ALICE income threshold.

To better understand and inform future programs, the study team compared the distribution of income-qualified households for EWEB's existing income thresholds and the ALICE income thresholds among renters. Figure 10 shows the distribution by building type for each of the two income designations.

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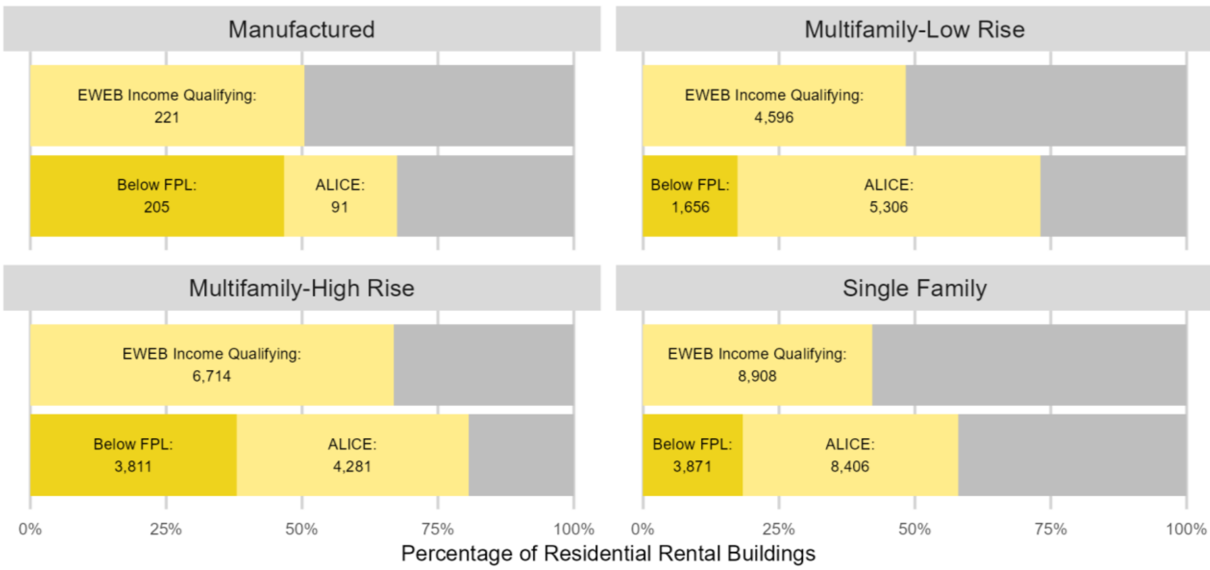
[7] The split incentive problem refers to a frequent barrier in energy efficiency adoption in rental properties where the owner is responsible for capital improvements to the property, but renters typically pay the electric bill.

Figure 10. 2024 Residential Rental Household Income Distributions



Note. The residential rental analysis includes university student households that may fall into the income-qualifying category but are not truly income-qualifying for EWEB programs.

Overall, 50% of rental households meet EWEB's existing income thresholds to qualify for programs, and 44% have household incomes that fall below the ALICE income threshold but are above the FPL. 23% of all rental households are below the FPL.

Equipment Saturations

One of the key metrics informing conservation potential in the residential sector is the saturation of end use appliances such as space and water heating equipment. Table 8 summarizes the equipment saturations by building type and construction vintage when applicable[8] for the DSPA.

Table 8. Residential Equipment Saturations

Building Type	Single Family	Multifamily-Low Rise	Multifamily-High Rise	Manufactured
Heating Equipment - Existing Buildings				
Electric Forced Air Furnace	3%	0%	2%	50%
Heat Pump	24%	0%	6%	20%
Ductless Heat Pump (DHP)	16%	0%	4%	14%
Electric Zonal/Baseboards	24%	81%	56%	9%
Heating Equipment - New Construction				
Electric Forced Air Furnace	0%	0%	2%	50%
Heat Pump	17%	0%	6%	20%
Ductless Heat Pump (DHP)	18%	0%	4%	14%
Electric Zonal/Baseboards	8%	81%	56%	9%

[8] The study team assumed that the Oregon Residential Specialty Code will result in builders installing electric heat pumps in single family new construction homes in lieu of electric furnaces. This is consistent with reporting from the Pacific Northwest National Lab. Additionally, the study team assumed that this code would encourage 50% of what would otherwise be zonally heated new construction homes to install DHPs.

Cooling Equipment				
Central Air Conditioning	10%	0%	2%	18%
Room Air Conditioners	17%	55%	32%	21%
Other Appliances				
Electric Water Heaters	88%	86%	92%	95%
Refrigerators	140%	98%	100%	104%
Freezers	44%	6%	7%	51%
Clothes Washers	93%	36%	27%	98%
Electric Clothes Dryers	79%	35%	26%	85%
Dishwashers	72%	73%	52%	85%
Electric Oven	70%	94%	83%	96%
Desktop Computer	55%	23%	12%	31%
Laptop Computer	78%	52%	70%	66%
Computer Monitors	102%	32%	45%	34%

In Table 8, numbers greater than 100% imply an average of more than one appliance per home. For example, the single family refrigerator saturation of 140% means that single-family homes in EWEB's territory average 1.4 refrigerators per home.

For this assessment, the study team used NEEA's 2022 Residential Building Stock Assessment (RBSA) data in conjunction with 2022 ACS data to develop equipment saturations[9]. ACS data was used to determine the heating fuel shares for each home type and vintage, while the RBSA was used to determine the shares of electric space heating equipment, cooling equipment, and other appliances[10]. Due to the small number of multifamily and manufactured customers in the 2022 RBSA, the study team used all Oregon multifamily buildings to quantify the multifamily saturations and all surveyed manufactured homes to quantify the manufactured saturations after first identifying the shares of electric heating for these home types based on more EWEB-specific ACS data.

The saturation of air conditioning is often of particular interest given the increasing need for cooling in the Northwest. In Table 8, the air conditioning saturation should be understood as the total across all of the equipment types that are capable of cooling, including Heat Pumps, Ductless Heat Pumps, and Cooling equipment. For example, 67% of existing single-family homes have some form of air conditioning.

Commercial

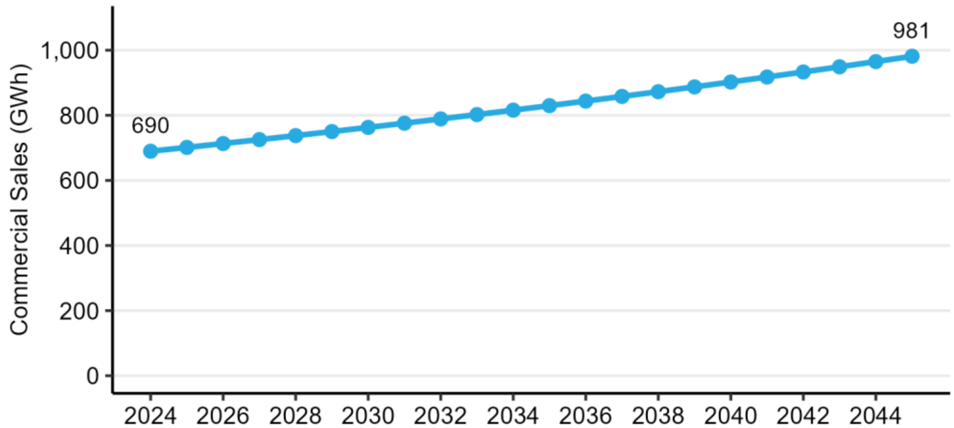
Unlike the residential sector, where customer counts heavily inform the demand side potential, conservation opportunities in the commercial sector are largely based on floor area. To estimate the commercial floor area and develop estimates of sales by building type in EWEB's service territory, the study team used the 2023 EWEB account sales data supplemented with Regional Land

[9] RLID data does not include equipment saturation information, so the study team had to rely on the ACS and RBSA for this data.

[10] The study team conducted additional analysis of single-family homes built after 2010 in the 2022 Lane County ACS 5-year data to determine the portion of new construction homes that would likely install gas heat during the study period. The result is documented in Table 8.

Information Database (RLID) classification information provided by EWEB. Based on the 2019 Commercial Building Stock Assessment's (CBSA) energy use intensity (EUI) data, the study team converted the sales to an estimated floor area by building type. This resulted in a total floor area of 69.6 million square feet in 2024. The sales growth (and corresponding floor area growth) within the commercial sector is shown in Figure 11.

Figure 11. Commercial Sales Forecast (GWh)



The sales forecast is based on the compound annual growth rate for EWEB's general service sales forecast divided between industrial and commercial using the customer database classification of premises and sales for 2023.

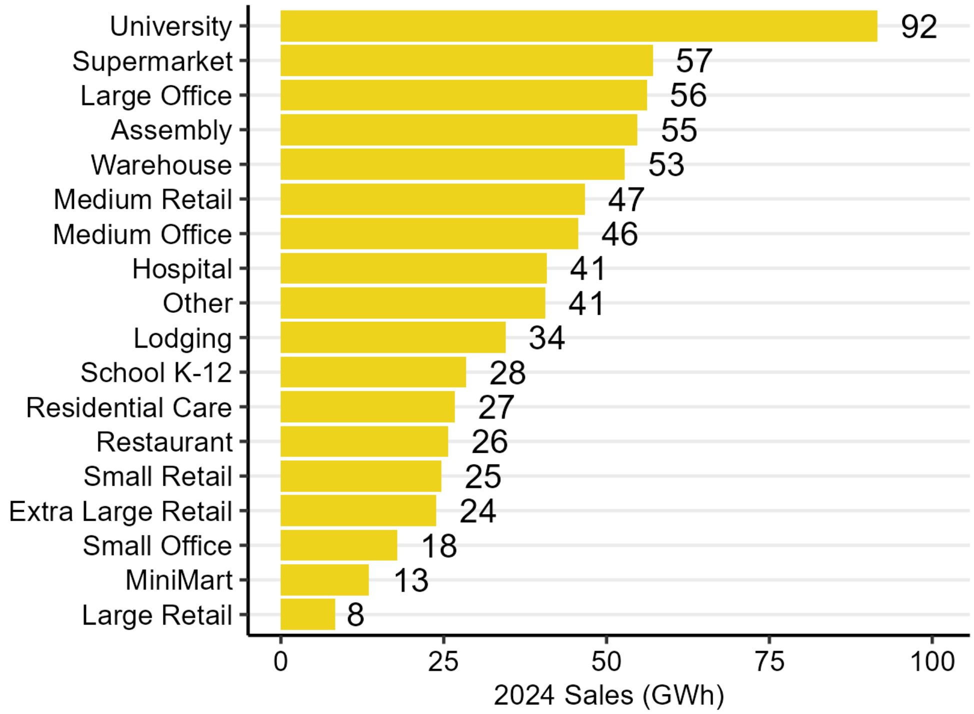
Commercial Segmentation

As mentioned above, the building floor area for the commercial sector is based on segment-level estimates of EUI and sales. To determine the distribution of sales across commercial segments, the study team mapped accounts to building types using RLID statistical class and dwelling type data when available and accurate.[11]

Figure 12 summarizes the 2024 sales estimates for each of the 18 commercial building segments.

[11] For key accounts and customers with ION meters, the study team manually mapped the sales to the most applicable segment to ensure commercial and industrial customers with larger loads were not mis-classified.

Figure 12. 2024 Commercial Sales by Building Segment (GWh)



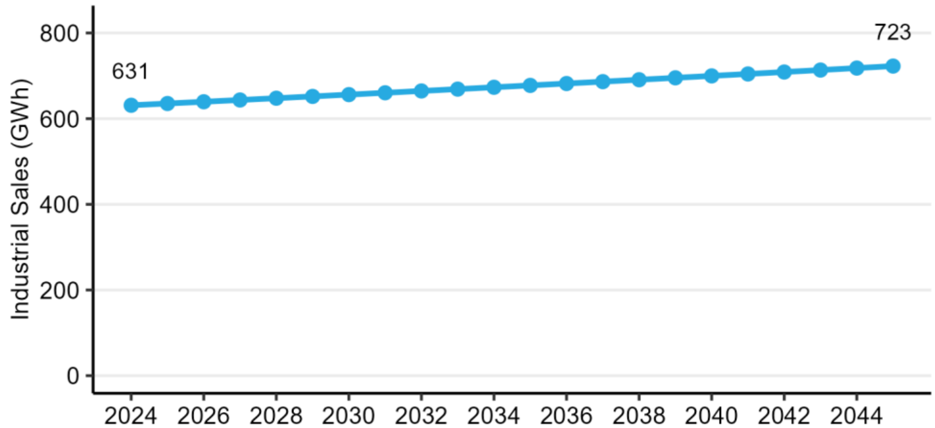
Based on the above, the university segment is the largest electricity consumer in the commercial sector, making up 13% of commercial sales. This is followed by supermarkets, large offices, assembly, and warehouse buildings, each making up approximately 8% of overall commercial usage.

Industrial

The methodology used to estimate conservation 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 scaled by the number of homes or floor area, 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 an assumed savings percentage to the applicable end use consumption within each industrial segment.

The forecast for industrial sales is shown in Figure 13 with a compound annual growth rate of 0.65%. The forecast is based on EWEB's general service sales forecast, divided between the commercial and industrial sectors using the distributions from the database of 2023 customer sales.

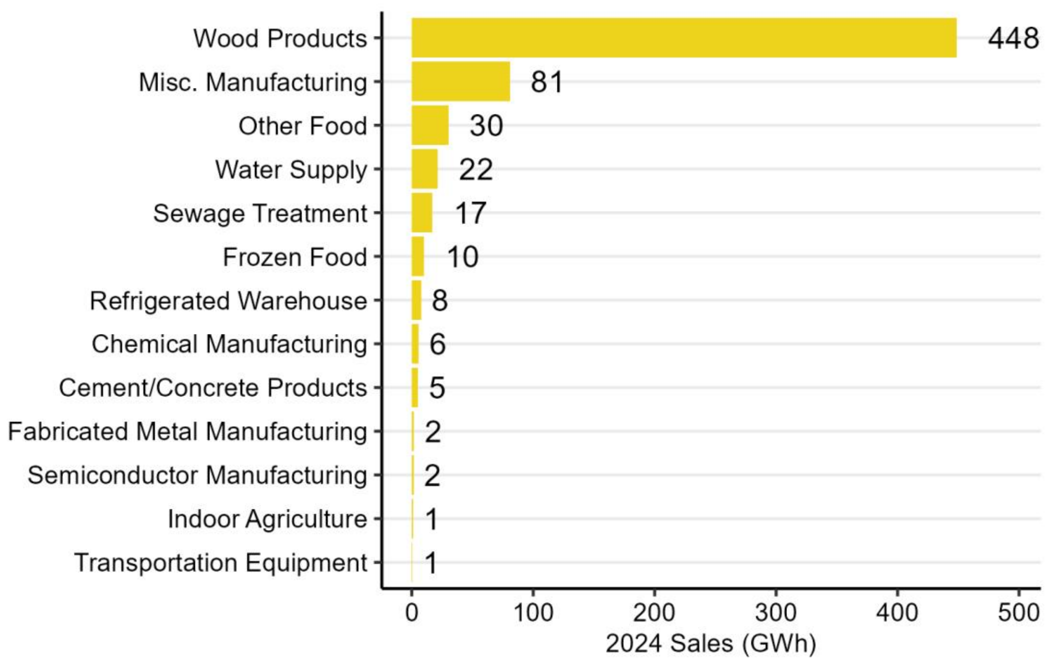
Figure 13. Industrial Sales Forecast (GWh)



Industrial Segmentation

To quantify the sales within individual industrial segments, the study team again used the database of 2023 customer sales provided by EWEB and mapped the RLID categorizations to the industrial segments used in this study with adjustments for key accounts and ION meter data where possible. The resulting industrial consumption for 2024 totaled 631,271 MWhs, as summarized in Figure 14.

Figure 14. 2024 Industrial Sales by Building Segment (GWh)



From this, 71% of the industrial sales are in the wood products segment, followed by miscellaneous manufacturing (13%) and food manufacturing excluding frozen food (5%).

Utility Distribution System Efficiency

The 2021 Power Plan used a new approach for quantifying the potential energy savings in measures that improve the efficiency of utility distribution systems. The Council's new approach estimates the savings potential based on the 2018 sales within each sector and estimates costs from the number of distribution substations and feeders for each utility. Table 9 summarizes the number of substations and feeders provided directly by EWEB and EWEB's reported 2018 sales, as reported to the US Energy Information Administration.

Table 9. Utility Distribution System Efficiency Assumptions

Characteristic	Count
Distribution Substations	34
Residential/Commercial Substations	29
Urban Feeders	145
Rural Feeders	6
2018 Residential Sales (MWh)	914,487
2018 Commercial Sales (MWh)	869,518
2018 Industrial/Other Sales (MWh)	557,949

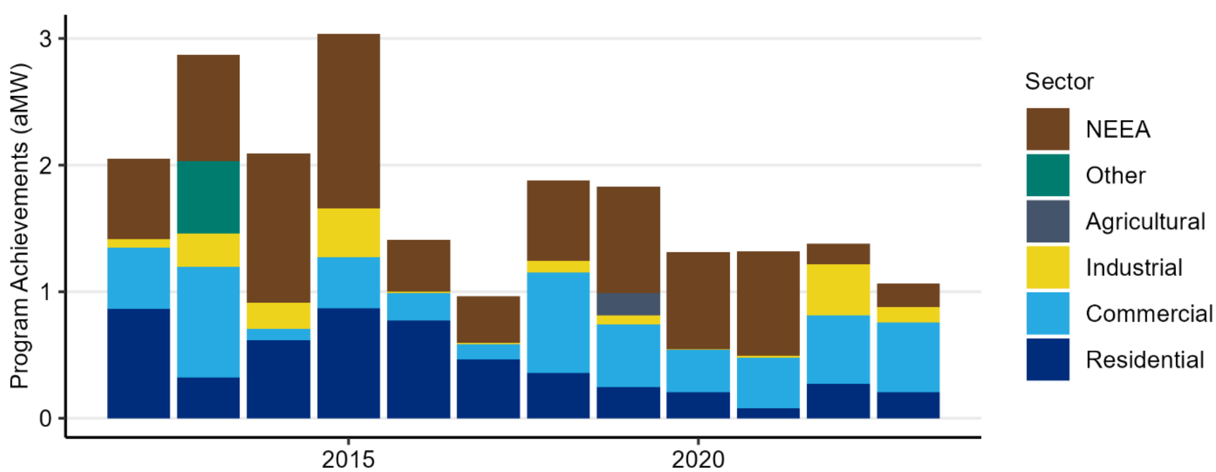
Recent Conservation Achievement

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

Overall

Figure 15 summarizes EWEB's 2012-2023 conservation achievement by sector, as reported by the RTF's 2023 Regional Conservation Progress Report.

Figure 15: Past Conservation Achievements by Sector (aMW)



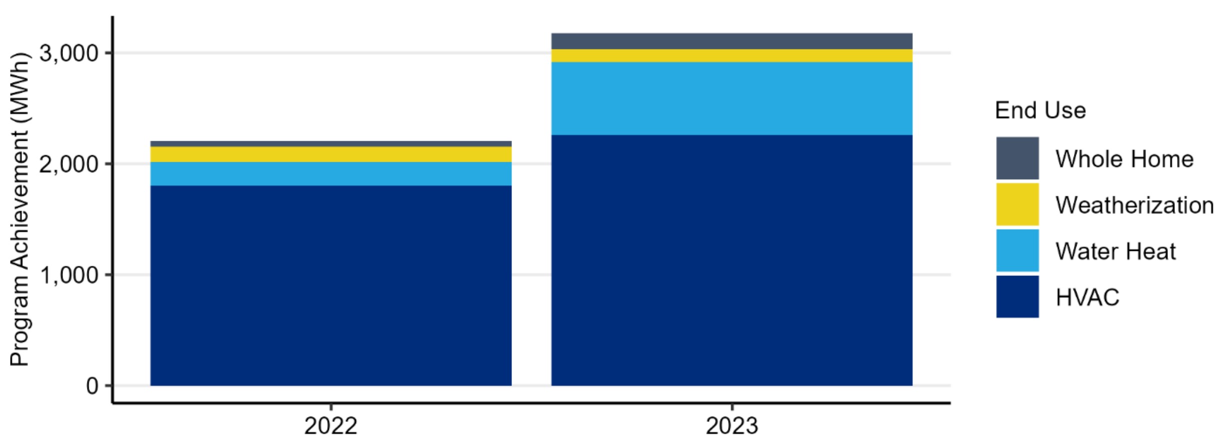
EWEB's program savings over this 12-year period are nearly 1.1 aMW or 9,500 MWh per year. Most of the historical savings are from EWEB's residential and commercial sectors. This figure also includes allocated savings from NEEA's market transformation initiatives, which add an average of 0.7 aMW per year over this period. Savings from NEEA's market transformation initiatives are primarily in the residential sector. Note that the baseline that NEEA claims savings against changes with the publication of each of the Council's power plans. This is why NEEA savings show sharp declines in 2016 and 2022.

EWEB provided detailed program achievement data for 2022 and 2023. The sections below summarize these recent achievements.

Residential

The recent residential program achievements by end use are shown in Figure 16. At the time of this report, complete 2024 program data was unavailable and, therefore, is not included. Between 2022 and 2023, the residential program savings amounted to 5,000 MWh or 0.57 aMW. HVAC savings make up 82% of those savings in 2022 and 71% of savings in 2023. Most HVAC savings are from installations of DHPs (70% of HVAC savings), with the remainder coming from air-source heat pumps (27%), duct sealing (1%), and smart thermostats (1%). Weatherization measures are broken out separately. In 2023, the water heating savings more than doubled due to a large number of water heaters being installed in a new apartment complex. The savings categorized in the whole home end use are from new homes. Note that these savings do not include savings from NEEA.

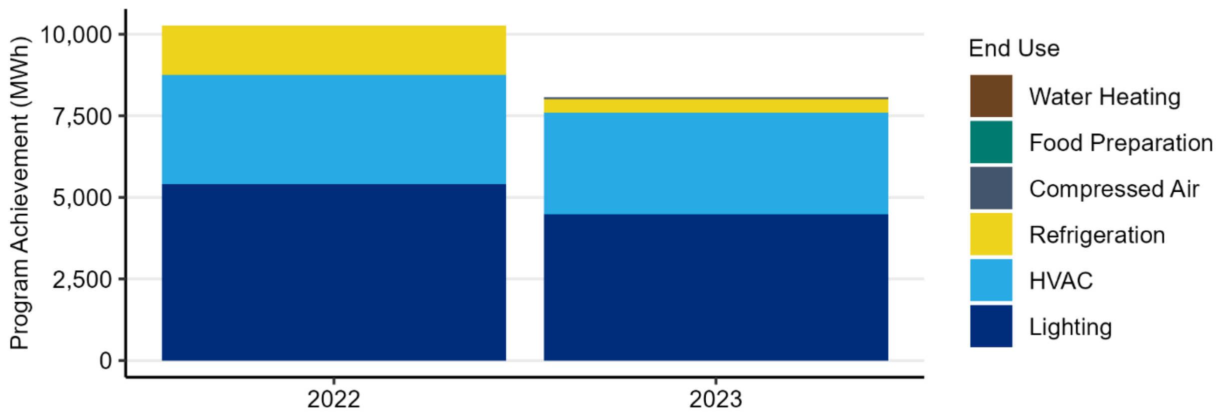
Figure 16: Recent Residential Program Achievements by End Use (MWh)



Commercial

Most of EWEB's commercial savings are split between the lighting and HVAC end use, as shown in Figure 17. In 2023, 56% of commercial savings were for lighting, followed by 39% in HVAC and 5% in refrigeration. The remaining savings from the compressed air and food preparation end uses make up less than 2%. In total, commercial savings total more than 17,000 MWh or 1.96 aMW over the two-year period.

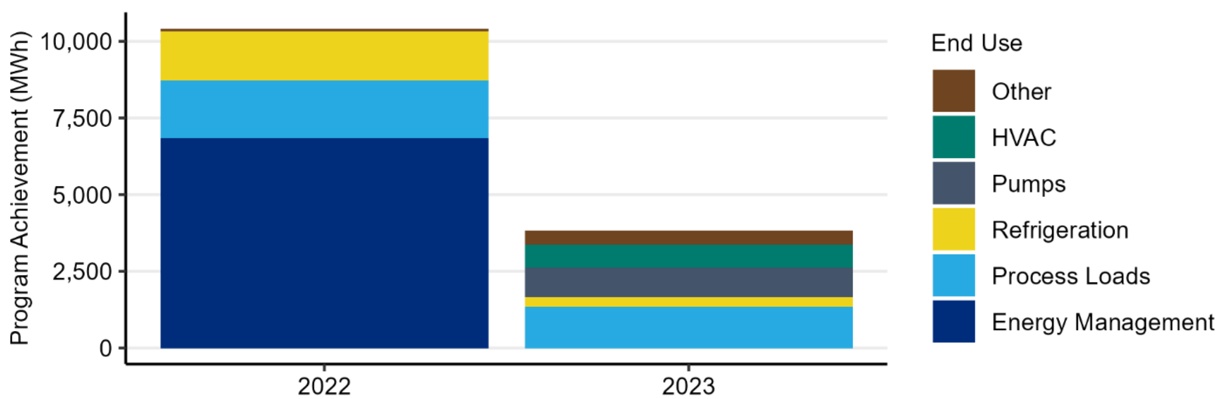
Figure 17: Recent Commercial Program Achievements by End Use



Industrial

In the industrial sector, there has been some variability in historical savings due to the unique and varying needs of industrial customers and the year that projects are completed. For example, Figure 18 shows 66% of program savings in 2022 through strategic energy management,[12] with no savings in this end use in 2023. Conversely, in 2022 and 2023, process loads were end uses with high savings values of 0.2 aMW and 0.14 aMW, respectively. Savings in the industrial sector often vary year to year due to variations in the size and timing of projects completed. Overall, industrial savings total more than 13,000 MWh or 1.5 aMW over the two years.

Figure 18: Recent Industrial Program Achievements by End Use



EWEB has not reported any savings in the agricultural or utility sectors over the past two years.

[12] Strategic Energy Management (SEM) refers to a systematic approach to improving energy efficiency within an organization by implementing policies, practices, and technologies that drive continuous energy performance improvements. These measures focus on long-term, sustainable energy savings rather than one-time efficiency upgrades

Achievable Potential Results

This section discusses the achievable potential identified in this CPA. It begins by discussing the high-level results and then covers additional detail on the potential within individual sectors and end uses.

High-Level Results

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 through efficiency programs.

Figure 19 shows the supply curve of achievable potential over the 22-year study period. A supply curve depicts the cumulative potential against the levelized cost of energy savings, with 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 and with supply-side resources considered in EWEB's IRP. The levelized cost calculations include credits for deferred transmission and distribution system costs, avoided periodic replacements, and non-energy impacts to make them comparable with other resources. With these credits, some of the lowest cost measures have a negative net levelized cost, meaning the credits exceed the measure costs.

Figure 19: 22-Year Supply Curve

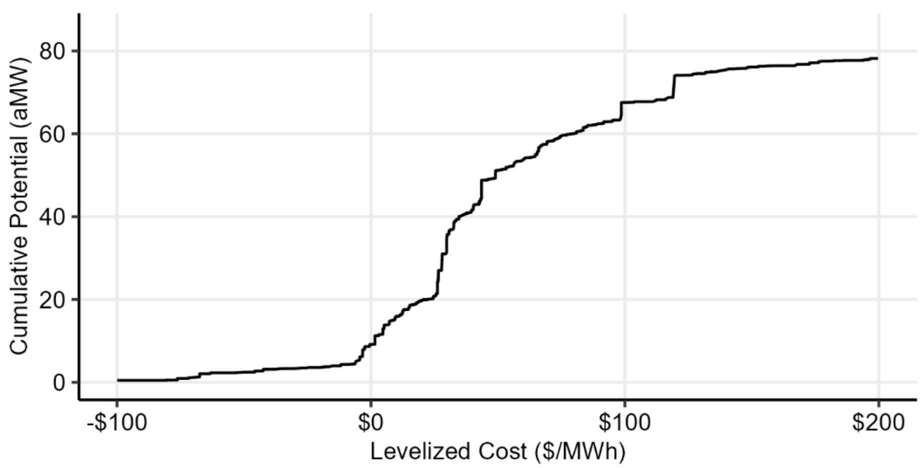
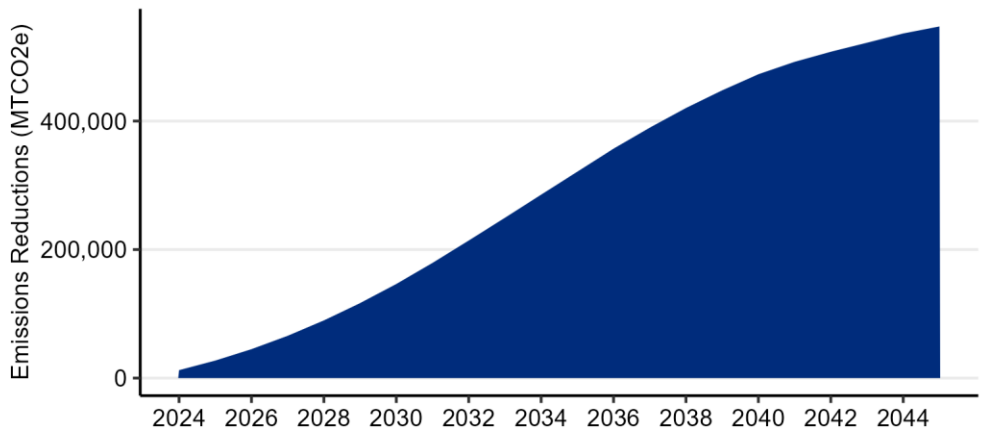


Figure 19 shows that approximately 10 aMW of potential are available at a cost at or below $0/MWh. Approximately 50 aMW of achievable potential are available for costs below $50/MWh. After approximately $100/MWh, further increases in potential come at an increasing cost. In total, there are nearly 85 aMW of achievable potential available in EWEB's service territory over the 22-year study period, but only potential below $200/MWh is shown.

As a part of the assessment, the project team also estimated the emissions reductions achievable through energy efficiency. The 2023 Western Power Pool Non-Baseload Emissions (EPA eGRID Database) emissions factor for conservation was used for this estimate. This factor represents a marginal emissions rate rather than an average emissions rate, as energy efficiency improvements will reduce the power generation on the margin, rather than reducing the output across all generation sources. In addition, it takes a broad perspective, accounting for the fact that energy savings in

EWEB's system may lead to clean energy sent elsewhere, offsetting more carbon intensive generation.[13] Over the 22-year study period, acquisition of the total cumulative achievable potential would result in over 545,000 metric tons of CO2e emissions reductions. The cumulative reduction is depicted over time in Figure 20.

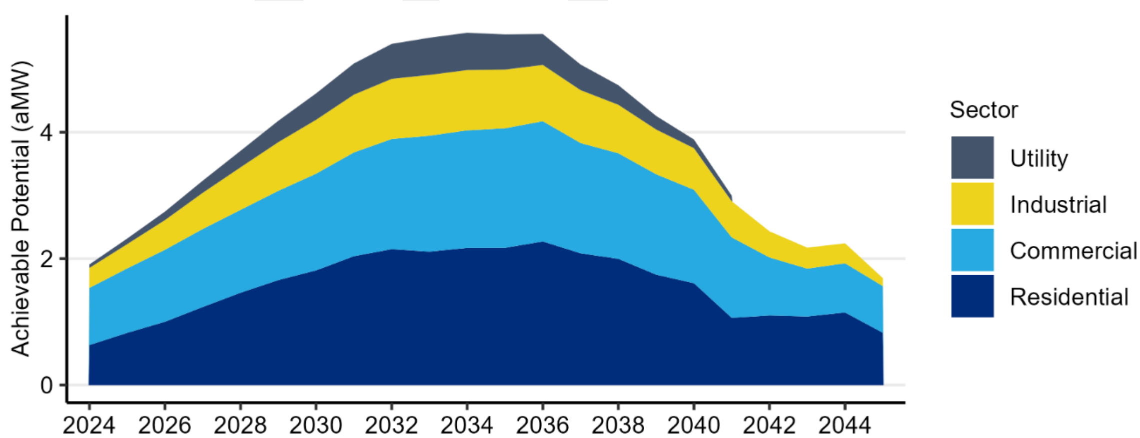
Figure 20. Achievable 22-Year Emissions Reductions



Sector Summary

Figure 21 shows the achievable potential by sector on an annual basis. Most of the potential is in EWEB's residential and commercial sectors, with less available in the industrial and utility sectors.

Figure 21: Annual Achievable Potential by Sector



The project team used the ramp rates from the 2021 Power Plan to establish reasonable rates of acquisition for all measures and sectors. The project team changed the ramp rates assigned to individual measures to better align the near-term potential with recent and expected savings in each sector. Appendix VII has more detail on the alignment of future potential with program expectations.

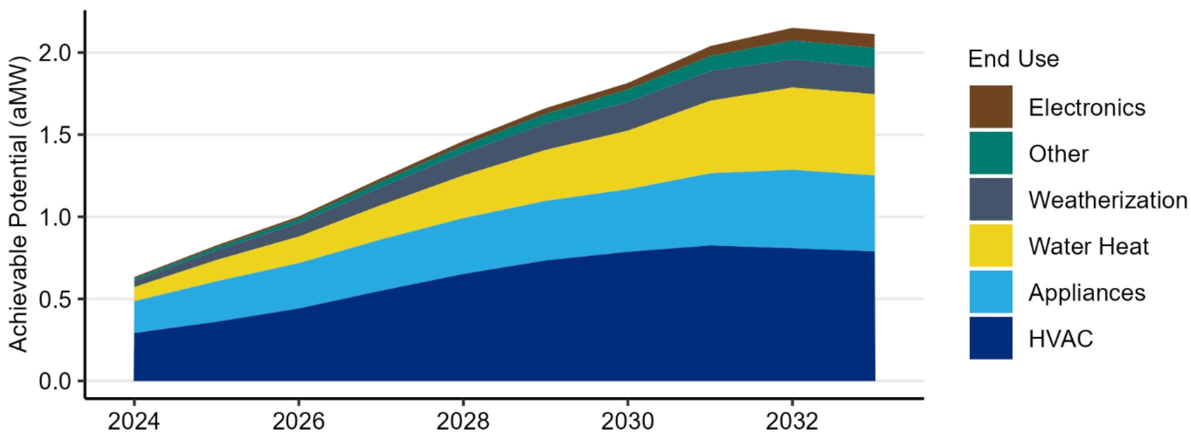
[13] See https://www.eweb.org/environment-and-climate/climate-guidebook/appendix-e-ewebs-carbon-intensity-guidance for further details.

The sections below describe the achievable potential within each sector.

Residential

Figure 22 shows the achievable potential by end use for the first 10 years of the study period. HVAC measures make up the largest share of potential in the sector in the near term, followed by appliances, water heating, and weatherization.

Figure 22: Annual Residential Achievable Potential by End Use



The potential grows during the initial years of the study as the expected market share of efficient equipment increases along with increases in the acquisition rate of retrofit measures, like attic insulation, which can be achieved at any time. By 2033, the rate of savings achievement begins to level off as the market shares of efficient equipment reach their maximum values and the remaining available retrofit measures start to diminish.

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. Demand response benefits were not included in this CPA. The decision to use them as demand response resources was treated as an incremental decision and included in EWEB's Demand Response Potential Assessment. However, energy efficiency programs can help build a stock of flexible equipment that could be called upon through demand response programs in the future.

In Figure 22, the other end use category includes measures in the cooking, electric vehicle supply equipment, lighting, motors, and whole home end uses.

Figure 23 shows how the 10-year achievable potential breaks down into end uses and measure categories. The area of each block represents the share of the total 10-year residential achievable potential. No economic screening was applied. Ductless heat pumps (DHP), Air source heat pumps (ASHP), smart thermostats, and duct sealing make up most of the potential in the HVAC end use, while heat pump dryers are the primary source of potential in the appliance end use. In the water heating end use, heat pump water heaters (HPWH) are the key measure.

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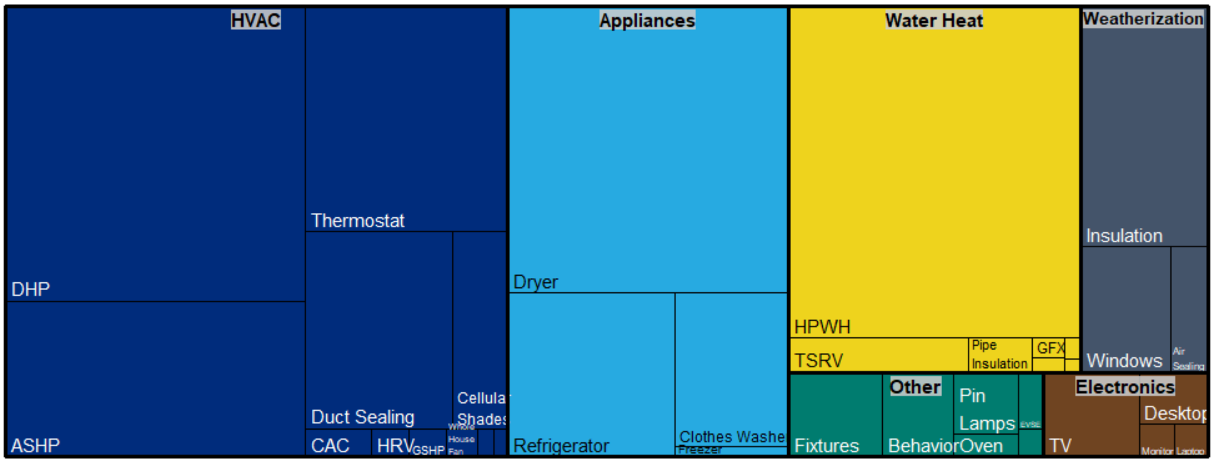
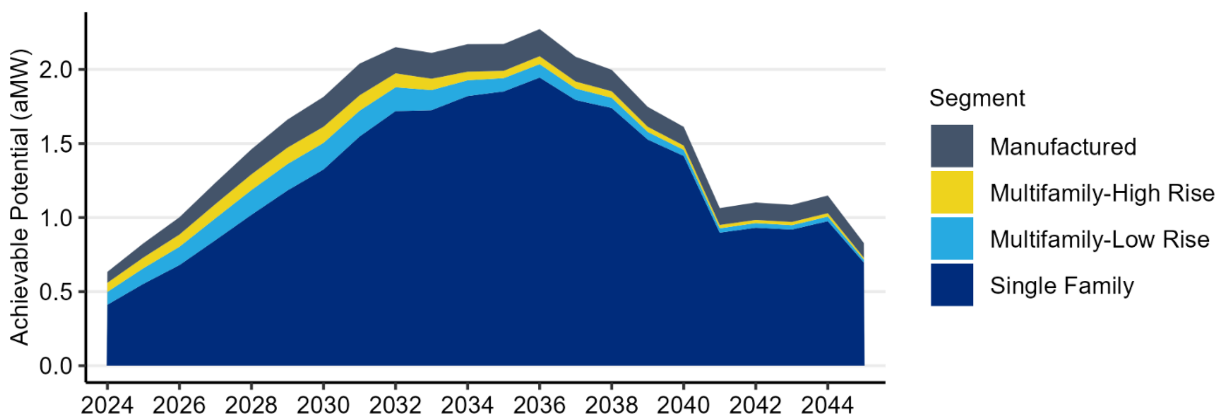
Figure 23: Residential 10-Year Achievable Potential by End Use and Measure Category



Since the type of home determines the number and type of energy efficiency opportunities, Figure 24 shows the distribution of achievable savings potential by home type. Single family homes have the greatest potential by far, given they make up the majority of EWEB homes and typically consume more energy than the other home types.

Figure 24: Achievable Potential by Home Type

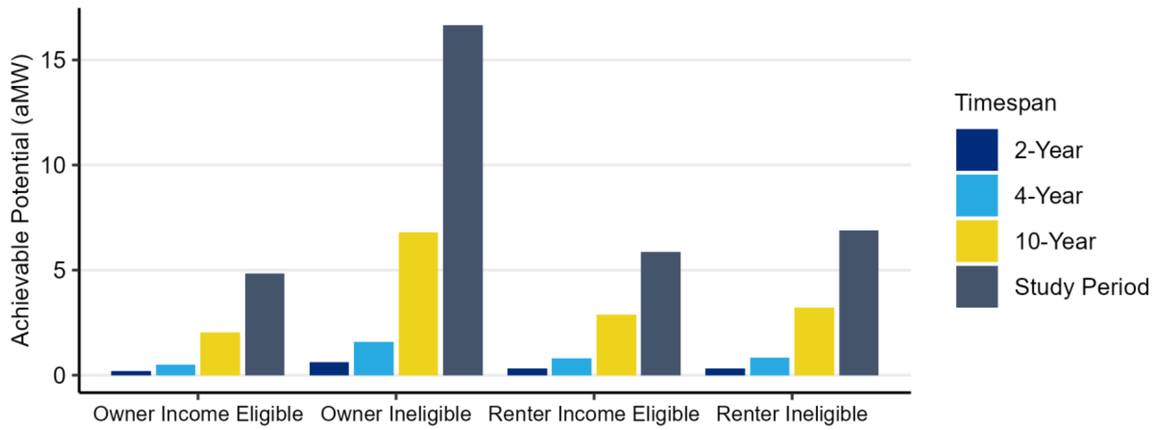


To better understand the distribution of achievable potential across EWEB's unique customer landscape, Figure 25 shows how the savings quantified[14] in this assessment are distributed across homes by occupancy status and eligibility for EWEB's income-qualified programs. Over the study horizon, 37% of the residential achievable potential is attributed to rental customers. This poses a challenge for program implementors due to the split incentive issue discussed in the Customer Characteristics portion of this report.

[14] The project team did not treat rental or income eligible customers differently than owner-occupied and non-eligible customers as a part of this assessment. The summarized distributions do not account for the programmatic barriers to adoption of efficiency measures in these customer segments.

Figure 25 also provides insight on the opportunity for conservation for EWEB's income qualifying customers. Of the 34 aMW of total residential achievable potential, 10.7 aMW is within the income qualifying households.

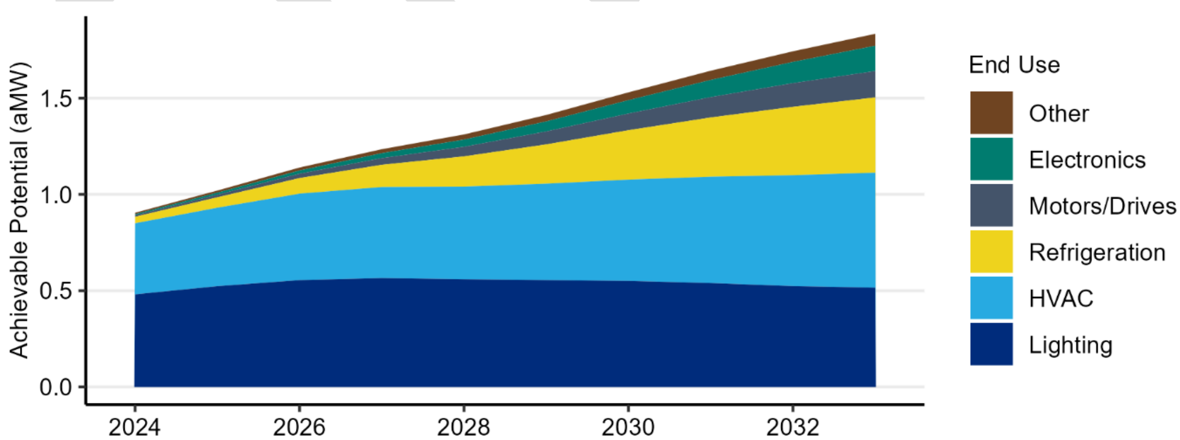
Figure 25: Residential Achievable Potential by Customer Type and Timespan



Commercial

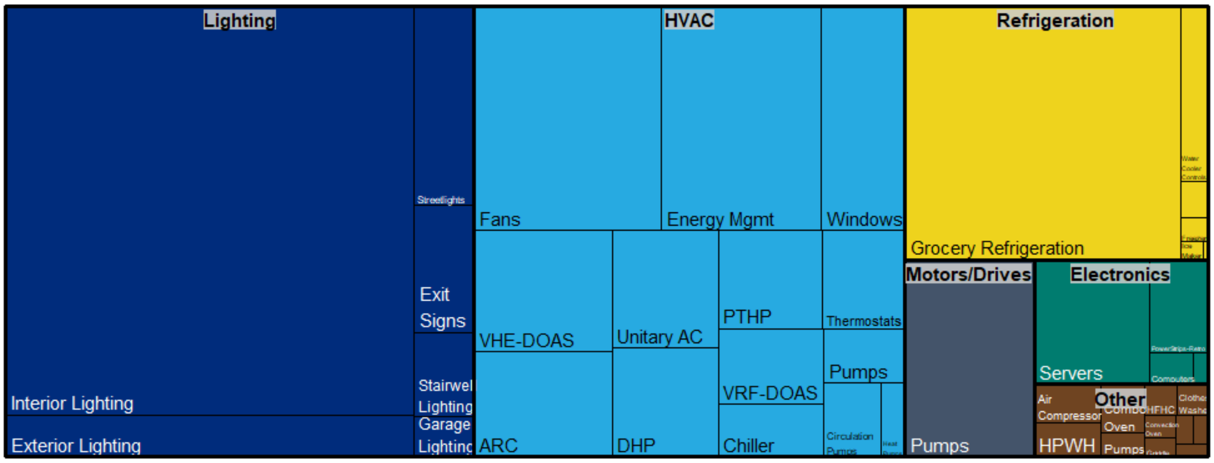
In the commercial sector, HVAC and lighting are the end uses with the highest potential. The lighting end use includes measures applicable to both interior and exterior lighting and shows decreasing amounts of potential over time, indicating that the remaining opportunities are beginning to diminish. In addition to the diminishing potential, much of commercial lighting is now subject to Oregon product standards that raise the baseline for commercial lighting. As a result, some of this potential may be achieved through the new standards and outside of EWEB's commercial lighting programs. In Figure 26, the other end use category includes measures in the compressed air, food preparation, process loads, and water heating end uses.

Figure 26: Annual Commercial Achievable Potential by End Use



The key end uses and measure categories within the commercial sector achievable potential are shown in Figure 27. The area of each block is proportional to its share of the 10-year commercial achievable potential, where no economic screening was applied. The commercial sector includes a variety of building types with different end uses. This is apparent in the range of measures included in Figure 27, especially within the HVAC end use.

Figure 27: Commercial 10-Year Achievable Potential by End Use and Measure Category



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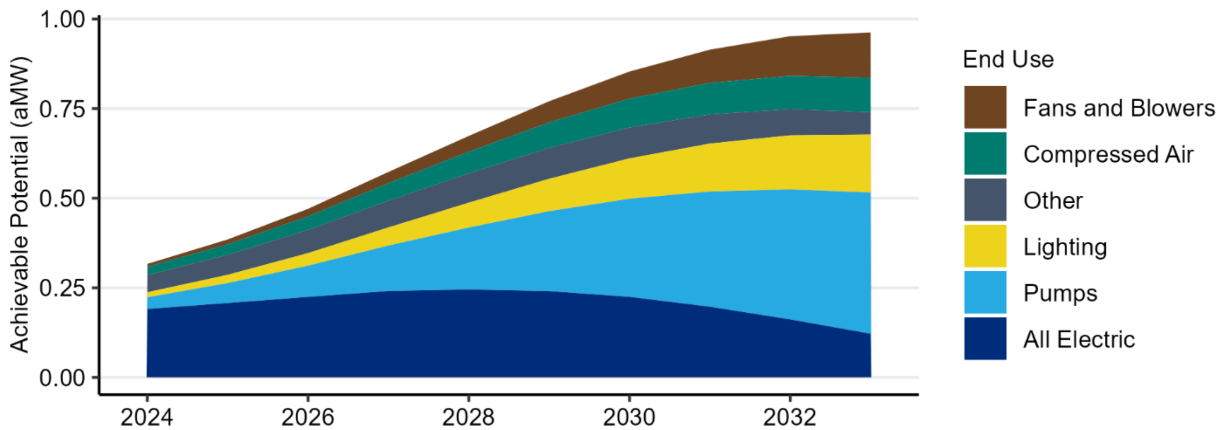
Industrial

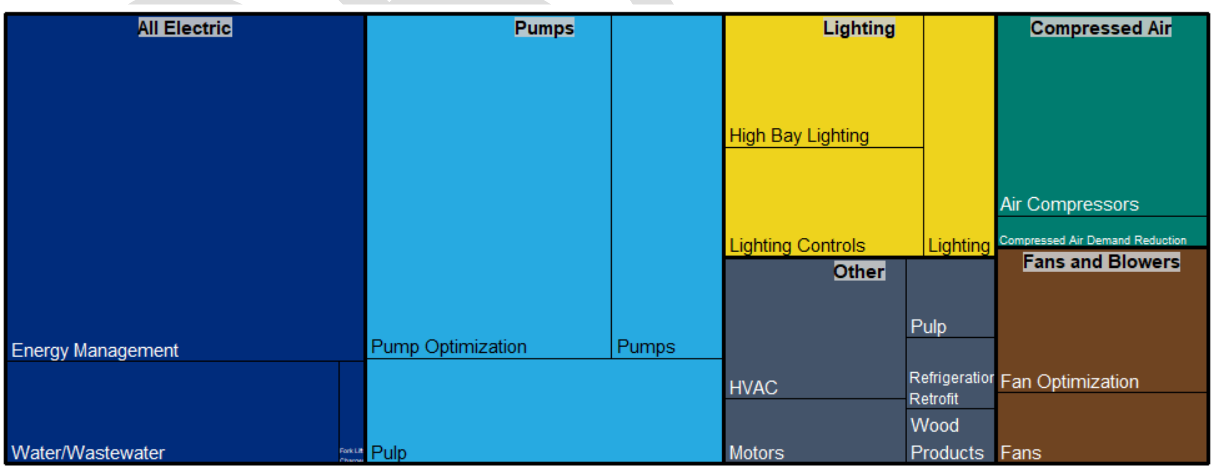
The annual industrial sector potential is shown in Figure 28, the majority of which is in the all electric, pumps, and lighting end uses. The all electric end use includes measures applicable to all end uses, such as strategic energy management programs and measures relevant to the water and wastewater segments. The potential in this category decreases over time due to EWEB's past successes and the remaining available potential. The other category in Figure 28 includes a variety of end uses, including refrigeration, material handling and processing, motors, and several other smaller end uses.

Figure 28: Annual Industrial Achievable Potential by End Use



The breakdown of 10-year industrial achievable potential into end uses and measure categories is shown in Figure 29.

Figure 29: Industrial 10-Year Achievable Potential by End Use and Measure Category

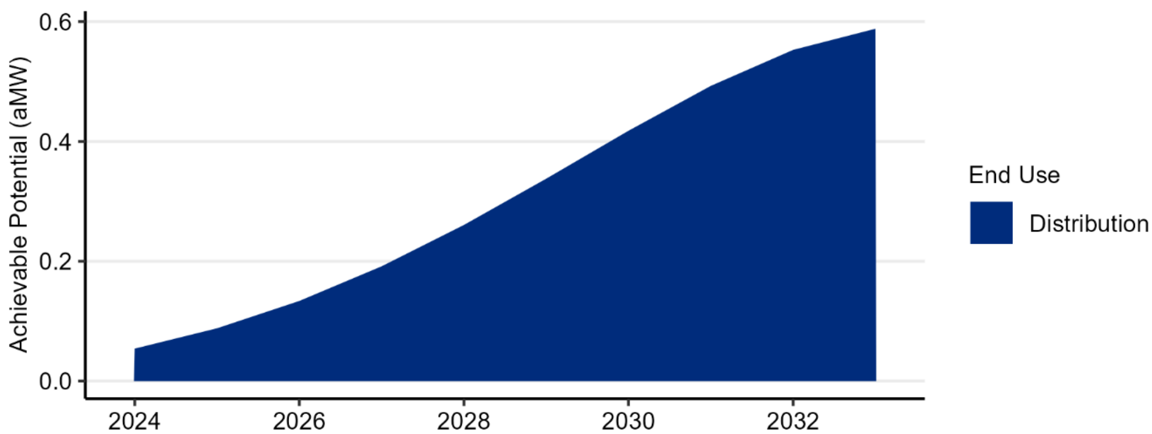


Utility Distribution System

Energy savings in the utility distribution system sector involve the regulation of voltage to improve the efficiency of utility distribution systems. This analysis includes the measures characterized in the 2021 Power Plan, which are scaled by EWEB's loads within the individual sectors and the ability to regulate voltage in those associated loads.

The annual distribution system potential is shown in Figure 30. The Council characterized three measures in the 2021 Power Plan, which use increasingly sophisticated control systems. The first measure uses line drop compensation to regulate voltage, while the remaining two use advanced controls to further regulate voltage.

Figure 30: Annual Utility Distribution System Achievable Potential



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Summary

This report summarized the results of the 2024 CPA conducted for EWEB. The assessment provided estimates of the achievable energy savings potential for the 22-year period beginning in 2024. The assessment considered the wide range of measures included in the 2021 Power Plan that are reliable and available during the study period.

The methodology used to estimate the energy efficiency potential described in this report is consistent with the methodology used by the Council in determining the potential of conservation resources in the 2021 Power Plan. While the methodology is consistent with the Council's 2021 Power Plan, the project team used utility-specific inputs to the greatest extent possible and only defaulted to assumptions from the 2021 Power Plan where utility-specific inputs were not available. Utility-specific inputs covering customer characteristics, previous conservation achievements, and some economic inputs were used. The assessment included the measures considered in the 2021 Power Plan materials, updated with new information from the RTF made available since its publication.

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Appendix I: Acronyms

aMW	Average Megawatt
BPA	Bonneville Power Administration
CPA	Conservation Potential Assessment
DSPA	Demand Side Potential Assessment
EUI	Energy Use Intensity
GWh	Gigawatt-hour
HPWH	Heat Pump Water Heater
HVAC	Heating, Ventilation, and Air Conditioning
IRP	Integrated Resource Plan
kW	kilowatt
kWh	kilowatt-hour
LED	Light-Emitting Diode
MTCO2e	Metric Tons of CO_2 equivalent
MW	Megawatt
MWh	Megawatt-hour
NEEA	Northwest Energy Efficiency Alliance
O&M	Operations and Maintenance
RTF	Regional Technical Forum
SEM	Strategic Energy Management
TRC	Total Resource Cost

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Appendix II: Glossary

Achievable 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.
Levelized Cost	A measure of costs when they are spread over the life of the measure, similar to a car payment. Levelized costs enable the comparison of resources with different useful lifetimes.
Megawatt (MW)	A unit of demand equal to 1,000 kilowatts (kW)
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 the predominant cost-effectiveness test used in utility resource planning throughout the Northwest and US.

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Appendix III: Measure List

This appendix provides a list of the measures included in this assessment, and the data sources used for any measure characteristics. The assessment used all measures from the 2021 Power Plan that were applicable to EWEB. The project team customized these measures to make them specific to EWEB's service territory and updated many with new information available from the Regional Technical Forum (RTF). The RTF continually updates estimates of measure savings, cost, lifetime, and other values. 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 measure. Instead, it summarizes measures by category. Many measure categories include numerous variations specific to different home or building types, efficiency levels, 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 apply to an individual utility service territory based on the characteristics of individual utilities and their customer sectors.

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Table A1: Residential End Uses and Measures

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

Table A2: Commercial End Uses and Measures

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

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Table A3: Industrial End Uses and Measures

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

Table A4: Utility Distribution System End Uses and Measures

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

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Appendix IV: Achievable Potential by End Use

The following tables detail the achievable energy efficiency potential by sector and end use.

Table A5: Residential Achievable Potential by End Use (aMW)

End Use	2-Year	4-Year	10-Year	22-Year
Appliances	0.44	1.03	3.49	7.02
Cooking	0.00	0.01	0.06	0.41
Electronics	0.02	0.06	0.38	1.10
EVSE	0.00	0.01	0.04	0.04
HVAC	0.65	1.64	6.24	14.39
Lighting	0.02	0.05	0.33	1.72
Motors	0.00	0.00	0.00	0.00
Water Heat	0.22	0.59	2.95	7.44
Weatherization	0.10	0.29	1.28	1.80
Whole Home	0.01	0.03	0.17	0.30
Total	**1.46**	**3.70**	**14.94**	**34.23**

Table A6: Commercial Achievable Potential by End Use (aMW)

End Use	2-Year	4-Year	10-Year	22-Year
Compressed Air	0.01	0.01	0.06	0.17
Electronics	0.02	0.06	0.55	1.20
Food Preparation	0.01	0.02	0.12	0.23
HVAC	0.78	1.70	4.93	11.61
Lighting	1.00	2.12	5.37	9.85
Motors/Drives	0.02	0.08	0.65	1.78
Process Loads	0.00	0.00	0.01	0.01
Refrigeration	0.09	0.28	1.96	4.89
Water Heat	0.00	0.01	0.12	0.62
Total	**1.92**	**4.30**	**13.77**	**30.37**

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Table A7: Industrial Achievable Potential by End Use (aMW)

End Use	2-Year	4-Year	10-Year	22-Year
All Electric	0.40	0.86	2.06	2.45
Compressed Air	0.05	0.14	0.63	1.58
Fans and Blowers	0.02	0.07	0.58	2.07
HVAC	0.05	0.12	0.33	0.35
Lighting	0.04	0.12	0.84	1.63
Low Temp Refrigeration	0.00	0.00	0.01	0.01
Material Handling	0.01	0.03	0.12	0.30
Material Processing	0.01	0.04	0.15	0.27
Med Temp Refrigeration	0.02	0.05	0.10	0.15
Melting and Casting	0.00	0.00	0.00	0.00
Other	0.00	0.00	0.01	0.01
Other Motors	0.00	0.00	0.01	0.02
Pollution Control	0.00	0.00	0.00	0.01
Pumps	0.09	0.30	2.05	5.53
Total	**0.70**	**1.75**	**6.87**	**14.38**

Table A8: Utility Distribution System Achievable Potential by End Use (aMW)

End Use	2-Year	4-Year	10-Year	22-Year
LDC with no VVO	0.02	0.36	0.68	0.68
LDC with VVO & AMI	0.13	2.76	5.23	5.23
Total	**0.14**	**3.12**	**5.91**	**5.91**

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Appendix V: Ramp Rate Alignment Documentation

This section documents the application of ramp rates in EWEB's 2024 CPA. Ramp rates are a series of annual values that approximate the share of available technical potential that is achievable each year. For example, all unweatherized homes in EWEB's service territory could theoretically be weatherized in a single year. However, program budgets, available contractors, and other dynamics make this unrealistic. Only a percentage of homes can be weatherized in a single year. For equipment measures like clothes washers, upgrading to more efficient equipment is only realistically available when it reaches the end of its life and needs to be replaced. For these measures, the ramp rates reflect the share of equipment turning over each year that is upgraded to more efficient equipment.

The ramp rates used in this study are based on those used in the 2021 Power Plan but were updated to reflect the study period of this CPA. The study team assigned ramp rates that align the near-term potential with the recent and expected achievements of EWEB's energy efficiency programs. This ensures that the near-term potential is feasible and achievable for EWEB's programs, given that energy efficiency programs take time to ramp up and are subject to local and dynamic market conditions. Since the energy efficiency potential quantified through the CPA will be included as a resource in EWEB's IRP, this forecast needs to be as precise as possible in quantifying the pace of future energy efficiency achievement to ensure the accuracy of EWEB's ultimate resource strategy.

Ramp Rate Alignment Process

EWEB staff provided program achievement data for 2022 through the first half of 2024, which the study team summarized by sector and end use. The study team also summarized the residential program achievements by high-level measure categories.

Additionally, EWEB benefits from the regional market transformation work of the Northwest Energy Efficiency Alliance (NEEA). Bonneville Power Administration (BPA) provided estimates of the NEEA savings occurring in EWEB's service territory. The study team allocated these savings to sectors, end uses, and measure categories based on recent reporting of NEEA's regional savings.

The study team compared the recent savings from EWEB's programs and NEEA's market transformation initiatives with the initial estimates of energy efficiency potential identified in the CPA. Because EWEB's IRP will be used to determine the subset of potential that is cost-effective, the study team compared EWEB's program achievements to the potential that was likely to be cost-effective in the IRP using a levelized cost threshold of $60 per megawatt-hour.

The study team began with the ramp rates that were assigned to each measure by the Council, then made changes to accelerate or decelerate the forecasted pace of savings acquisition to align future savings potential with recent programmatic achievements. Areas with little to no recent program achievements typically have a slow ramp rate applied to account for the fact that a program may need to start from scratch and build momentum over several years.

The following tables show how EWEB's recent programmatic achievements and allocated NEEA market transformation savings compare to the potential estimated to be cost-effective after adjusting the ramp rates. Color scaling has been applied to highlight the larger values. Discussion follows each table with additional detail.

Residential

Table shows how residential potential was aligned with recent achievements by measure category.

Note that ramp rate choices are discrete and may not provide exact alignment. The overall goal is to achieve a general alignment across end uses and measures. In addition, the program history values for 2024 contain savings from EWEB's programs for the first half of the year and forecasted savings from NEEA for the entirety of 2024.

Table A9: Alignment of Residential Program History and Potential by Measure Category (MWh)

		Program History			Estimated CPA Cost-Effective Potential			
End Use	**Category**	**2022**	**2023**	**2024***	**2024**	**2025**	**2026**	**2027**
Appliances	Clothes Washer	253	294	344	264	320	341	374
Appliances	Dryer	107	124	146	101	138	164	194
Appliances	Freezer	-	-	-	1	2	4	6
Appliances	Refrigerator	151	175	205	217	248	251	258
Cooking	Microwave	-	-	-	1	3	4	7
Cooking	Oven	-	-	-	0	0	1	1
Electronics	Advanced Power Strips	1	1	1	-	-	-	-
Electronics	Desktop	21	24	28	-	-	-	-
Electronics	Laptop	-	-	-	2	3	5	9
Electronics	TV	-	-	-	14	27	44	70
HVAC	ASHP	203	916	306	344	400	453	528
HVAC	Circulator Controls	-	-	-	0	0	0	0
HVAC	DHP	1,776	1,507	1,085	1,505	1,774	2,058	2,433
HVAC	Duct Sealing	37	33	-	77	134	218	335
HVAC	Room AC	1	1	1	-	-	-	-
HVAC	Thermostat	-	46	20	93	193	351	552
Lighting	Fixtures	-	-	-	76	102	124	158
Water Heat	Circulator	-	-	-	0	1	1	1
Water Heat	Circulator Controls	-	-	-	1	1	1	2
Water Heat	HPWH	431	913	430	664	993	1,221	1,566
Water Heat	TSRV	-	-	-	8	13	20	30
Weatherization	Air Sealing	4	4	4	20	32	49	70
Weatherization	Insulation	300	356	386	287	406	554	725
Weatherization	Windows	85	46	14	48	78	117	168
Whole Home	Behavior	-	-	-	25	41	61	88
	Total	**3,370**	**4,440**	**2,971**	**3,747**	**4,908**	**6,043**	**7,573**

**2024 includes EWEB program savings for the first half of 2024 and estimated savings from NEEA for the whole year.*

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 the following tables while a true zero value is shown as a dash.

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

Appliances

In this end use, the savings are from NEEA's market transformation. NEEA's work includes an initiative for retail products and appliances that contributes savings. The savings from this work typically grow over time as markets transform. Ramp rates were adjusted to align with NEEA's savings.

Cooking

Neither EWEB nor NEEA have savings in this end use, so the measures—microwaves and ovens—were given slow ramp rates.

Electronics

Most of the savings in this end use come from NEEA's work advancing efficient computers. There are also some savings from advanced power strips. However, the Regional Technical Forum (RTF) has recently deactivated this measure due to a lack of data and confidence in the savings, so the measure was removed from this CPA. Additional potential is available through TVs and laptops; the study team slowed the ramp rate for these categories since there are no current EWEB programs or NEEA initiatives that would address these measures.

HVAC

The HVAC category is EWEB's largest source of program savings, and the top program measures include ductless heat pumps (DHP) and air source heat pumps (ASHP). Measures in the HVAC end use are often expensive. While ASHPs typically struggle to be cost-effective, the study team included the tax credits and incentives provided for heat pumps through the federal Inflation Reduction Act (IRA). These credits help make the measures cost-effective. Because IRA incentives are dependent on income levels, their effect is particularly impactful for residential income-qualified households.

None of the DHP measures fell below the $60 levelized cost threshold. However, they may still be chosen by EWEB's IRP since they provide more capacity savings than other measures, which is only partially addressed in the levelized cost calculation. EWEB's IRP model will account for these capacity benefits separately. To address this discrepancy, the study team removed the levelized cost screening from these measures.

Additional potential is available through smart thermostats, which were given a slower ramp rate to align with EWEB's recent program history.

Lighting

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

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Water Heat

The past savings in the water heating category are from heat pump water heaters, both from EWEB's programs and NEEA's market transformation efforts.

Oregon has state product standards for showerheads and aerators, so there is no potential in these categories. The study team applied slower ramp rates to the remaining categories, including circulator pumps and controls and thermostatic restrictor valves (TSRV).

Weatherization

EWEB's programmatic savings in the weatherization end use come primarily from insulation measures. Like the HVAC measures described above, many of these measures had costs above the $60/MWh threshold used to estimate cost-effectiveness but have larger capacity contributions that are not fully counted. Likewise, the study team removed the levelized cost screening for these measures.

Table A10 below summarizes the residential measure category results in Table by end use. This table also incorporates savings from whole home measures that do not align with categories included in the CPA but could be grouped in the end uses listed below.

Table A10: Alignment of Residential Program History and Potential by End Use (MWh)

	Program History			Estimated CPA Cost-Effective Potential			
End Use	**2022**	**2023**	**2024***	**2024**	**2025**	**2026**	**2027**
Appliances	511	594	695	584	708	759	831
Cooking	-	-	-	1	3	5	7
Electronics	21	25	29	15	30	49	79
EVSE	-	-	-	-	-	-	-
HVAC	2,018	2,503	1,413	2,018	2,501	3,080	3,848
Lighting	-	-	-	76	102	124	158
Motors	-	-	-	-	-	-	-
Water Heat	431	913	430	673	1,007	1,243	1,599
Weatherization	389	406	404	354	516	720	963
Whole Home	-	-	-	25	41	61	88
Total	**3,370**	**4,440**	**2,971**	**3,747**	**4,908**	**6,043**	**7,573**

**2024 includes EWEB program savings for the first half of 2024 and estimated savings from NEEA for the whole year.*

Commercial

In the commercial sector, the greatest potential lies within lighting and HVAC end uses, which are also the areas where EWEB's achieves most of its programmatic savings. NEEA contributes additional savings in these end uses, and the electronics and motors/drives end uses. The end uses outside of the lighting and HVAC end uses were generally given slower ramp rates to reflect the lower program activity in these areas.

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

Table A11: Alignment of Commercial Program History and Potential by End Use (MWh)

	Program History			Estimated Cost-Effective Potential			
End Use	**2022**	**2023**	**2024***	**2024**	**2025**	**2026**	**2027**
Compressed Air	-	56	-	22	28	35	42
Electronics	54	62	73	29	55	94	151
Food Preparation	21	30	27	22	33	46	61
HVAC	3,401	3,181	994	2,358	2,531	2,715	2,747
Lighting	5,415	4,492	1,187	4,126	4,492	4,762	4,860
Motors/Drives	47	54	64	30	56	93	144
Process Loads	1	2	2	-	-	-	-
Refrigeration	1,500	403	-	253	402	597	846
Water Heat	3	-	188	2	5	8	13
Total	**10,442**	**8,280**	**2,535**	**6,844**	**7,601**	**8,351**	**8,863**

**2024 includes EWEB program savings for the first half of 2024 and estimated savings from NEEA for the whole year.*

Industrial

Savings in the industrial sector are often irregular and uneven, subject to the projects that get completed each year. Table shows the alignment of industrial potential and recent program history by end use. Since the savings in any particular end use may not be known in advance, the study team sought to align the overall level of potential with recent program history.

Table A12: Alignment of Industrial Program History and Potential by End Use (MWh)

	Program History			Estimated Cost-Effective Potential			
End Use	**2022**	**2023**	**2024***	**2024**	**2025**	**2026**	**2027**
Energy Management	6,845	-	-	1,672	1,817	1,966	2,111
Compressed Air	52	265	312	183	229	292	379
Fans and Blowers	-	-	-	71	119	186	275
HVAC	-	752	-	209	244	280	329
Lighting	41	197	-	117	191	292	421
Motors	-	-	-	2	3	4	5
Refrigeration	1,600	325	-	112	115	119	113
Process	1,883	1,343	145	91	120	155	196
Pumps	-	951	-	285	488	764	1,111
Other	-	-	-	6	7	8	9
Total	**10,422**	**3,834**	**457**	**2,746**	**3,333**	**4,066**	**4,950**

**2024 includes EWEB program savings for the first half of 2024.*

Utility Distribution System

The amount of potential in the utility distribution system, shown in Table A13, is limited compared to other sectors. In addition, the 2021 Power Plan assumes that the potential in this sector will be acquired slowly. This assessment includes two measures, only one falling below the levelized cost threshold.

Table A13: Alignment of Distribution System Program History and Potential by End Use (MWh)

	Program History			Estimated CPA Cost-Effective Potential			
End Use	**2022**	**2023**	**2024**	**2024**	**2025**	**2026**	**2027**
Distribution System	0	0	0	54	88	134	192

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Appendix VI: Estimated Cost-Effective Potential by Sector & End Use

The following tables detail the energy efficiency potential estimated to be cost-effective through preliminary findings of EWEB's IRP work. Based on this work, measures with a levelized cost of less than $65 per megawatt-hour were likely to be cost-effective.

Table A14: Residential Estimated Cost-Effective Potential by End Use (aMW)

End Use	2-Year	4-Year	10-Year	22-Year
Appliances	0.15	0.33	1.05	2.13
Cooking	0.00	0.02	0.13	0.14
Electronics	0.01	0.35	1.03	1.06
EVSE	0.00	0.00	0.00	0.00
HVAC	0.14	2.54	7.64	8.51
Lighting	0.02	0.33	1.47	1.72
Motors	0.00	0.00	0.00	0.00
Water Heat	0.19	2.57	6.30	6.50
Weatherization	0.00	0.00	0.00	0.00
Whole Home	0.01	0.16	0.29	0.29
Total	**0.52**	**6.30**	**17.92**	**20.35**

Table A15: Commercial Estimated Cost-Effective Potential by End Use (aMW)

End Use	2-Year	4-Year	10-Year	22-Year
Compressed Air	0.01	0.01	0.06	0.17
Electronics	0.02	0.06	0.55	1.20
Food Preparation	0.01	0.02	0.10	0.20
HVAC	0.56	1.19	3.10	6.83
Lighting	0.98	2.08	5.29	9.77
Motors/Drives	0.01	0.04	0.31	0.91
Process Loads	0.00	0.00	0.00	0.00
Refrigeration	0.08	0.24	1.63	4.09
Water Heat	0.00	0.00	0.03	0.16
Total	**1.66**	**3.65**	**11.07**	**23.33**

Table A16: Industrial Estimated Cost-Effective Potential by End Use (aMW)

End Use	2-Year	4-Year	10-Year	22-Year
All Electric	0.40	0.86	2.06	2.45
Compressed Air	0.05	0.12	0.56	1.42
Fans and Blowers	0.02	0.07	0.58	2.07
HVAC	0.05	0.12	0.33	0.35
Lighting	0.04	0.12	0.80	1.54
Low Temp Refer	0.00	0.00	0.01	0.01
Material Handling	0.01	0.03	0.12	0.30
Material Processing	0.01	0.04	0.15	0.27
Med Temp Refer	0.02	0.05	0.10	0.15
Melting and Casting	0.00	0.00	0.00	0.00
Other	0.00	0.00	0.01	0.01
Other Motors	0.00	0.00	0.01	0.02
Pollution Control	0.00	0.00	0.00	0.01
Pumps	0.09	0.30	2.05	5.53
Total	**0.69**	**1.72**	**6.76**	**14.13**

Table A17: Utility Distribution System Estimated Cost-Effective Potential by End Use (aMW)

End Use	2-Year	4-Year	10-Year	22-Year
EMC-1 LDC with no VVO	0.02	0.05	0.36	0.68
ECM-2 & ECM-3 LDC with VVO & AMI	0.00	0.00	0.00	0.00
Total	**0.02**	**0.05**	**0.36**	**0.68**

DRAFT

APPENDIX B

2024 DEMAND RESPONSE POTENTIAL ASSESSMENT

Eugene Water & Electric Board

February 10, 2025

Prepared by:

LIGHTHOUSE ENERGY CONSULTING

Nauvoo Solutions

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Introduction

This report summarizes the methodology and results of a Demand Response Potential Assessment (DRPA) conducted by Lighthouse Energy Consulting and Nauvoo Solutions (the project team) for Eugene Water & Electric Board (EWEB). The DRPA estimated the achievable demand response potential for 2024 to 2045, the results of which were provided as an input to EWEB's integrated resource planning (IRP) process, where the cost-effective potential was determined through EWEB's optimization modeling.

The DRPA followed the methodology used by the Northwest Power and Conservation Council (Council) in the 2021 Power Plan and included many of the same demand response (DR) products. The products included apply 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 drive reductions in peak demand. The assessment included DR products addressing both winter and summer demand.

This report is one component of a broader Demand Side Potential Assessment (DSPA) that includes energy efficiency, customer-owned rooftop solar, and electrification. The results of these other assessments are not covered in this report but are reported separately.

Background

The 2021 Power Plan defines demand response (DR) as "a non-persistent intentional change in net electricity usage by end use customers from normal consumptive patterns in response to a request on behalf of, or by, a power and/or distribution/transmission system operator. This change is driven by an agreement, potentially financial, or tariff between two or more participating parties."[1]

DR has not been widely used in the Northwest but has received increased interest recently. Growing capacity constraints associated with the closure of regional coal-fired power plants, increasing policies requiring 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 reduce congestion on transmission and distribution systems.

EWEB has completed DR pilots in the past, including multiple that began in 2012 and covered municipal water pumping and storage, wastewater aeration and pumping, cold storage, and residential water heating. Since that time, technology has advanced, and the need for demand flexibility has increased.

[1] Northwest Power and Conservation Council, *2021 Power Plan.* March 10, 2022. https://www.nwcouncil.org/fs/17680/2021powerplan_2022-3.pdf

Methodology

The project team began by working with EWEB to characterize the utility's customers, identify the DR products to be included in the assessment, and quantify their costs and benefits. Next, the project team estimated how many of EWEB's customers would adopt each product and modeled the pace of that adoption over time.

Like the conservation potential assessment (CPA), the DR potential calculation process began with quantifying technical potential, which is the maximum amount of DR possible without regard to cost or market barriers. The project team incorporated assumptions for market barriers, program participation rates, and other factors to quantify the achievable potential. The subset of the achievable potential that is cost-effective will be determined through EWEB's IRP modeling. The methodology used to calculate technical and achievable potential is discussed below.

Demand Response Products

For this DRPA, the project team began with the products included in the 2021 Power Plan and then narrowed the scope to focus on the products most applicable and of interest to EWEB. The project team included products targeting both the summer and winter seasons. While EWEB is a winter-peaking utility, demand response in the summer could help avoid high market prices.

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.

Table 1: Demand Response Products

	Residential	Commercial	Industrial
Direct Load Control	Grid-Enabled Water Heaters Smart Thermostat EV Chargers Behind-the-Meter Battery	Smart Thermostat	
Customer-Initiated		Demand Curtailment	Demand Curtailment
Time-Varying Prices	Time of Use Rates Critical Peak Pricing	Time of Use Rates Critical Peak Pricing	Time of Use Rates Critical Peak Pricing

Direct load control (DLC) products are those in which the utility directly controls 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 water heaters. For this DRPA, EWEB focused on DR products with modern controls where the equipment is grid-enabled and omitted older switch-controlled products. DLC products typically achieve high event participation rates as participation is only limited by the success of the controlled equipment receiving and implementing instructions to change its operation or customer intervention to opt out of specific events. 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 the utility that specify the amount, duration, frequency, advanced notice provided, and compensation for load reductions. Time-varying price products rely on various tariff-based strategies to encourage customers to respond to higher energy or demand prices.

Note that the assessment excluded utility demand voltage reduction (DVR). This product reduces the voltage on the utility distribution system such that the voltage is on the lower end of allowable limits. This can reduce system demands with no customer intervention or impact. This product was excluded because the project team included a similar measure, conservation voltage reduction (CVR), in EWEB's 2024 CPA. CVR and DVR are essentially the same practice, differing only in the duration of when voltage reductions are applied. Utilities cannot do both, however, so EWEB will need to determine the capabilities of its system and which program to pursue, if any.

Appendix I of this report includes a complete list of the products used in this assessment.

Customer and Sales Forecasts

Once the products were identified, the next step in a DRPA is to quantify the customer base that could adopt the products. The project team worked closely with EWEB's staff to develop sales forecasts and customer counts for each sector. The complete customer characterization results, methodology, and documentation are covered in EWEB's 2024 CPA Report. The resulting sales and customer forecasts are shown in Figure 1 and Figure 2. The majority of EWEB's sales and customers are in the residential sector.

Figure 1: Sales Forecast by Sector

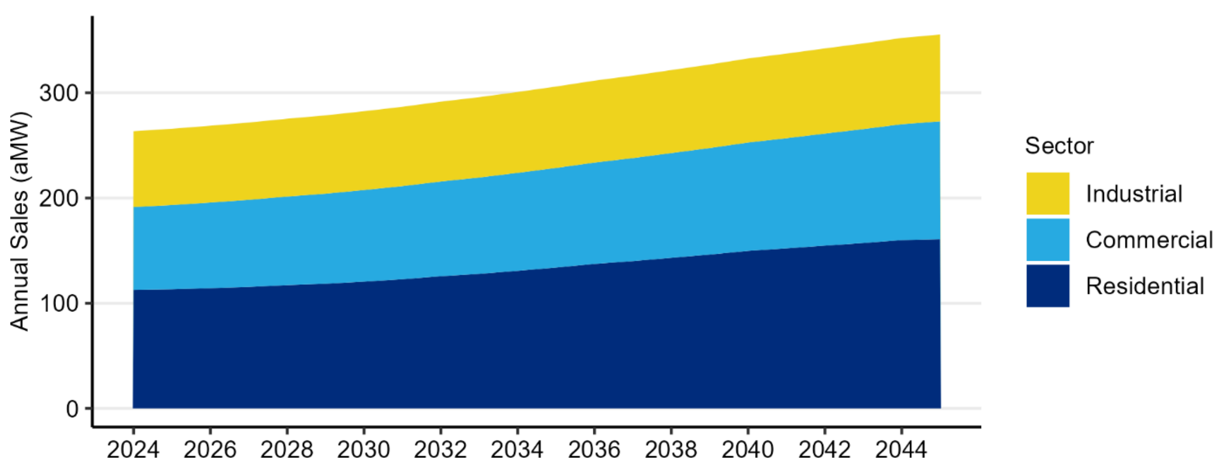
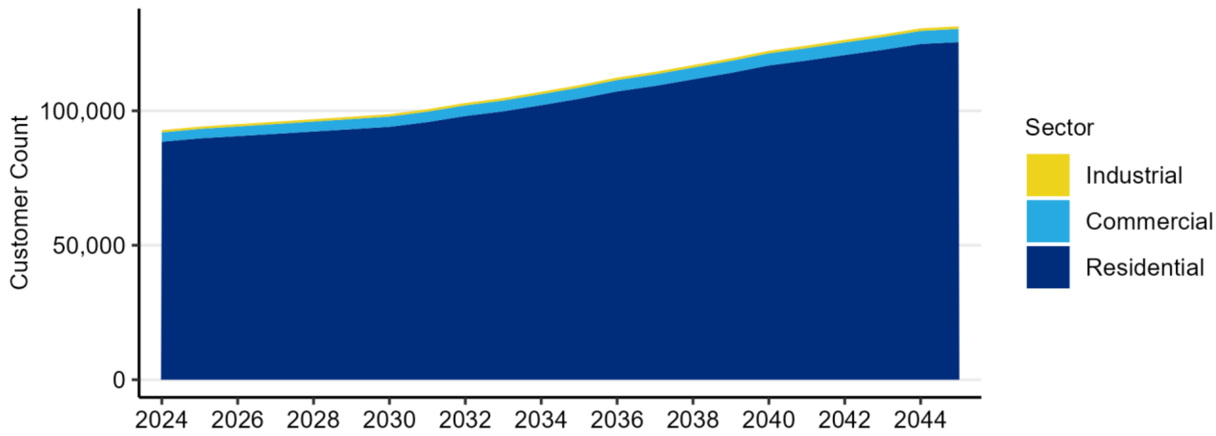
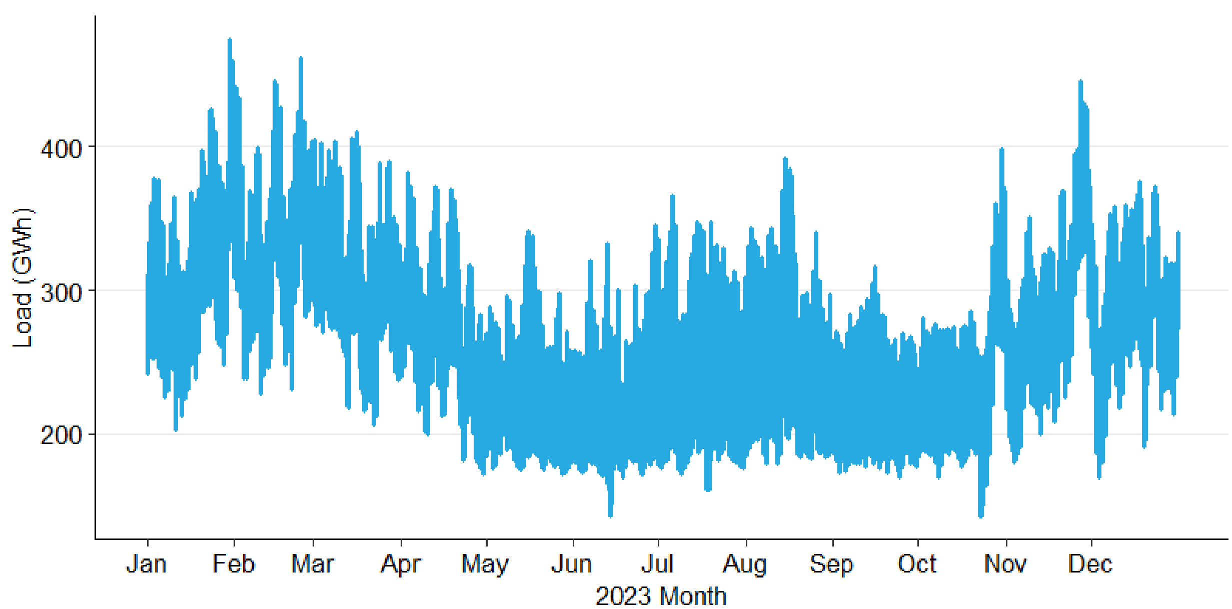


Figure 2: Customer Count Forecast by Sector



The assessment also accounts for EWEB's unique system shape. EWEB's staff provided hourly load data, which the project team used to determine when demand response events would be called. The assessment used the hourly load for the 2023 calendar year, shown below.

Figure 3: EWEB Hourly System Load

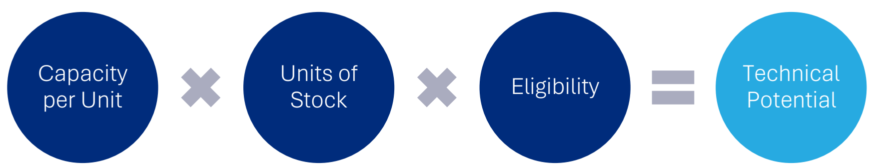


Technical Potential

The project team quantified the technical DR potential by combining bottom-up and top-down methodologies, depending on how the impact of a given product is quantified. For bottom-up products, the impacts are quantified in terms of an assumed demand impact per unit. For example, smart thermostats have an assumed demand impact of approximately 1 kilowatt per unit in the winter. Top-down products use percentage-based impacts. Residential time of use rates are modeled top-down and assume a demand reduction of approximately 3% during winter on-peak periods. These methodologies are described further below.

In the bottom-up method, illustrated in Figure 4, 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 participate in a program, typically by having the appropriate equipment installed. For example, in quantifying the potential associated with a smart thermostat demand response program, the eligibility factor would be the share of homes with a smart thermostat installed in EWEB's service territory.

Figure 4: Bottom-Up Technical Potential Calculation

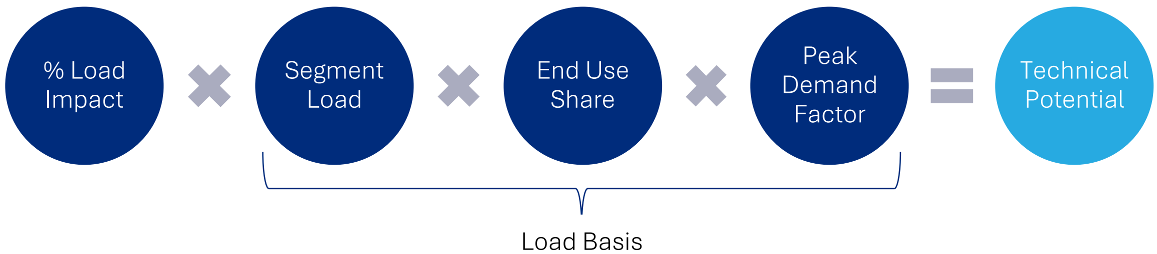


This analysis used the capacity per unit values determined by Council staff in the 2021 Power Plan. Stock unit counts were developed from data provided by EWEB's staff, Census data, regional stock assessments, and other data produced as a part of EWEB's 2024 DSPA.[2] Finally, the eligibility factors were determined by combining data from EWEB's 2024 CPA and the 2021 Power Plan. The project team used the expected future adoption from EWEB's 2024 CPA for smart thermostat and grid-enabled water heat DLC.

In the top-down method, the technical potential was determined by multiplying each DR product's assumed load impact by an applicable load basis. The impact is the estimated demand reduction, expressed as a percentage, and the load basis is measured in demand units. 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, for products controlling HVAC equipment, the load basis is calculated by multiplying the overall load of the customer segment and the share of energy used by HVAC equipment, Finally, a peak demand factor converts 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 5.

[2] See EWEB's 2024 Conservation Potential Assessment Report for further details.

Figure 5: Top-Down Technical Potential Calculation



The load impact assumptions and end use shares were taken from the 2021 Power Plan for this study. The segment loads within each sector were developed from EWEB's customer data. The project team calculated the peak demand factors based on 2021 Power Plan load shapes and their coincidence with EWEB's system shape.

Achievable Potential

The project team quantified the achievable potential for each product by adjusting the technical potential to include considerations for program and event participation rates and program ramp-up periods. Program participation is the proportion of eligible customers participating in a DR program, while event participation quantifies the share of program participants engaging 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. For other types of programs, this factor considers the likelihood of human intervention.

The annual rate of DR program adoption was based on the ramp rates developed in the 2021 Power Plan. 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. The 2021 Power Plan ramp rates assume a 5- or 10-year ramp-up period for most products. For this assessment, the starting year of some ramp rates was modified to reflect that EWEB would not have the internal systems in place for time-varying products until 2027.

The calculation of achievable potential is the same for both bottom-up and top-down methods and is shown in Figure 6.

Figure 6: Achievable Potential Calculation

Economic Potential

The economic or cost-effective potential was not determined in this assessment but instead will be determined through EWEB's IRP modeling process. The project team provided a levelized cost of capacity for each product and details on the amount and timing of demand response available as an input to EWEB's IRP model.

The costs included in the levelized cost calculation cover the following:

- Program setup costs
- Operation and maintenance costs
- Equipment costs
- Marketing costs
- Program incentives[3]

These costs are projected over 22 years, along with the projected demand reductions and associated avoided costs.

The levelized cost calculations also include credits for avoided capital costs related to the deferral or avoidance of capacity expansions on the transmission and distribution systems that deliver power to EWEB's customers. In the development of the 9th Power Plan, Council staff surveyed regional utilities to collect values for deferred transmission and distribution system values. Council staff reported on these values, differentiating the results between east and west of the Cascades. This assessment uses the west values of $22 and $33 per kW-year for transmission and distribution, respectively. Because EWEB is a winter-peaking utility, these credits were applied to the winter products.

This assessment assumes that DR events can be called with perfect anticipation of peak demands. In implementing a DR program, utilities typically specify a maximum number of events per season that will be called. This gives participants an upper limit of what may be asked of them but also provides utilities with a number of events to call when forecasted demands are high. However, challenges still exist in deciding the dates and hours to call DR events, and any peak events occurring when DR events were not planned may result in reductions in the ultimate cost-effectiveness of a DR program.

[3] While program costs are not typically included in the Total Resource Cost perspective typically used in utility planning, for demand response, some portion of the incentive is assumed to represent the cost of a DR program participant's burden or inconvenience in participating in a program. For example, in the residential sector, 25-35% of the incentives are included.

Results

This section documents the results of the DRPA. It begins with the available winter and summer achievable potential and then discusses the costs.

Winter Achievable Potential

The estimated achievable winter DR potential is summarized by sector and year in Figure 7. The total winter potential is 49 MW, approximately 7% of EWEB's estimated 2045 winter peak demand. Most of the potential is in the residential sector, which grows throughout the study period.

The potential in the residential sector totals 44 MW in the last year of the study period. The potential in each commercial and industrial sector totals approximately 2 MW.

Figure 7: Annual Achievable Winter DR Potential by Sector

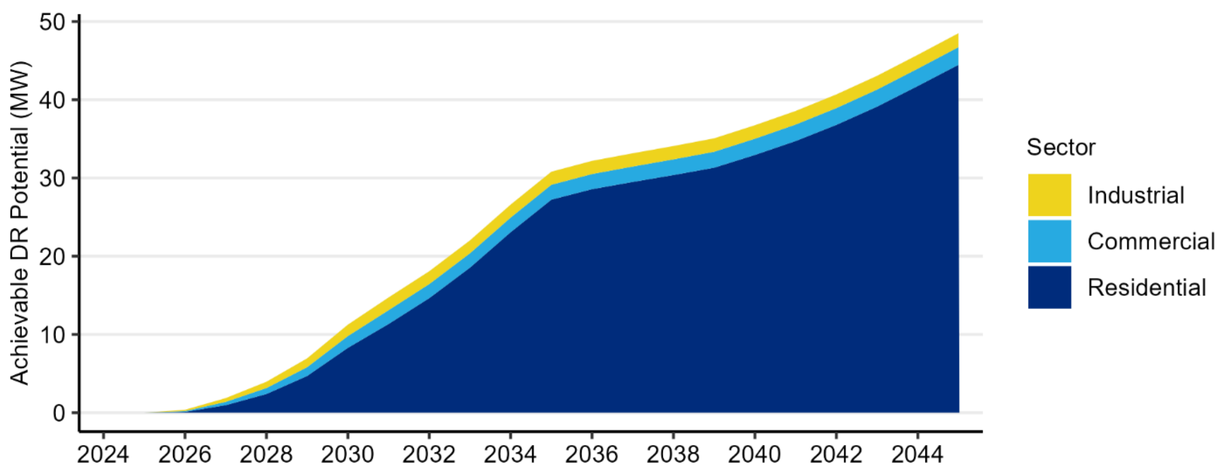


Figure 8 shows how this potential breaks down by end use. In 2045, the "All" end use is the largest category. This includes pricing and curtailment strategies assumed to impact all customer end uses. The remainder of the winter potential is spread across space heating, water heating, and EV charging categories. The growth in potential from EV charging is driven by the Advanced Clean Cars II rule in Oregon. This rule requires that 100% of new car sales must be EVs by 2035, with intermediate requirements along the way. The DR potential in water heating is impacted by the adoption of heat pump water heaters, which provide energy savings throughout the year but less callable load reductions for demand response.

Figure 8: Annual Achievable Winter DR Potential by End Use

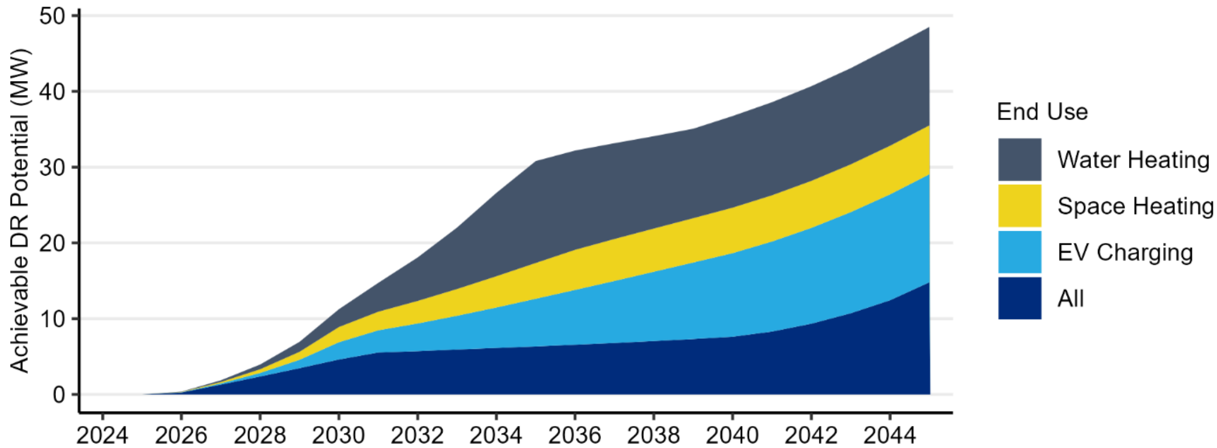
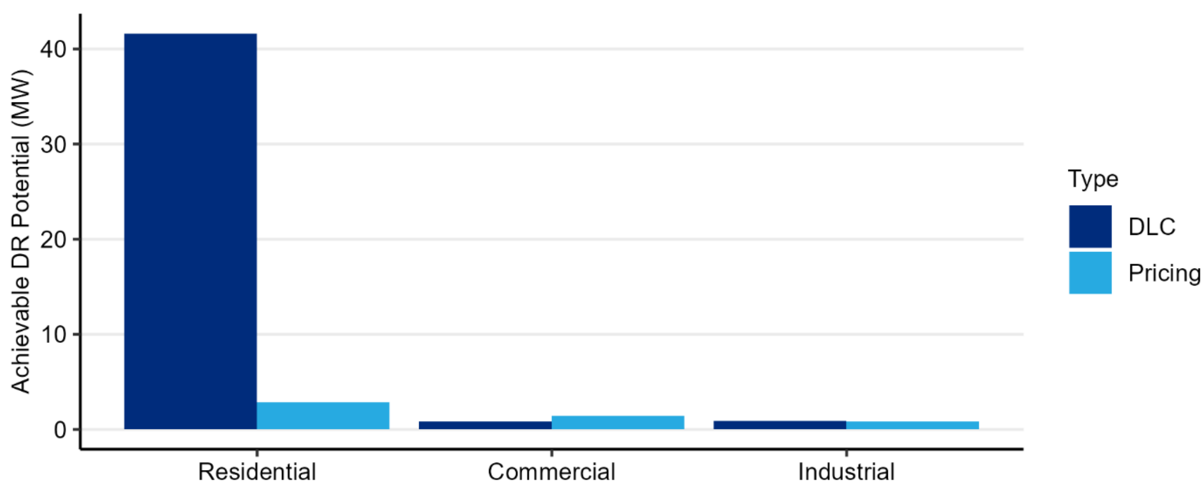


Figure 9 shows how this potential breaks down across the various product types within each sector. The commercial and industrial curtailment products are classified as DLC products in this figure. Most of the potential is from residential DLC products, with smaller amounts coming from pricing strategies.

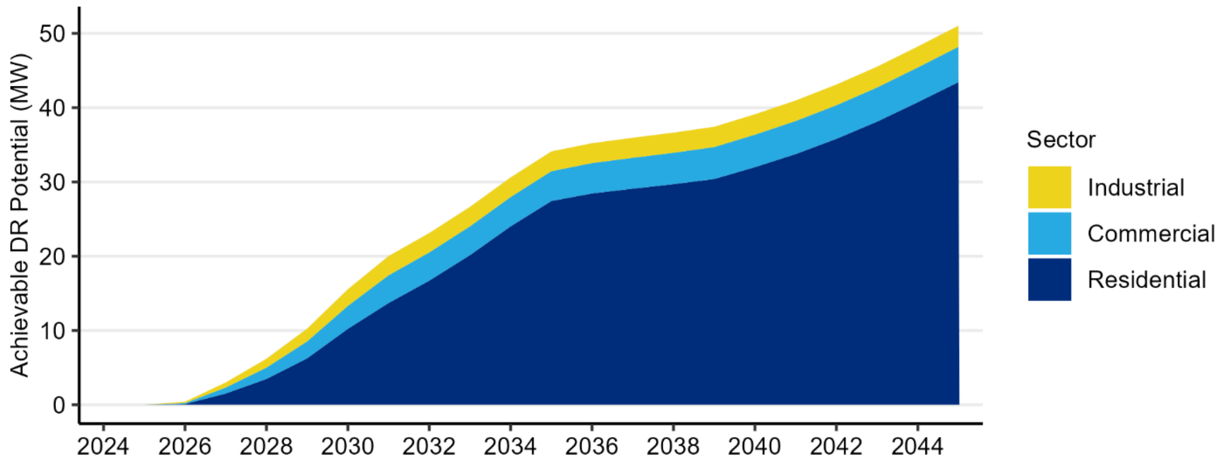
Figure 9: Achievable Winter DR Potential by Sector and Type



Summer Achievable Potential

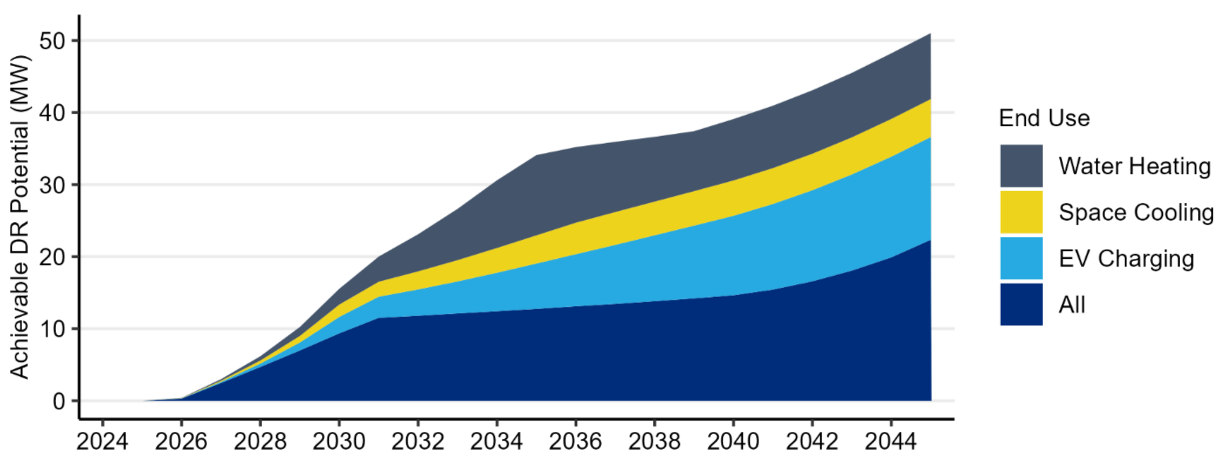
In the summer, EWEB has approximately 51 MW of achievable demand response available. While EWEB typically has higher loads in the winter, there is more DR potential in the summer due to the coincidence of commercial and industrial sector loads with EWEB's summer peak demand periods. Therefore, commercial and industrial DR programs can contribute greater demand reductions in the summer compared to the winter. Figure 10 shows the annual achievable summer potential by sector.

Figure 10: Annual Achievable Summer DR Potential by Sector



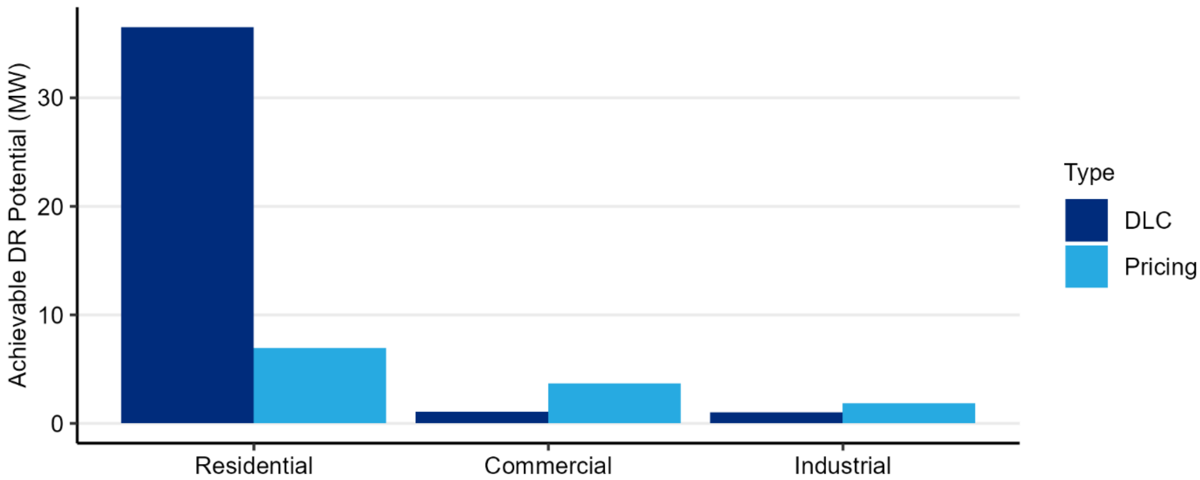
As shown in Figure 11, the "All" end use category has the largest amount of summer potential, similar to the winter season. As before, the "All" end use includes pricing and curtailment strategies which are assumed to impact all customer end uses. The EV charging, space cooling, and water heating end uses make up the remainder of the summer potential.

Figure 11: Annual Achievable Summer DR Potential by End Use



The breakdown of the 22-year potential by sector and product type is shown in Figure 12. While most of the potential is associated with residential DLC products, similar to the winter season, pricing products across all three sectors provide a greater contribution to the summer potential.

Figure 12: Achievable Summer DR Potential by Sector and Type



Costs

A demand response supply curve details the quantity of capacity available at different cost thresholds. The supply curves for winter and summer DR are shown in Figure 13 and Figure 14, respectively. The products are ranked by levelized cost in $/kW-year, with the lowest-cost product at the bottom. Moving 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 light 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. As discussed above, the levelized cost calculations for winter products include credits for deferred distribution and transmission system capacity costs. With these credits, some products can have negative net levelized costs when the credits exceed the costs.

Across the two seasons, the lowest-cost products include residential smart thermostats, behind-the-meter storage, and several commercial and industrial products. The thermostat and storage products also have large amounts of potential, although the storage product potential grows slowly and is dependent on customer adoption of storage systems. EV charging and several products associated with residential water heating offer larger amounts of potential, albeit at higher costs.

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

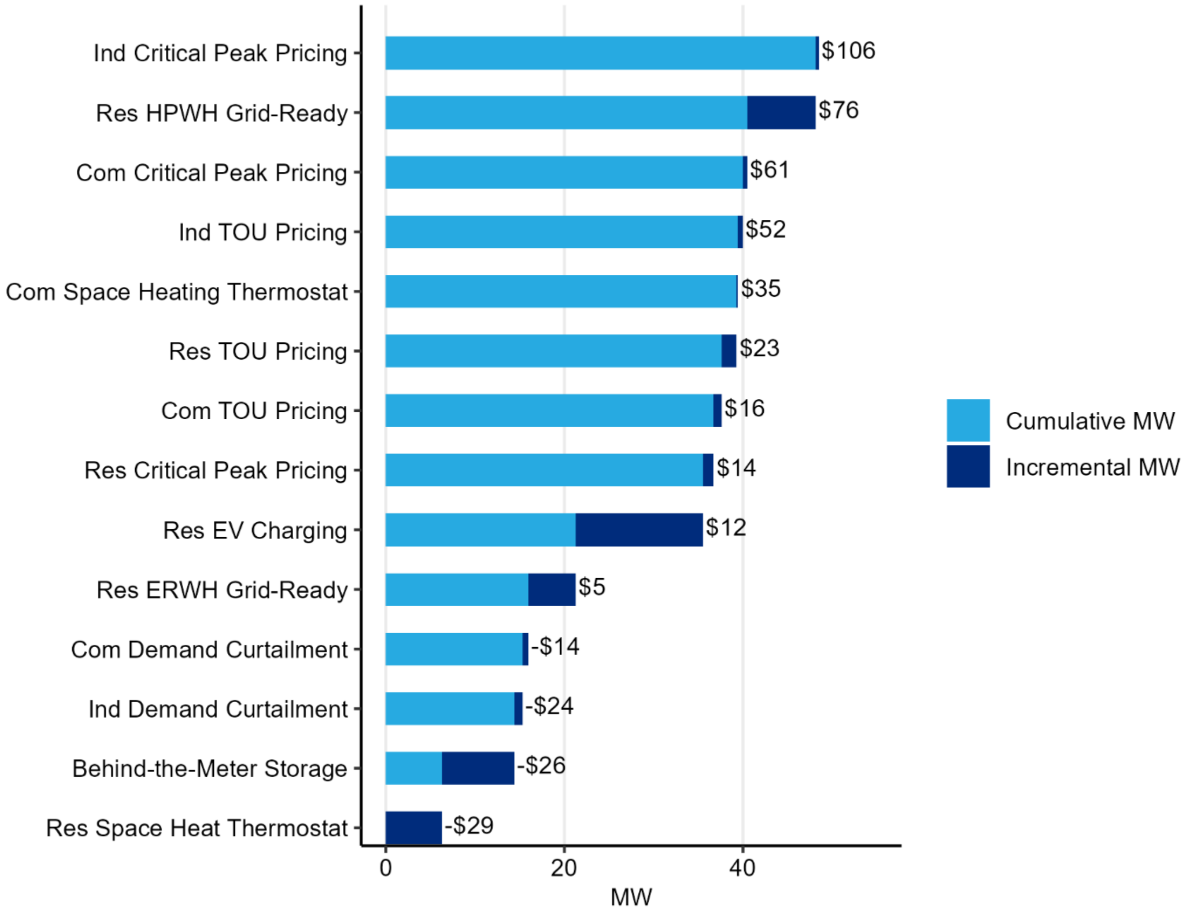
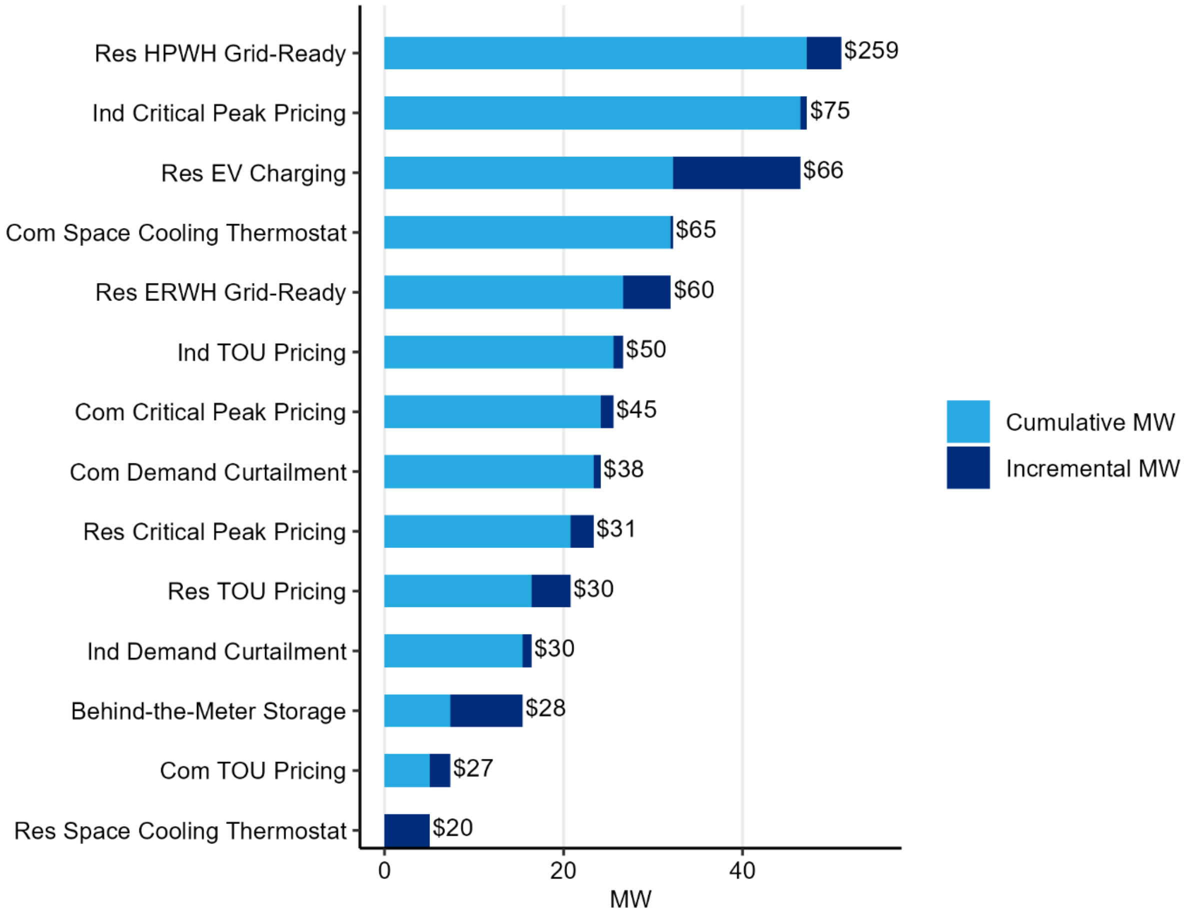


Figure 14 shows a supply curve for the summer DR products. Smart thermostats and behind-the-meter storage offer significant amounts of potential at a low cost. At the same time, water heating, residential TOU pricing, and EV charging contribute additional potential at higher costs.

Figure 14: Summer DR Supply Curve (MW and $/kW-year)



Summary

This report summarized the results of the 2024 DRPA conducted for EWEB. The products included and the methodology used were based on those used by the Council in the 2021 Power Plan, customized to EWEB's service territory, and aligned with EWEB's 2024 CPA projections. It included products applicable to the winter and summer seasons across the residential, commercial, and industrial sectors using a variety of DLC, demand curtailment, and price-based strategies and targeting a variety of end uses.

Overall, the assessment quantified 49 MW of achievable winter DR potential and 51 MW in the summer. Most of the DR potential identified is in the residential sector, which is consistent with the makeup of EWEB's customer base. In the summer, the commercial and industrial sectors contribute more but are still smaller overall. Across both seasons, residential smart thermostats and behind-the-meter storage offer larger amounts of demand response capacity at lower costs. However, the potential associated with storage will take time to develop as batteries gain adoption. Time of use rates and EV charging may also be options for EWEB to consider as it builds its internal systems to offer time-varying rates and the adoption of electric vehicles in its service territory continues.

Appendix I: DR Product List

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 Grid-Ready - Winter	DLC	Winter	Bottom-up
Residential	Water Heating	Res ERWH Grid-Ready - 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 Thermostat - West	DLC	Winter	Bottom-up
Residential	Space Cooling	Res Space Cooling Thermostat - West	DLC	Summer	Bottom-up
Commercial	Space Heating	Com Space Heating Thermostat - West	DLC	Winter	Bottom-up
Commercial	Space Cooling	Com Space Cooling Thermostat - West	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
Commercial	All	Com TOU Pricing - Winter	Pricing	Winter	Top-down
Commercial	All	Com TOU Pricing - Summer	Pricing	Summer	Top-down
Industrial	All	Ind TOU Pricing - Winter	Pricing	Winter	Top-down
Industrial	All	Ind 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
Residential	All	Behind the Meter Storage - Winter	DLC	Winter	Bottom-up
Residential	All	Behind the Meter Storage - Summer	DLC	Summer	Bottom-up

Appendix II: Acronyms

AC	Air Conditioning
aMW	Average Megawatt
CPA	Conservation Potential Assessment
CVR	Conservation Voltage Reduction
DLC	Direct Load Control
DR	Demand Response
DRPA	Demand Response Potential Assessment
DSPA	Demand Side Potential Assessment
DVR	Demand Voltage Reduction
ERWH	Electric Resistance Water Heater
EV	Electric Vehicle
HPWH	Heat Pump Water Heater
HVAC	Heating, Ventilation, and Air Conditioning
IRP	Integrated Resources Plan
kW	Kilowatt
MW	Megawatt
TOU	Time of Use

Appendix III: Detailed Results

Product	End Use	Levelized Cost ($/kW-year)	4-Year Achievable Potential (MW)	10-Year Achievable Potential (MW)	22-Year Achievable Potential (MW)
Res EV Charging - Winter	EV Charging	$12	0.16	4.45	14.26
Res EV Charging - Summer	EV Charging	$66	0.16	4.45	14.26
Res ERWH Grid-Ready - Winter	Water Heating	$5	0.21	6.13	5.32
Res ERWH Grid-Ready - Summer	Water Heating	$60	0.21	6.13	5.32
Res HPWH Grid-Ready - Winter	Water Heating	$76	0.02	1.98	7.67
Res HPWH Grid-Ready - Summer	Water Heating	$259	0.01	0.99	3.83
Res Space Heat Thermostat - West	Space Heating	-$29	0.17	3.42	6.31
Res Space Cooling Thermostat - West	Space Cooling	$20	0.14	2.77	5.03
Com Space Heating Thermostat - West	Space Heating	$35	0.01	0.11	0.15
Com Space Cooling Thermostat - West	Space Cooling	$65	0.02	0.18	0.24
Com Demand Curtailment - Winter	All	-$14	0.19	0.54	0.66
Com Demand Curtailment - Summer	All	$38	0.24	0.67	0.82
Ind Demand Curtailment - Winter	All	-$24	0.33	0.85	0.92
Ind Demand Curtailment - Summer	All	$30	0.36	0.93	1.01
Res TOU Pricing - Winter	All	$23	0.24	1.33	1.68
Res TOU Pricing - Summer	All	$30	0.63	3.46	4.36
Com TOU Pricing - Winter	All	$16	0.13	0.73	0.90
Com TOU Pricing - Summer	All	$27	0.34	1.87	2.29
Ind TOU Pricing - Winter	All	$52	0.09	0.48	0.52
Ind TOU Pricing - Summer	All	$50	0.20	1.02	1.10
Res Critical Peak Pricing - Winter	All	$14	0.17	0.92	1.16
Res Critical Peak Pricing - Summer	All	$31	0.37	2.04	2.56
Com Critical Peak Pricing - Winter	All	$61	0.08	0.45	0.55
Com Critical Peak Pricing - Summer	All	$45	0.21	1.15	1.40
Ind Critical Peak Pricing - Winter	All	$106	0.06	0.32	0.34

Product	End Use	Levelized Cost ($/kW-year)	4-Year Achievable Potential (MW)	10-Year Achievable Potential (MW)	22-Year Achievable Potential (MW)
Ind Critical Peak Pricing - Summer	All	$75	0.13	0.68	0.73
Behind the Meter Storage - Winter	All	-$26	0.00	0.30	8.08
Behind the Meter Storage - Summer	All	$28	0.00	0.30	8.08